POZNAN UNIVERSITY OF TECHNOLOGY ACADEMIC JOURNALS
No 100 Electrical Engineering 2019

DOI 10.21008/j.1897-0737.2019.100.0017

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VIRTUAL EDUCATION ENVIRONMENT: THE SUPPORT OF STUDENTS CREATIVITY, FLEXIBILITY, ACTIVITY

Engineering education has been and will continue to be vital in everyday life of people around the real world, but students must have competences in development of creativity, flexibility and activity, to keep up with the speed of innovations. The experts say flexibility is more important than specific skills. The paper is focused on effective flexible environment for engineering education at technical faculties. The main aim of the article relates to the setting up of flexible educational environment, the integration of the learning content and the support of effective transfer of knowledge into the actual environment of the European working market challenges. The research works respond to the outputs of the National Project "Key Competences Formation and Effective Support of Students Mobility at Technology Faculties" in the context of massive amount of active researchers who work and use knowledge and technology base for this paper. It is also in intention of the Faculty of Electrical Engineering, University of Zilina, Slovakia, through the knowledge obtained from project research to offer each interested educational institutions the opportunity to adopt virtual education environment concept to support students creativity, flexibility, activity (CFA) in order to better focus on improving student´s learning procedure and increasing the quality of instruction procedure. The underlying basis for the research of the effectiveness of the virtual learning environment the paper CFA concept and methodology respect natural principles that while research experts take to account that the students “archetype” behind learning procedure has not changed importantly over time, the external factors affecting how student comprehend, retain and receive new education material are constantly evolving. The paper brings the results of the current national educational agency research project focused on effectiveness of modular didactic cycle with new virtual technologies, methods and forms in student-focused concept through the processing of experimental data of the electronics study program from the period of 2017-2018. Based on the framework, a set of virtual tools and supports that allow this flexible education process to run smoothly, were implemented. The innovative concept is based on standardized automated equipment and virtual instrumentation software with the new assessment to identify and reflect on the students´ competences outcomes of learning experiences during modular didactic cycle

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to examine the flexible environment helpfulness of virtual instrumentation based learning and to explore how the concept enhances career-ready competences. Finally, this paper discusses the findings and experiences gained from the effective virtual education environment model which was piloted with a multinational company that is a producer of automated equipment and virtual instrumentation software.

KEYWORDS: engineering career-ready competences, creativity, flexibility and activity, virtual environment, modular cycle didactics.

1. INTRODUCTION

1.1. General background and assumptions in the field of virtual education environment

The experts in pedagogy believe that the internal human factors behind learning have not changed vastly over time, but the external factors affecting how students comprehend, retain and receive key competences using new education material are constantly evolving [1]. As the digital transformation in social and production sphere accelerates, technology in education environment gives students support in exciting opportunities to shape learning experiences and effectively achieve learning goals. Applying teaching and learning didactics insights to engineering education, teachers can create a digital virtual, dynamic, and hands-on learning experience that is personal-tailored to foster student´s creative, flexible, and active approach developing the individual talent needed to power the 21st century digital economy [2, 3, 4]. The defining feature of an advice to student is that education environment encourages faculty to ask what a student can do with the technology tools instead of focusing on what the technology alone can do. This is an important point that we would all benefit from applying our decisions about which educational tools we believe are most effective. In addition, we must continuously monitor and ask what a student can do or make with a technology tool instead of falling into the trap of focusing only on what a tool can do for a student. Also we would like to keep in mind that the literature references in the paper there are the particular sources of our own many years of knowledge, experiences and publications activities.

1.2. Virtual environment adoption

Let us to focus on the current offer and opportunity to adopt virtual education environment concept to support students creativity, flexibility, activity (CFA) in order to better focus on improving student´s learning procedure and increasing the quality of instruction procedure. Virtual digital platform has enabled expansion into more units and subjects than faculty itself has in operations [5]. Additionally, the “virtual education environment” insights generated from virtual instruments research and application, are being used to create a variety of learning tools, courses, and academic programs. At the same time, it is important to recognise the role that a human teacher will always play in the classroom [6, 7]. Teachers have a personal and unique insight into each student's progress, serving as a competent role model and local expert, and providing creativity, flexibility, activity and cooperation in a way technology itself cannot. Integrating the engineering education didactics with virtual environment digital innovative tools, we can leverage the best of what digitally-enhanced and human-driven attractive education have to offer, creating students´ learning experiences that keep pace with the digital skills demanded by the industry market in turn, affecting individual students professional lives, supporting business and transforming global society [8]. For many manufacturers, the tendency to look toward retraining rather than hiring is rising of a simple reality – it is not easy to attract young technicians´ minds into the industry they consider not attractive and antiquated, but they are trying as it is possible. The industry is not the typical kind of job that current young people with creativity, flexibility and activity skills want to come and work. The long term and intensive cooperation with the industry show us that one of the main challenges is a lack of cohesion between academic students´ set of specific skills, and industrial sphere preferred flexibility competences needs [9, 10, 11]. As technical faculty curriculum continues to play a larger role in education, new standards for teaching technology are being developed to provide students improved key competences development compatibility with a more comprehensive, flexible and extensive education environment. The 21st century generation key competences in technology include principal goals in:

- fostering a greater interest of technology skills in higher education,
- exploring the key competences standards in virtual creative, flexible, and active education environment,
- expanding adoption the virtual instrumentation in flexible education concept,
- diversification of technical faculty graduates mobility towards to social and production area needs.

As we see more of a shift towards student-centred learning - the creativity, flexibility and activity are playing more crucial role in both classroom group processes and in student´s individual learning [12]. At the beginning we wanted to know what is seeing right now in selected engineering subjects as it relates to the learner-centred transformation taking place across faculty perspective study programs. Virtual environment goals raised dominantly from graphical programming environment detect and configure hardware and software which manage all peripherals. The block diagram (Fig. 1) of a designed system in the virtual environment is organized into sections for system configuration settings (channels, timing, logging, data acquiring, etc.). Students in creating original or ready-to-run project use virtual environment to actively observe data at virtual dashboard (Fig. 2) in flexible connection to share variable signals showing actual measured values, and cooperate in connection to other students sharing variables. Virtual instrumentation environment covers many engineering systems and areas to explore, learn, and form key competences and to communicate in flexible environment built from external vibrant community developers, data acquisition experts, and other students that get the support they need.

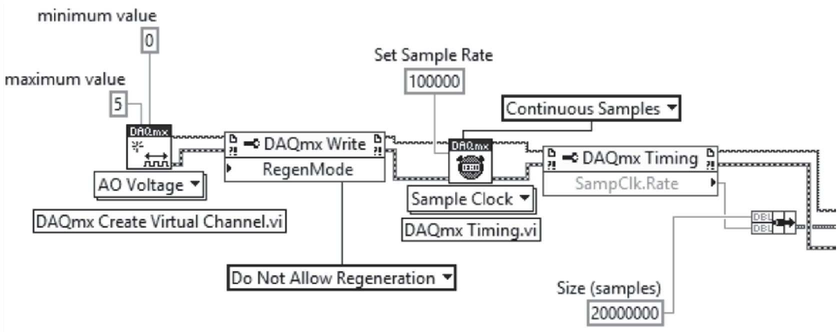

Fig. 1. Virtual Instrumentation: Control diagram design in virtual environment

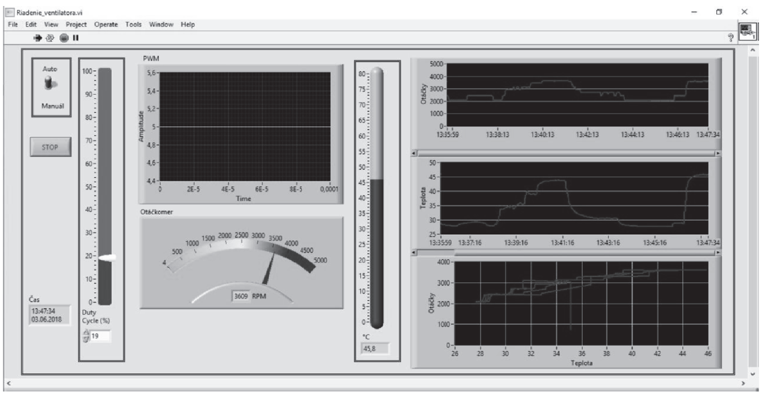

Fig. 2. Virtual Instrumentation: Data Dashboard Control Panels

1.3. Modular course model in virtual environment

Module-based education structure and learning content management has been proven to be the most effective concept of students key competences development within knowledge, skills, schedule, and overall resources constraints. This intensive and hands-on series of modules enhanced with virtual instrumentation hardware and software tools give students the skills to ensure that specific tasks are fully completed on time and on effort while giving the students the education environment benefits they expect and adopt [13]. We also ascertained whether students gain a strong working competency of the basics of learning management to be able to immediately use that knowledge and experiences to effectively manage activities to fill educational outcomes. The aim at the end of the modules series is that they are able to identify and manage the educational product scope, to build working structure, to create a project plan, to communicate the project idea, to define tasks and allocate particular works, to understand the knowledge forming process, to manage individual key competences development and identify risks, and to present achieved results. An optimal subject learning content scheduling in modular concept in virtual environment helps all students' group members' to work together to meet unit objectives and to form individual competences. The each module content with realistic elements constraints is also essential bedrock of elements of the curriculum. In virtual education environment courses concept students learn to plan and stick to time and elements constraints in order to ensure the success of their effort.

2. RESEARCH METHODOLOGY

2.1. Student-centered concept in virtual environment: Respect to individual learning style

Much of the literature on university-industry research partnerships has focused on collaborations that address curriculum, instruction, and leadership [1]. Less scholarly attention has been paid to how practitioners and academics work together to improve education environment in key competences formation.

General research project objectives related to national project are aimed at:

- critique the definition of virtual education environment beyond content and technology using the quality items scored items updated research,
- evaluate the adoption of a virtual education modular curriculum at the engineering study program,
- assess best practices in relation to learner, teacher, and learning content to support and improve creativity, flexibility, activity,
- assess best practices in relation to technology, non-technology and learning support,
- determine the steps needed to incorporate the implementation of teaching and learning in a virtual concept,
- propose an evaluation strategy for gathering data on the effectiveness of the virtual education environment approach.

We seek to deepen understanding of how educators and students collaborate to address aspects of the education environment that matter to students' learning. We discuss findings from the second year of a project research alliance between a university research team and pilot groups of students focused on improving education environment. First, we report results from our analysis of students' learning style monitoring survey adapted from Felder-Silverman methodology concept based on 4 antagonistic learning styles twins: active-reflective, sensing-intuitive, visual-verbal, sequential-global [14]. In a research design we analysed students' survey responses (n = 100) in 9 working experimental groups (EG1-EG9). We linked students' survey data to their learning preferences to determine the extent, to which students' individual perceptions were associated to their educational outcomes, what is evident in the Fig. 3.

Fig. 3. Learning style "archetype" in experimental pilot group EG1 (proportional)

2.2. Monitoring, collection and processing of data

Technology does not just support students´ key competences, and in addition it effectively shapes creativity, flexibility, and activity, as well. Many of the technical engineering education trends of the last ten years have come not from cultural and pedagogy shifts, but from technological pull. More data is available through our increased dependence on computers and automated systems, which evolved faster than the ability to make best use of their capabilities. But we were not unable to answer those questions because we did not understand the data, we did not have access to the specific data we need in virtual education environment concept or lack the know-how to turn the data into actionable information, because up to now, we do not systematically and sustainably shared reliable data. We examined the affordances and challenges at every stage of the investigative process, highlighting factors critical to creativity, flexibility, activity. We also analysed the cohort of engaged research experts' observations which shifted their views on the virtual flexible education environment items as documented in Fig. 4.

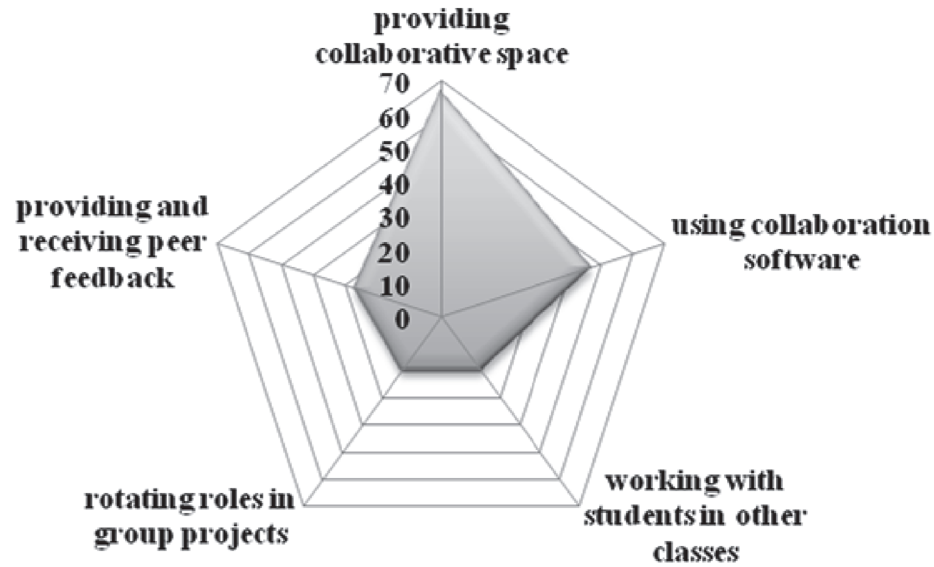

Fig. 4. Organization forms in virtual environment to strengthen and increase the effectiveness of the collaboration enhancing creativity, flexibility, activity (proportional)

The current study gives us now more data than we need to answer common innovative concept questions. The research study relates to virtual education environment support of students' creativity, flexibility, activity aims to promote a deeper understanding of virtual environment characteristics research and practice in learning among teaching faculty members, instructional designers, and institutional executives through a discussion and critique of recent literature on virtual education environment.

3. RESULTS

Following the quality items scored for students creativity, flexibility, activity as a framework, the topics of the modules include an institutional implementation of virtual environment, evidence-based best practices, and evaluation of virtual instruments in teaching and learning. This study have looked at the virtual education environment and technology enhance pedagogy to accommodate changing student educational needs, and experiential learning can be promoted by flexible or adaptive teaching methods as presented in Fig. 5, which conforms to the requirements of the industry to engage students through innovative pedagogy concepts.

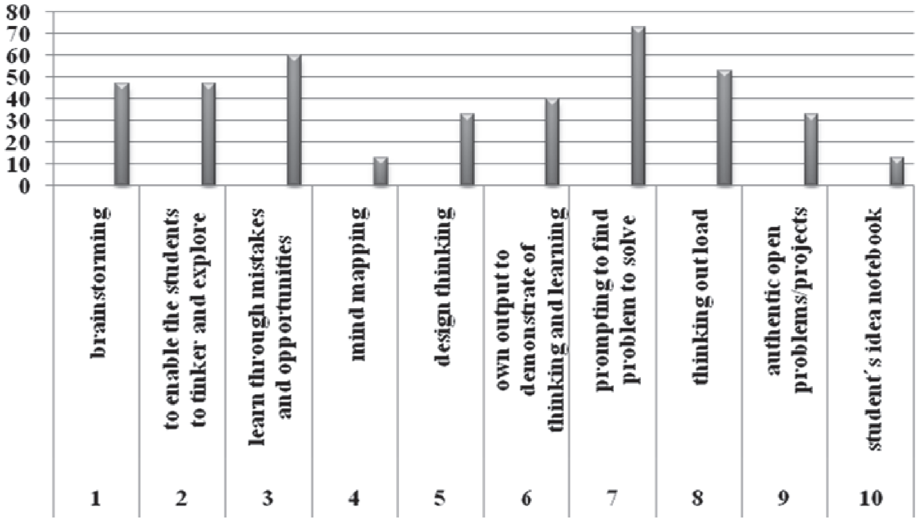

Fig. 5. Proportional representation of the selected teaching methods in virtual environment education methodology to foster creativity, flexibility, activity

Teachers in bachelor and engineering study programs reported positive experiences on student's engagement. At the conclusion, we completed an action plan that includes a problem statement where areas of virtual education environment instruction and/or implementation can be improved, best practices research alliance between a university research team and pilot groups of students focused on improving education environment. First, we report results from our analysis of students' learning style monitoring survey based on Felder-Silverman concept. Then, we examine the affordances and challenges at every stage of the investigative process, highlighting factors critical to creativity, flexibility, activity. Also, the virtual instrumentation transition had a positive influence on students who reported higher perceptions of creativity, flexibility, activity care in their key competences formation. Reflecting on the university-industry partnership process, we found that responding promptly to the concerns of stakeholders helped establish credibility and trust. Open and frequent communication was also essential to maintain focus, sustain commitment, and ensure the longevity of the faculty-industry alliance. Further, allowing partners to contribute and make decisions throughout the data collection and processing helped ensure that all perspectives were considered, thus increasing the validity of research findings as documented clearly in Fig. 6, 7, 8.

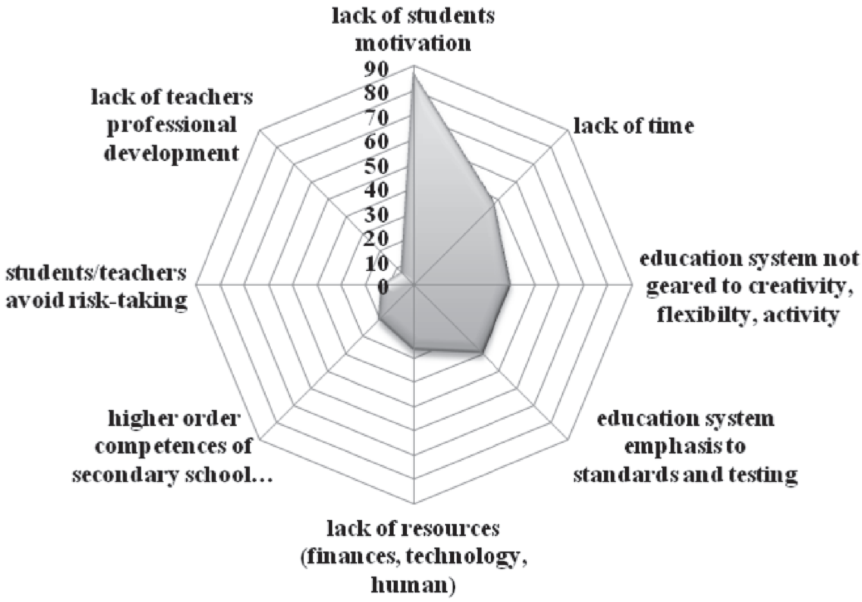

Fig. 6. The findings and challenges in virtual education environment to foster creativity, flexibility, activity (proportional)

This study extends the literature on virtual learning and teaching, and empirically evaluates the perceived value of CFA concept as a subjective evaluation measure of student learning effectiveness with respect to several relevant factors in the literature such as perceived competences, challenges, and satisfaction with engineering courses modular format and access the virtual education environment.

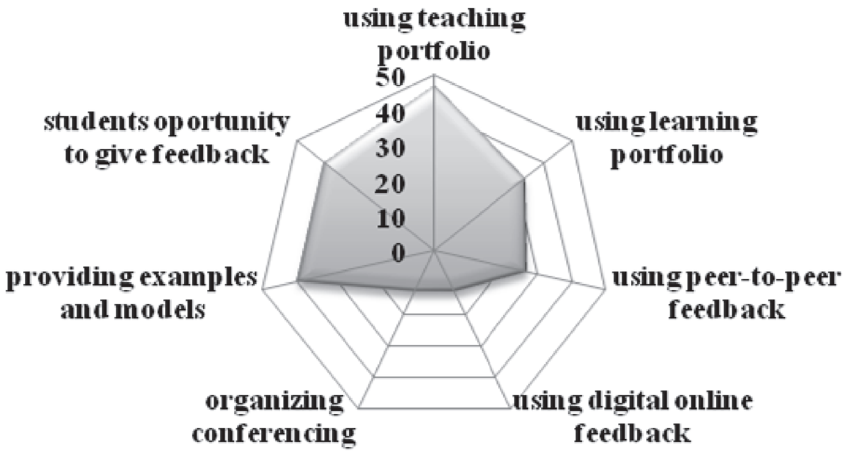

Fig. 7. Monitoring of concepts and tools in virtual education environment (proportional)

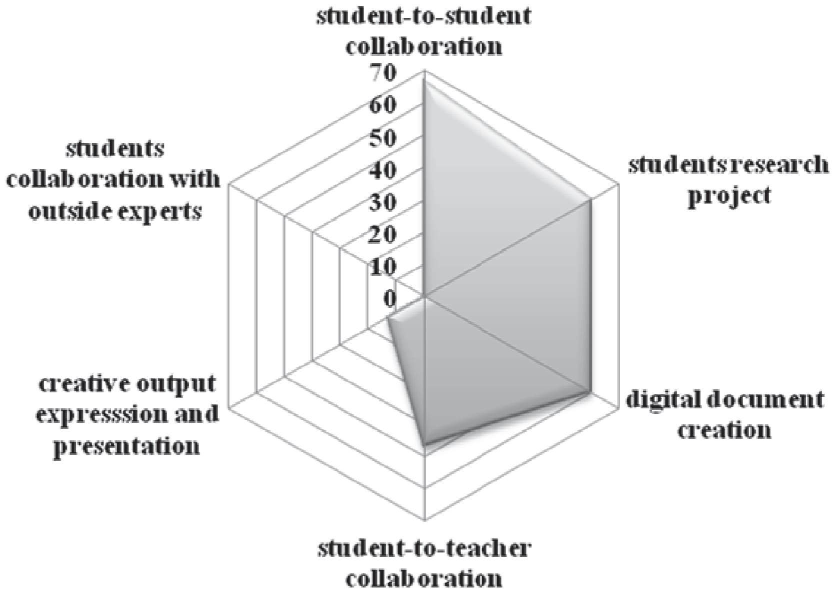

Fig. 8. Monitoring of collaboration and communication in flexible environment to speed CFA concept (proportional)

4. CONCLUSIONS

University-industry collaborations can be challenging to maintain. This study suggests that reforming education environment is a long-term participatory process that demands significant resources and on-going engagement from both university researchers and industry practitioners. By providing a thorough examination of the give and take of a university-industry research alliance, we identified pedagogical elements and technology incentives that can enhance graduates career-ready key competences and provide rich evidence that virtual education environment can serve as a foundation for further inquiry. Since flexibility of graduates of engineering education is considered as a critical factor to promote each individual student learning effectiveness, not only in the traditional classroom settings, but also in virtual education environment increases student engagement, the key factors – creativity, flexibility, activity to promote academic success in career-ready graduates competences. Against this backdrop, we intended to examine how the integration of a virtual instrumentation concept in modular didactic cycle could enhance student learning and thus learning and teaching effectiveness. Based on the extant research attention has been paid to the use of virtual technology in the engineering education field in cooperation with a world leading producer of automated equipment and virtual instrumentation hardware and software.

Acknowledgment. The paper was created in financial support to KEGA project No.: 071ZU-4/2017 "Key Competences Formation and Effective Support of Students Mobility at Technology Faculties: Modelling, Design and Assessment of Flexible Education Concept".

LITERATURE

[1] Laire M., Pavlasek P., et al., eMechatronics. Online Web-based Training Solution Devoted to Transfer Emerging Mechatronic Scientific and Technological Knowledge towards the Educational and Professional Communities. eContentplus 2005, Proposal No. 38217.

[2] Resnick M., Robinson, K., Lifelong Kindergarten: Cultivating Creativity through Projects, Passion, Peers, and Play. MIT Press, Cambridge ISBN: B07534YTP3.

[4] Pavlasek P., Adaptive educational environment: Creating a culture of innovation to support students' practical key competences development. In Proceedings of INTED2014 International Conference, 10th–12th March 2014, Valencia, Spain, ISBN 978-84-616-8412-0.

[5] Pavlasek P., Pavlaskova V., Information and Communications Technology in Education Process. In: Proceeding of Schools Colloquium, Budmerice, Methodology and Pedagogy Centre Bratislava, 2002, ISBN 80-8052-186-7 (in Slovak).

[6] Pavlasek P., (2007), eMechatronics: Digital Content in Transformation of Teaching and Learning. Communications - Science Letters of the University of Zilina, 1/2007, pp. 52–59, ISSN 1335-4205.

[7] Pavlásek P., eContent: Digital Content in Effective Teaching and Learning of Mechatronics. In: Proceedings of the 9th International Workshop on Research and Education in Mechatronics, September 18th–19th 2008, Bergamo, Italy, ISBN 88-88412-33-6.

[8] Pavlasek P., Implementation of Creative Project-Based Concept: Assessment of Engineering Students Competences in Flexible Learning Environment. In: EDULEARN18 10th International Conference on Education and New Learning Technologies, 2nd–4th July 2018, Palma, IATED, Mallorca, Spain, ISBN 978-84-09-02709-5.

[9] Pavlasek P., E-Content: The Core Competencies Formation in Effective Teaching and Learning of Engineers. In: EDULEARN09 Proceedings of International Conference on Education and New Learning Technologies, IATED, Barcelona, Spain, 6th–8th July 2009, ISBN 978-84-612-9802-0.

[10] Pavlasek P., Digital Teaching and Learning Environment in Student-Focused Teaching Concept: Making it Work in the Technology Oriented Content. In: Proceedings of INTED2010 International Conference. 8–10 March 2010, Valencia, Spain, ISBN 978-84-613-5538-9

[11] Pavlasek P., Curricular Innovation in Beginning Teachers Qualification: Archetypal Insights to Increase the Quality of Supplementary Education. In: Proceedings of EDULEARN15 International Conference on Education and New Learning Technologies, 6th–8th July, 2015, IATED, Barcelona, Spain, ISBN 978-84-606-8243-1.

[12] Pavlasek P., Innovations in Supplementary Pedagogical Study: Learning Style Insights to Increase the Quality of Beginning Teachers Education. In: Proceedings of EDULEARN17 International Conference on Education and New Learning Technologies, 3th–5th July, 2017, IATED, Barcelona, Spain, ISBN 978-84-697-3777-4, ISSN 2340-1117.
[13] Pavlasek P. et al., Modelling, Design and Assessment of Flexible Education Concept: Key Competences Formation and Effective Support of Students Mobility at Technology Faculties. In: Proceedings of INTED2018 Conference, 12th Edition, Valencia, Spain, 5th–7th March 2018, pp. 867–876, ISBN 978-84-697-9480-7.
[14] Felder R. M., Silverman L. K., Learning Styles and Teaching Styles in Engineering Education. In: Engineering Education 78 (7), pp. 674–681.

(Received: 30.01.2019, revised: 05.03.2019)