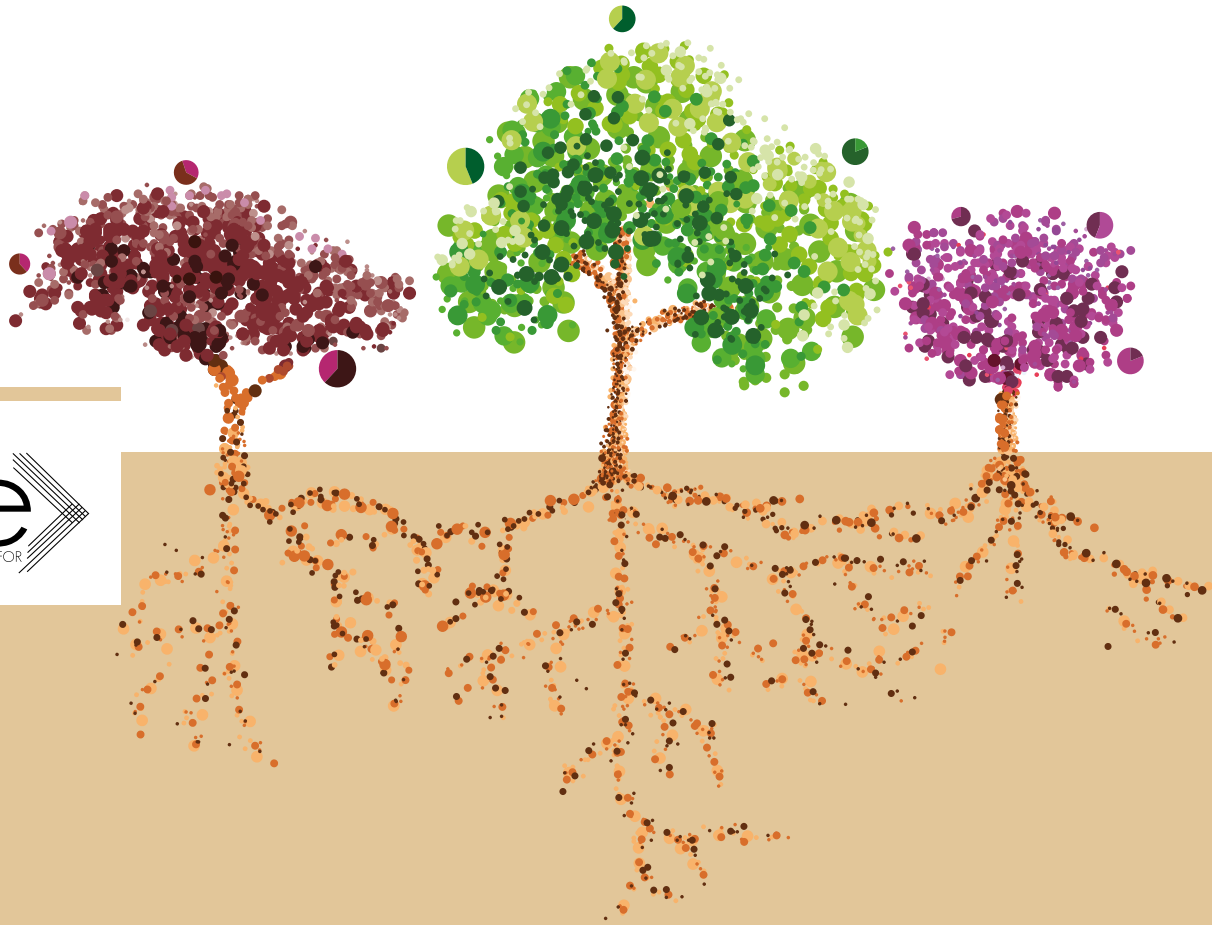
How to assess and evaluate the influence of entrepreneurship education



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ASSESSMENT TOOLS AND INDICATORS FOR ENTREPRENEURSHIP EDUCATION

A report of the ASTEE project with a user guide to the tools

June 2014

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The ASTEE project – Assessment Tools and Indicators for Entrepreneurship Education

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PREFACE

"Minds are not vessels to be filled, but fires to be ignited" – Plutarch

The ASTEE project (Assessment Tools and indicators for Entrepreneurship Education) was initiated as a result of a recognised need for impact assessment of entrepreneurship education at different levels of education. It was the aim of the project to develop measurement tools for assessing entrepreneurial skills, knowledge, attitudes and mindsets among pupils and students, and the goal going forward is to implement these tools across educational institutions in Europe. It is by providing access to such necessary measurement tools that discussion and action to further improve and disseminate entrepreneurship education on a larger scale across Europe will be stimulated. The ASTEE project was co-funded by the European Community, the Competitiveness and Innovation Framework Programme (CIP), and lasted from December 2012 until June 2014. The project partners behind the ASTEE project are the following:

Project Coordinator Lene Vestergaard, Danish Foundation for Entrepreneurship – Young Enterprise

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Deputy CEO Diana Filip, Junior Achievement – Young Enterprise Europe

ACKNOWLEDGEMENTS

We would first like to thank the European Commission for co-funding this project, making it possible to develop measurement tools for the benefit of students, teachers, education institution leaders, and policy makers at national and international level. We also wish to extend our gratitude to Governo de Portugal and the Danish Business Authority for their support to the project. Furthermore, we want to thank the participating staff, pupils, and students at educational institutions across Europe for their time and cooperation during the test phase of this project, where a set of common European tools for measuring the impact of Entrepreneurship Education (EE) on pupils and students has been developed, tested and put to use in many schools and institutions across Europe.

We also wish to extend much gratitude to our advisory group - Karen Wilson, Founder of GV Partners, Advisor and Board member at EFER, Consultant at OECD; Paul Hannon, Director of LEAD Wales and Director of the Institute of Entrepreneurial Leadership at Swansea University; Caroline Verzat, Professor of Entrepreneurship, NOVANCIA; Sannie Fisker, Consultant at the Technical University of Denmark; Andrea-Rosalinde Hofer, Policy analyst, OECD. As well as to Mr. Simone Baldassarri, Policy Officer at DG Enterprise and Industry.

FOREWORD

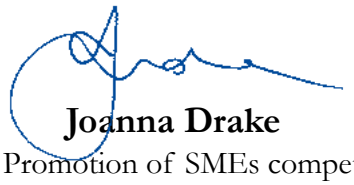
Entrepreneurship education is crucial for boosting economic growth in Europe, as it unleashes the entrepreneurial potential of young people, helping them to develop a keener eye for entrepreneurial opportunities, skills to realise projects, and an aptitude for taking responsibility. Developing these key competencies requires a school environment that encourages invention and creativity, allowing for taking risk and also for making mistakes, which should be valued as a learning opportunity.

Given that enhancing entrepreneurship education is a policy priority in the EU, there is a requirement to better understand its state of play and its effects across Europe. The goal of entrepreneurship education is to give people the knowledge, skills and attitudes to act in an entrepreneurial way. In order to determine the degree to which this goal has been reached, it is essential to develop suitable assessment tools, as those traditionally used to assess knowledge in specific subjects will not serve the purpose. These tools should reflect that entrepreneurship is a key competence for life, and is not solely aimed at setting up a business.

Promoting a European reference framework and common indicators to assess the entrepreneurial knowledge, attitudes and skills acquired by students during their education will benefit the coherence and comparability of results, and is therefore amongst the priorities of the European Commission.

The objective of the ASTEE project is precisely to develop such tools, based on the identification of key learning outcomes at the primary, secondary and tertiary levels of education. The tools developed will deliver an immediate image of the state of play of entrepreneurship education, and will also allow for measurements in the longer term. In this way they will serve as an instrument for students to assess their own development and for teachers, educational institutions and policy makers to assess the state of play and measure progress in this field.

The commitment of the European Commission to foster the entrepreneurial culture across Europe is clear and we are proud to support projects such as ASTEE. We are expecting positive long-term implications from its findings. We would like therefore to encourage educational authorities and institutions at all levels to embrace it and further support it.



Joanna Drake
Director, Promotion of SMEs competitiveness,
DG Enterprise and Industry,
European Commission

INTRODUCTION

The economy has experienced a significant change during the last decades. As an effect of the globalisation process the economy, the labour markets as well as societies and social structures are increasingly characterised by constant change and dynamic transformation[1]. To cope with this constant change it has become increasingly important to have the competence to act entrepreneurially in many different situations, and the European Commission has identified it as one out of eight key competences that all citizens in the member countries should possess[2]. In order to reach this goal it is important that the educational system focuses on developing entrepreneurial skills and abilities already at the lower levels of education. Entrepreneurial skills are, however, not just synonymous with business start-up skills. The role of entrepreneurship education is to foster a mindset of entrepreneurial spirit in pupils and students by providing them with skill-sets, knowledge and behavioural patterns that allow them to be entrepreneurial in their own lives.

Studying the impact of entrepreneurship education naturally leads to studying the question of its evaluation, which cannot be totally disconnected from that of its pedagogical engineering, both at the design level and at programme implementation level[3]. Entrepreneurial skills and abilities in the broad definition (proactiveness; innovativeness in problem definition and problem solutions; and the capacity for taking responsibility for one's own choice), are hard to codify and evaluate by means of traditional exams and methods[4]. This makes the evaluation of education in the topic a complex issue[5]. A number of studies have been done to understand the impact of education in entrepreneurship on participant' knowledge, skills and attitudes[6], but most of them concern higher education. Although interest in entrepreneurship education has grown significantly within the policy agendas of the EU's member states, there is room for improvement regarding the measuring of progress, performance and impact of relevant education policies, projects and initiatives. In order to overcome current shortfalls in entrepreneurship education, a coherent entrepreneurship education strategy must be integrated across all education levels and across government departments in each country with guidance from EU policy[7].

In order to do this, it is necessary that there be access to valid and reliable tools that can measure the influence of a large variety of educational initiatives within the field, both initiatives that target students within different educational fields, and initiatives that target pupils and students at different levels of education. The objective of the ASTEE project has been to develop a set of common European tools for measuring the impact of Entrepreneurship Education (EE) on students' entrepreneurial competences across all educational levels. The tools are parsimonious and easy to use and interpret and based on the identification of key learning outcomes at the primary, secondary and tertiary levels. The survey questionnaires are research-based and have been validated in two major surveys including 13 countries and a total of 6,488 respondents.

The report and user guide is meant as an introduction to the ASTEE project and its main

1 Lundvall, 1992.
2 European Commission, 2007.
3 Béchard & Grégoire, 2005; Fayolle & Gailly, 2008.
4 Pittaway & Edwards, 2012.
5 Dionne, 1995; Ostroff, 1991; Ng and Feldman, 2009.
6 See for example: Sexton and Upton, 1987; Gibb, 1993; Vesper, 1997; Fayolle and Gailly, 2008; Oosterbeek, van Praag & Ijsselstein, 2010; Rideout & Gray, 2013; Katz, Roberts, Strom & Freilich, 2013.
7 As agreed upon in the Budapest Agenda (Budapest Agenda: Enabling Teachers for Entrepreneurship Education).

outcome, the assessment tool, for its intended users; the pupils and students, teachers and institutional leaders as well as national policy makers. First, we present the background for the ASTEE project, the economy and the fast-changing world of today which has brought a new focus on entrepreneurship education and its positive outcomes – as well as on the importance of evaluating and monitoring these outcomes. We then go on to describe the process that led to the development of the ASTEE tool; the setting up of a Consortium and an Advisory group to the project, both consisting of experts within entrepreneurship education, and the working process behind the development of the tool. "The design of the measures" section is about how we identified the indicators which were used to develop the tool. This identification was based on the Directorate-General of Enterprise and Industry framework for educational initiatives within entrepreneurship education. Five dimensions were identified; *skills*, *knowledge*, *mindset*, *connectedness to education*, and *connectedness to future career*. We elaborate further on these five dimensions in the section.

The more technical sections "Validation of the measures" and "Analysis" are for those readers who want an in-depth explanation about the statistical validity and reliability of the assessment tools and the methods of analysis which were used. The reader who is mainly interested in what the tools can be used for can skip these sections and continue with section "How to use the assessment tools".

The tools are, first of all, a help for teachers to assess the progress of their pupils and students and to evaluate their own teaching methods, but they can also be used by researchers and policy makers when assessing the effects of different initiatives in entrepreneurship education at different levels of the education system.

BACKGROUND

There is no doubt that small and medium-sized businesses play an imperative role at an economical level with 99% of businesses in the EU registered as Small to Medium-sized Enterprises (SME), equating to a total of over 20 million[8]. SMEs are a vital source of new employment with approximately two-thirds of all EU jobs coming from SMEs, thus significantly contributing to economic growth within EU member countries. In 2012 the SME sector provided 57.6% of the gross value added generated by the non-financial economy in Europe. The role of the innovativeness in established businesses is also an important factor for the economy[9]. However, it is now recognised that there is a lack of entrepreneurial activity across Europe to support a healthy supply of new ventures with a variety of factors contributing to this situation[10]. One of the enablers of innovation is considered to be human resources, thus the innovation performance of the EU member states is closely linked to the level of education among the populations.

In light of the positive benefits of entrepreneurship and in recognition of the obstacles to achieving a sustained and healthy flow of entrepreneurial activity within Europe, the European Commission has, over the past decade, given serious consideration to entrepreneurship education and its importance for building a sustainable European economy and society. In the 2004 European Agenda for Entrepreneurship it was stated that "The EU is not fully exploiting its entrepreneurial potential - it is failing to encourage enough people to become an entrepreneur"[11]. In the Entrepreneurship *2020 Action Plan* the promotion of entrepreneurship education was identified as one of three key objectives[12]. The positive effects of entrepreneurship education at a social level include the initiation of students' interest in new business activities and start-ups, heightening their sense of ambition, and increasing their engagement in extracurricular activities that are beneficial to their personal development. At an economic level, it has been shown that entrepreneurial education increases the number of business start-ups, increases the innovative activities of established organizations, creates new jobs, and increases taxable income[13].

At the Policy Level

To ensure sustainable engagement in entrepreneurship education, there must be robust monitoring and evaluation of the impact of strategies and actions in Member States and at EU level. Monitoring can help assess what is (or is not) working regarding the achievement of goals. This allows for an assessment of outcomes and impact of measures. Based on such data, authorities can better forecast expected outcomes of entrepreneurship education programmes and initiatives. In that way, resources can be invested in policies/programmes that are actually effective and demonstrate areas for improvement. In December 2012 the European Commission put together an expert group on indicators of entrepreneurial learning and competences. They identified key areas where assessment and evaluation of entrepreneurship education could contribute:

8 Gagliardi et al., 2013.
9 Ibid.
10 European Commission, 2014.
11 European Commission, 2004, p. 3.
12 European Commission, 2013.
13 Martin et al., 2013; Elert, Andersson & Wennberg, 2012; Charney & Libecap, 2000.

- Effective policy planning, programme/initiatives' design and implementation
- Efficient choice of suitable tools (for example, teaching methods)
- Understanding reasons of "underperformance" and acting correctively
- Understanding what is feasible to achieve and accordingly accommodate planning, programme designing etc.
- Systematic monitoring of entrepreneurship education which also provides the possibility to compare different programmes in the long term, allowing for the identification of trends and areas for improvement.

In order to evaluate whether or not these indicators are supported, various data sources could be used[14], but the expert group also concluded that it would be necessary to develop new data sources to cover indicators such as: entrepreneurial learning activity, entrepreneurial self-efficacy, and gains from entrepreneurial learning. Given the focus on entrepreneurship education at the European policy level, there exists a key requirement to understand and develop the state of play of entrepreneurship education across Europe. Monitoring supports the European Commission in understanding the progress and effectiveness of its programmes and initiatives. A monitoring framework and relevant indicators on an EU level are a precondition for assessing progress against strategic objectives and targets (in this context, progress towards realisation of the EU2020 objectives). Based on the information regarding progress and effectiveness, monitoring indicators can support evidence-based decisions on policy changes.

For Educators and Practitioners

Entrepreneurship educators are often at a loss with regard to evaluation and assessment practices to measure the learning outcomes of their students. Current assessment practices remain fairly traditional in the EU member states[15]. Little research about useful innovative methods is available, and development of new methods is needed. The ASTEE tool meets a need among educators for formative assessment, since it can be used to gauge different types of educational designs. The use of the self-assessment tool on students can give educators an indication of whether their teaching works. By using the tool at the beginning of a course, and by measuring again at a later time in the course the educator can get information about the development of the individual student as well as of the entire class. The analysis of the responses can thus not just be used in their guidance of the students but also for adjusting courses and the teaching. The tool is designed to be used generically for entrepreneurship education, which adds to its value and usefulness on a broad scale. It is important to note, though, that the tool may well be supplemented with additional measurements.

14 For example: Eurydice Q&A on Entrepreneurship Education at School in Europe; Flash Eurobarometer; Global Entrepreneurship Monitor (GEM); OECD Programme for International Student Assessment (PISA).

15 Pittaway & Edwards, 2012.

THE DEVELOPMENT OF THE MEASUREMENT TOOLS

The aim of the project was to develop assessment tools to a common European framework of indicators which can assess entrepreneurial mindsets, attitudes and perceived skills acquired by students in entrepreneurship education. These concepts are complicated to observe directly which makes them difficult to measure. The term latent construct is generally used for such a variable that cannot be measured directly and cannot be fully captured by a single question[16]. In order to develop a suitable measurement tool we therefore needed to capture the variable through multiple questions representing the variable. However, we needed first to establish the indicators of entrepreneurial mindset, attitudes and skills. Figure 1 below uses trees as a metaphor to illustrate how the single questions (the roots) of the separate constructs relate to and influence one another and the constructs.

Figure 1: The roots are metaphors for the questions that are comprised in the different constructs

16 Ullman, 1996.

The latent constructs can look very different, depending on context (the individual and the environment), but the roots should have the same shape and relationship to one another. So, if we observe two trees in different environments (countries, high / low altitude), and we think that these are the same type of tree we can dig up the roots and compare them. The roots do not have to look the same, but they should have similar relationships (loadings and intercepts).

In the following section we describe the process of developing the measurement tools. 1) How we established the project group and organised ourselves with an overall coordinator and working groups in each country represented. 2) How the actual work was done in phases starting with establishing a consensus on definitions and concepts, 3) what and 4) who we wanted to measure and 5) how data was collected in several testing phases. The design of the measures is described in depth in the following chapter.

The Process

A consortium group was established consisting of members from countries across Europe: Ireland, France, Portugal, Germany, Croatia, JA-YE Europe (Belgium), and Denmark to work on the development of a common framework of tools and indicators. These countries represent all corners of the EU and also a wide difference in the maturity level with regard to implementation of entrepreneurship education at all levels of their education system. In Denmark, for example, a strategy for implementing entrepreneurship education in the entire education system was established in 2009, while Portugal is still in the initial stage with regard to development of a strategy for the area. The members representing the countries have all been working with entrepreneurship education for a number of years and have solid experience and knowledge in the area. In addition, a number of experts offered their assistance to the project and formed the advisory group. Numerous fruitful discussions have taken place and all members have gained new knowledge about the difference in education systems across Europe, cultural differences, and views on entrepreneurship education, amongst others.

To further ensure the applicability of the tool across Europe, the consortium members decided to involve a number of partner countries. This means that the tool was tested in additional six countries: Sweden, United Kingdom, Austria, Italy, Romania, and Spain. In the development process several issues had to be considered: the content, the target groups, and the format. In the following, each of these dimensions will be described, starting with our definition of entrepreneurship education.

Defining Entrepreneurship and Entrepreneurship Education

In some countries entrepreneurship education is interpreted solely as dealing with starting a business and the term 'enterprise education' is used to describe other methods of equipping students with entrepreneurial skills and competences[17]. In other countries this distinction is not made in the language, thus the term 'entrepreneurship education' covers both definitions.

For the purpose of creating a common understanding the ASTEE consortium has been operating with some key concepts for entrepreneurship and entrepreneurship education.

17 Jones and Iredale, 2010.

"Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social."

"Entrepreneurship education relates to content, methods and activities supporting the creation and development of knowledge, competences and experiences that make it desirable and feasible for students to initiate and participate in entrepreneurial value creating processes. "

The concepts are adopted from the Danish Foundation for Entrepreneurship – Young Enterprise and are inspired by numerous different definitions[18]. There are a myriad of different ways to define entrepreneurship depending on the approach. This definition is simple and broad, yet expresses the core concept.

What Do We Want to Measure?

A thorough desk research was done to uncover relevant research and empirical studies of assessment of entrepreneurship skills, knowledge, and attitudes. Based on this and on the project owners' own research and experience the themes for the questions were identified and a common understanding of the competences was established. The starting point was the European definition of entrepreneurship as a key competence and entrepreneurship education consisting of different elements. Five categories of indicators were identified as relevant for our survey. The design of the constructs and questions in the survey will be described below.

Who do We Want to Measure?

One of the first issues we discussed was which age groups to target. As the education systems in the European countries are not the same, the group had to decide on age groups, not on class levels. We decided to target the questions at primary level at children aged 10-11. At secondary level the questions were targeted at students at the age of 16-17 and at tertiary level at students aged 20+. The wording and phrasing of questions should be in such a way that they could be understood by students at the different age levels.

Entrepreneurship and enterprise is often embedded in other disciplines and not just taught as a separate, special topic. Therefore we wanted the questions to be generic in such a way that not only entrepreneurship students were able to understand them. The tool should be applicable and useful in all disciplines and lines of education to measure perceived entrepreneurial competences, knowledge and mindset. We also had to consider the length of the questionnaire as a large number of questions often increase the tardiness level of the respondents and limit the reliability of the questionnaire as well as the number of respondents.

How do We Want to Collect the Data?

The objective was to develop a quantitative measurement tool which would be easy to access for both respondents and project owners. The online format was therefore chosen, but keeping in mind that respondents should also have the option of responding in a hard copy version. We made

18 I . Drucker, 1985; Gartner, 1988; European Commission, 2006; Ahmad and Seymour, 2008; Skolverket, 2010; Shane & Venkataraman, 2000; World Economic Forum, 2009; Stevenson, 1983, 1985; Stevenson and Jarillo, 1990.

use of the internet based SurveyMonkey which was then integrated in the project web page. The questionnaires were also produced as paper copies for hand-outs and the data was then registered by the team members.

The Testing

The questions in the survey are a combination of validated constructs and constructs developed or adjusted by the project members. The first draft of the three surveys was translated into the languages represented in the project group, and especially the questionnaire for primary level demanded considerations both to language, culture, and age level. This questionnaire was tested by the children of some of the project group members and modified before the first pilot test was done in the spring of 2013. The data from 1,050 respondents in three countries was analysed. The results of the analysis led to more modifications, and a 1.1 version was tested in the four remaining countries in the consortium. Based on the experiences with the questionnaire at primary level, a child psychologist was involved to modify the questions further. It turned out that at this level the pupils often needed help from the teacher to explain some of the questions.

The analysis of data from the first pilot tests (1,410 respondents) gave valuable information whether the students were able to answer the questions and about the internal validity of the questions. Further modifications were done including shortening the questionnaires to include a total of 48 questions at primary level, 64 at secondary level, and 57 at tertiary level.

The final version of the questionnaires was translated and tested in the following countries: Denmark, Sweden, Ireland, United Kingdom, France, Italy, Germany, Austria, Croatia, Belgium, Romania, Portugal, and Spain. The questionnaires were distributed to teachers, institutional leaders, and municipalities by the consortium members as well as by members of the advisory group. In some countries the project members personally distributed the questionnaires to students and thus got the immediate responses from students and teachers. The data collected from 4,900 respondents were analysed by the Danish team and different statistical tests were used. This will be described in the Analysis chapter below.

	No. of questions			No. of respondents			No. of countries		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
First draft	67	103	100	4			2		
Pilot 1,0	81	96	85	69	798	185	2	3	3
Pilot 1,1	74	88	85	150	102	280	3	2	4
Large scale	48	64	57	1.567	2.230	1.103	12	11	11

Table 1: The number of questions, respondents and countries involved in testing the questionnaires.

The Design of the Measures

The principal role of entrepreneurship education programmes (EEP) is to increase student awareness, to highlight the entrepreneurial path as a viable career option, and to develop positive attitudes, entrepreneurial knowledge and skills[19]. The focus does, however, naturally differ at different levels of education[20]. The educational system has a long tradition of focusing on teaching skills and

19 Donckels, 1991; Fayolle and Gailly, 2013; Johannisson, 1991; Gibb, 1993.
20 Jones & Iredale, 2010; Moberg, 2014.

knowledge[21], but when it comes to teaching entrepreneurship it is also important to address elements such as the pupils' and students' mindset, attitudes and career aspirations. This is also recognised at EU level where the Directorate-General for Enterprise and Industry (DG Enterprise and Industry) has used an inclusive framework (see figure 1) to illustrate the dimensions which educational initiatives should focus on in order to develop enterprising individuals.

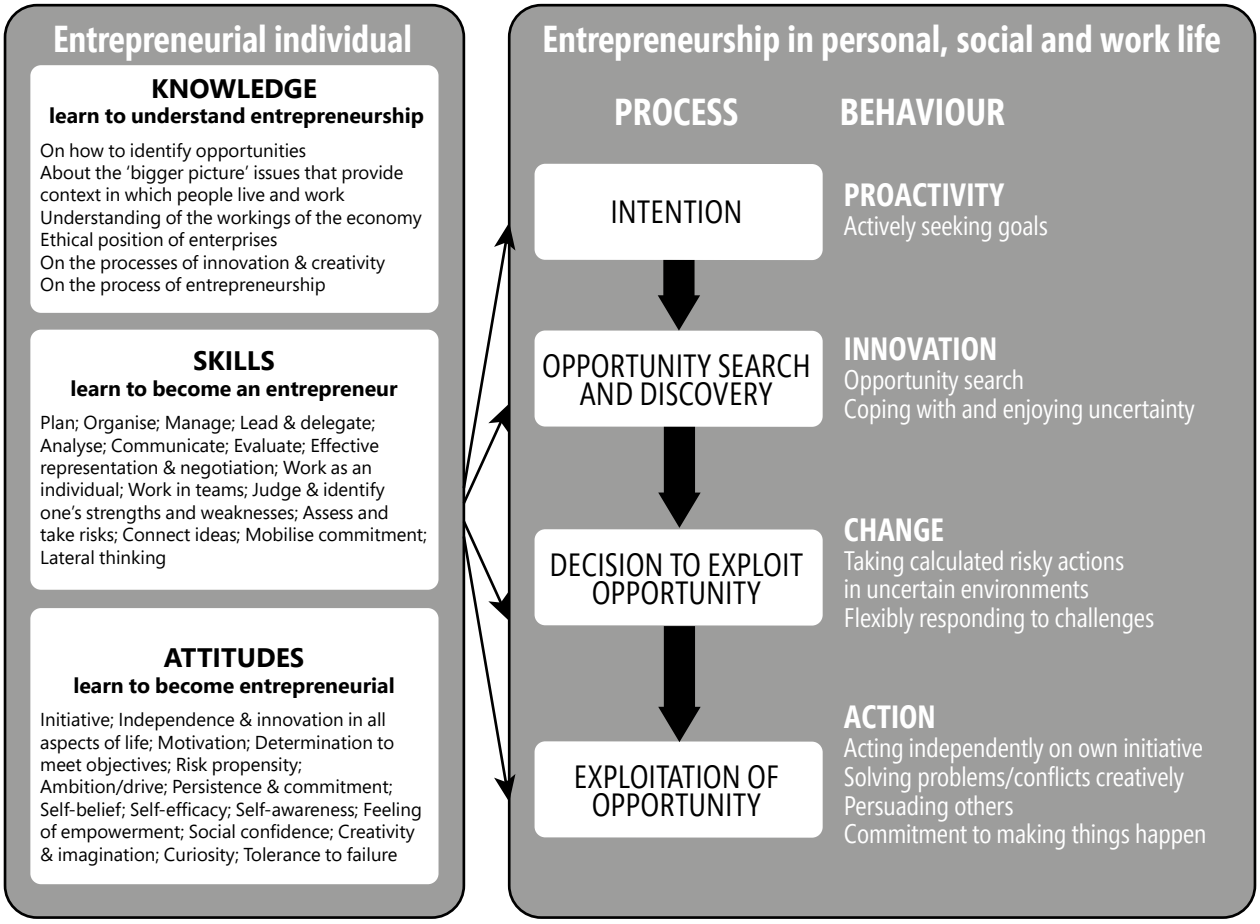


Figure 2: The EU framework for elements of entrepreneurship education.[22]

This framework has been used in the ASTEE project in order to develop indicators of each dimension. The project partners identified five dimensions as being especially relevant: *skills*, *knowledge*, *mindset*, *connectedness to education*, and *connectedness to future career*. In the following, each dimension included in the measurement tools will be presented. All questions included in the various dimensions are presented in Appendix A.

Entrepreneurial Skills

The concept of skills is too often taken for granted and its complexity (its social construction) is ignored. For the ASTEE project partners skills are a combination of the knowledge, the know-how and the experiences that have been acquired and that are necessary / useful in order to carry out an activity in a professional way. In the case with which we are concerned this activity or set of

21 Fayolle, 2013.
22 This framework is elaborated from Heinonen and Poikkijoki, 2006.

activities relates to entrepreneurial behaviour. Entrepreneurial activities require many different types of skills and abilities, both cognitively-oriented skills and skills of a more non-cognitive character[23]. Different stages in entrepreneurial ventures entail different challenges[24], which makes it necessary for the entrepreneur to be a jack-of-all trades[25]. Since individuals will not perform activities that they perceive to be beyond their capabilities, regardless of whether there is an apparent social demand for those kinds of behaviour[26], the education system has an important role to play in increasing young pupils' and students' perceived beliefs and confidence in their own entrepreneurial abilities[27].

There are, however, many different views on which types of skills entrepreneurship education should predominantly focus on[28]. In the framework which is used by the DG Enterprise and Industry a large variety of skills have been identified as being important in order to perform entrepreneurial activities. Since it is problematic to include too many dimensions in a measurement tool we have chosen to organise these skills under six inclusive skill sets which cover both cognitively-oriented entrepreneurial skills and entrepreneurial skills of a more non-cognitive character: *creativity*, *planning*, *financial literacy*, *resource marshalling*, *managing uncertainty*, and *teamwork*. The skills are needed in the different phases of an entrepreneurial venture, phases including exploration, evaluation, and exploitation, relevant in self-employment and within established organisations. Naturally, we cannot capture the respondents' true level when it comes to these skills, but extensive research has demonstrated that individuals' perceived competence in specific assignments and activities, that is, their task specific self-efficacy, also increases their success rate in performing these activities as well as the likeliness that they will engage in the specific behaviour which requires this competence[29]. In an educational setting this means that the students will be more likely to practise what they learn and apply the knowledge they acquire.

Exploration

- *Creative ability*: the ability to think in new and imaginative ways. Numerous studies have demonstrated that creative ability is of great importance to entrepreneurs[30]. Creativity is typically used during the exploration phase in order to identify and discover business opportunities[31].

Evaluation

- *Planning ability:* the ability to plan and structure tasks. The focus on planning ability has a long-standing tradition within entrepreneurship education[32], and numerous studies show how important it is for entrepreneurs to have this ability[33].

23 Kuratko and Hodgetts, 2004); Rosendahl-Huber, Sloof and Van Praag, 2012.
24 Shane & Venkataraman, 2000; Stevenson, Roberts and Grousbeck, 1985.
25 Lazear, 2005.
26 Bandura, 1991; Boyd and Vozikis, 1994.
27 Mauer, Neergaard and Kirketerp, 2009.
28 Fayolle, 2013.
29 Bandura, 1997.
30 See for example Baron, 2012; Elsbach, 2003; Lee, Florida and Acs, 2004.
31 Foss and Klein, 2012; Kirzner, 1997; McGee et al., 2009.
32 Honig, 2004.
33 See for example Delmar and Shane, 2003; Matthews and Scott, 1995; McGrath and MacMillan, 2000; Stevenson, Roberts, and Grousbeck, 1985; Timmons, Muzyka, Stevenson, and Bygrave, 1987.

- *Financial literacy:* the ability to understand financial statements and budgets. This is an important ability in order to successfully engage in entrepreneurial activities. Even though issues such as return on investment, cash flow and liquidity may be delegated to experts, it is important that the entrepreneur has at least a basic understanding of the financial concept in order to be trustworthy to external and internal stakeholders[34].

Planning ability and *financial literacy* are interrelated entrepreneurial skills which are important first of all during the preparation and evaluation phase of an entrepreneurial venture. As these skills are cognitively oriented, they are easy to codify and teach in an educational setting[35].

Exploitation

- *Marshalling of resources*: the ability to assemble and organise resources in order to exploit a business opportunity. This ability is seen by many researchers as the essence of entrepreneurship[36]. There is often a strong focus on the role which social capital plays in this process[37]. The process often takes place in a context characterised by high uncertainty[38].
- *Managing ambiguity*: The ability to manage and cope with uncertainty and ambiguity in the process of implementing and exploiting a business idea. Entrepreneurship has more or less been synonymous with uncertainty ever since the field's pioneering researchers conceptualised entrepreneurship and the activities of entrepreneurs[39], as entrepreneurial activities always unfold in a context characterised by uncertainty[40]. In order to successfully perform entrepreneurial activities, it is thus important that the individual can manage and cope with uncertainty and ambiguity.
- *Marshalling of resources* and *managing ambiguity* can be categorised as interrelated entrepreneurial skills which are important first of all during the execution and exploitation phase of an entrepreneurial venture. These skills which are of a non-cognitive character are difficult to teach, because they require practice and hands-on experience to be learnt.
- *Teamwork*: the ability to reach goals and achieve assignments through collaboration, as well as building effective relationships with others. Most entrepreneurial ventures, both inside and outside established firms are today performed by teams[41]. It is important to have well-developed interpersonal skills and to be able to collaborate with others and to promote own ideas and perspectives in group assignments during all the phases of an entrepreneurial venture, but it is especially during the exploitation phase that this ability is put to the test.

34 Castrogiovanni, 1996; Delmar and Shane, 2003; Stevenson et al., 1985.
35 Moberg, 2014.
36 See for example Foss and Klein, 2012; Gartner and Carter, 2003; Sarasvathy, 2001, 2008.
37 Davidsson and Honig, 2003; Karlsson & Honig, 2009.
38 Foss and Klein, 2012.
39 See for example Cantillion, 1755; Knight, 1921; Schumpeter, 1911.
40 Foss and Klein, 2012; Sarasvathy, 2001.
41 West, 2003.

Entrepreneurial Mindset

An entrepreneurial mindset is focused on action and responsibility. It is important to get the pupils and students to understand their role as active agents and as creators of their own future. This mindset can be contrasted with a passive and responsive by-stander mentality[42].

Many entrepreneurial skills, especially those of a more non-cognitive character, are often closely interconnected with the individual's mindset. Resource marshalling, managing uncertainty, creativity and interpersonal skills are, for example, in a natural way connected to the individual's degree of curiosity, adaptability and sociability, or what personality researchers categorise as openness, extroversion and agreeableness. Traits like perseverance, grit and independence, which personality researchers categorise as conscientiousness, are, however, also important elements in these skill sets[43]. In the framework proposed by DG Enterprise and Industry (figure 2) there are many different attitudes identified as being important to foster if we seek to increase the likeliness that more individuals will engage in entrepreneurial activities and behaviour. Many of these attitudes revolve around the individual's belief in his or her own capability of successfully performing challenging activities and tasks. A key element in all these attitudes is that they are not static in the same way as personality traits are believed to be, but they can be fostered and adopted by the individuals.

In the ASTEE project we have chosen to measure these various attitudes by three measures. The individual's attitude towards his or her own capability to successfully perform various activities and tasks is captured by the measure *Core Self Evaluation* (CSE), developed by Judge, Eres, Bono and Thoresen[44]. CSE is a validated measure of the individual's *general self-efficacy*, *locus of control*, and *self-esteem*[45]. The combination of these three measures captures the individual's core sense of being able to perform challenging assignments, and the measures cover many entrepreneurial attitudes included in the DG Enterprise and Industry's framework.

The mindset dimension presented above can be perceived as being important in many different contexts and assignments, so we also wanted to include a measure which is more specifically oriented towards an entrepreneurial mindset. Based on the identified attitudes in the DG Enterprise and Industry framework, a measure capturing the respondent's sense of initiative, attitude towards challenges as well as perseverance and determination to follow through challenging tasks was developed.

Furthermore, we also included a measure of the respondent's general attitudes towards self-employment. This measure was developed by McGee et al[46]. but the wording of the questions was adapted to suit the target groups.

Entrepreneurial Knowledge

The educational system has a long tradition of assessing knowledge, which limits the importance of including this dimension in an assessment tool. In the framework presented in figure 2, the DG Enterprise and Industry has identified many areas which are important to have knowledge about, such

42 Mauer et al., 2009.
43 Tough, 2013.
44 Judge, Eres, Bono, and Thoresen, 2003.
45 It also includes neuroticism in its original version, but since these questions can be awkward to pose to young pupils and students, we decided to exclude these dimensions from the measure.
46 McGee et al., 2009.

as: knowledge about how to identify opportunities, the bigger picture regarding the context in which people live and work, how the economy functions, as well as ethical positions of enterprises. These are all areas which are hard to cover with questionnaire items. However, it is important to assess pupils' and students' own perception of their knowledge, as it relates to their perception of their skills and capability. We therefore included a measure which focuses on 1) assessing the respondents' perceived knowledge about how to assess business opportunities, 2) the role and function which entrepreneurs have in society, as well as 3) knowledge about the different types of entrepreneurial career options existing.

Connectedness to Education

Researchers within educational psychology have repeatedly demonstrated that school assignments which are authentic, meaningful, challenging, varied, and which have a value in addition to the learning they create, are important elements in creating cognitive commitment and stimulating educational motivation[47]. When the educational initiative focuses on fostering non-cognitive entrepreneurial skills, action-based teaching methods and authentic and group-based educational assignments are typically required[48]. These teaching methods and pedagogical approaches can have many positive effects beside increasing knowledge about entrepreneurship and fostering entrepreneurial skills and mindsets, since they increase the pupils' and students' understanding of their education and its purpose. Elements such as school engagement and the student-teacher relationship have been demonstrated to have an important influence on variables such as health, drop-out rates, academic performance and socio-economic status[49]. Relationships with classmates and teachers play an important role here, as well as to what extent the pupils find their education purposeful and useful.

To many policy makers, teachers and practitioners, these variables can be seen as being even more important than the more entrepreneurship and innovation related dimensions, especially at the lower levels of education since pupils here are far away from the labour market[50]. Both in primary and secondary school there is typically a problem of motivating pupils to engage in their educational activities, especially pupils who do not have an academic family background[51]. Authentic and group-based entrepreneurial assignments can be especially stimulating to academically challenged pupils, since these assignments emphasise the importance of diverse forms of talents[52] and draw on the individual pupil's interests and motivation[53].

Many different scales are available for assessing such dimensions[54]. We will elaborate more extensively on this in the "How to use the tools" section. In the ASTEE questionnaire we chose to only focus on the student-teacher relationship since this has been demonstrated to be a good proxy for the other dimensions as well. The focus of this measure is to assess in what extent the pupils or students feel that they are supported by their teachers, and in what extent the teacher encourages them to act proactively and engage in innovative and entrepreneurial activities.

47 Wentzel and Brophy, 2013
48 Moberg, 2014.
49 Fredricks et al., 2004; Libbey, 2004.
50 Johannisson, 2010.
51 Eccles et al., 1993.
52 Moberg, 2014.
53 Jones and Iredale, 2010.
54 See for example Moberg, 2014; FFE-YE, 2011, 2012, 2013; Karcher, 2003.

Connectedness to Future Career

Purposeful and authentic educational assignments typically display how the pupils and students can use the knowledge and the skills practically in their everyday life, both in the present and in the future. Even if employment and work is distant to pupils at the lower levels of education, it is important that pupils and students naturally connect their learning process with real job assignments and understand in which ways the skills they attain can be used in their future work life. Many jobs that the pupils will work with in future do not exist today, and some will require specific skills which are hard to identify today. It is, however, safe to say that the knowledge intensity is increasing and the educational requirements are becoming higher. High career ambitions are typically connected to high educational ambitions, and when pupils increase their understanding of the importance of education, they often also start to understand that many different career paths exist.

There are many ways in which to measure the pupils' and students' connectedness to the labour market and to their future career[55]. In the ASTEE project we have focused on the pupils' and students' enterprising activities in the present and not only included questions about their work experience, but also questions about whether they have started or led any activities outside school, whether they engage in volunteer work, and their experience with self-employment. We have also included a measure of their intention to start up a company in the near future as well as a measure which focuses on their preference for working with innovative work assignments, which typically characterises intrapreneurial work positions.

55 See FFE-YE, 2011, 2012, 2013 for examples of this.

VALIDATION OF THE MEASURES

As described in the *Process* section, the development of the measurement tools has been performed in a stepwise process including pre-studies and pilot-tests. This has allowed us to increase the precision, validity and reliability of the measurement tools, as well as making them more parsimonious. In this section the results of the large-scale survey will be presented. Since the measurement tools include multiple latent constructs which cannot be observed and therefore have been measured with multiple questions, we have used the statistical technique "structural equation modelling" (SEM).

Before we present the results of the analyses we will briefly present the analysis technique which we have applied, which measures we have used at the different levels, and how the results of our tests should be interpreted, that is, which cut-off levels for passing or failing the tests we have used and what the passing or failing of the tests means.

Analysis Technique

The statistical technique "structural equation modelling" (SEM) has been used extensively in educational research and psychology, but it can be perceived as un-accessible and fairly opaque to many readers who are not used to this method. We will therefore, in this section, briefly describe the various analyses we have performed on the data and what these tests mean. The dimensions we focus on are so-called latent constructs because they are hard to observe and measure and we need to use multiple questions to identify them[56]. In order to assess how well the questions are reflected by the constructs we wish to measure, we have performed various confirmatory factor analyses (CFA) which provide us with model fit indices. The fit indices establish whether, overall, the model is acceptable and whether or not our structuring of the questions is statistically adequate. We have followed the recommended levels proposed by Hu and Bentler[57].

The CFA also provide us with information regarding the questions' loadings, in other words how well the questions are reflected by the construct. This gives us the answer to some important questions, namely how well the questions are reflected by the construct (internal consistency and convergent validity) and to what extent the questions are reflected by their intended construct and not other constructs included in the model (discriminant validity). The Fornell and Larcker-test[58] has been used to assess this, and their recommended values regarding composite reliability (CR) and average value extracted (AVE) values have been followed.

Group analyses – do different groups of respondents interpret the questions in the same way?

In order to rule out the possibility that the respondents have understood the questions

56 Brown, 2006; Little, 2013.

57 According to Hu and Bentler (1998, 1999) a model should have a comparative fit index (CFI) and a Tucker Lewis Index (TLI) above .90; a root mean square error of approximation (RMSEA) and a standardised root mean square residual (SRMR) below .08 in order to demonstrate acceptable fit.

58 According to Fornell and Larcker (1981) the CR should be higher than .70 in order to demonstrate sufficient internal consistency, the AVE should be higher than .50 in order to demonstrate convergent validity, and the square root of AVE should be higher than the constructs highest co-variance value in order to demonstrate discriminant validity.

in different ways depending on their background (culture, experience, education), we have also performed multiple tests of "factorial invariance". As we discussed earlier, when we used the "trees" and the "roots" as a metaphor for a latent construct (see figure 1), the factorial invariance test investigates if the relationship between the roots (the questions) looks the same for different groups, that is, whether the length (loadings) and the thickness (intercepts) of the roots have similar relations. It is important to determine that the respondents who have experience with the activity do not interpret the questions in a different way as this would bias the assessment, especially since entrepreneurial behaviour is a fairly uncommon activity, one which many respondents have limited familiarity with.

We have assessed the measures' factorial invariance by dividing the samples into subgroups. These groups differ at the different educational levels which we have studied. We have divided the sample by gender and country at all educational levels, but we have not included a measure of experience with self-employment and entrepreneurship education in the questionnaire that targets pupils at primary level since such activities are rather uncommon to pupils in this age group. At this level we have instead asked the pupils to indicate whether they have started/founded any activities outside of school, which we use as a rough proxy for their enterprising behaviour.

At tertiary level, the students' extracurricular activities were not deemed to be an adequate measure of their enterprising behaviour. Here we instead included questions about experience with self-employment and entrepreneurship education. At secondary level, where the students are between the two stages, that is, they are old enough to have had experience with self-employment and entrepreneurship education, but they are also young enough for extracurricular activities to make out a relevant proxy for their enterprising behaviour. Therefore we have included all three measures. An overview of the groupings at the different levels and what these are measures of are presented in table 2.

	Primary	Secondary	Tertiary	
Factorial Invariance	Gender	Gender	Gender	
	Country	Country	Country	
	Ent. Behaviour	Ent. Behaviour		Predictive Validity
		E'ship Education	E'ship Education	
		Self-employment Exp.	Self-employment Exp.	

Table 2: The group analyses performed at the different levels of education.

These groupings make it possible to test whether the respondents have understood the questions in the same way, regardless of gender, culture, educational experience, experience with self-employment or enterprising activities. The tests we have performed are the so called weak (loadings) and strong (intercepts) factorial invariance tests. By imposing constraints on the indicators we can investigate the model fit indices and assess whether or not the models pass the tests. We have followed the recommended cut-off levels proposed by Cheung and Rensvold[59].

Predictive validity – do the measures explain what we want them to explain?

The group analysis technique has also been used in order to assess the measures' predictive

59 According to Cheung & Rensvold (2002), the comparative fit indices (CFI) should not change >.01 after imposing the constraint if the measures are to demonstrate factorial invariance.

validity. We have used the so-called "known groups analysis" that is, we have investigated whether or not a group that should theoretically experience higher values in the dimensions that we measure also does so[60] and that this difference is statistically significant. Since the measures included in our assessment tool should be indicators of entrepreneurial behaviour, attitudes and competences, we have at the secondary and tertiary levels of education divided the sample according to whether or not the respondents have entrepreneurial experience and whether or not the respondents have experienced entrepreneurship education. However, at primary level we divided the sample only according to whether or not the pupils had experience with starting/founding an activity outside school. The predictive validity of the measures depend on in what extent the "entrepreneurial groups" demonstrate a significantly higher level in the dimension.

Analysis

The analysis is based on our large scale test which includes 4,900 respondents. Since our measurement tool focuses on assessing entrepreneurial individuals we have oversampled students who participate in entrepreneurship education. The level of entrepreneurial activities is thus high in our samples. In table 3 the descriptive statistics of the samples are presented.

	Primary	Secondary	Tertiary
Raw sample	1,567	2,230	1,103
- Listwise deletion	205	224	120
Number of respondents in the analyses	1,362	2,006	983
Females	52.9%	42.1%	47.6%
Parents born in another country:			
- Both	16.0%	10.8%	11.5%
- One	14.9%	10.2%	8.4%
Parents have a university degree	54.5%	44.1%	53.9%
Has anyone close to you started a company:			
- Mother	7.6%	8.0%	12.6%
- Father	17.5%	20.7%	28.0%
- Other relative	21.4%	37.5%	34.8%
- Friend	12.3%	16.5%	25.6%
- No	53.4%	37.7%	31.0%
Have started/founded and activity or project outside of school?	37.2%	39.7%	
Have participated in an activity focusing on entrepreneurship		50.8%	
Have participated in an entrepreneurship course			56.7%
Have participated in extracurricular activities focusing on entrepreneurship			32.2%
Participate in volunteer work		33.5%	37.5%
Work in addition to going to school		28.8%	
Exchange student			10.5%
Years of part-time work experience:			
-0			29.0%
-Under 2			33.9%
-3-5			25.7%
-6-8			7.9%
-Over 8			3.5%
Years of full-time work experience:			
-0			57.8%
-Under 2			29.2%
-3-5			6.9%
-6-8			2.5%
-Over 8			3.5%

Table 3: Descriptive statistics of the three samples.

60 DeVellis, 2012.

Statistical Properties – do our dimensions reflect our indicators?

The results of the confirmatory factor analyses, presented in table 4, demonstrate sufficient levels of model fit, well within the range of Hu's and Bentler's (1999) cut-off values[61] for all three educational levels. The Fornell and Larcker-tests indicate that the constructs demonstrate excellent levels of internal consistency and convergent validity, for the measurement tools which focus on secondary and tertiary level, but at primary level there are some constructs which experience problematic low values. However, the discriminant validity of many of the constructs can be questioned at all levels, since the co-variance between some of the constructs is very high.

This is not an uncommon characteristic of a multidimensional measure which aims to capture a specific underlying dimension, which in our case is *entrepreneurial individuals*. It is fairly natural that individuals who perceive they have a high level in one of the dimensions also perceive they have a high level in the other dimensions. This problem can be solved by using the parcelling technique where similar questions of different constructs are combined[62]. Overall, the results demonstrate that the items are reflected by their intended constructs and that the dimensionalities of the models are structured in a sensible way close to the real perceived dimensions of the respondents, but that the measurement tool which targets pupils at primary level has some problems that need to be solved.

	Primary level			Secondary level			Tertiary level		
Variable	**CR**	**AVE[1]**	**Highest covariance**	**CR**	**AVE**	**Highest covariance**	**CR**	**AVE**	**Highest covariance**
ESE (Skills)									
- Creativity	.84	.64 (.80)	.83	.85	.65 (.81)	.86	.84	.64 (.80)	.81
- Planning	.84	.64 (.80)	.87	.85	.66 (.81)	.91	.86	.67 (.82)	.74
- Financial literacy				.82	.60 (.77)	.72	.80	.58 (.76)	.69
- Marshalling of resources				.82	.60 (.77)	.91	.85	.65 (.81)	.74
- Managing ambiguity	.74	.49 (.70)	.87	.74	.49 (.70)	.86	.80	.57 (.75)	.81
- Teamwork	.77	.53 (.73)	.82	.81	.59 (.77)	.90			
- Entrepreneurial knowledge	.71	.46 (.68)	.69	.84	.64 (.80)	.41	.85	.65 (.81)	.68
Mindset									
- Entrepreneurial Mindset	.62	.35 (.59)	.76	.73	.48 (.69)	.74	.73	.48 (.69)	.81
- Core self-evaluation	.81	.59 (.77)	.76	.89	.73 (.85)	.66	.88	.72 (.85)	.70
- Entrepreneurial Attitudes	.86	.68 (.83)	.70	.84	.65 (.81)	.57	.87	.68 (.82)	.57
Career Ambitions									
- Entrepreneurial intentions	.75	.50 (.71)	.70	.90	.76 (.87)	.57	.91	.77 (.88)	.54
- Innovative employee	.75	.50 (.71)	.76	.86	.68 (.82)	.65	.85	.65 (.81)	.74
Education									
- Entrepreneurship education	.86	.68 (.83)	.74	.94	.84 (.92)	.61			
- Teacher support	.69	.43 (.66)	.74	.81	.59 (.77)	.61			
Primary model fit indices: χ^2=1668.09 (df:528), RMSEA=.040(.038;.042); CFI=.951; TLI=.942; SRMR=.032									
Secondary model fit indices: χ^2= 3691.34 (df:728), RMSEA=.045(.044;.046); CFI=.944; TLI=.933; SRMR=.037									
Tertiary model fit indices: χ^2= 1567.46 (df:440), RMSEA=.051(.048;.054); CFI=.944; TLI=.933; SRMR=.038									
[1]The square root of AVE is presneted within parantheses									

Table 4: Confirmatory factor analysis, internal consistency, convergent validity, and discriminant validity

61 According to Hu and Bentler (1998, 1999) a model should have a comparative fit index (CFI) and a Tucker Lewis Index (TLI) above.90; a root mean square error of approximation (RMSEA) and a standardised root mean square residual (SRMR) below.08 in order to demonstrate acceptable fit.

62 Little, 2013; Little, Cunningham, Shahar, and Widaman, 2002. See also Moberg (2014b) for an example of how this can be done.

Factorial invariance – do different groups interpret the questions in the same way?

The next tests we performed are the so-called tests of factorial invariance. As described above, we tested, at all three levels, whether or not there were any gender bias regarding the interpretation of the questions or if national culture had any impact on this. At the primary and secondary levels we furthermore tested whether respondents who had experience with starting an activity outside of school had understood the questions in the same way as other respondents. At the secondary and tertiary levels we also tested whether experience with self-employment and entrepreneurship education had any influence on the respondents' understanding of the questions. We performed tests for both weak (loadings) and strong (intercepts) variance. In table 5 and table 6 the results of these tests are presented.

Entrepreneurial behaviour (starter)	**Primary** (Starter=507, Non-starter=855)			**Secondary** (Starter=796, Non-starter=1210)		
Model	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**
Config.	2434.35	1056	.941	4715.73	1456	.937
Weak	2475.44	1080	.940	4763.38	1484	.937
Δ Weak (vs. Config.)	41.08	24	-.001	47.65	28	0
Strong	2538.00	1104	.938	4826.12	1512	.936
Δ Strong (vs. Weak)	62.56	24	-.002	62.74	28	-.001
Entrepreneurship education	**Secondary** (E'ship Edu=1019, Control=987)			**Tertiary** (E'ship Edu=557, Control=426)		
Model	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**
Config.	4642.70	1456	.938	2176.57	880	.936
Weak	4685.73	1484	.938	2209.30	902	.935
Δ Weak (vs. Config.)	43.03	28	0	32.73	22	-.001
Strong	4824.53	1512	.936	2255.65	924	.934
Δ Strong (vs. Weak)	138.80	28	-.002	46.34	22	-.001
Exp. With self-employment	**Secondary** (Exp.=535, Control=1471)			**Tertiary** (Exp.=327, Control=656)		
Model	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**
Config.	4589.47	1456	.940	2113.21	880	.938
Weak	4664.22	1484	.939	2156.56	902	.937
Δ Weak (vs. Config.)	74.76	28	-.001	43.35	22	-.001
Strong	4768.02	1512	.937	2242.24	924	.934
Δ Strong (vs. Weak)	103.80	28	-.002	85,68	22	-.003

Table 5: Weak and strong factorial invariance

Gender	**Primary** (Female=641, Male=721)			**Secondary** (Female=1161, Male=845)			**Tertiary**(Female=515, Male=468)		
Model	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**
Config.	2429.23	1056	.942	4703.89	1456	.939	2113.21	880	.939
Weak	2467.93	1080	.942	4748.20	1484	.938	2158.22	902	.938
Δ Weak (vs. Config.)	38.70	24	0	44.31	28	-.001	44.81	22	-.001
Strong	2521.60	1104	.940	4842.57	1512	.937	2265.07	924	.934
Δ Strong (vs. Weak)	53.67	24	-.002	94.37	28	-.001	106.85	22	-.004
Country	**Primary** (Poor=253, Rich=1039)			**Secondary** (Poor=1161, Rich=845)			**Tertiary**(Poor=335, Rich=648)		
Model	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**	**Chi-sq.**	**DF**	**CFI**
Config.	2535.92	1056	.935	4817.57	1456	.936	2111.45	880	.941
Weak	2590.18	1080	.934	4890.18	1484	.935	2185.47	902	.938
Δ Weak (vs. Config.)	54.26	24	-.001	72.62	28	-.001	47.02	22	-.003
Strong	2776.55	1104	.927	5251.53	1512	.929	2361.56	924	.931
Δ Strong (vs. Weak)	186.37	24	-.007	361.35	28	-.006	176.08	22	-.007

Table 6: Weak and strong factorial invariance

As we can see in table 5 and table 6, the tests indicate that the constructs included in the models both demonstrate weak and strong factorial invariance, since they pass the recommended values proposed by Cheung and Rensvold[63]. We can thus conclude that the respondents understand the questions in similar ways, regardless of gender, entrepreneurial experience, educational background, and national culture.

Predictive Validity – do we measure what we intend to measure?

In order to assess the predictive validity of the measures, that is, do they measure what they are intended to measure, we performed additional tests on the groups which were divided according to the respondents' experience with entrepreneurial activities, self-employment and entrepreneurship education (see table 2 above). In these tests we investigated whether the mean values significantly differed between respondents in the groups. In table 7 the results of these tests are presented.

63 According to Cheung & Rensvold (2002), the comparative fit indices (CFI) should not change >.01 after imposing the constraint if the measures are to demonstrate factorial invariance.

	Primary level				Secondary level			
Variable	**Starter (n=507) Mean**	**Non-Starter (n=855) Mean**	**ΔMean**	**ΔChi-sq Sig.**	**Starter (n=796) Mean**	**Non-Starter (n=1210) Mean**	**ΔMean**	**ΔChi-sq[1] Sig.[2]**
ESE (Skills)								
Creativity	5.55	5.17	.38	28.16***	5.29	4.82	.48	77.90***
Planning	5.26	4.80	.46	32.06***	5.44	4.99	.45	61.02***
Financial literacy					4.46	4.06	.40	39.86***
Marshalling of resources					5.53	5.13	.39	47.12***
Managing ambiguity	4.95	4.68	.28	13.41***	5.20	4.93	.28	27.66***
Teamwork	5.79	5.53	.26	13.85***	5.88	5.62	.26	24.87***
Entrepreneurial knowledge	5.79	5.60	.20	8.34**	5.44	5.14	.30	22.50***
Mindset								
Entrepreneurial Mindset	4.71	4.29	.42	36.90***	5.04	4.63	.41	57.17***
Core self-evaluation	5.35	5.10	.25	16.44***	5.47	5.27	.20	17.09***
Entrepreneurial Attitudes	5.55	5.12	.43	26.94***	5.23	5.01	.22	12.68***
Career Ambitions								
Entrepreneurial intentions	4.99	4.26	.73	62.53***	4.09	3.54	.55	43.48***
Innovative employee	5.47	5.12	.36	23.28***	5.62	5.31	.31	29.12***
Education								
Entrepreneurship education	5.46	5.08	.38	21.13***	4.55	4.17	.38	34.75***
Teacher support	5.19	4.99	.19	5.87*	4.54	4.28	.26	13.34***
	Secondary level				**Tertiary level**			
Variable	**E'ship Edu (n=1019) Mean**	**Control (n=987) Mean**	**ΔMean**	**ΔChi-sq Sig.**	**E'ship Edu (n=557) Mean**	**Control (n=426) Mean**	**ΔMean**	**ΔChi-sq[1] Sig.[2]**
ESE (Skills)								
Creativity	5.16	4.84	.32	37.23***	5.23	4.94	.29	18.08***
Planning	5.40	4.92	.48	73.42***	5.31	5.01	.30	17.13***
Financial literacy	4.52	3.90	.62	98.65***	4.60	4.37	.23	9.00**
Marshalling of resources	5.42	5.15	.27	21.79***	5.36	5.14	.22	8.76**
Managing ambiguity	5.18	4.88	.30	33.95***	5.41	5.11	.30	19.27***
Teamwork	5.85	5.59	.27	27.00***				
Entrepreneurial knowledge	5.42	5.11	.31	24.34***	5.96	5.47	.50	47.52***
Mindset								
Entrepreneurial Mindset	4.97	4.61	.36	46.21***	5.11	4.82	.30	18.90***
Core self-evaluation	5.47	5.23	.24	25.34***	5.46	5.26	.21	10.12**
Entrepreneurial Attitudes	5.27	4.91	.36	35.98***	5.62	5.41	.22	6.90**
Career Ambitions								
Entrepreneurial intentions	4.16	3.34	.81	102.62***	4.55	4.11	.44	15.58***
Innovative employee	5.53	5.35	.18	10.75**	5.69	5.48	.21	9.35**
Education								
Entrepreneurship education	4.72	3.90	.83	179.31***				
Teacher support	4.70	4.06	.64	87.69***				
	Secondary level				**Tertiary level**			
Variable	**Exp. S-emp. (n=535) Mean**	**Control (n=1471) Mean**	**ΔMean**	**ΔChi-sq Sig.**	**Exp. S-emp. (n=327) Mean**	**Control (n=656) Mean**	**ΔMean**	**ΔChi-sq[1] Sig.[2]**
ESE (Skills)								
Creativity	5,29	4,90	.39	40.27***	5.39	4.97	.43	33.95***
Planning	5,38	5,09	.30	22.76***	5.42	5.07	.35	21.87***
Financial literacy	4,71	4,03	.68	102.99***	4.78	4.36	.42	26.61***
Marshalling of resources	5,44	5,24	.20	10.29**	5.50	5.15	.35	21.09***
Managing ambiguity	5,20	4,98	.22	14.95***	5.49	5.17	.32	19.07***
Teamwork	5,78	5,70	.09	2.32				
Entrepreneurial knowledge	5.55	5.16	.39	33.00 ***	5.89	5.68	.21	8.13**
Mindset								
Entrepreneurial Mindset	4.99	4.72	.27	20.10***	5.27	4.84	.43	33.45***
Core self-evaluation	5.46	5.31	.15	8.23 **	5.48	5.32	.16	5.312*
Entrepreneurial Attitudes	5.48	4.96	.52	62.79***	5.86	5.36	.50	35.54***
Career Ambitions								
Entrepreneurial intentions	4.54	3.47	1.07	138.25***	5.17	3.95	1.23	114.49 ***
Innovative employee	5.61	5.38	.23	13.76***	5.76	5.52	.24	10.31**
Education								
Entrepreneurship education	4.79	4.15	.64	83.47***				
Teacher support	4.65	4.28	.38	23.17***				

[1] All constructs have been tested individually (Δdegrees of freedom=1)
[2] *=.05, **=.01, ***=.001

Table 7: Known-group analysis

As we can see in table 7 the respondents at primary and secondary level who have indicated that they have experience with entrepreneurial activities (started/founded an activity outside of school) also experience significantly higher levels in each of the constructs. We can also see that these respondents perceive that their educators have been more encouraging and that their education has focused to a larger extent on teaching them cognitively-oriented and non-cognitive entrepreneurial skills and abilities. Since our data have not been collected in an experimental setting and it is of a cross-sectional rather than a longitudinal character, we cannot assess the directionality of the association. It is, however, to be expected that the entrepreneurial behaviour of the respondents is a result of the entrepreneurial focus they have experienced during their education.

We can also see that the respondents at the secondary and tertiary levels of education who have indicated that they have experience with self-employment and entrepreneurship education also experience significantly higher values in the constructs included in the models. It is only the construct which measures secondary level students' perceived ability to participate in teamwork that does not significantly differ for the respondents who have indicated that they have experience with self-employment. This demonstrates that self-employment in itself does not lead to an increased perceived ability to participate in teamwork, which is not surprising, since many firms may very well be founded by single individuals. However, we can see that the respondents who have indicated that they have experience with entrepreneurship education have significantly higher values in this construct, which shows that from the viewpoint of entrepreneurship educators most companies are founded by teams, which is also why teamwork is a natural component in this type of education.

Overall, the known-group tests that we have performed demonstrate a high level of predictive validity of the measures at all three educational levels.

Summary of the Analysis

Overall, the tests indicate that the measures demonstrate sufficient statistical properties and levels of internal consistency and convergent validity. At primary level there are some problems with the constructs entrepreneurial mindset, teacher support, entrepreneurial knowledge, and perceived ability to manage ambiguity. This is not surprising given the age of the respondents at this level (10-11 years), but it indicates that the questions included in these constructs might have been too complex for the respondents and should be altered. An alternative is to assist the pupils in the process of filling out the questionnaires and to explain to them the meaning of the different questions. At the secondary and tertiary level all the measures demonstrate excellent levels of internal consistency and convergent validity.

There are some issues when it comes to the constructs' discriminant validity since many of the constructs co-vary at a high level. This is especially a problem with the constructs which measure the respondents' perceived entrepreneurial skills (ESE). This is due to the fact that entrepreneurial self-efficacy can be viewed as a multidimensional measure, and the problem could be solved by combining some of the constructs and thereby reducing the number of items included in the analysis.

Our multiple tests of factorial invariance demonstrate that regardless of the respondents' gender and national culture, as well as of their experience with self-employment, entrepreneurial activities and entrepreneurship education, they have interpreted the questions in the same way. This means that we can use the assessment tool in different contexts which include students with various backgrounds.

The predictive validity of the measures – perhaps the most important of all the tests – demonstrates that the assessment tools have a high level of predictive validity. The known-group tests which we have performed all show that pupils and students who demonstrate entrepreneurial behaviour or who have experience with entrepreneurship education also have significantly higher levels in each of the constructs.

Now that we have established that our measures are reliable, that the questions are reflected by their intended dimensions and understood in the same way regardless of the background of the respondents, and that they are valid measures of entrepreneurial behaviour, we can continue with less technical (but perhaps more important) matters, that is, how to use the measurement tools.

HOW TO USE THE ASTEE ASSESSMENT TOOLS

When developing the ASTEE assessment tools we focused on fulfilling the needs of the practitioners within the field of entrepreneurship education, that is, researchers and policy makers, but first and foremost educators. It was therefore important to us that the tools have a user-friendly design and generate results that are easy to interpret and use. The previous part of our text was very technical and involved a lot of advanced statistical methods which were necessary in order to validate the assessment tools. However, you do not have to be a trained statistician in order to use the assessment tools. In this section we will describe how you can use the ASTEE assessment tools in order to increase your understanding of the kind of effects which different elements in your teaching have on your students.

We will start by describing how you can use our assessment tools to perform a quasi-experiment. This will be followed by a presentation of the levels which different groups in our sample (4,900 respondents in 13 European countries) had in the individual dimensions included in our measurement tools. You can use this to compare with your pupils or students of the same level and see whether they are significantly above or below the mean of other pupils/students in the different categories. The section will end with a discussion about how our assessment tools can be complemented with other measures and assessment methods.

How to perform a quasi-experiment

Use pre-tests and post-tests

The majority of all educational evaluations only include post-tests, that is, in the end of the programme the participants are asked to fill out an evaluation form of the programme. This type of evaluation typically only offers us information about to which degree the participants enjoyed different elements of the curricular design and how they perceived the teaching styles of those who delivered it. When it comes to assessing the effect of an educational initiative, that is a course or educational programme, it is important to use pre-tests in order to assess the participants' level in each of the dimensions you wish to influence, at the start of the programme, that is, before you have influenced them through your educational initiative. The post-testing should then be done at the end of your programme or directly after the educational initiative that you wish to assess. By comparing the participants' mean levels in the different dimensions pre and post, you can determine the effect of your educational initiative.

Since the ASTEE measurement tools include multiple dimensions important for entrepreneurial activities you will be able to analyse the influence of your educational design on multiple indicators, not just on the ones you intend to affect. This is of great value in assessment studies since education and learning activities take place in a social context, where many dimensions are inter-related and reinforce one another, which makes it complicated to isolate the effects of one certain "treatment". For example, you have designed a module intended to increase your students' creative ability and you teach them different idea generation techniques that they can apply when they formulate venture ideas. It is likely that the result of your module is going to be an increase in your students' perceived creative ability, because they previously have perceived themselves as lacking in creative ability or saw

it as a barrier when it came to entrepreneurial activities: "I never have any good ideas", "I am not a creative person". However, the curriculum design of your module may very well affect many other dimensions than the perceived creative ability, for instance the participants' entrepreneurial attitudes and intentions. Since it is difficult to predict the association between different dimensions for different students, and how your educational initiatives will influence these dimensions, it is important to assess its effect on multiple dimensions.

Team up with a colleague

In order to assess the influence of different types of educational designs it is usually a good idea to compare the results of your educational initiative with the results of other types of educational initiative. To make experiments with educational design typically requires a control group that does not receive the "treatment". In natural science studies this is fairly uncomplicated (half of the plants do not receive fertilizers, half of the participants are treated with a placebo pill, etc.). However, when it comes to social science and educational settings, there are multiple factors that can influence the dimensions we wish to assess. A pure control group is difficult to attain in educational settings because this type of setting always has some sort of influence on the participants, both regarding their cognitive and their non-cognitive skills, as well as attitudes, mindset and career ambitions.

Since our assessment tools focus on dimensions which are of a very generic character it may even be the case that the natural maturity process of young students influences the dimensions. However, it is still to be preferred that you compare your results with the results of other types of educational designs. The other does not have to be an educational initiative that completely lacks entrepreneurial elements; it can be an entrepreneurship course that merely focuses on other dimensions than yours. For example, maybe your colleague wants to teach his or her students cognitively-oriented entrepreneurial skills, such as how to assess business ideas and how to write a business plan - which can be taught in a classroom setting - while your idea is to teach your students entrepreneurial skills of a more non-cognitive character, such as how to manage ambiguity and marshal resources through an action-based educational initiative where the students go out and realise their projects in collaboration with organisations in the local community. The educational initiatives of your colleague and you may be expected to have very different effects on different dimensions included in the ASTEE measurement tools.

Naturally, the influence of the educational initiatives will depend on the type of students you have. Different students will react and respond in different ways to various types of educational initiative. This is to a large extent reflected in how the students perceive their education. We have therefore included a measure of the students' perception of what the educational initiative has focused on, especially when it comes to its focus on fostering cognitive and non-cognitive entrepreneurial skills (see Appendix section B1 for students at Primary and Secondary level). You will therefore be able to take this into account when evaluating your programmes. For example, you can divide the sample into high/low groups regarding these dimensions and then assess how your educational initiative has influenced these different groups.

Compare with our large scale sample

We have gathered data from 4,900 respondents in 13 European countries in our large scale survey. You can use these data to compare the level of your students on the different measures

included in our survey. We have in our survey oversampled entrepreneurship students, so it is important that you compare your students with the correct group. You can do this with individual students but you can also compare your class average before and after with our sample. In the following the mean values of different groups in our sample will be presented, as well as their high and low values[64]. If your students are above or below these values (the high and the low ends) you can determine that they differ significantly from the mean average of students in our sample. The mean averages of the entrepreneurship students, non-entrepreneurship students, females and males, students who have experience with starting an activity outside of school, and students who have experience with self-employment for the three educational levels are presented below[65].

Entrepreneurship students	Secondary level				Tertiary level			
	Entr Educ (n=1019)		Non-entr Educ (n=987)		Entr Educ (n=557)		Non-entr Educ (n=426)	
Variable	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**
ESE (Skills)								
Creativity	5.16	[5.09-5.24]	4.84	[4.76-4.91]	5.24	[5.15-5.33]	4.94	[4.84-5.04]
Planning	5.4 0	[5.33-5.48]	4.92	[4.84-5.00]	5.31	[5.22-5.40]	5.02	[4.91-5.13]
Financial literacy	4.54	[4.46-4.63]	3.88	[3.79-3,96]	4.61	[4.51-4.71]	4.37	[4.25-4.48]
Marshalling of resources	5.42	[5.34-5.50]	5.15	[5.08-5.23]	5.36	[5.26-5.45]	5.13	[5.02-5.24]
Managing ambiguity	5.19	[5.12-5.26]	4.88	[4.81-4.96]	5.41	[5.33-5.50]	5.11	[5.00-5.21]
Teamwork	5.85	[5.78-5.92]	5.59	[5.52-5.66]				
Entrepreneurial knowledge	4.44	[5.36-5.53]	5.08	[4.98-5.17]	5.96	[5.87-6.04]	5.47	[5.36-5.58]
Mindset								
Entrepreneurial Mindset	4.97	[4.90-5.05]	4.61	[4.54-4.68]	5.12	[5.03-5.20]	4.82	[4.71-4.92]
Core self-evaluation	5.47	[5.40-5.53]	5.23	[5.16-5.29]	5.46	[5.39-5.54]	5.25	[5.15-5.35]
Entrepreneurial Attitudes	5.28	[5.20-5.36]	4.90	[4.82-4.99]	5.62	[5.51-5.73]	5.40	[5.28-5.53]
Career Ambitions								
Entrepreneurial intentions	4.15	[4.04-4.27]	3.34	[3.23.3.45]	4.55	[4.40-4.70]	4.11	[3.95-4.27]
Innovative employee	5.54	[5.46-5.62]	5.18	[5.25-5.11]	5.76	[5.61-5.90]	5.46	[5.35-5.56]
Education								
Entrepreneurship education	4.72	[4.64-4.81]	3.90	[3.82-3.98]				
Teacher suppor	4.69	[4.60-4.79]	4.06	[3.97-4.15]				

Table 8: Mean and CI for Entrepreneurship/Non-entrepreneurship students

64 The high and low values are calculated in terms of a 95 pct. Confidence interval (CI). The interpretation is that 95 pct. of all other samples in the population will report an averaged construct- mean within this CI. If not, the specific sample is statistically different, from the sample presented in this guide. The CI are calculated with a t-distribution and assumes normal distribution of data.

65 It is important to keep in mind that we have over-sampled respondents who participate in entrepreneurship education. When you for example assess if your female students are above or below the mean-average of females in our sample you should remember that many of the students in this sample have participated in entrepreneurship education and might have very high levels in the dimensions.

Gender	Primary level				Secondary level				Tertiary level			
	Female (n=641)		Male (n=721)		Female (n=1161)		Male (n=845)		Female (n=515)		Male (n=468)	
Variable	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**
ESE (Skills)												
Creativity	5.31	[5.21-5.41]	5.31	[5.21-5.41]	4.93	[4.86-5.00]	5.11	[5.03-5.19]	5.00	[4.90-5.09]	5.23	[5.13-5.32]
Planning	4.98	[4.87-5.10]	4.97	[4.86-5.07]	5.19	[5.12-5.26]	5.13	[5.04-5.22]	5.17	[5.07-5.27]	5.20	[5.10-5.29]
Financial literacy					4.07	[3.98-4.15]	4.42	[4.32-4.51]	4.33	[4.22-4.44]	4.70	[4.60-4.80]
Marshalling of resources					5.28	[5.21-5.38]	5.30	[5.21-5.39]	5.28	[5.18-5.38]	5.24	[5.13-5.34]
Managing ambiguity	4.74	[4.64-4.85]	4.81	[4.70-4.91]	4.99	[4.92-5.05]	5.11	[5.03-5.19]	5.21	[5.12-5.30]	5.35	[5.26-5.45]
Teamwork	5.69	[5.60-5.79]	5.56	[5.47-5.66]	5.76	[5.69-5.82]	5.67	[5.59-5.75]				
Entrepreneurial knowledge	5.67	[5.58-5.77]	5.66	[5.57-5.76]	5.23	[5.15-5.32]	5.31	[5.21-5.40]	5.73	[5.63-5.82]	5.77	[5.66-5.87]
Mindset												
Entrepreneurial Mindset	4.49	[4.39-4.58]	4.41	[4.32-4.50]	4.75	[4.68-4.81]	4.86	[4.78-4.94]	4.84	[4.75-4.94]	5.14	[5.05-5.24]
Core self-evaluation	5.13	[5.05-5.22]	5.24	[5.16-5.32]	5.25	[5.19-5.31]	5.48	[5.41-5.56]	5.27	[5.18-5.36]	5.48	[5.40-5.57]
Entrepreneurial Attitudes	5.22	[5.11-5.34]	5.33	[5.22-5.44]	5.12	[4.93-5-31	5.21	[5.12-5.30]	5.38	[5.27-5.50]	5.76	[5.58-5.94]
Career Ambitions												
Entrepreneurial intentions	4.38	[4.25-4.51]	4.66	[4.54-4.78]	3.50	[3.40-3.60]	4.10	[3.98-4.23]	3.96	[3.81-4.11]	4.79	[4.64-4.94]
Innovative employee	5.26	[5.16-5.36]	5.23	[5.13-5.33]	5.43	[5.36-5.50]	5.45	[5.37-5.54	5.53	[5.44-5.63]	5.66	[5.56-5.76]
Education												
Entrepreneurship education	5.22	[5.11-5.33]	5.22	[5.11-5.33]	4.34	[4.25-4.42]	4.29	[4.20-4.39]				
Teacher support	5.06	[4.95-5.17]	5.07	[4.96-5.18]	4.37	[4.28-4.46]	4.40	[4.30-4.51]				

Table 9: Mean and CI for gender

Starter	Primary level				Secondary level			
	Starter (n=507)		Non-starter (n=855)		Starter (n=796)		Non-starter (n=1210)	
Variable	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**	**Mean**	**95 % CI.**
ESE (Skills)								
Creativity	5.56	[5.45-5.67]	5.16	[5.07-5.25]	5.29	[5.21-5.38]	4.81	[4.75-4.88]
Planning	5.26	[5.14-5.38]	4.80	[4.71-4.90]	5.44	[5.36-5.52]	4.99	[4.91-5.06]
Financial literacy					4.46	[4.37-4.56]	4.05	[3.97-4.13]
Marshalling of resources					5.53	[5.44-5.61]	5.13	[5.06-5.21]
Managing ambiguity	4.98	[4.86-5.10]	4.66	[4.56-4.75]	5.20	[5.12-5.28]	4.93	[4.86-4.99]
Teamwork	5.79	[5.69-5.90]	5.53	[5.44-5.61]	5.87	[5.79-5.95]	5.62	[5.56-5.69]
Entrepreneurial knowledge	5.80	[5.69-5.90]	5.59	[5.50-5.67]	5.45	[5.36-5.55]	5.14	[5.05-5.22]
Mindset								
Entrepreneurial Mindset	4.71	[4.60-4.81]	4.29	[4.20-4.37]	5.05	[4.96-5.13]	4.63	[4.57-4.70]
Core self-evaluation	5.36	[5.26-5.45]	5.09	[5.02-5.17]	5.48	[5.40-5.55]	5.27	[5.21-5.33]
Entrepreneurial Attitudes	5.54	[5.42-5.67]	5.12	[5.02-5.23]	5.24	[5.14-5.33]	5.00	[4.93-5.08]
Career Ambitions								
Entrepreneurial intentions	5.00	[4.86-5.14]	4.25	[4.14-4.36]	4.08	[3.95-4.21]	3.54	[3.44-3.64]
Innovative employee	5.46	[5.35-5.57]	5.12	[5.03-5.21]	5.63	[5.55-5.72]	5.31	[5.24-5.38]
Education								
Entrepreneurship education	5.47	[5.35-5.60]	5.07	[4.97-5.17]	4.55	[4.45-4.65]	4.17	[4.09-4.24]
Teacher support	5.19	[5.06-5.31]	4.99	[4.89-5.09]	4.54	[4.44-4.65]	4.27	[4.19-4.36]

Table 10: Mean and CI for experience with starting an activity outside of school

Entrepreneursship Students	Secondary level				Tertiary level			
	Exp (n=535)		Control (n=1471)		Exp (n=327)		Control (n=656)	
Variable	Mean	95 % CI.	Mean	95 % CI.	Mean	95 % CI.	Mean	95 % CI.
ESE (Skills)								
Creativity	5.29	[5.19-5.39]	4.90	[4.84-4.96]	5.40	[5.28-5.51]	4.96	[4.88-5.04]
Planning	5.38	[5.28-5.48]	5.09	[5.02-5.15]	5.42	[5.30-5.54]	5.07	[4.98-5.15]
Financial literacy	4.73	[4.62-4.83]	4.03	[3.95-4.10]	4.79	[4.66-4.92]	4.36	[4.27-4.45]
Marshalling of resources	5.44	[5.33-5.54]	5.24	[5.17-5.30]	5.50	[5.38-5.62]	5.14	[5.05-5.23]
Managing ambiguity	5.18	[5.09-5.28]	4.98	[4.92-5.04]	5.50	[5.38-5.62]	5.14	[5.05-5.23]
Teamwork	5.79	[5.69-5.89]	5.70	[5.64-5.76]				
Entrepreneurial knowledge	5.60	[5.48-5.71]	5.14	[5.07-5.22]	5.89	[5.77-6.01]	5.68	[5.59-5.76]
Mindset								
Entrepreneurial Mindset	4.99	[4.89-5.09]	4.72	[4.66-4.78]	5.27	[5.15-5.39]	4.84	[4.76-4.92]
Core self-evaluation	5.47	[5.38-5.56]	5.31	[5.25-5.36]	5.49	[5.38-5.50]	5.31	[5.24-5.39]
Entrepreneurial Attitudes	5.51	[5.40-5.61]	4.95	[4.88-5.02]	5.86	[5.73-5.99]	5.26	[5.15-5.46]
Career Ambitions								
Entrepreneurial intentions	4.54	[4.39-4.69]	3.47	[3.38-3.56]	5.18	[5.01-5.36]	3.94	[3.82-4.07]
Innovative employee	5.62	[5.51-5.72]	5.37	[5.31-5.44]	5.76	[5.63-5.88]	5.51	[5.44-5.59]
Education								
Entrepreneurship education	4.80	[4.68-4.91]	4.14	[4.07-4.21]				
Teacher support	4.68	[4.55-4.81]	4.27	[4.19-4.35]				

Table 11: Mean and CI for students with experience with self-employment

Other measures and methods to use

Educational assessment is a complicated activity and you need to carefully consider which type of influence you wish your educational initiatives to have and which type of indicator you need in order to assess this. The focus of the ASTEE assessment tools has been to focus on multiple dimensions which have been proven to influence entrepreneurial behaviour. The aim has been to develop a generic tool that can be applied in many different settings on many different types of students. An important part has been to reduce the amount of questions as much as possible in order to increase the reliability of the questionnaire and make sure that we get responses that are as truthful as possible. To put this in plain text: we wanted to have a questionnaire that only takes five to ten minutes to complete in order not to annoy our respondents with too long questionnaires.

Since we had to limit the number of dimensions which we assess, we chose to cut down on the more educationally-oriented indicators which focus on the "connectedness to education". We of course acknowledge the importance of this dimension, especially when it comes to the lower levels of education where the students are far away from the labour market, but there has already been extensive research on these fairly generic dimensions[66]. Instead we chose to focus on the more entrepreneurship-oriented dimensions which are not as developed in terms of the measurement of indicators. If your goal is to assess the influence of your educational initiatives on students' educational motivation, school engagement, connectedness to classmates and teachers, we recommend that you include measures developed by researchers who focus on self-determination theory[67] as well as social control and school attachment theory[68].

66 See for example Karcher, 2003; Moberg, 2014a; Wentzel & Brophy, 2013.
67 See for example Ryan & Deci, 2000, 2006.
68 See for example Battistich et al. 1995; Dornbusch et al. 2001; Fredricks et al., 2004; Hirschi 1969; Karcher, 2003; Libbey, 2004; Moberg, 2014a.

Furthermore, there is a lot of research done on the role which emotions play in education, which could also be interesting for you to include in your assessment[69].

Our assessment tools are furthermore limited to self-assessed responses, that is, it is the respondents who themselves assess their perceived level in the various dimensions which we measure. There is a lot of research demonstrating the predictive power of these types of assessment[70], but it would also be a good idea to complement these self-assessed measures with data of a more objective nature, such as register data and grade scores. There are different tests that could also be used to assess the students' abilities, such as creativity tests and verbal tests which gauge their ability to identify opportunities, manage uncertainty and ambiguity as well as marshal resources. Qualitative methods such as interviews and focus groups as well as participatory observations would also be interesting methods to use when it comes to assessing both the effects as well as the educational process. If you team up with colleagues, for example, you could function as arbiters and observers of each other's classes and give formative feedback on each other's performances and the reactions of the students.

To sum up, there are many different ways to evaluate the effects of your educational initiatives. Naturally, it is important that you include measures of indicators that you wish to assess. Many assessment methods are, however, very time consuming and it can be complicated to access the right measurement tools of the indicators you wish to assess. The goal of the ASTEE project has been to design valid assessment tools that cover a wide range of indicators which are important to entrepreneurial behaviour and which require very minimal effort to administrate and assess the results of. By comparing your students' mean average with the respondents in our sample you will be able to assess whether they are below or above the average of specific groups. By distributing the measurement tools to test your students at the start and at the end of your educational initiative you will be able to assess how different students have reacted to your educational content and teaching methods, and you can adjust them accordingly.

69 See for example Lackeus, 2013; Schutz and Pekrun, 2007.
70 See for example Bandura, 1997.

SUMMARY

The ASTEE project has developed a set of common European tools for assessing entrepreneurial skills, knowledge, attitudes, and mindset among pupils and students across all educational levels. The tools can be used by teachers and educators at the primary, secondary and tertiary levels and will also be useful for institutional leaders, policy makers and decision makers, nationally as well as at a European level. The project has involved partners from seven European countries and the tools have been validated in two major surveys including 13 countries and a total of 6,488 respondents.

The project partners from Ireland, France, Portugal, Germany, Croatia, JA-YE Europe and Denmark did a thorough desk research to uncover any studies, reports and survey tools which the project could be inspired by. The starting point for the development of the tools was the European Key Competence Framework. The partners established a common understanding of key concepts and decided which age groups to target as well as how to measure. A self-assessment tool in the form of a questionnaire seemed to be the most adequate means to capture students' entrepreneurial skills, knowledge, attitudes, and mindset, as these are dimensions that are difficult to observe or test by existing means of evaluation.

It was a common wish of the consortium members to develop tools which would be applicable and useful in all disciplines and areas of education, because entrepreneurship and enterprise is often an embedded element in the teaching and not just taught as a separate, special course. The questions therefore had to have a generic wording, yet be specifically aimed at measuring entrepreneurial skills, knowledge, attitudes, and mindset. It was also a challenge to limit the number of questions in the questionnaire in order to ensure that as many respondents as possible would fill it in. Through discussion, testing, and several amendments the questionnaires were finally limited to a total of 48 questions at primary level, 64 at secondary level, and 57 at tertiary level including demographic questions about age, gender, and background.

The ASTEE measurement tools include five dimensions (figure 3 below) as well as a number of demographic questions. Some of the dimensions are measured by several constructs of questions. The dimension Entrepreneurial skills covers both cognitive and non-cognitive skills required in the different phases of an entrepreneurial venture. The Entrepreneurial mindset is measured by the validated Core Self Evaluation measure, which in three constructs captures the individual's core sense of being able to perform challenging tasks. The dimension Entrepreneurial knowledge is measured by a single construct, which focuses on the respondent's perceived knowledge about entrepreneurship. Connectedness to education focuses on the student-teacher relationship and is measured by a single construct. The dimension Connectedness to future career includes questions about the student's enterprising activities, work experience, preference for intrapreneurial work assignments as well as intentions to start up a company.

In the winter and early spring of 2014 a large scale test of the questionnaires was done in 13 countries resulting in 4,900 responses. The data were subsequently analysed using a number of statistical tests.

The statistical technique Structural Equation Modelling (SEM) was used because the measurement tools include multiple constructs which cannot be observed (latent). A number of analyses were performed in order to establish whether, overall, the model is acceptable and whether

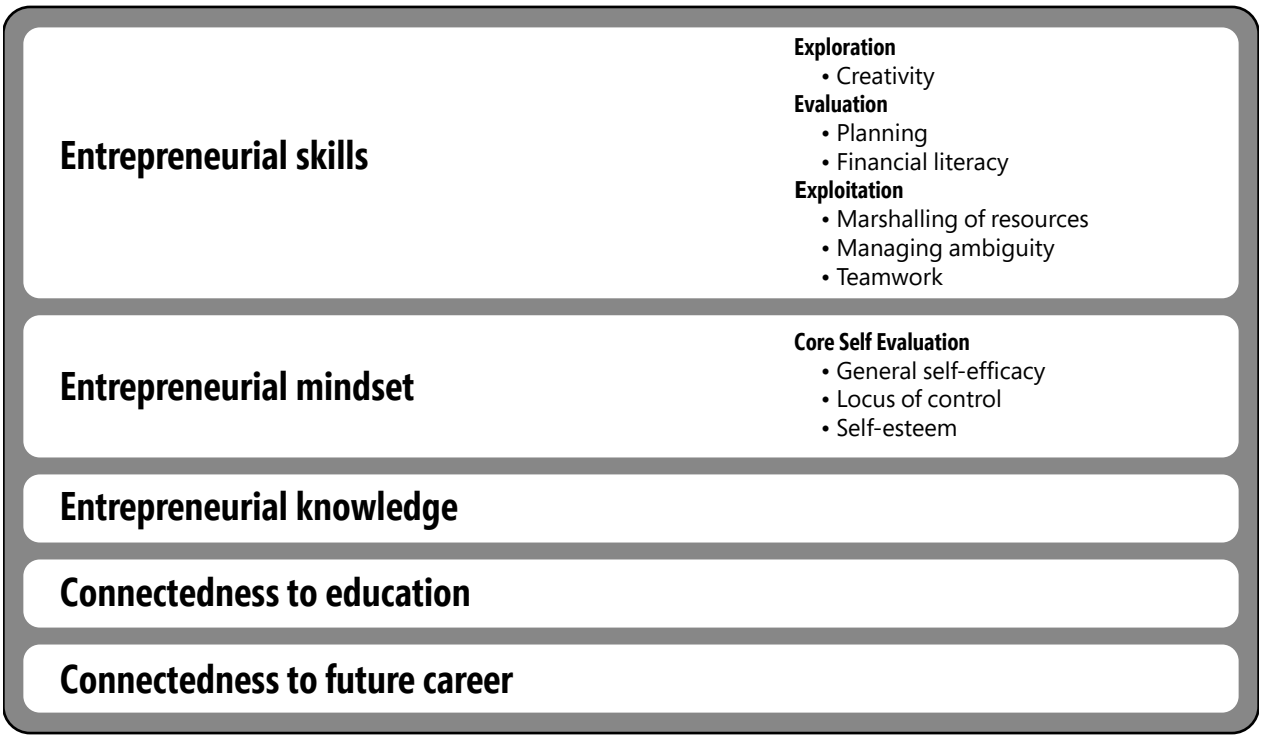


Figure 3 The dimensions and constructs included in the questionnaires

or not the structuring of the questions is statistically adequate. The analyses include confirmatory factor analyses (CFA), factorial invariance, and known groups analysis.

Through the various tests it was demonstrated that the measures are reliable, that the questions provide a good reflection of their intended dimensions and that they are understood in the same way by the respondents regardless of their background, and that they are valid measures of entrepreneurial behaviour.

We were able to conclude that the respondents understand the questions in similar ways, regardless of gender, entrepreneurial experience, educational background, and national culture. This means that the assessment tools can be used in different contexts which include students with various backgrounds. The known-group tests demonstrated a high level of predictive validity of the measures at all three educational levels, which means that the constructs measure what they are intended to measure. The tests showed that pupils and students who demonstrate entrepreneurial behaviour or who have experience with entrepreneurship education also have significantly higher levels in each of the constructs.

The ASTEE tools can be used directly by teachers to assess the entrepreneurial competences and learning progress of pupils and students as well as to evaluate different teaching methods. In generating such knowledge the tools are also of great interest to institutional leaders and educational planners who will become better equipped for the design and planning of education at their individual institutions. At a more general level, the tools are valuable for researchers who wish to assess the effects of different kinds of entrepreneurship education. And at a national and European level, policy makers can use the tools and the knowledge they create as a basis for the implementation of new strategies in the education area. Putting the tools to such use will fulfill the original aspiration of the ASTEE project and will contribute to the realisation of the EU2020 objectives.

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Appendix

ASTEE MEASUREMENT TOOL – PRIMARY LEVEL

SECTION A1 (DEMOGRAPHIC QUESTIONS)

1a. I am a…

☐Girl ☐Boy

2a. Year of birth?

3a. Which country do you live in?

4a. What is the name of your school?

5a. Were your parents born in another country?

☐Yes, both ☐Yes, one ☐No

If yes, which country?

6a. Do any of your parents, or the grownups you are living with, have a university degree?

☐Yes ☐No

7a. Has anyone close to you started a company? (Check all boxes that apply)

☐ Mother / stepmother

☐ Father / stepfather

☐ Other relative

☐ Friend

☐ No

11a. Have you been in charge of an activity or a project outside school (e.g. sports, music, drama, politics)

☐ Yes ☐ No

12a. Have you started an activity or a project outside school (e.g. sports, music, drama, politics)

☐ Yes ☐ No

SECTION A2: (MINDSET) ENTREPRENEURIAL MINDSET

On a scale from 1 to 7 (how much do you agree):

8a. I am often the first one to suggest a solution to a problem

9a. I keep trying until I find the solution to a problem

10a. I see possibilities where others see problems

CORE SELF-EVALUATION

On a scale from 1 to 7 (how much do you agree):

13a. I am confident I will succeed in life

14a. When I try, I generally succeed

15a. I complete tasks successfully

16a. Overall, I am satisfied with myself

17a. I feel I can determine what happens in my life

ENTREPRENEURIAL ATTITUDES

On a scale from 1 to 7:

In general, starting a business is…

7d. Worthless / Worthwhile

8d. Boring / Fun

9d. Negative / Positive

SECTION B1: (CONNECTEDNESS TO EDUCATION)

TEACHING METHODS

On a scale from 1 to 7 (how much do you agree):

In school I have been taught...

1b. How to think creatively

2b. To come up with ideas

3b. To translate ideas into action

ENTREPRENEURIAL TEACHERS

On a scale from 1 to 7:

I feel that...

4b. Teachers encourage me to participate in extra activities

5b. Teachers listen to my ideas

6b. Teachers say it is alright to make mistakes

SECTION B2: (ENTREPRENEURIAL KNOWLEDGE)

On a scale from 1 to 7 (how much do you agree):

7b. I understand that it is possible to be your own boss

8b. I understand that there are different reasons why people start businesses (making money, helping others, or doing something different)

9b. I understand that some business ideas work and others don't

SECTION C: (ENTREPRENEURIAL SKILLS – Entrepreneurial self efficacy)

CREATIVITY

On a scale from 1 to 7:

I am able to…

1c. Come up with new ideas

3c. Come up with new and different solutions

5c. Find new ways of doing things

MANAGING AMBIGUITY

8c. Deal with sudden changes and surprises

10c. Continue work despite problems

12c. Work under stress and pressure

PLANNING

7c. Create a project plan

9c. Structure tasks in a project

11c. Set project goals

TEAM WORK

2c. Work together with other people

4c. Promote my own ideas and opinions when working in a group

6c. Actively participate in team work

SECTION D: (CONNECTEDNESS TO LABOUR MARKET)

INNOVATIVE EMPLOYEE

On a scale from 1 to 7 (how much do you agree):

I would like to have a job that allows me to...

1d. Solve problems in new ways

2d. Work on my own ideas

3d. Define my own tasks

ENTREPRENEURIAL INTENTIONS

On a scale from 1 to 7 (how much do you agree):

4d. I often think about starting a business

5d. I have many ideas for making money

6d. My goal is to become my own boss

ASTEE MEASUREMENT TOOL – SECONDARY LEVEL

SECTION A1 (DEMOGRAPHIC QUESTIONS)

1a. I am…

☐ Female ☐ Male

2a. Year of birth?

3a. Which country do you live in?

4a. What is the name of your school?

5a. Have you participated in an activity that focuses on entrepreneurship / self-employment?

☐ Yes ☐ No

6a. Do you volunteer (youth organisation or a club or other)?

☐ Yes ☐ No

7a. Are you working in addition to going to school ?

☐ Yes ☐ No

8a. Were your parents born in another country?

☐ Yes, both ☐ Yes, one ☐ No

If yes, which country?

9a. Do any of your parents, or the grownups you are living with, have a university degree?

☐ Yes ☐ No

10a. Do you plan to take a university / higher education degree?

☐ Yes ☐ No

11a. Has anyone close to you started a company? (Check all boxes that apply)

☐ Mother / stepmother

☐ Father / stepfather

☐ Other relative

☐ Friend

☐ No

15a. Have you been in charge of an activity or a project outside school (e.g. sports, music, drama, politics)?

☐ Yes ☐ No

16a. Have you started an activity or a project outside school (e.g. sports, music, drama, politics)?

☐ Yes ☐ No

SECTION A2: (MINDSET) ENTREPRENEURIAL MINDSET

On a scale from 1 to 7 (how much do you agree):

12a. I am often the first one to suggest a solution to a problem

13a. I keep trying until I find the solution

14a. I see possibilities where others see problems

CORE SELF-EVALUATION

On a scale from 1 to 7 (how much do you agree):

17a. I am confident I will succeed in life

18a. When I try, I generally succeed

19a. I complete tasks successfully

20a. Overall, I am satisfied with myself

21a. I feel I can determine what happens in my life

ENTREPRENEURIAL ATTITUDES

On a scale from 1 to 7:

In general, starting a business is…

10d. Worthless / Worthwhile

11d. Boring / Fun

12d. Negative / Positive

SECTION B1: (CONNECTEDNESS TO EDUCATION)

TEACHING METHODS

On a scale from 1 to 7 (how much do you agree):

In school I have been taught...
(Non-cognitive entrepreneurial skills)

1b. How to think creatively

2b. To come up with ideas

3b. To translate ideas into actions

(Cognitive entrepreneurial skills)

4b. To create a business

5b. About the role of the entrepreneur in society

6b. How to evaluate a business idea

ENTREPRENEURIAL TEACHERS

On a scale from 1 to 7 (how much do you agree):

7b. Teachers encourage me to participate in extra activities

8b. Teachers listen to my ideas

9b. Teachers say it is alright to make mistakes

SECTION B2: (ENTREPRENEURIAL KNOWLEDGE)

On a scale from 1 to 7 (how much do you agree)

I understand:

10b. The role entrepreneurs play in our society

11b. That there are different reasons why people start business (making money, helping others, or "doing something different")

12b. That some business ideas work and others don't

SECTION C: (ENTREPRENEURIAL SKILLS – Entrepreneurial self efficacy)

CREATIVITY

On a scale from 1 to 7:

I am able to…

3c. Come up with new ideas

6c. Come up with new and different solutions

9c. Find new ways of doing things

FINANCIAL LITERACY

2c. Read and interpret financial statements

5c. Estimate a budget for a new project

8c. Control costs for projects

MANAGING AMBIGUITY

1c. Deal with sudden changes and surprises

4c. Work under stress and pressure

7c. Continue work despite problems

MARSHALLING OF RESOURCES

12c. Form partnerships in order to achieve goals

15c. Network (i.e. make contacts with and exchange information with others)

18c. Establish new contacts

PLANNING

11c. Create a project plan

14c. Set project goals

17c. Structure tasks in a project

TEAM WORK

10c. Work together with other people

13c. Actively participate in team work

SECTION D: (CONNECTEDNESS TO LABOUR MARKET)

INNOVATIVE EMPLOYEE

On a scale from 1 to 7 (how much do you agree):

I would like to have a job that allows me to...

1d. Solve problems in new ways

2d. Work on my own ideas

3d. Define my own tasks

ENTREPRENEURIAL INTENTIONS

On a scale from 1 to 7 (how much do you agree):

4d. I often think about starting a business

5d. I have business ideas I am going to implement

6d. My goal is to become my own boss

EXPERIENCE WITH SELF-EMPLOYMENT

7d. Have you, on your own or together with others, started a business in the past?

☐ Yes ☐ No

8d. Do you, on your own or together with others, operate a business today?

☐ Yes ☐ No

9d. Are you at the moment trying to set up a business?

☐ Yes ☐ No

ASTEE MEASUREMENT TOOL – TERTIARY LEVEL

DEMOGRAPHIC QUESTIONS

1a. I am…

O Female O Male

2a. Year of birth?

3a. Which country do you live in?

4a. Are you an exchange/international student?

5a. Were your parents born in a different country from where you usually live?

☐ Yes, both ☐ Yes, one ☐ No

6a. What is the name of your current higher education institution?

7a. Which type of educational programme do you participate in today?

☐ Natural sciences ☐ Social sciences
☐ Law
☐ Engineering and technology ☐ Humanities
☐ Other
☐ Medical and health ☐ Business
☐ Agricultural sciences ☐ Arts, architecture and design

8a. Do you volunteer (youth organisation or a club or other)?

☐ Yes ☐ No

9a. How many years of part-time work experience do you have?

☐ 0 ☐ Less than 2 ☐ 3-5 ☐ 6-8 ☐ More than 8

10a. How many years of full-time work experience do you have?

☐ 0 ☐ Less than 2 ☐ 3-5 ☐ 6-8 ☐ More than 8

11a. How many years of higher education do you have?

☐ Less than 1 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ More than 6

12a. Do any of your parents, or the grown-ups you grew up with, have a university degree?

☐ Yes ☐ No

13a. Is anyone close to you self-employed? (Check all boxes that apply)

☐ Mother / stepmother
☐ Father / stepfather
☐ Other relatives
☐ Friends
☐ No

14a. Are you participating in or did you previously participate in an entrepreneurship course or module?

☐ Yes ☐ No

15a. Have you participated in an extra-curricular activity that focuses on entrepreneurship / self-employment?

☐ Yes ☐ No

SECTION A2: (MINDSET)

ENTREPRENEURIAL MINDSET

On a scale from 1 to 7 (how much do you agree):

16a. I am often the first one to suggest a solution to a problem

17a. I keep trying until I find the solution to a problem

18a. I see possibilities where others see problems

CORE SELF-EVALUATION

On a scale from 1 to 7 (how much do you agree):

19a. I am confident I will succeed in life

20a. When I try, I generally succeed

21a. I complete tasks successfully

22a. Overall, I am satisfied with myself

23a. I feel I can determine what happens in my life

ENTREPRENEURIAL ATTITUDES

On a scale from 1 to 7:

In general, starting a business is…

10c. Worthless / Worthwhile

11c. Disappointing / Rewarding

12c. Negative / Positive

SECTION B1: (ENTREPRENEURIAL KNOWLEDGE)

On a scale from 1 to 7 (how much do you agree):

I understand...

1b. The role entrepreneurs play in our society

2b. That there are different reasons why people start business (e.g. social entrepreneurship, profit making, independency)

3b. That some business ideas work and others don't

SECTION B2: (ENTREPRENEURIAL SKILLS – Entrepreneurial self efficacy)

CREATIVITY

On a scale from 1 to 7 (how much do you agree):

I am able to…

6b. Come up with new ideas

9b. Think outisde the box

12b. Identify opportunities for new ways to conduct activities

14b. Come up with new and different solutions

FINANCIAL LITERACY

On a scale from 1 to 7 (how much do you agree):

I am able to…

5b. Read and interpret financial statements

8b. Estimate a budget for a new project

11b. Control costs for projects

MANAGING AMBIGUITY

On a scale from 1 to 7 (how much do you agree):

I am able to…

4b. Deal with sudden changes and surprises

7b. Work under stress and pressure

10b. Continue work despite problems

13b. Manage uncertainty in projects and processes

MARSHALLING OF RESOURCES

On a scale from 1 to 7 (how much do you agree):

I am able to…

15b. Put together the right group/team in order to solve a problem

17b. Form partnerships in order to achieve goals

19b. Network (i.e. make contacts with and exchange information with others)

21b. Establish new contacts

PLANNING

On a scale from 1 to 7 (how much do you agree):

I am able to…

16b. Create a project plan

18b. Set project goals

20b. Structure tasks in a project

13c. Actively participate in team work

SECTION D: (CONNECTEDNESS TO LABOUR MARKET)

INNOVATIVE EMPLOYEE

On a scale from 1 to 7 (how much do you agree):

I would like to have a job that allows me to...

1d. Solve problems in new ways

2d. Work on my own ideas

3d. Define my own tasks

ENTREPRENEURIAL INTENTIONS

On a scale from 1 to 7 (how much do you agree):

4d. I often think about starting a business

5d. I have business ideas I am going to implement

6d. My goal is to become my own boss

EXPERIENCE WITH SELF-EMPLOYMENT

7d. Have you, on your own or together with others, started a business in the past?

☐ Yes ☐ No

8d. Do you, on your own or together with others, operate a business today?

☐ Yes ☐ No

9d. Are you at the moment trying to set up a business?

☐ Yes ☐ No


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