EFFECTIVE FLEXIBLE EDUCATION CONCEPT: VIRTUAL EDUCATION ENVIRONMENT SUPPORT OF STUDENTS CREATIVITY, FLEXIBILITY, ACTIVITY

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Abstract

Due to continuous change and diversification of modern society many traditional job positions and working operation functions is either disappearing or vastly changing in nature. The recent studies on employee’s flexibility are showing that the amount of career-ready employees with the required competences, who are also motivated, is rising. In many operational work positions in modern manufacturing companies, employees must manage a wider range of issues and responsibilities than before. 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 main aims of the paper are focused on setting up flexible educational environment, integration of learning content and support of effective transfer of knowledge into the actual environment of the European working market challenges. The article responds to the outputs of the National Project “Key Competences Formation and Effective Support of Students Mobility at Technology Faculties” in the context of the work and use of technology knowledge and didactics. It is also in the intention of the Faculty of Electrical Engineering, University of Zilina, Slovakia, through the knowledge obtained from the project research to offer each interested educational institutions an opportunity to adopt virtual education environment concept to support students creativity, flexibility and activity concept (CFAC) in order to focus better on improving student’s learning procedure and increasing the quality of instruction procedure. 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. This contribution discusses the findings and experiences gained from the new virtual education environment model which was piloted with a multinational company that is a producer of automated equipment and virtual instrumentation software. The implementation of a new CFAC has proven an effective flexible learning environment to work well as a method for elevating key career-ready competences. The main benefit of the paper is the new virtual instrumentation based concept of engineering students’ career-ready knowledge scaffold with significant findings and recommendations. 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 to examine the flexible environment helpfulness of virtual instrumentation based learning and to explore how the concept enhances career-ready competences. Finally, the article brings a summary of the benefits and a proposal to expand the areas of utilization of project findings in wide educational applications and to form forecasts to improve the key competences of students of technical faculties through innovative virtual educational environment support.

Keywords: virtual education environment, virtual instrumentation, creativity, flexibility, activity, key competences, higher education didactics.

1 INTRODUCTION TO FLEXIBLE EDUCATION ENVIRONMENT

The continuous change and diversification of modern society many traditional job positions and working operation functions is either disappearing or vastly changing in nature. The recent studies on employee’s flexibility are showing that the amount of career-ready employees with the required competences, who are also motivated, is rising. In many operational works positions in modern manufacturing companies, employees must manage a wider range of issues and responsibilities than before.
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 individual’s working flexibility and self motivation are more important than specific engineering skills [1]. The effective flexible educational environment for technological education at technical faculties examines the obstacles concentrated on the support of development of key competences of graduates of technical faculties by means of massive technological support directed at synergy of components of knowledge base and its integration with competences of graduates of technical study fields in an actual working environment. The main aims are related to the setting up educational environment, the integration of the content of education and the support of effective transfer of knowledge into the actual environment of the European working market challenges [2]. In the last years, virtual instrumentation concepts are used increasingly more as education environment for students in various domains. On the one hand these virtual instrumentation tools are used for data visualization and on the other hand are used as simulation tools in virtual world and capable to make advanced modeling, simulation and analysis into a laboratory to support students’ key competences and as an important concept to individual’s working flexibility improvement [3]. In this way the virtual instrumentation tools are allowed to students to understand better the learning content in electronics course of engineering study program to discover the various connections between materials phenomena, making connections between the various disciplines studied as a synergy of mathematics, physics, mechanics, electronics, as well as control theory for better assimilation the learning content presented in the course teaching/learning processes [4]. The use of virtual instrumentation in electrical engineering study program, especially for electronics, mechatronics and autotronics courses which are taking place in the real world the virtual instrumentation can be used very effectively for virtual experiments used in the teaching/learning process of different science areas while specific aspects for graduates’ flexibility [5].

1.1 Support of graduates creativity, flexibility, activity

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 [1]. 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 can do. This is an important point that the flexible concept would have all benefits from applying our decisions about which virtual educational tools we believe are most effective. During didactic cycle we arranged continuous monitoring and asked what 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. Based on the framework, a set of virtual tools and supports that allow this flexible education process to run smoothly, were implemented. The project research work discusses the findings and experiences gained from the new virtual education environment concept which was piloted with a multinational company that is a producer of automated equipment and virtual instrumentation software. The implementation of creativity, flexibility and activity concept (CFAC) is offered to prove an effective flexible learning environment for working well as a method to support elevation of real world newcomers’ career-ready key competences.

1.2 Virtual digital education environment: Objectives, adoption, assessment

Virtual digital education environment laboratory adoption is gaining popularity as technology study programs educational tools that are able to form, measure and assessed students’ higher order of competences such as problem solving and technology inquiry within classroom technology environment and course learning content. In this context, competences support is a combination of learning content knowledge and education process skills with students’ individual personal soft skills level that lead to the practices and culture of learning engineering graduates’ competences by doing it, which require assessment that measure and grade teaching/learning process effectiveness. Focusing on the career-ready graduate competences objectives, in currently solving education project tasks we offer an opportunity to present the design and adoption procedure of virtual education environment to support technical faculty students’ creativity, flexibility, activity in order to effective improving the
individual student’s learning process and increasing the quality of teaching didactics in methodology and instruction procedure. Virtual digital platform has enabled expansion into more units and subjects than faculty itself has in courses portfolio. The virtual education environment insights generated from virtual instruments research 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 teacher will always play in the virtual classroom environment. Teachers have a personal and unique insight into each student’s progress, serving as a competent role model and local expert, and providing creativity, activity, cooperation in a way technology itself cannot. Integrating the engineering education didactics with virtual environment digital innovative virtual tools, we can leverage the best of what digitally-enhanced and human-driven attractive education have to offer, improving students’ learning experiences that keep pace with the digital skills demands in the running industry market, affecting individual faculty graduates professional lives, supporting business and transforming global society [6].

2 METHODOLOGY OF FLEXIBLE EDUCATION ENVIRONMENT CONCEPT

The creativity, flexibility, activity as unique individual students’ soft skills are very hard to teach, so employers want to know that job candidates already have the soft skills that enable them to be successful in the real workplaces. Soft skills are the personal attributes that graduates need to succeed in the workplace. These are often related to how employee works with others, in other words, these are individual people characteristics for further engagement of graduate mobility in workplace. The hard technology skills are often more quantifiable, and easier to learn. A hard skill for an object identification technology in many areas, for example, might be the ability to design, tune and operate monitoring machine modules, visual data collection, identification software procedure and to use communication tools. Regardless of the job position to which a graduate is applying, career-ready newcomer needs at least some soft skills. In order to succeed at job, all workplace newcomers must get along well with all the people with whom is in interaction, including managers, co-workers, clients, vendors, customers, and anyone else graduates communicate with while on the job. For many manufacturers in the faculty cooperative industrial area, specifically automotive production, the tendency to look toward retraining rather than hiring is rising of a simple reality, because it is not easy to attract young people with “technicians’ minds” into the technology faculty and industry, as well; they consider technology education extra difficult, not attractive and antiquated [7]. But local companies are trying as it is possible to look toward retraining faculty graduates rather than hiring career-ready students. The industry is not the typical kind of job that current young people with creativity, flexibility, 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 academically formed technical students’ set of specific hard skills, and production sphere preferred individual personal newcomer flexibility competences. 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 with a more comprehensive, flexible and extensive education environment [8]. The 21st century generation, the technology key competences standard goals for graduates according to faculty-industry communication include:

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

2.1 Flexible education: Design of creativity, flexibility, activity culture

As we see more of a shift towards student-centred learning the creativity, flexibility, activity skills are playing more crucial role in both classroom group processes and in student’s individual learning [9]. We wanted to know what they are seeing right now in selected engineering subjects as it relates to the learner-centred transformation taking place across faculty perspective study programs. Modular education concept structure and learning content management has been proven to be the most effective way of students key competences development within knowledge, skills, schedule, and overall resources constraints. The intensive and hands-on series of modules enhanced with virtual instrumentation hardware and software tools give technology faculty students the skills to ensure that specific tasks are completed on time and on effort while giving the students the education environment
benefits they expect and adopt [10]. Students gain a strong and effective working competency of the basics of learning management and to be able to immediately use that knowledge and experiences to effectively manage activities to fill educational outcomes. At the end of the modules series they are able to:

- identify and manage the educational product scope,
- build a work breakdown structure,
- create a project plan,
- communicate the project idea,
- define and allocate particular works,
- manage the key competences development,
- identify and manage risks,
- understand the knowledge forming process,
- present results.

2.2 Flexible education: Design of modular concept

An optimal subject learning content scheduling in flexible environment concept helps all students’ pilot group members’ to work together to meet unit objectives and to form hard engineering competences and individual soft skill competences. The each learning content module with realistic elements constraints is also essential bedrock of elements of the specific engineering program curriculum. In virtual education environment concept students learn to plan and stick to time and elements constraints in order to ensure the success of their effort. Upon completing each task of individual modules, students are targeted to:

- identify the resource needs of the learning module,
- decompose work packages into activities,
- define what is needed to estimate activity durations,
- define milestones and create a milestone schedule,
- determine the critical path and eliminate errors,
- describe the purpose of using tools leads in modules scheduling,
- estimate the quantities and important resources required to perform module activities,
- select one of common techniques to determine a module outcomes filling,
- use an assignment to key competences and individual responsibilities,
- recognize the components of a problem/project management plan.

3 OPTIMAL FLEXIBLE EDUCATION ENVIRONMENT

Virtual environment aims rise dominantly from graphical programming of elements, modules and systems; electronics study program students from the creativity, flexibility point of view configure hardware and software which manage all peripherals. As an example, the diagram of designed system in the virtual environment is organized into sections for system configuration settings. Students in creating original project or ready-to-run project use virtual environment to actively observe data at virtual dashboard (Fig. 1) 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 [11].

4 RESEARCH METHODOLOGY

Much of the literature sources on university-industry research partnerships are focused on collaborations that address curriculum, instruction, and leadership [12]. Less scholarly attention has been paid to how practitioners and academics work together to improve education environment in graduates key competences formation. The research project goals seek to deepen the understanding of how teachers and students collaborate to address aspects of the education environment that matter to students’ learning processes. We discuss findings from the third year of a project research alliance between a university research team members 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 methodology concept [13], [14], as an example, for engineering study pilot groups (Fig.2) and bachelor study pilot group (Fig.3). Then, we examine the affordances and challenges at every stage of the investigative process, highlighting factors critical to creativity, flexibility, activity. In a research design we analysed students’ survey responses (n = 100) in 9 working experimental pilot groups [15]. We linked students’ survey data to their learning preferences to determine the extent to which students’ individual perceptions were associated to their educational outcomes. We also analysed the cohort of engaged research experts’ observations which shifted their views on the virtual flexible education environment items.

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 content to improve creativity, flexibility, activity support,
- 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,
4.1 General research background of virtual education environment

Technology does not just support students’ key competences, and in addition it effectively shapes creativity, flexibility, and activity [15]. 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. 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. 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 [16]. 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.

5 RESULTS AND BENEFITS OF VIRTUAL ENVIRONMENT IMPLEMENTATION

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. 4, which conforms to the requirements of the industry to engage students through innovative pedagogy concepts. Teachers in bachelor and engineering study programs reported positive experiences on student’s engagement. 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 with effective methods (Fig. 5), didactic forms, and education technology (Fig. 7). 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 alliance. Further, allowing partners to contribute and make decisions throughout the analysis helped ensure that all perspectives were considered, thus increasing the validity of research findings. This study extends the literature on virtual learning and teaching, and empirically evaluates the perceived value of CFAC 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.

![Figure 4. Radar diagram of experts monitoring: creativity, flexibility, activity weakness in virtual education environment (proportional).](image-url)
Figure 5. Experts reporting: creativity, flexibility, activity improvement related to didactic methods in virtual education environment (proportional).

Figure 6. Experts reporting: creativity, flexibility, activity improvement with didactic forms in virtual education environment (proportional).
6 CONCLUSIONS

Faculty-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 faculty 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.

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REFERENCES


