

# *Digital transformation of higher education: integrating multimedia systems into the study process*

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**Abstract.** Higher education and digital transformation are two essential areas that interact and influence each other today. The rapid development of technology requires higher education institutions to provide students with the digital skills needed in the labor market and everyday life. At the same time, educational institutions are embracing digital solutions to improve the efficiency of the learning process and offer new opportunities for students and lecturers.

The digital transformation of higher education covers many areas, including integrating multimedia systems in the study process. This process refers to the use of digital technologies to enhance the learning experience by making it more interactive, accessible and effective. The integration of multimedia systems can include several aspects, including interactive classes, seminars and lectures on various collaborative platforms, interactive learning materials (e.g., interactive e-books, videos with 3D animations or simulations, virtual or augmented reality solutions), e-assignments and tests, automated assessment systems (data analysis and learning analytics). Also, multimedia systems can help universities to automate study administrative processes.

The aim of the study is to analyse the solutions for integrating multimedia systems in higher education, their potential for digital transformation of study courses and for increasing the efficiency of the study process.

The study used both qualitative and quantitative methods for data extraction and analysis. The study uses a case study approach - it evaluates the digitisation initiative of 12 distance and face-to-face bachelor level study courses of Turība University, integrating multimedia system solutions for asynchronous learning process into the course content and form. The case study analysis includes a student evaluation survey of the study courses through an online questionnaire, semi-structured interviews with course developers and lecturers, as well as document analysis.

As a result of the research, the authors conclude that the integration of multimedia systems in studying study courses provides additional support to students in strengthening their self-directed learning skills. At the same time, under the

influence of the digitalization of the study process, the space for both asynchronous and direct communication between lecturers and students, for the development of soft skills of students, as well as for the formation of practical knowledge and competences, increases the efficiency of the study process and the quality of education.

**Keywords:** *digital transformation, higher education, interactive study process, multimedia systems.*

## I. INTRODUCTION

Analyzing economic development processes and the main factors influencing them, the works of economic analysts of the second half of the 20th century refer to the knowledge economy, which has already become a generally accepted term for this period. However, nowadays, with the rapid and even revolutionary development of various technologies (and this is especially true of the digital environment), to adapt to fast changes, ensure competitiveness, and promote sustainable development, comprehensive or in-depth knowledge is no longer enough. At a time when new technologies are constantly being developed in various fields, which often have a very short life cycle, because more technological solutions are constantly being sought, previously acquired knowledge and skills to use them become obsolete rather quickly or become irrelevant. Therefore, to achieve greater efficiency, the ability to apply or interpret knowledge innovatively and creatively becomes more and more essential. Because of these processes, the economy of the 21st century is called the economy of innovation, thus emphasizing a new approach to the acquisition or use of knowledge. Although these two economic models often interact and are interrelated, their main difference is their emphasis on resources and activities, which are considered the main drivers of the economy. A knowledge economy views knowledge as a central element of economic development, while an innovation economy places more

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emphasis on the creation of new ideas and techniques and their commercialization to create economic value.

One of the most important concepts directly related to the innovation economy is digital transformation, whose impact is growing rapidly from year to year. As a concept, digital transformation envisages a significant transformation of an organization's operations and processes to create value by continuously implementing technologies on a large scale and thus creating competitive advantages, including reducing costs and improving the customer experience [1]. Researcher Gregory Vial also includes other processes in the definition of digital transformation: "Digital technologies create disruptions, triggering strategic responses from organizations that seek to alter their value creation paths while managing the structural changes and organizational barriers that affect the positive and negative outcomes of this process" [2].

Universities have traditionally been places where people acquire knowledge and develop themselves. However, digital transformation is changing this picture, offering new opportunities for both students and educational institutions themselves. This transformation process not only transforms teaching methodologies but also changes the way universities operate, making them more flexible, accessible, and efficient. The ever-increasing development of technology, the availability of the Internet, and the latest digital platforms have created new opportunities in the learning process. In addition, it should be taken into account that today's students are representatives of the digital generation, which is using technology on a daily basis. Thus, higher education institutions have to adapt to these new realities to maintain their importance and competitiveness in the educational market, and the main approach is the transformation of the learning process using the opportunities provided by digital technologies and the development of the digital learning space [3].

Digital transformation involves significant structural changes in four areas: organizational structure, organizational culture, leadership, and employee roles and skills. The digital transformation of higher education requires university leaders to create new and thoughtful partnerships throughout the institution to implement the transformation and involve all persons involved in the educational process to meet the needs of the university as a business unit, to quickly make informed decisions, balance risks and benefits, and broadly and rapidly implement innovations and improvements. Such an organizational culture should be aimed at all groups involved in the educational process that come into contact with each other—students, researchers, teaching staff, and other university employees—based on their knowledge and experience [4].

The implementation of digital transformation in universities brings many benefits. One of the most important is improving accessibility. With digital learning platforms and distance learning resources, students no longer need to be in person to participate in classes. This allows students to plan their time more flexibly and adapt their studies to their circumstances. In addition, digital technologies offer new teaching methods and tools that make learning more interactive and engaging; for example, virtual reality and simulations can help students better

understand complex issues or learn practice-oriented skills. However, digital transformation is not without its challenges. Even though new technologies offer opportunities for creativity and growth, one of the main problems is the need for significant financial investments to create and maintain modern digital infrastructures in universities or to integrate them into existing technologies. In addition, data security and privacy issues also need to be addressed, especially given that digital platforms can store large amounts of sensitive data and information about students. Likewise, resistance of staff and teaching staff to changes can be observed in practice, which can make it difficult to successfully integrate technology into the educational process [5].

One of the ways that organically fits into the digital transformation of the universities is the development of a multimedia environment and the use of its various channels and tools. They help adapt to the demands of today's technology, offer diverse learning experiences, and encourage student engagement. The role of multimedia in online course development has become a key factor in creating an engaging and effective learning experience. Positive factors associated with the use of multimedia in higher education:

- Enhanced Engagement and Retention: multimedia elements, such as videos, graphics, and interactive content, have a profound impact on student engagement and information retention. The combination of visual and auditory stimuli not only captures attention but also facilitates a deeper understanding of complex concepts. Engaged students are more likely to retain information and actively participate in discussions, creating a vibrant online learning community;

- Accessibility and Inclusivity: multimedia in online course design goes beyond text-based content, making educational materials accessible to diverse learners. Visual aids, for instance, benefit those with different learning preferences, and captioned videos ensure content accessibility for individuals with hearing impairments. Embracing multimedia promotes inclusivity and accommodates a wide range of learning styles, fostering an environment where every student can thrive;

- Real-world Applications: Integrating multimedia elements allows educators to bridge the gap between theoretical knowledge and real-world application. Videos, simulations, and case studies provide students with practical insights, enabling them to see how the concepts they learn in class are applied in professional settings. This approach not only enhances the relevance of the content but also prepares students for the challenges they may encounter in their future careers;

- Global Collaboration and Connectivity: Multimedia facilitates global collaboration by breaking down geographical barriers. Video conferencing, collaborative online projects, and multimedia-rich discussions enable students to connect with peers and experts from around the world. This interconnectedness not only broadens perspectives but also prepares students for a globalized workforce where effective communication and collaboration are essential skills;

- Adaptability and Personalization: multimedia supports the creation of adaptive and personalized learning

experiences. Through interactive quizzes, multimedia presentations, and self-paced modules, students can tailor their learning journey to their individual needs and preferences. This flexibility accommodates diverse learning paces and styles, empowering students to take control of their education [6].

Today, the inclusion of multimedia in the development of online courses in higher education is not only a trend but also a necessity, creating a dynamic, engaging, and inclusive learning environment. As educational institutions continue to embrace the digital environment, the transformative power of multimedia will play a central role in shaping the future of online education, facilitating rich and interactive educational experiences for students worldwide. It significantly changes the landscape of education, and keeping abreast of the current events of digital transformation helps higher education institutions operate efficiently, remain increasingly competitive in the digital world, and prepare students for the digital workplace.

## II. MATERIALS AND METHODS

This study is approached from the methodology of evaluation research. It is a research approach that integrates into the design of action research. Action research can be defined as collaborative critical inquiry by reflexive practitioners who are both evaluating their practice and engaged in problem solving and continuous professional development related to the research environment and its object [7]. One of the types of action research is evaluation research that involves assessing the effectiveness and achievement of a specific programme, policy, intervention, or project. It aims to determine whether the intended objectives have been successfully attained and identifies areas requiring enhancement. The data obtained through evaluation research provides valuable insights into the overall value of the initiative. These findings inform decisions regarding the continuation, modification, discontinuation, or enhancement of future interventions.

The evaluation study combines qualitative and quantitative research methods [7]. Qualitative interviews aim not only to obtain data on the implemented activities, but also on the actors' assessment of the intervention and its possible further development, modification and improvement [8]. The research participants are directly involved in the reflection on the evaluation. Consequently, the analysis of the data, in line with the nature of the action research, takes place in continuous interaction with the study participants. The design of the evaluation research is characterised by the involvement of potential users of the research output, with implications on the way in which findings are articulated and presented [9]. Quantitative methods can be used for baseline measurements to capture the situation before an intervention, such as the introduction of a new study course design, and after an intervention, to assess the impact of the implemented actions on the direct target groups, draw conclusions and make decisions on future actions.

The object of the authors' study is 12 bachelor level study courses and their digitisation process, which was implemented as a wider activity of the European Social Fund project "Digitisation initiatives for improving the

quality of studies in the areas of strategic specialisation of universities" (No 8.2.3.0/22/A/005). The digital transformation of study courses is evaluated as a key intervention in the framework of this study. The research environment is Turība University (Latvia) and the university's distance learning digital platform, the main target groups are lecturers and students of the specific study courses, as well as strategic experts in methodology and use of information technologies involved in the planning and implementation of the intervention. The study uses both qualitative and quantitative research methods in parallel: the analysis of secondary data from student surveys (n=87; n=46) before and after the intervention, qualitative interviews of lecturers involved in the project (n=8) and document analysis, analysing documents on the process of developing the digitisation methodology, guidelines for the structure, form and content of the developed study courses, documentation on the project implementation, which reflects the process of the intervention under study. The questions of the qualitative interviews with lecturers covered the following thematic blocks: evaluation of the course digitalisation process, use of methods in the digitised study process, impact on students' performance and lecturers' professional competence. Descriptive statistical methods were used in the analysis of quantitative data, while qualitative data and documents were analysed using thematic analysis.

## III. RESULTS AND DISCUSSION

The intervention involved the digital transformation of 10 distance learning courses of the Professional Bachelor's degree programme and the development of two new courses, which were planned to be developed both as face-to-face courses and as distance learning courses on the university's distance learning platform. The objectives of the digital transformation of study courses (defined as an intervention in the context of this study) were: first, to create model courses by developing guidelines and support materials for creating courses in a digital environment; second, to promote the use of interactive tools and multimedia systems in the creation of courses; third, to find technical and study process organisation solutions in order to introduce practices for the maximum use of these courses in the implementation of face-to-face study programmes; fourth, to develop and strengthen students' digital competences through the digitisation of the study process.

The 10 distance learning courses evaluated in this study had already been developed and implemented in the distance learning environment of the university before the intervention, but their design and the methods used in the asynchronous learning process were not appropriate for a modern learning process characterised by a shift from lecturer-facilitated learning to self-regulated and further to self-directed learning. Self-directed learning cuts across all domains of learning and has a significant potential in shaping transformational learning experiences. The students learn on their initiative and have primary responsibility for planning, implementing, and evaluating the effort. The content needs to be delivered through a teacher or a facilitator who communicates with the learner through face-to-face discussion, virtual online, or email posts. On the other hand, self-paced learning needs the learner to be motivated, oriented towards learning, and

competent to choose suitable resources for the required content [10].

To ensure that the study process in the digital environment can take place and that the goals and objectives of each study programme are achieved, the digital competences of students are an essential prerequisite. Prior to the implementation of the intervention, an initial assessment of students' digital competences in five categories – information and data literacy, communication and collaboration, digital content creation, digital safety and problem solving – was carried out. Within each category, several sub-categories were identified, making a total of 21 competences covered by the digital competences assessment. The questionnaire was uploaded to the university information system for those groups of students whose study programmes included one of the courses under development in the relevant semester (the questionnaire was distributed in September 2023). The survey was completed by students of the undergraduate programmes in Business Administration, Business Logistics Management and Marketing and Sales Management. The results obtained are not generalisable, as they are applicable to the survey population, given the method of conducting the survey (online questionnaire, voluntary). The results of the survey are presented in Figure 1. In all categories of digital competences, the level of the majority of students is average.

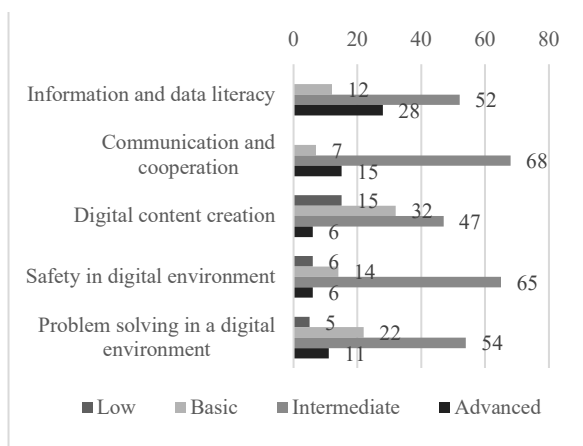


Fig. 1. Level of students' digital competences (n=87, %)

The intervention process was carried out in a series of sequential steps – preparation, development, implementation and initial impact assessment. The initial guidelines for course development were developed during the preparation phase, which included, firstly, guidance on the structure of the course content outline, secondly, methodological recommendations for the student assessment process both during the course and at the end of the course, thirdly, requirements for the inclusion of interactive tools and multimedia systems, fourthly, guidance on the development of digital competences for students. During the preparatory phase, lecturers' training sessions were also held, during which the thematic structure of the study courses, technical design, possibilities of using multimedia systems were jointly discussed. The data obtained from the interviews of the lecturers during the preparatory phase show that they had the greatest difficulty integrating interactive tools into the course content in order to ensure asynchronous communication with the students. To this end, training was

organised for lecturers on the Html-5-Package (H5P) tool and its possibilities of use. H5P is a plug-in tool designed for the creation of a wide variety of interactive content.

During the course development phase, lecturers reviewed the existing course content and updated the reading material, supplementing it with visual material, prepared video lecture presentations following a common design, filmed and then technically processed and edited video lectures, integrating interactive tasks, developed self-assessment tasks and tests to be carried out during the study course, using interactive tools and methods where possible, instructions for taking the tests, as well as references for additional resources to be used. The material prepared by the lecturers was passed on to the technical staff, who uploaded the material to the university's moodle environment. Throughout the course development phase, both methodological and technical support was provided to the lecturers. The most support was needed for the inclusion of H5P tools in the course of study, which was new for most of the lecturers and created a need to acquire new digital and methodological competences. The final activity of the development phase was to carry out a quality check of each study course at two levels. This was first carried out by the lecturer and then by a strategic expert in course development. For the purpose of the quality check, a course development checklist was prepared covering all components of the course.

The structure of the distance learning courses was the same for all courses - introduction, course content outlined in thematic blocks, self-testing tasks, current and final examinations. As already indicated above, the outline of each topic required the integration of H5P tools, with the aim of ensuring as interactive as possible asynchronous study process on the one hand and creating favourable conditions for an effective self-directed study process in a digital environment on the other hand. In the introductory part of the study course, the lecturer's task is to provide information on the aim, objectives, thematic plan, assessment criteria and recommendations for the learning of the course. This information should be included in the distance learning learning environment (moodle) in written and video format. In order to create the effect of the lecturer's presence and interaction between the lecturer and the student, a video introduction of the lecturer was prepared, lasting up to five minutes, in which the lecturer introduces himself/herself and verbally presents all the information related to the study course. The introductory part of the course also includes a glossary of commonly used terms and concepts, which allows the student to clarify or recall the meaning of a particular term at any point during the course. The content of the course was structured in thematic blocks, while the presentation of each topic was organised according to a common structure. At the beginning of the topic, the student is presented with the competences to be acquired according to the cognitive skills assessment categories of Bloom's taxonomy [11] and the digital competences according to levels 5-6 of the DigComp 2.1 framework [12].

Each topic is first presented by the lecturer in a video lecture, which integrates interactive tools and a lecture presentation based on a common, pre-defined design. The total duration of the video lectures per course was initially set at six academic hours or 270 minutes. Following the development of the courses, this criterion was modified to

define the total duration of the video material to include both the delivery of the lecture and other video material that complements the learning of the course content.

The purpose of using H5P tools in the presentation of course content is to ensure interactivity between the lecturer and students, as well as to create dynamic and varied learning of course content. All lecture presentations in the moodle environment were included in the H5P format. In each video lecture the lecturers included a number of interactive questions that the learner has to answer before continuing to listen to the video lecture. After each such question, the lecturer also included feedback on the answers to the questions in the video lecture, allowing the learner to self-assess his/her performance and to re-listen to the previously presented material as needed. In each course, the lecturer was required to include at least one branching scenario as one of the practical activities. The branching scenarios are learning opportunities that depend on the choices made by the students. They require the user to make decisions and then reflect the consequences of the action taken. For example, in the course Research “Methods and Presentation Skills”, a branching scenario task was to identify the steps to be taken in a study to find out students' satisfaction with a university parking service. In the course “Record-keeping”, the objective of the branching scenario was to follow the correct sequence of steps for filing an electronically signed appeal with the court.

Each video lecture is accompanied by reading material in text form with visualisations (images, diagrams, etc.) prepared by the lecturer. In addition to this compulsory material, the lecturer also provides guidance on additional resources for learning the topic, e.g. literature, websites, broadcasts, videos, etc. In several courses, lecturers supplemented the content with interviews with industry experts, managers of real companies, thus creating synergies between theory and practice. In face-to-face studies, this function is performed by the lecturer or guest lecturers, so video interviews with invited experts are seen by lecturers as a way to ensure this in an asynchronous study process.

At the end of the topic, the student is given the opportunity to complete self-assessment exercises, which are not graded, but which allow students to monitor their own progress in the topic and to be aware of the need to revise the topic or any issues related to it. In designing the self-assessment tasks, the lecturers' responsibility was to design them in such a way that they required the student to apply digital competences in order to develop or acquire new ones. For example, in the course “Project Management”, the assignment was to review the Project Management Institute website, select from the “Case Studies” section an article of interest to the student on the application of project management methodology to a real business problem and prepare a short presentation with video commentary on the main information and the student's opinion on the article.

According to the lecturers' interview results, within the study course digitisation process they had improved their digital skills in asynchronous communication, learned new technology-based teaching methods, and overcome psychological barriers when delivering video lectures.

Those lecturers who had already added digital content to the face-to-face learning process during the intervention emphasised in interviews that this approach allows them to focus on practical tasks in the classroom, observe students in action and develop such students' skills as debating, collaboration, argumentation, problem-solving and conflict resolution, critical and creative thinking and others.

In order to obtain students' evaluation of the developed distance learning courses, an evaluation questionnaire was included at the end of each course with four closed-ended questions and answer options according to a five-point Likert scale and one open-ended question. The questionnaire included the following indicators: the comprehensibility of the course presentation, the format of the course presentation, the usefulness of the supplementary materials offered (podcasts, interviews, additional reading, etc.), the overall quality of the course and recommendations for further development of the course. The overall results of the survey in absolute figures are summarised in Table 1. The course evaluations provided so far (n=46) show that the majority of students' evaluations fall into the positive categories, i.e. 42 students rated the readability of the course presentation as rather or very good, 42 students indicated that the format of the course presentation was rather or very interesting, 41 informant indicated that the supplementary material was rather or very useful for learning the course content and 44 students rated the overall course quality as excellent or outstanding.

TABLE 1. STUDENTS' EVALUATION OF DISTANCE LEARNING COURSES (N=46, COUNT)

Indicator/ Survey question	1	2	3	4	5
How do you rate the <b>comprehensibility</b> of the course outline on a scale from 1 to 5, where 1 means the course outline is very difficult to comprehend, 5 – the course outline is very well comprehensible?	2	0	2	19	23
How do you evaluate the <b>format of the course outline</b> on a scale from 1 to 5, where 1 means the course outline is very monotonous, 5 means the course outline is very interesting?	2	0	2	21	21
To what extent did you find the <b>additional materials</b> offered, such as podcasts, interviews, additional literature, etc., useful for the study of the course?	2	2	1	17	24
Please evaluate the <b>overall quality</b> of this distance learning course on a scale of 1 to 5, where 1 is poor and 5 is excellent.	1	0	1	18	26

Analysing the students' recommendations, three thematic groups of suggestions can be identified: firstly, to improve the other distance learning courses on the model of the improved and newly developed courses, and to supplement the face-to-face courses with moodle-based content; secondly, to add subtitles to the video lectures; and thirdly, to provide more practical examples on the topic.

In order to assess the changes in the level of digital competences of the students after the completion of the improved and newly developed courses, a reassessment of the students' digital competences was carried out (re-survey

in December 2023). According to the results, 22% of students increased their information and data literacy competence by at least one level (e.g. from low to basic or from basic to intermediate), 17% – their communication and collaboration competence, 39% – their digital content creation competence, 26% – their digital security competence and the same proportion increased their competence in using digital technologies to solve problems.

Through an integrated analysis of the results of the student evaluations and the qualitative interviews with lecturers, a number of insights can be put forward for discussion. The role of the lecturer in the learning process is changing with the digitalisation of higher education and the increasing shift towards self-regulated learning. The lecturer is no longer just a knowledge transmission agent, but also a visionary, coach, mentor and cognitive guide. It is no longer enough to know a specific area of knowledge, a course of study. The lecturer must have the competences to transfer and create new knowledge in a way that is engaging for the student of the digital age. The learning process must be dynamic, practical, technological, open and collaborative in order to mitigate the risk of social skills weaknesses, social communication competences. The model courses developed serve as a basis for integrating digital learning materials and activities into face-to-face studies.

Teaching and learning have changed significantly in the last five years as a result of various external environmental factors and the entry of new generations into the education space. The university is no longer just a geographically defined place; its physical boundaries are no longer strictly defined. The diversity of digital and technical infrastructures increases the accessibility of higher education and creates new forms of learning. However, as the lecturers interviewed in the study acknowledged, the digital transformation of education, along with the development of generative artificial intelligence, also poses risks and challenges. The main risks are seen as the weakness of qualitative thinking (which includes analytical, critical and creative thinking) and social skills.

In order to use the full potential of the diversity of environments, contents and forms of modern higher education, the intervention analysed in this study has led to a decision to increasingly combine face-to-face learning with digital tools for self-directed learning environments, providing access to distance learning course materials to students studying on the programme in a face-to-face mode. In turn, face-to-face workshops should be organised for distance learning students.

#### IV. CONCLUSIONS

The digital transformation of higher education is a process that involves the adaptation of educational institutions to the digital environment using information and communication technologies. This process includes both technological infrastructure development as well as pedagogical and administrative practices to improve the effectiveness and efficiency of educational processes. The digital transformation of higher education is essential to shape the education system according to today's requirements and opportunities, as well as to ensure better learning experiences and results for students.

Multimedia in higher education refers to the integration of various forms of media such as text, images, audio, video, animations, and interactive elements into the teaching and learning process. This approach aims to enhance the educational experience by catering to diverse learning styles, promoting engagement, and facilitating deeper understanding of complex concepts. Multimedia enriches the teaching and learning experience in higher education by providing diverse and interactive ways to engage with course materials, fostering deeper understanding, and catering to the needs of a diverse student population.

The intervention has strengthened digital capacity in existing and new study courses and ensured piloting of the integration of the new digital solutions in distance and face-to-face studies. The developed study courses serve not only as a prototype for the development of distance learning study courses, but also for the integration of digital learning materials and activities in face-to-face studies.

The digitalisation of the study process and the inclusion of multimedia systems in the study courses expand the space for asynchronous and direct communication between lecturers and students, the development of students' social and general competences, as well as the development of practical knowledge and skills, increasing the efficiency of the study process and the quality of higher education.

In the digital transformation of higher education, the role of the lecturer is also changing with the diversification of the content and form of studies. The lecturer becomes a support for self-directed learning and builds horizontal partnership relations with students in the study process. The study supports the assumption that the integration of multimedia systems in the learning process provides additional support for students in strengthening their self-directed learning skills and digital competences. This assumption needs to be further examined in future research on the impact of digitisation of the study process on students' academic, social and digital performance.

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