Rebus approach in training professionals for digital economics through educational information technologies

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Abstract

The development of the digital economy raises issues of harmonization of students' knowledge, skills and competences with actual social challenges. In this regard, educational institutions around the world actively investigate innovation approaches to teach disciplines of higher and additional professional education. The approach of the European educational Erasmus+ REBUS project represents one such approach, in the frames of which a course "Digital Entrepreneurship" is taught at SibSUTIS. Experience

in teaching the course showed that student training in the learning environment Mahara with the use of such tools as Moodle and LEVEL5 allows students to acquire additional education of the European quality by developing new competences in a quicker and more effective way. Moreover, REBUS approach allows to develop, implement and teach new courses for students of telecommunication and infocommunication profiles. In the light of global trends in the development of digital technologies, and also in order to logically continue the trend of cooperation between SibSUTIS and universities of the European Union, it is necessary to consolidate and develop the competences achieved by students through the design on further educational programs and commercially successful cases of Russian and European IT companies in the field of e-commerce, Internet of Things and Artificial Intelligence. The relevance of the study of commerce in the digital economy is due to the fact that information and communication technologies (ICT) are becoming increasingly important for businesses, consumers and governments in all sectors of the economy and around the world. The Internet of Things Entrepreneurship program allows to improve an ability to develop business plans, manage projects on computer networks of devices. The Artificial Intelligence Entrepreneurship program aims to improve an ability to develop business plans, manage projects on creation of networks that can correctly interpret external data, learn from these data and use the results to achieve specific goals and objectives through flexible adaptation.

Key words: *digital economics, information society, additional professional education, educational IT-technologies, learning environment, self-assessment, e-commerce, Internet of Things, Artificial Intelligence*

Educational standards of different countries prescribe to implement a competency-based approach in higher education [1, 2]. In pedagogical literature competence is defined as a compliance with the requirements for employment, the ability to perform specific employment functions, i.e. competence is a characteristic given to a person as a result of evaluating the effectiveness of his actions aimed at resolving a certain number of significant tasks for this community [2]. The term "key competences" indicates that they serve as a basis for more specific and subject-oriented competences. Using the competence model in the education requires fundamental changes in the organization of educational process, in the pedagogical activity, in the methods of evaluation of educational results. The acquisition of competences becomes the main goal and result of the educational process.

The educational standards also set strict requirements to the educational IT-technologies and electronic information educational environment. It should provide a complex of services: access to didactic materials, possibility to organize all types

of training including evaluation of learning outcomes in computer laboratories, access to electronic library systems containing learning resources, transparent communication and interaction between participants in the educational process in virtual classrooms, recording of midterm and final performance results, forming of students' e-portfilio [2].

The above mentioned requirements are fully met by the European educational Erasmus+ project REBUS approach by using the Mahara environment which is also an important part of the implementation of the competency-based approach as well as the automated assessment of the levels of competences [3]. This system is a learner-centered form of organization of the personal learning environment: personal information, past and present achievements, assignments and projects, goals for the future [4]. In fact, it involves the social networking principle in the educational project. Technically, Mahara is a stand-alone system that can be integrated into a wider virtual learning framework. Mahara's architecture is provided with the modular, extensible architecture of Moodle [5]. Examples of using Mahara in training "Digital Entrepreneurship" course are shown in figures 1 and 2.

FIGURE 1. The home page of the REBUS Students SibSUTIS group in Mahara

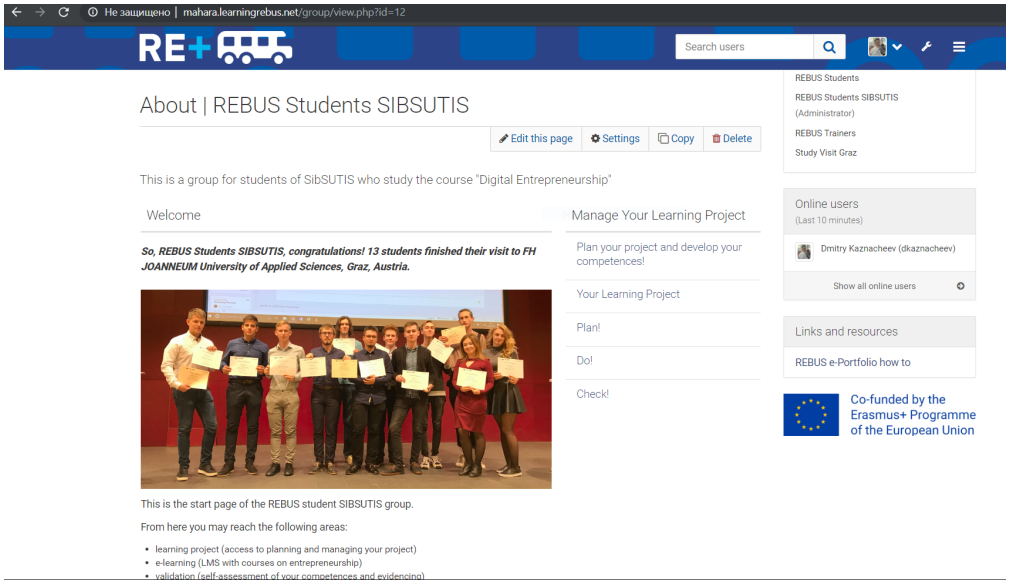
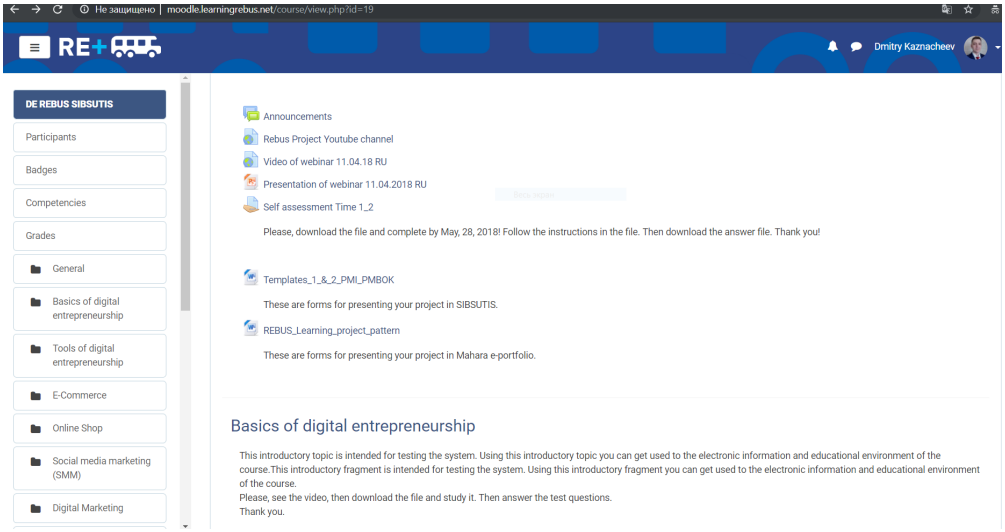
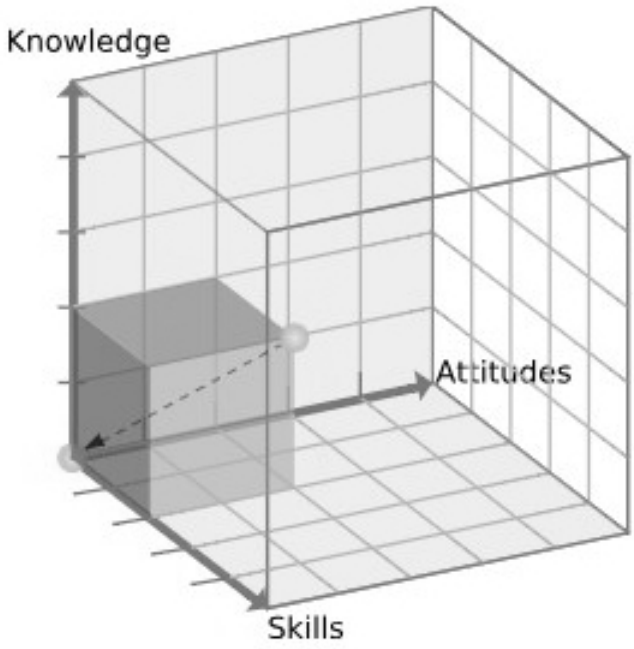


FIGURE 2. Summary of the Moodle course «Digital Entrepreneurship» in Mahara



Mahara will continue to evolve as a "pluggable", modular ePortfolio system intended for use by various web services. ePortfolio is a generic term encompassing as wide a range of types and products as there are reasons for using them. The assessment technology of the Mahara environment is based on the use of the LEVEL5 program (tool) that allows to rate on a five-point scale the following parameters: "Knowledge", "Skills", "Attitude and emotions". The system allows to visualize the levels of a selected competence in the form of a three-dimensional model - a cube (Fig. 3). With its help you can see the current assessments of the user and get a visual representation of how well the user developed the selected competence in the complex. It is a learner-centered personal online space that allows to manage the life of users, identify their goals, present themselves to potential employers and to complement applications for research funding.

FIGURE 3. Three-dimensional model of development of a selected competence in the LEVEL5 system



At the same time, the method of self-assessment of competence development based on the use of the software LEVEL5 has significant shortcomings. The level of competence development given by students built on the principles of self-assessment is frequently not relevant to the real one. In evaluating their abilities and skills level by themselves, students provide an example proving the descriptor of the chosen level that commonly leads to the following error due to the lack of experience: when students measure the level of competence development at "5" but the evidence is equivalent to the descriptor "4", the level "4" will be relevant. To avoid such misjudgments of students working on the methodology of LEVEL5 for the first time, the support of a teacher able to help with harmonizing levels and examples is highly required [6, 7, 8].

Nevertheless, on the basis of the approach described above and in an effort to address some of its weaknesses several additional educational programs were developed for students of IT specialties at SIBSUTIS. The duration of the course is 72 hours. According to the REBUS methodology the training program consists of 3 main phases involving the use of various educative technologies. Thus, phase 1 "Introduction and theory" implied the face-to-face lectures with the use of video material, webinars, discussions, group work, distance learning in the

learning environment Moodle as well as testing. Phase 2 "Practical work" included primarily the work with cases and examples using the learning environment Moodle, collection and analysis of information in open sources, screening and discussion of video material, completion of practical tasks, selection of project themes, project development. Phase 3 "Feedback" involves the presentation of projects, their justification and evaluation of student performance, final assessment and attestation paperwork. Brief summary of each program is shown in tables 1-3.

Additional educational program "Commerce in the digital economy".

Program objective – mastering and (or) acquisition of new competences required for a successful professional activity in the field of commerce in conditions of the establishment and development of the digital economy.

The program aims to develop the following general professional competences: ability to efficiently create and manage a commercial activity in the digital economy; ability to establish and maintain professional communication with business subjects in the digital economy.

The learning outcomes of the first competence are:

- knowledge – principles of organization and management of commercial activities in the digital economy;
- skills – project prototyping, project management in the field of commercial activities in the digital economy, use of modern information technologies in commerce;
- abilities – collection, analysis and interpretation of data needed to organize and manage commercial activities in the digital economy.

The learning outcomes of the second competence are:

- knowledge – basics of modern business communication using various information technologies;
- skills – maintenance of business communication with the use of information technologies;
- abilities – establishment of sustainable business communication using various information technologies.

In the framework of the program students learn the following topics:

- Basic notions of commerce in digital economy;
- Tools for commercial activity in digital economy;
- Participants in commercial activity in digital economy;
- Features of commercial transactions with the use of digital technologies;
- Logistics and goods movement in conditions of digital economy;

- E-commerce strategies;
- Integrated marketing communications;
- Information security in commercial activity within the context of digital economy;
- Socio-cultural, ethical principles of commerce in digital economy.

TABLE 1. Summary of the program "Commerce in the digital economy"

Course #1 – Commerce in the digital economy			
Modality	F2F	Project	e-Learning
Phase 1 (duration)	8 hours – Introduction and theory	-	16 hours – Theory
Phase 2 (duration)	8 hours – Group work, brainstorming	16 hours – Project activities	Supporting materials in Mahara and Moodle
Phase 3 (duration)	16 hours – Presentation, discussion, assessment	8 hours – Learning projects, speeches	Profile&e-portfolio in Mahara
Contents	· Basic notions (2) · Tools (2) · Participants (4) · Features (4) · Logistics and goods movement (4) · E-Commerce strategies (2) · Integrated marketing communication (2) · Information security (2) · Socio-cultural and ethical framework (2)	· E-commerce projects (8) · Product description (8) · Making presentations (8)	· Theory (16) · Webinars (4) · E-Portfolio (4)
Activities	· Lectures with video · Webinars · Discussion · Round table discussion	· Analysis · Brainstorming · Benchmarking · Planning · Writing · Consultations in-person · Presentation · Speeches · Discussion	· Social network correspondences · Learning projects templates · Assessment · LEVEL 5 self-assessments

The relevance of the study of commerce in the digital economy is due to the fact that information and communication technologies (ICT) are becoming increasingly important for businesses, consumers and governments in all sectors of the economy and around the world. E-commerce and value chain participation, distance learning and social media, smart cities and e – government, and more - the opportunities are truly endless.

The digital economy is growing at a rapid rate of 10% per year, more than three times the rate of global economic growth. In 2017, the global digital economy generated $ 24 trillion. In the area of e-commerce, accounting for 30% of all global transactions, many of which were made using mobile devices. In most OECD countries, the digital economy accounts for about 4-7% of GDP. The lowest indices in Austria (3.8%) and Norway (3.9%), while first three positions are occupied by Ireland (to 11.9%), Korea (9.6%) and Japan (8.1%).

Many people understand that the digital economy can contribute to economic growth and sustainable development, but not all countries of the world are moving in this direction equally fast. After analyzing the digital transformation in 50 countries, which account for 90% of global GDP and 78% of the world's population, Huawei has compiled the global connectivity Index in 2016. Countries were divided into three groups: leading, undergoing adaptation and beginners. The first group was led by the USA, Singapore and Sweden. In the middle of the second group are China (23rd place), Russia (26th place) and Brazil (30th place). At the very end of the rating and the third group were Nigeria, Bangladesh and Pakistan.

Increased access to the open and global Internet maximizes opportunities for economic growth, job creation and e-commerce. These benefits can be facilitated by the adoption of special measures by governments at national and international levels. At the same time, special attention will need to be paid to trade barriers, as well as new risks associated with the protection of private information, data transfers and payment mechanisms [9].

Additional educational program "Internet of Things Entrepreneurship".

Program objective - mastering and (or) acquisition of new competences required for the development of commercially successful projects on computer networks of devices (things), connected to each other.

The program aims to develop the following general professional competences: ability to develop business plans, conduct a feasibility study on creation of computer networks of devices (things), connected to each other; ability to manage projects on computer networks of devices.

The learning outcomes of the first competence are:

- knowledge – principles and algorithms of developing business plans, conducting feasibility studies on creation of computer networks of devices (things), connected to each other;

- skills – adequate visual presentation of business plans, feasibility studies on creation of computer networks of devices (things), connected to each other;
- abilities – ideation and subsequent implementation of ideas in developing business plans, conducting feasibility studies on creation of computer networks of devices (things), connected to each other.

The learning outcomes of the second competence are:

- knowledge – basics of project prototyping, project management in the field of creation of computer networks of devices (things), connected to each other;
- skills – organization of the team work for creating computer networks of devices (things), connected to each other;
- abilities – collection, analysis and interpretation of data needed to develop and manage projects in the field of creation of computer networks of devices (things), connected to each other.

In the framework of the program students learn the following topics:

- Basics of the Internet of Things (IoT);
- Tools of the IoT;
- The most promising for the IoT;
- Commercial potential of the IoT;
- Project and team work in the field of IoT.

TABLE 2. Summary of the program "Internet of Things Entrepreneurship"

Course #2 – INTERNET OF THINGS ENTREPRENEURSHIP			
Modality	F2F	Project	e-Learning
Phase 1 (duration)	8 hours – Introduction and theory	-	16 hours – Theory
Phase 2 (duration)	8 hours – Group work, brain-storming	16 hours – Project activities	Supporting materials in Mahara and Moodle
Phase 3 (duration)	16 hours – Presentation, discussion, assessment	8 hours – Learning projects, speeches	Profile&e-portfolio in Mahara
Contents	· Basic notions (2) · Tools (2) · Devices (4) · Commercial potential of the IoT (8) · Project and team work in the field of IoT (8)	· Device project (8) · Product description (8) · Making presentations (8)	· Theory (16) · Webinars (4) · E-Portfolio (4)

Activities	· Lectures with video · Webinars · Discussion · Round table discussion	· Analysis · Brainstorming · Benchmarking · Planning · Writing · Consultations in-person · Presentation · Speeches · Discussion	· Social network correspondences · Learning projects templates · Assessment · LEVEL 5 self-assessments

Additional educational program "Artificial Intelligence Entrepreneurship"

Program goals - mastering and (or) acquisition of new competences required for developing commercially successful intelligent devices and software.

The program aims to develop the following general professional competences: ability to develop business plans, conduct feasibility studies on creation of intelligent devices and software; ability to manage projects on creation of networks that can correctly interpret external data, learn from these data and use the results to achieve specific goals and objectives through flexible adaptation.

The learning outcomes of the first competence are:

- knowledge – principles and algorithms of developing business plans, conducting feasibility studies on creation of intelligent devices and software;
- skills – adequate visual presentation of business plans, feasibility studies on creation of intelligent devices and software;
- abilities – ideation and subsequent implementation of ideas in developing business plans, feasibility studies on creation of intellectual devices and software.

The learning outcomes of the second competence are:

- knowledge – basics of prototyping and project management in the field of developing networks that can correctly interpret external data, learn from these data and use the results to achieve specific goals and objectives through flexible adaptation;
- skills – organization of the team work for developing computer networks of intelligent devices and software;
- abilities – collection, analysis and interpretation of data needed to develop and manage projects in the field of creation of intelligent devices and software.

In the framework of the program students learn the following topics:

- Basics of Artificial Intelligence Entrepreneurship (AIE);
- Tools of AIE;
- Spheres of life that are most promising for AIE;
- Commercial potential of Artificial Intelligence;
- Project and team work in the field of AIE.

TABLE 3. Summary of the program "Artificial Intelligence Entrepreneurship"

Course #3 – ARTIFICIAL INTELLIGENCE ENTREPRENEURSHIP			
Modality	F2F	Project	e-Learning
Phase 1 (duration)	8 hours – Introduction and theory	-	16 hours – Theory
Phase 2 (duration)	8 hours – Group work, brainstorming	16 hours – Project activities	Supporting materials in Mahara and Moodle
Phase 3 (duration)	16 hours – Presentation, discussion, assessment	8 hours – Learning projects, speeches	Profile&e-portfolio in Mahara
Contents	· Basic notions (2) · Tools (2) · Spheres of AIE (4) · Commercial potential of AI (8) · Project and team work in the field of AIE (8)	· AI project (8) · Product description (8) · Making presentations (8)	· Theory (16) · Webinars (4) · E-Portfolio (4)
	· Lectures with video · Webinars · Discussion · Round table discussion	· Analysis · Brainstorming · Benchmarking · Planning · Writing · Consultations in-person · Presentation · Speeches · Discussion	· Social network correspondences · Learning projects templates · Assessment · LEVEL 5 self-assessments

A practical necessity in the development of entrepreneurship in the areas of It and AIE is caused by the changes of people's habits. The future when people will come home after work and ask their TV to turn on and the washing machine to wash clothes in the economy mode doesn't seem so distant.

People can already talk to virtual assistants like Siri or Alexa to search for a movie or order a new scarf with delivery to the door. Why not doing the same thing with everything else?

In fact, this is what everyone now calls the Internet of Things which is according to Wikipedia basically the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data [10].

In its essence, the technology of IoT is about devices with built-in sensors, which provide data to one or more central locations through internet connectivity. That data is then analyzed and corresponding actions are initiated.

For any IoT service to be worth buying, such actions must demonstrate true value and yield benefit to the user. Of course, they vary from adequate physical actions (e.g. deploying a taxi to the site) to simply informing users (e.g. sending a message to inform a user that they have run out of milk).

It is here at the data analysis step, that the true value of any IoT application is determined, and this is where Artificial Intelligence provides a crucial role by making sense of data streamed from devices. AI serves to detect patterns in this data from which it can learn to adjust the behavior of IoT service.

Probably the best example of AI and IoT successfully working together is self-driving cars by Tesla Motors. Cars act as "things" and use the power of Artificial Intelligence to predict the behavior of cars and pedestrians in various circumstances. Moreover, all Tesla cars operate as a network. When one car learns something, they all learn it.

Automated vacuum cleaners are a good example of artificial intelligence "embodied" in a robot. For example, iRobot by Roomba controlled through an app can map and "remember" a home layout, adapt to different surfaces or new items, clean a room with the most efficient movement pattern, and dock itself to recharge its batteries.

Another good example of AI and IoT combined together is a smart thermostat solution by Nest Labs. Nest's smartphone integration allows to check and control temperature from anywhere. The device analyzes temperature preferences and work schedule of its users and adapts temperature accordingly.

Applications, where IoT works together with AI, are only growing, creating new markets and opportunities and they are highly unlikely to lose ground in the nearest future.

Thus, the experience of teaching the course "Digital Entrepreneurship" at SibSUTIS in the frames of the European educational project Erasmus+ REBUS showed that student training in the learning environment Mahara using such technologies as the distance learning platform Moodle and self-assessment tool LEVEL5 allows students to form an efficient mechanism of evaluation needed for

an adequate perception of themselves as active and creative personalities, develop a critical way of thinking and self-demanding, evaluate objectives and the level of their acquisition; develop new competences quickly and effectively as well as obtain an additional professional education of the European level. In the light of global trends in the development of digital technologies, and also in order to logically continue the trend of cooperation between SibSUTIS and universities of the European Union, it is necessary to consolidate and develop the competences achieved by students through the design on further educational programs and commercially successful cases of Russian and European IT companies in the field of e-commerce, Internet of Things and Artificial Intelligence.

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