Chapter 8
Customization of BIM Educational Process During the COVID-19 Crisis at Department of Technology, Economics and Management in Construction at Faculty of Civil Engineering in Košice

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8.1 Introduction and Problem Statement

Information and communication technologies are important in several industrial areas and sectors of the economy [1]. Innovations in materials or specific technologies are very much needed [2, 3]. These are all components necessary for growth in industries of any production. The current time, however, requires a little more. The current uncertain situation in the world requires much more innovation in every area than ever before [4, 5]. The current time is marked by the impact of the COVID-19 pandemic, which has paralyzed the functioning of several sectors. Several European countries have taken various measures to prevent the spread of COVID-19. This situation is very sensitive also because this change and circumstances have occurred very quickly. The change in conditions did not only occur in industrial areas and in the management of manufacturing companies. This current situation and development have also affected ordinary people and day-to-day operations. As already mentioned, each country has taken different measures, which have resulted in the problematic functioning of several spheres. Under the conditions of the current situation in Slovakia, industry and production areas were largely paralyzed.

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This resulted in the temporary cessation of production in selected companies. An example can be the great impact on the automotive industry, which is largely developed in Slovakia and has a significant share in GDP in Slovakia. Not only the industry itself but also other sectors are paralyzed. For example, construction is also showing signs of a slowdown in production and is also beginning to have a negative impact on unemployment and other macroeconomic indicators. Education and training is another area where the situation around the COVID-19 pandemic has brought widespread restrictions and changes. This whole situation has brought new requirements to achieve a state of basic functioning. This situation resulted in the interruption of the full-time form of study at each level of study, which represented complications, but at the same time new challenges for setting up the functioning of the given processes. The consequences of this situation resulted in the educational process of students from home, which means a huge change in the current functioning of education. The need for ICT training for industry has been of great importance over the last few decades [6]. In the situation caused by the pandemic, COVID-19 only emphasized these needs. The field of construction has long demanded the teaching of BIM technologies for practice. The implementation and expansion of BIM technologies begin with the implementation of teaching BIM technologies at faculties. This need stems from several surveys carried out in the construction industry. Several studies and researches address this issue. They also map the use of BIM technologies at the University of Zagreb [7–10]. The issue of BIM technology and the educational process is also solved by international research, in which participants from Slovenia, Germany and the Czech Republic and Croatia also participate [11]. This issue was also addressed in the framework of cooperation in research by Slovakia in cooperation with Croatia. The current global situation around COVID-19 only multiplies the need to implement information and communication technologies in all areas (industry, education, services, etc.). The Faculty of Civil Engineering at the University of Technology in Košice has long sought to imply the maximum possible level of ICT from the educational process. He also tries to bring BIM technologies closer to students. They have previously tried to customize the teaching process to the real needs of praxes and students. However, the situation during the COVID-19 pandemic has more demanding requirements for this process. Customization in education is of great importance. Students get what they need for practice and at the same time it reflects their individual requirements. Of course, the degree of customization must be acceptable by the set processes and functions of the faculty or department. The level of customization in the field of BIM technology education must intensify during the current situation. On the contrary, this also applies to the construction industry and its needs. The degree of customization of teaching the given technologies acquires a much greater meaning and need. The main goal of the research is to describe the customization of teaching BIM technologies at Department of Technology, Economics and Management in Construction at Faculty of Civil Engineering in Košice.

8.2 Mass Customization and Educational Process

The term mass customization was first defined in 1987. The term represents the way in which one type of product is produced. Production is tailored to customer specifications, regardless of the economics of production [12]. Mass customization is characterized by high flexibility in the production process. Customers directly influence the properties of the product [13]. Mass customization is the ability to design and manufacture customized products while maintaining the same level of efficiency and speed of the production process as in mass production [13].

The aim of this method of production is to bring the consumer a product or service in the required form and quality, without increasing the selling price. Mass customization is characterized by:

- Rapid response to consumer demands
- Taking into account individual requirements in the supply of goods and services
- A high degree of modularization of components (support for meeting individual requirements)
- Individual approach to the production of products and the provision of services
- individualization of services for standardized products and services [14, 15].

We know several types of mass customization, specifically (see Fig. 8.1):

- Transparent customization—the aim of this method of customization is to deliver products to measure, while the customer is not aware that the products are adapted directly to him
- Adaptive customization—the aim of this type of customization is to adapt the standardized products to the needs of producers or consumers. The settings of the product are additionally changed, without changing the final product or the final presentation
- Collaborative customization—this type of customization represents the most perfect strategy. The customer acts directly into the production process and precisely specifies his needs
- Cosmetic customization—a type of customization in which the product itself does not change, only its presentation changes [16].

Types of customization	Product		Presentation	
	change	without a change	change	without a change
Transparent customization	X			X
Adaptive customization		X		X
Collaborative customization	X		X	
Cosmetic customization		X	X	

Fig. 8.1 Types of customization

8.3 Customization of BIM Educational Process at the Study Program of Technology and Management in the Building industry

Competition is increasingly being perceived among educational institutions as well. The aim of universities is to provide the best possible environment for increasing the expertise and experience of their students. For this purpose, several innovative approaches and strategies are introduced into the educational process, which individual universities implement and incorporate into the educational process. The aim of individual universities is to adapt education to the needs of students as much as possible. It is therefore very important to support student willingness in improving and adapting the educational process. The level of quality of the educational process is directly proportional to student satisfaction, so it is important to look for ways to improve services and how to differentiate as much as possible from competitors, therefore from other universities and educational institutions [17]. Despite the growing competitive environment, schools manage their education system in the same way as they did 50 years ago. The education system is made up of traditional ways, which do not provide differentiation in order to satisfy the needs of students and maximize their potential. These "traditional" universities are increasingly fighting for their "client" with emerging subsectors—virtual universities, development companies and others [18].

There are many ways to differentiate and individualize education as much as possible. In the United Kingdom, several studies have been carried out to differentiate the guidelines and to monitor their impact after their implementation. Based on the research, four elements (see Fig. 8.2) in the class were defined:

- Content—what the student must learn and how to obtain this information (access to information)
- Process—a set of activities in which the student is involved in order to manage and understand the content
- Product—project outputs. Their aim is to stimulate students—practicing, applying and disseminating knowledge
- Learning environment—creating an engaging way of teaching and creative environment [18].

Education is during a historic shift towards a less centralized model oriented primarily to students. The implementation of innovative ways in the educational process is constantly increasing; students require the implementation of innovative technology in the educational process.

The study "The Future of Education" brought the following findings:

- 50% of students do not need to be physically present in the classroom (they prefer online teaching)
- 53% of students prefer the so-called online education
- 39% of students expect the start of the so-called virtual education

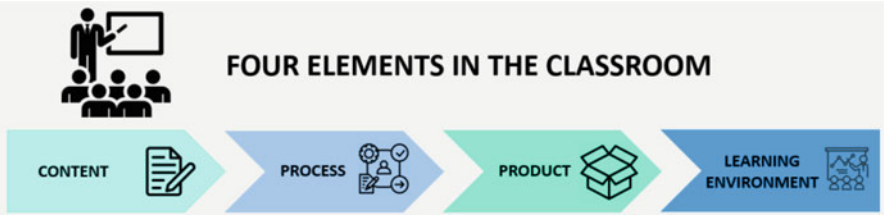

Fig. 8.2 Four elements in the classroom

- Up to 84% of students use PC when studying
- 19% of students use a tablet and a mobile phone to study
- 43% of students state that online education is education of the same or higher quality as traditional higher education
- 78% of students state that online learning is more demanding than education in a traditional classroom
- 63% of students would be interested in the so-called online internships [17].

The Faculty of Civil Engineering of the Technical University in Košice has been providing education in the field of construction for 43 years. The faculty offers 18 study programs in three levels of study—bachelor, master and PhD studies (see Fig. 8.3). During its existence, the faculty has educated more than 8000 graduates who work in various positions as successful protectants, construction managers, general managers, scientific research and pedagogical staff. The faculty is one of the leading educational institutions. As many as 89.5% of graduates will find employment within 1 year after graduation.

Students are provided with basic knowledge in the field of business management, law, principles of teamwork and coordination of specialists.

Many innovative teaching methods are used in the educational process. Undoubtedly, such innovative teaching methods include the use of mass customization, transparent customization. The aim of transparent customization is to provide students with products and services that are "tailor-made" for them, while students are unaware of the targeted profiling of education. Faculty supports the use of progressive tools such as 3D laser scanning, 3D printer, virtual reality tools and new innovative software solutions. Students of the study field of Technology and management in construction participate in the preparation and implementation of constructions. Building information modelling technology is increasingly being used in this phase.

Building information modelling is the process of creating and managing digital characteristics. Building information models are files that can be extracted, exchanged or networked. The aim is to connect and support decision-making. BIM is a source of knowledge and information that forms the basis for decision-making during the life cycle of a building [19].

BIM is a process for creating and managing information about a construction project throughout the project life cycle. One of the key outputs of this process is

Level of study	Study programs
Bachelor study	Building construction and architecture Civil engineering and transport construction Technology and management in construction Reailzation of transport construction Construction with environmental determination Buildings for sustainable water management in the country
Master study	Building construction Load-bearing structures and transport construction Technology and management in construction Technical equipment of buildings Load-bearing structures Reailzation of transport construction Construction with environmental determination Buildings for sustainable water management in the country
PhD. Study	Theory of building and environment creation Theory and design of civil engineering Theory of technology and management in construction Environmental engineering

Fig. 8.3 Study programs of Faculty of Civil Engineering, Technical University of Košice

the building information model. The model is based on information collected and updated in the key phases of the project. BIM collects all the information about each part of the building in one place. The technology helps to effectively integrate various aspects of the design, reducing the risk of errors or inconsistencies and minimizing costs [20].

The result of work in the environment of information modelling of buildings is a model of an object that contains graphic and non-graphic information. Individual information can be considered as individual dimensions of information modelling of buildings. The 3D model is the carrier of graphic information of the object. The model has time parameters (4D-time), cost parameters (5D-cost), information on sustainability (6D sustainability) and information on building management (7D-facility management) (see Fig. 8.4).

Education at the Faculty of Civil Engineering changed its form during the COVID-19 crisis. The faculty moved from the full-time form of study to the

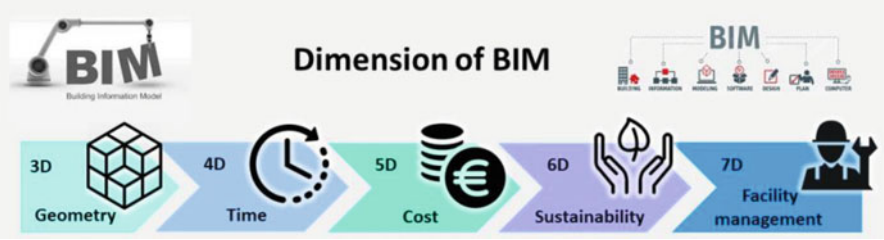

Fig. 8.4 Dimension of building information modelling

distance form of study. The use of various cloud technologies, shared databases, social networks, teamwork between students and the faculty is supported to a greater extent, the use of BIM software applications, creates online training of these applications and provides students with school licenses for selected applications.

The whole educational process has moved to the online space. The faculty has created an online account for each teacher in the Cisco Webex portals, through which all subjects are taught. Cisco Webex allows to virtually schedule lessons, create virtual rooms, virtual meetings and video conferences. The application allows you to create online exercises. The teacher creates the video metering, determines the topic, date and time. After creating the meeting, the application automatically generates a link, access code and allows to send this information to students to their student email accounts. Information about the created meeting is also shared on the portals Moodle Tuke, which represents the Learning Management System—LMS. LMS are applications that integrate various online tools for communication and study management (discussion forums, chat rooms, records, etc.) and make available to students teaching materials and online or offline teaching tools [21].

Teamwork is encouraged for students. In the last years of master studies, the study subject Team project is created in which students of individual fields of study cooperate with each other. Within the subject, students solve the assignment, the project. The aim of the faculty is to support the connection of study with practice. Therefore, projects are selected from external contractors, whether private companies or the public sector. Currently, students are working on a project to restore the House of Culture in Svidník. Members of the team project are the assignors (the town of Svidník), project coordinators (tutors within the study fields) and students—solvers of project documentation—design of structures of the building, static design, design of construction site equipment and other (see Fig. 8.5).

Individual team members work up their part of the project in BIM software applications. Teaching takes place online, individual team members (students, investors and tutors) communicate and share their solutions and ideas through the Webex platform. As part of the consultations, a meeting room is created, where students and tutors share their plans and explain their solutions. The advantage of a given online conversation is the ability to record video and audio, which leads to a perfect

Fig. 8.5 Structure of team project

recording of all stimuli, whether by students, investors or tutors. The research team is divided into four areas of design: design, static solution, consideration of the environmental aspect and preparation and implementation of constructions. The result of this cooperation is the preparation of project documentation for the construction, technical equipment of buildings, static solutions, environmental assessment of the building and at the same time a work schedule, construction budget and construction organization project are compiled.

The faculty is increasingly supporting the implementation of information modelling of buildings in construction processes. Within the subject Technological project, students are creating an information model of the building. Students are provided with 2D project documentation, which then model in selected BIM software applications such as AutoCad Revit. Within the mentioned subject, students are provided with student licenses for selected software applications. As part of the exercises, online tutorials are prepared on how to work in the given software environment.

In addition to supporting the creation of 3D models, students are also acquainted with the time and economic planning of construction. Students create construction budgets and time schedules. Within the subject Technology of construction of buildings and units, students are explained through online meetings various forms of time planning—schedules, cycloramas, histograms of materials, machines, workers and the other. Subsequently, students are presented with information in which BIM software applications it is possible to create the same time schedules and what is their creation process (see Fig. 8.6).

The customization of the teaching process was also at the course Economic Information Systems. This course was the first to start online teaching since the first week. The online form is suitable for this subject and it was not problematic to provide the entire content to the online environment. During one lecture, students also attended a webinar with the partner company Kros, which is a leading company in the field of development and production of construction and economic software. Enterprise information systems, their modules and BIM technologies that are taught in the subject have been moved to the online environment. The bulk and student versions also allowed access from home. This form of customization for a given subject ensured 100% content for students and at the same time saved their time. The

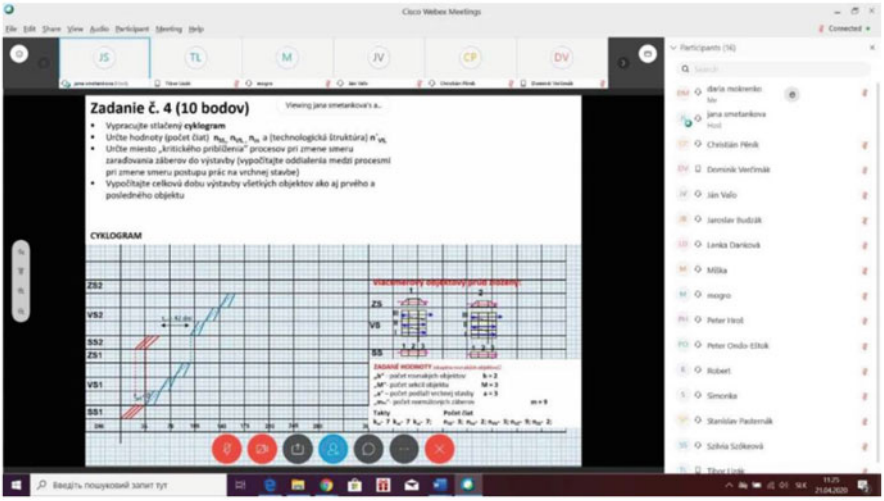

Fig. 8.6 BIM software applications and schedule creating by Webex meetings

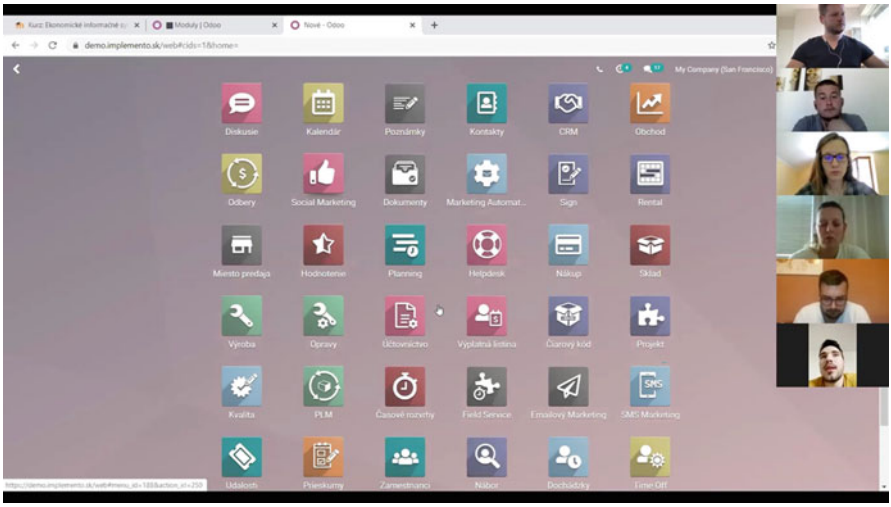

Fig. 8.7 Economic Information System lecture by Zoom platform

online lectures were conducted via the already mentioned Webex Meetings platform from Cisco, or via the Zoom platform, as can be seen in Fig. 8.7. The process of presentation of selected information systems during the lecture and mediation of information content to students can be seen in Fig. 8.8.

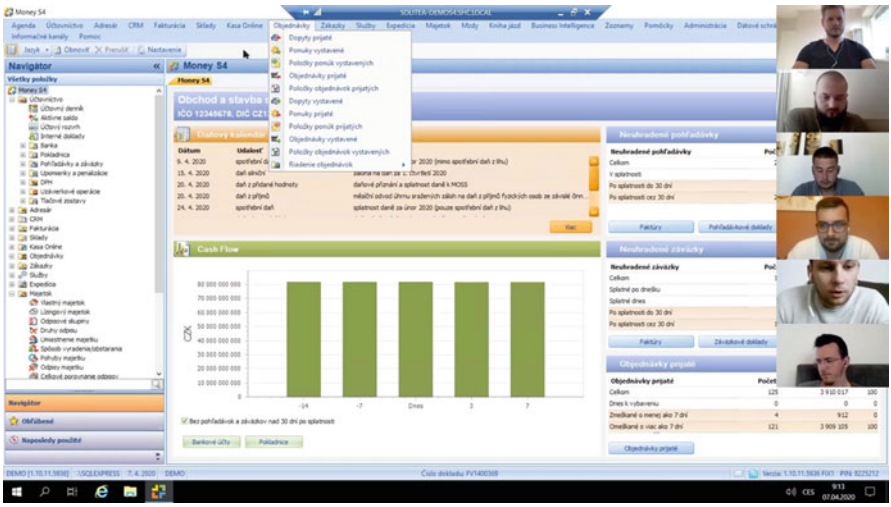

Fig. 8.8 Presentation of economic information software by online platform

8.4 Conclusion

The issue of customizing the educational process is a much-needed topic that needs to be addressed. In general, internships argue that students need to be educated so that the content is consistent with what the internship needs. Customizing the educational process and content is one way to achieve this. BIM technology is one of the most sought after requirements for practice in this area. Mediation and implementation of this process into the teaching process are very necessary for the construction industry in every country. The rate of customization and the needs of construction and students should be as high as possible. This well-started process at the Faculty of Civil Engineering, Technical University in Košice is positively evaluated by practice, but also by students. However, with the current situation associated with the COVID-19 pandemic came a new challenge. The established process had to change quickly as the full-time form of the study was suspended. The construction market, but also students, still demand the content needed for a successful career and work in the field. This situation had to change quickly. The Study Program of Technology and Management in the Building industry study program showed a high degree of flexibility and adaptability. Several subjects, where the customization of content for students was also in the use of information and communication technologies and BIM, had to be adapted to current conditions. It could be said that the degree of customization has increased even more. This situation also confirmed the importance of the implementation of information and communication technologies in all areas and industries. This is an important finding that confirms several previous studies. The rate of customization is slightly higher due to the COVID-19 pandemic and subsequent measures in securing the

teaching process. This is where the need for customization and the advantage of its application in the field of education was confirmed.

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