

# *Algorithm development for the formation of entrepreneurial activity in educational process*

Sherstneva A.A.

Siberian State University of Telecommunications and Information Science  
Novosibirsk, Russia  
asherstneva@sibgti.ru

**Abstract** — The article discusses the conceptual issues for formation of the competence approach to increase entrepreneurial skills in digital economy and ICT studies. Based on the conceptual model, ways of its formation are proposed. The theoretical aspects of the conceptual model are refined and expanded by the results of practical research. The article was aimed to develop the algorithms as a method for technical project management. The algorithm allows forming, developing and evaluating an entrepreneurial competency and “Sense of Initiative” concept. This concept was integrated for students are involved in the educational process to improve their ability to communicate ideas into action and really create a working concept of knowledge, skills and attitudes.

**Keywords** — *competence approach, digital economy, initiative sense, entrepreneurship learning, educational process*

## I. INTRODUCTION

Sense of initiative and entrepreneurship can be broadly defined as the capacity to turn ideas into action, ideas that generate value for someone other than oneself. Sense of initiative and entrepreneurship is a transversal key competence, which every student needs for personal fulfillment and development, active citizenship, social inclusion and employment in the knowledge society.

The entrepreneurship’s framework presented in this report proposes a shared definition of entrepreneurship as a competence, with the aim to raise consensus among all stakeholders and to establish a bridge between the worlds of education and work. The framework can be used as a basis for the development of curricula and learning activities fostering entrepreneurship as a competence. Also, it can be used for the definition of parameters to assess students’ entrepreneurial competences for a knowledge-based society.

## II. PROBLEM STATEMENT

In the context of the study, entrepreneurship is understood as a transversal key competence applicable by individuals and groups, including existing organizations, across all spheres of life. It is defined as follows: “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”[1]. This definition focuses on value creation, no matter what type of value or context. It covers value creation in any domain and possible value chain. It refers to value creation in the private, public and third sectors and in any hybrid combination of the three. It thus embraces different types of entrepreneurship, including

entrepreneurship, social entrepreneurship, green entrepreneurship and digital entrepreneurship. Digital entrepreneurship is entrepreneurship that involves the use of new digital technologies (particularly social media, big data, mobile and cloud solutions). The purpose of this use may be to improve business operations, invent new business models, improve business intelligence or to engage with customers.

The study was launched to establish a common reference framework for entrepreneurship as a competence to help students to develop their ability to actively participate in society, to manage their own lives and careers and to start value-creating initiatives. The conceptualization of entrepreneurship as a competence was therefore the stepping stone for the development of a reference framework.

The actual is task to find out cross-cutting competences related to entrepreneurship and to point out their importance for enterprises, companies, private and public employers. Another purpose of survey is in investigation of competence-based approach in the Russian universities and increase entrepreneurial skills in engineering and ICT studies.

## III. THEORY

Entrepreneurship as a competence applies to all spheres of life. It enables students to nurture their personal development, to actively contribute to social development, to enter the job market as employee or as self-employed, and to start-up or scale-up ventures which may have a cultural, social or commercial motive. The conceptual model is made up of two main dimensions: the 3 competence areas that directly mirror the definition of entrepreneurship as the ability to turn ideas into action that generate value for someone other than oneself; and the 15 competences that, together, make up the building blocks of the entrepreneurship as a competence for all citizens. We have listed the competences in Table 1. Each one is accompanied by a hint or an exhortation to the learner to put the competence into practice and a descriptor, which breaks it down into its core aspects. ‘Ideas and opportunities’, ‘Resources’ and ‘Into Action’ are the 3 areas of the conceptual model and they have been labeled to stress entrepreneurship competence as the ability to transform ideas and opportunities into action by mobilizing resources. These resources can be personal (namely, self-awareness and self-efficacy, motivation and perseverance), material (for instance, production means and financial resources) or non-material (for instance, specific knowledge, skills and attitudes). ‘Attitudes’ are motivators of performance. They include values, aspirations and priorities. The 3 competence areas are tightly intertwined: entrepreneurship as a competence stands above all three of these together. The 15 competences are also interrelated and

interconnected and should be treated as parts of a whole. We are not suggesting that the learner should acquire the highest level of proficiency in all 15 competences, or have the same proficiency across all the competences. The framework does, however, imply that entrepreneurship as a competence is made up of 15 building blocks.

Table 1 provides an overview of the Conceptual model, showing how the entrepreneurship competence has been broken down into its constituent parts within the framework. Competences are numbered for ease of reference – the order in which they are presented does not imply a sequence in the acquisition process or a hierarchy: no one element comes first, and none of them is more important than the others. There are no core competences and enabling competences in the conceptualization.

Depending on the context of take-up, it is reasonable to expect that more emphasis may be put on some of the competences and less on others, or else that competences are streamlined to mirror an entrepreneurial process created to foster learning through entrepreneurship. In other words, the framework can be seen as a starting point for the interpretation of the entrepreneurship competence, which over time will be further elaborated and refined to address the particular needs of specific target groups.

The students involved in the review of the conceptual model as a very comprehensive and broad-based tool with 3 competence areas, 1 key- competence and 15 descriptors. They acknowledge that the model reflects the complexity of the entrepreneurship competence domain, which touches upon several aspects of our everyday lives, and can be used as a multi-purpose reference guide.

The advantage of having a broad yet comprehensive competence framework is that although it can accommodate bespoke customizations, it also allows initiatives that tackle entrepreneurship as a competence to be compared, facilitating a common understanding of what being entrepreneurial means. The comprehensiveness of the model is one of its main assets. However, we should bear in mind that not all citizens, learners, or users will be interested in developing all the competences here described to the highest level of proficiency. It is expected that institutions, intermediaries and initiative developers who are willing to adopt the model as a reference framework adapt it to their own purposes and to the needs of the user group they intend to target. In other words, the frameworks presented in this report should be considered as a starting point. It must be tailored to the context of use in order to be implemented.

TABLE I. THE CONCEPTUAL MODEL.

Areas	Competences	Definition
1. Ideas and opportunities	1.1 Spotting opportunities	Use your imagination and abilities to identify opportunities for creating value
	1.2 Creativity	Develop creative and purposeful ideas
	1.3. Vision	Work towards your vision of the future
	1.4 Valuing ideas	Make the most of ideas and opportunities
	1.5 Ethical and sustainable thinking	Assess the consequences and impact of ideas, opportunities and actions
2. Res our	2.1 Self-awareness and self-efficacy	Believe in yourself and keep developing
	2.2 Motivation and	Stay focused and don't give up

3. Into action	perseverance	
	2.3 Mobilizing resources	Gather and manage the resources you need
	2.4 Financial and economic literacy	Develop financial and economic know how
	2.5. Mobilizing others	Inspire, enthuse and get others on board
	3.1 Taking the initiative	Go for it
	3.2 Planning and management	Prioritize, organize and follow-up
	3.3 Coping with uncertainty, ambiguity and risk	Make decisions dealing with uncertainty, ambiguity and risk
	3.4 Working with others	Team up, collaborate and network
	3.5. Learning through experience	Learn by doing

Entrepreneurship as a competence is developed through action by individuals or collective entities to create value for others. The progression in entrepreneurial learning is made up of two aspects:

- Developing increasing autonomy and responsibility in acting upon ideas and opportunities to create value;
- Developing the capacity to generate value from simple and predictable contexts up to complex, constantly changing environments.

The Progression Model does not lay down a linear sequence of steps that every student must take to become proficiently entrepreneurial or to start-up a venture. Instead, it shows that the boundaries of individual and collective entrepreneurial competences can be pushed forward, to achieve greater and greater impact through value creating endeavors.

The Progression Model provides a reference for the development of proficiency starting from value creation achieved through external support, up to transformative value creation. It consists of four main levels: Foundation, Intermediate, Advanced and Expert. Each level is in turn split into two sub-levels, as illustrated in Table 2. At Foundation level, entrepreneurial value is created with external support. At Intermediate level, entrepreneurial value is created with increasing autonomy. At Advanced level, responsibility to transform ideas into action is developed. At Expert level, the value created has considerable impact in its reference domain.

These proficiency levels provide a way for the student to look at the learning outcomes.

The learning outcomes are statements of what a learner knows, understands and is able to do after completion of learning [2]. Such statements can be designed and used for educational planning and curriculum development or for different types of accountability such as legal accountability or professional accountability [3].

The model aims to be comprehensive and to offer a tool that can be adapted to different needs. It is not prescriptive and it does not suggest that all students should acquire the highest level of proficiency in the competences, or that they should reach the same proficiency across all the competences. For example, we could imagine designing an entrepreneurial learning experience targeted at the employees of the shoe-making district of our region. In our programme we could, for instance, aim at an advanced level of proficiency in competences like ‘spotting opportunities’, ‘vision’,

‘mobilizing resources’, ‘mobilizing others’ and ‘planning and organizing’. At the same time, we could aim to achieve an intermediate level of proficiency in ‘financial and economic literacy’. We could deem it important to provide our learners with the skills to understand the financial viability of their ideas, but not important to have them develop double-entry bookkeeping skills, which would require an advanced level of proficiency. It’s also necessary to point out that entrepreneurial value creation and entrepreneurial learning can take place in any sphere of life.

TABLE II. THE PROGRESSION MODEL

<b>Foundation</b>	Relying on support from others	Under direct supervision.	Discover
		With reduced support from others, some autonomy and together with my peers.	Explore
<b>Intermediate</b>	Building independence	On my own and together with my peers.	Experiment
		Taking and sharing some responsibilities.	Dare
<b>Advance</b>	Taking responsibility	With some guidance and together with others	Improve
		Taking responsibility for making decisions and working with others	Reinforce
<b>Expert</b>	Driving transformation, innovations and growth	Taking responsibility for contributing to complex development in a specific field	Expand
		Contributing substantially to the development of a specific field	Transform

The Progression Model does not refer to any specific setting, especially not to formal education settings. By focusing on the development of competences through the actual creation of entrepreneurial value, the progression model breaks down the boundaries between education, work and civic engagement. In this respect, the Progression Model is transversal to formal, non-formal and informal learning contexts.

Entrepreneurial learning can hardly be reduced to fixed pre-specified statements of learning outcomes since it deals with the creation of value that does not exist prior to the entrepreneurial learning process and cannot be foreseen in abstraction. However, learning outcome statements are considered as crucial to make the framework actionable. The learning outcomes have been developed as references for different purposes. They could be used in the formal education and training sector for curricula design. In a non-formal learning context, they could be used to inspire the creation of programmes which aim to foster entrepreneurship within existing organizations. They could also be used to guide the definition of tailored pedagogies, assessment methods, and learning environments that foster effective entrepreneurial learning. Thus, learning outcomes should not be taken as normative statements to be directly transposed into actual learning activities, or be used to measure student performance. They are a basis for the development of specific learning outcomes that are fit for the specific context and a basis for the development of performance indicators. Although the vast majority of learning outcomes have been formulated as ‘I’ statements, this does not mean that Entrepreneurship

Competence only refers to the capacity of individuals. On the contrary, the subject of entrepreneurial learning and behavior can be a group, like a project team, a non-profit organization, a company, a public body or a civil society movement. Though comprehensive, it aims to suggest transversal applicability across educational contexts and application sectors.

#### IV. EXPERIMENTAL RESULTS

In the framework of cooperation with the University of Southern Denmark, the author conducted a survey among students, teachers and all stakeholders to identify opportunities for improving business education in higher education institutions and making decisions that contribute to improving the business environment.

Additionally, the author has spoken with few lectures from university. The result of Q&A part shows that the majority of respondents (90%) believe that entrepreneurship is an important component of economic education, therefore, more effective teaching of entrepreneurship through informal channels (networks, mentoring, etc.) is needed, and not only through compulsory education. The author would like to note that the core-subject programs for students of technical specialties don’t provide the formation of such competencies in particular.

The second effective result was achieved with development the algorithms as a method for technical project management. The algorithm allows forming, developing and evaluating an entrepreneurial competence “the capacity to entrepreneurship and the development of a sense of entrepreneurial initiative” concept.

TABLE III. LEVELS OF PROFICIENCY

		Levels of proficiency		
Areas	Competences	Foundation	Intermediate	Advanced
1. Ideas and opportunities	1.1 Spotting opportunities	can find opportunities to generate value for others	can recognize opportunities to address needs that have not been met	can seize and shape opportunities to respond to challenges and create value for others
	1.2 Creativity	can develop multiple ideas that create value for others.	can test and refine ideas that create value for others	can transform ideas into solutions that create value for others
	1.3. Vision	can imagine a desirable future.	can build an inspiring vision that engages others.	can use their vision to guide strategic decision-making
	1.4 Valuing ideas	can understand and appreciate the value of ideas	understand that ideas can have different types of value, which can be used in different ways	can develop strategies to make the most of the value generated by ideas
	1.5 Ethical and sustainable thinking	can recognize the impact of their choices and behaviors, both within	are driven by ethics and sustainability when making decisions	act to make sure that their ethical and sustainability goals are met

		the community and the environment		
2. Resources	2.1 Self-awareness and self-efficacy	trust their own ability to generate value for others	can make the most of their strengths and weaknesses.	Can compensate for their weaknesses by teaming up with others and by further developing their strengths
	2.2 Motivation and perseverance	want to follow their passion and create value for others	are willing to put effort and resources into following their passion and create value for others	can stay focused on their passion and keep creating value despite setbacks
	2.3 Mobilizing resources	can find and use resources responsibly	can gather and manage different types of resources to create value for others	can define strategies to mobilize the resources they need to generate value for others
	2.4 Financial and economic literacy	can draw up the budget for a simple activity	can find funding options and manage a budget for their value creating activity	can make a plan for the financial sustainability of a value creating activity.
	2.5. Mobilizing others	Can communicate their ideas clearly and with enthusiasm	can persuade, involve and inspire others in value-creating activities	can inspire others and get them on board for value-creating activities
3. Into action	3.1 Taking the initiative	are willing to have a go at solving problems that affect their communities	can initiate value-creating activities	can look for opportunities to take the initiative to add or create value
	3.2 Planning and management	can define the goals for a simple value-creating activity	can create an action plan, which identifies the priorities and milestones to achieve their goals	can refine priorities and plans to adjust to changing circumstances
	3.3 Coping with uncertainty, ambiguity and risk	are not afraid of making mistakes while trying new things	can evaluate the benefits and risks of alternative options and make choices that reflect their preferences	can weigh up risks and make decisions despite uncertainty and ambiguity
	3.4 Working with others	can work in a team to create value	can work together with a wide range of individuals and groups to create value	can build a team and networks based on the needs of their value-creating activity
	3.5. Learning through experience	can recognize what they have learnt	can reflect and judge their achievements	can improve their abilities to create value

		through taking part in value-creating activities	and failures and learn from these.	by building on their previous experiences and interactions with others
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This concept was integrated for students are involved in the educational process to improve their ability to communicate ideas into action and really create a working concept of knowledge, skills and attitudes.

The overview table of levels of proficiency depicts the 3 areas and all the 15 competences, but develops them only on the three levels of proficiency that apply to all students: the foundation, intermediate and advanced levels. The expert level by definition captures a level of expertise that is beyond average, and more context-dependent and, as a result, it is not detailed in the overview table. The overview table consists of descriptors that capture the essence of the different levels of proficiency.

The overview table of levels of proficiency aims to establish a common understanding of what entrepreneurship as a competence is. Its goal is to become a reference for a broad spectrum of initiatives which aim to foster entrepreneurial learning in education process. The definition of the basic terms that make up the backbone of this report is therefore a critical building block of the full framework.

During cooperation particular attention was paid to questions of the moderating role of national culture in the relationship between university entrepreneurship offerings and student start-up activity. The research find out linkages between research and teaching that benefit both and focused on decision-making for academic entrepreneurship by the influence of the main trends in the development of the education system.

## V. DISCUSSION OF RESULTS

According to the results of the study, there was a stable opinion that for the development and strengthening competencies that recommended by educational programs, an integrated approach to the educational process is necessary. This approach includes both theoretical and practical training of students. Its peculiarity is that theoretical training should be based on the achieved practical results and be constantly adjusted to reflect innovation. Practical training of students should take place directly in the enterprise and the specialty in demand of company.

Competence approach is based on professional standards and future demands. In accordance with the predicted economic and technological changes, there is a demand for new competencies and methods of their formation. Professional standards and interaction with the employer allows bringing closer the training of specialists today for their future successful career. The specificity and the main advantage of a corporate university lies in the interaction between business and education, the existence of a mechanism for the practical implementation of a company's request and receiving feedback. Hybridization of higher education is a consequence of general institutional changes.



For the development of student entrepreneurship, the article proposes to introduce the competence “the capacity to entrepreneurship and the development of a sense of entrepreneurial initiative”. Based on the conceptual model, ways of its formation are proposed. The theoretical aspects of the conceptual model are refined and expanded by the results of practical research. The main aspects of entrepreneurial thinking are highlighted. The implementation of conceptual model and the development of competence “the capacity to entrepreneurship and the development of a sense of entrepreneurial initiative” is an innovative educational solution for the implementation of educational programs of technical and economic specialties.

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