DETERMINING THE DEGREE OF DIGITALIZATION OF A HIGHER EDUCATION INSTITUTION

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Abstract. The digitalization of education institutions has become increasingly important in the modern era, where technology plays a vital role in teaching, learning, and administrative processes. This article aims to explore and present a framework for determining the degree of digitalization within (higher) education institutions, considering both quality and quantity factors. By analysing various factors such as infrastructure, curriculum integration, digital tools and resources, student engagement, administrative systems, as well as the scale and depth of digital implementation, this study provides a comprehensive approach to assess the level of digital transformation. Additionally, the article discusses the potential benefits and challenges associated with digitalization, emphasizing the need for strategic planning and implementation to ensure effective integration of technology in educational settings. The findings of this research contribute to a deeper understanding of the digitalization process in (higher) education institutions, considering both the quality and quantity aspects, and provide valuable insights for educators, administrators, and policymakers seeking to enhance and optimize digital learning environments.

Keywords: higher education; evaluation; digitalization; framework; quality and quantity aspects; digitalization process

1. Introduction

In today's rapidly evolving technological landscape, digitalization has emerged as a transformative force across various sectors, including education. The integration of digital technologies and resources in educational institutions has the potential to revolutionize teaching and learning methodologies, enhance student engagement, and improve administrative processes. The digitalization of education refers to the comprehensive adoption and utilization of digital tools, platforms, and approaches to enhance the educational experience.

The background and significance of digitalization in education lie in its ability to address the evolving needs and expectations of learners in the digital age. With the proliferation of smartphones, tablets, and internet connectivity, students are increasingly exposed to digital devices and interactive online platforms outside the classroom. As a result, there is a growing demand for educational institutions to incorporate technology seamlessly into the learning environment to bridge the gap between traditional instruction and the digital experiences students encounter in their daily lives.

Digitalization in education offers numerous advantages. It provides learners with access to a vast array of educational resources, facilitates personalized learning experiences, and fosters collaboration among students and educators. By leveraging digital tools, educational institutions can transcend geographical boundaries, enabling remote learning opportunities and expanding access to education for marginalized populations. Moreover, digitalization empowers educators to employ innovative teaching methods, leverage data-driven insights to tailor instruction, and engage students through interactive multimedia content.

The significance of determining the degree of digitalization in education institutions lies in its potential to guide strategic decision-making and resource allocation. By assessing the current state of digitalization, educational leaders can identify strengths, weaknesses, and areas for improvement. This evaluation enables institutions to set goals, develop targeted interventions, and allocate resources effectively to enhance the overall digital learning environment.

Additionally, understanding the degree of digitalization within education institutions provides valuable insights for policymakers, researchers, and education stakeholders (Atanasov & Ivanova 2022). It helps inform policy initiatives, funding allocation, and the design of professional development programs to support educators in effectively integrating technology into their instructional practices. Furthermore, studying the impact of digitalization in education contributes to the broader research discourse on effective educational practices and informs evidence-based strategies for future educational reforms.

Considering the growing significance of digitalization in education, this article aims to explore and present a framework for determining the degree of digitalization within (higher) education institutions. By examining various factors and indicators, we seek to provide a comprehensive assessment tool that can guide educational leaders in enhancing and optimizing the digital learning environment. Through this research, we hope to contribute to the ongoing efforts to create a future-ready education system that harnesses the power of digital technologies to empower learners and prepare them for the challenges and opportunities of the digital age.

2. University of Ruse – leading the digitalization revolution in higher education

The system for determining the degree of digitalization of a (higher) education institution has been developed by the University of Ruse, a leading institution in the field of educational innovation. Recognizing the importance of digital transformation in education, the University of Ruse has taken proactive steps to create a comprehensive assessment framework that evaluates the level of digitalization within the institution.

Drawing on the expertise of its faculty members and research teams, the University of Ruse has designed a systematic approach to assess the digitization degree of the institution. This approach encompasses various factors and indicators that are crucial in determining the level of digital integration and effectiveness of digital tools and practices.

The University of Ruse has dedicated significant resources to ensure the successful implementation and utilization of the assessment framework. The system has been integrated into the institution's administrative processes and is actively used to monitor and enhance the digitization efforts across departments, faculties, and administrative units.

Through the utilization of the system, the University of Ruse has gained valuable insights into the institution's digital readiness, identified areas for improvement, and made informed decisions to enhance the digital learning environment. The assessment framework has served as a guide for strategic planning, resource allocation, and the development of targeted initiatives aimed at enhancing digital integration in teaching, learning, and administrative processes.

By leveraging the system for determining the degree of digitalization, the University of Ruse has positioned itself as a pioneer in digital transformation within the higher education sector. The institution serves as a model for other educational institutions seeking to assess and enhance their digitization efforts. The successful implementation of the system at the University of Ruse showcases the institution's commitment to staying at the forefront of educational innovation and providing a digitally enabled learning environment for its students and faculty.

As digitalization continues to shape the landscape of higher education, the University of Ruse remains dedicated to further refining and advancing its assessment framework. Through ongoing research, collaboration, and the integration of emerging technologies, the university strives to continuously improve the system and contribute to the broader knowledge and practice of determining and enhancing the degree of digitalization in (higher) education institutions.

The University of Ruse has embraced the future of education by establishing a dedicated Future Education Space as part of its digitalization efforts (Beloev et al. 2020). This innovative space serves as a hub for exploring and implementing cutting-edge technologies and pedagogical approaches to enhance the learning

experience. The Future Education Space provides students and faculty with a collaborative environment where they can experiment with emerging technologies, such as virtual reality, augmented reality, and artificial intelligence, to transform traditional teaching and learning practices. By integrating this space into its digitalization strategy, the university demonstrates its commitment to preparing students for the challenges and opportunities of the digital age.

Scan the QR code to "enter" the Future Education Space

Figure 1. Future Education Space in University of Ruse

3. Digitalization in education institutions: key concepts and factors

In the context of education, digitalization refers to the comprehensive adoption and integration of digital technologies, tools, and resources to enhance teaching, learning, and administrative processes (Deroncele-Acosta 2023; Frolova 2020). It involves leveraging digital platforms, software applications, online resources, and communication tools to transform traditional educational practices and create a dynamic and interactive learning environment.

Digitalization goes beyond the mere incorporation of technology into classrooms (Chavdarova-Kostova 2016). It encompasses a holistic approach that embraces technological advancements to improve the overall educational experience. This includes reimagining instructional strategies, curriculum design, and assessment methods to align with digital tools and resources. It also entails optimizing administrative systems and processes by leveraging technology to streamline tasks, enhance communication, and facilitate data-driven decision-making.

At its core, digitalization aims to empower learners and educators by providing access to a wide array of digital resources, fostering collaboration and engagement, and promoting personalized learning experiences (Doncheva 2017). It enables educators to leverage multimedia content, interactive simulations, virtual laboratories, and adaptive learning platforms to cater to diverse learning styles and individual needs. Digitalization also expands access to education by breaking down geographical barriers, enabling remote learning, and reaching underserved populations.

Furthermore, digitalization in education promotes digital literacy skills among learners, preparing them for the demands of the digital age (Shoilekova 2021). It cultivates critical thinking, problem-solving, digital citizenship, and information literacy skills necessary to navigate the digital landscape responsibly. Digitalization also offers opportunities for lifelong learning, professional development, and continuous upskilling for educators, enabling them to adapt to evolving pedagogical approaches and technological advancements.

Digitalization in education institutions encompasses a range of key concepts and factors that shape the integration of technology in teaching, learning, and administrative processes (Gaftandzhieva 2020; Siemens 2005). Understanding these concepts and factors is essential for assessing the degree of digitalization within educational settings. In this section, we will delve into the key concepts and factors that drive digitalization in education institutions.

Infrastructure and Technological Capabilities

A robust technological infrastructure forms the foundation for effective digitalization in education. This includes reliable network connectivity, adequate hardware such as computers or mobile devices, and access to necessary software and applications. The availability of high-speed internet, secure data storage, and IT support are crucial components of a well-established infrastructure.

Curriculum Integration and Instructional Design

Integrating digital technologies seamlessly into the curriculum and instructional design is vital for meaningful digitalization. This involves aligning learning objectives with digital tools and resources, designing interactive and engaging learning experiences, and promoting digital literacy among both educators and students. The effective integration of technology enables the creation of multimedia content, collaborative projects, and online assessments that enhance student engagement and understanding.

Availability and Utilization of Digital Tools and Resources

The availability and utilization of a diverse range of digital tools and resources play a significant role in the degree of digitalization. These can include learning management systems (LMS), educational software, online databases, virtual reality (VR) and augmented reality (AR) applications, digital libraries, and open educational resources (OER). The accessibility, quality, and relevance of these resources are crucial for supporting a digitally rich learning environment.

Student Engagement and Digital Learning Experiences

Engaging students in digital learning experiences is a pivotal aspect of digitalization in education. This involves creating interactive and immersive learning opportunities that foster collaboration, critical thinking, and problem-solving skills. Engaging digital learning experiences can be achieved through gamification, virtual simulations, online discussions, and personalized adaptive learning platforms.

Administrative Systems and Processes

Digitalization extends beyond the classroom to encompass administrative systems and processes within educational institutions. This includes digital record-keeping, online registration, electronic grading systems, automated communication channels, and data-driven decision-making processes. Streamlining administrative tasks through digital platforms enhances efficiency, accuracy, and transparency.

Quality and Quantity Factors in Digitalization

Assessing the degree of digitalization requires considering both quality and quantity factors (Gafurov 2020; Dar 2018). Quality factors involve the effectiveness and impact of digital technologies on teaching and learning outcomes. This includes evaluating the pedagogical approaches used, the alignment with curriculum standards, and the level of student engagement. Quantity factors encompass the scale and depth of digital implementation, such as the extent of technology integration across courses, the breadth of available digital resources, and the overall reach of digitalization efforts within the institution.

Understanding these key concepts and factors provides a comprehensive framework for evaluating the degree of digitalization within education institutions. By examining these factors, educational leaders can identify areas of strength, areas in need of improvement, and develop targeted strategies to enhance digital integration. In the following section, we will present a framework for determining the degree of digitalization, utilizing these key concepts and factors as foundational elements.

4. Framework for determining the degree of digitalization
4.1. Development of a comprehensive assessment framework

To effectively determine the degree of digitalization within (higher) education institutions, the development of a comprehensive assessment framework is essential. Such a framework provides a structured approach to evaluate the various dimensions of digital integration and helps educational leaders gain insights into

the strengths and areas for improvement within their institutions. In this section, we will explore the key components involved in the development of a comprehensive assessment framework.

Defining Assessment Objectives

The first step in developing an assessment framework is to clearly define the objectives. What aspects of digitalization do you want to evaluate? Is the focus on infrastructure, curriculum integration, student engagement, administrative systems, or a combination of these factors? Clearly outlining the assessment objectives will help guide the subsequent stages of framework development.

Identifying Key Indicators and Metrics

Once the objectives are defined, the next step is to identify the key indicators and metrics that will be used to assess the degree of digitalization. These indicators can be both qualitative and quantitative and should align with the specific objectives of the assessment. Examples of indicators include the availability of digital resources, the integration of technology into the curriculum, student satisfaction with digital learning experiences, and the efficiency of administrative processes through technology adoption.

Designing Assessment Tools and Methods

After identifying the indicators, the assessment framework needs to define the tools and methods for data collection. This may involve surveys, interviews, focus groups, classroom observations, analysis of institutional data, or a combination of these approaches. The assessment tools should be designed to gather reliable and valid data that can effectively measure the identified indicators and metrics.

Developing a Scoring or Rating System

To quantify the degree of digitalization, it is often useful to develop a scoring or rating system. This system assigns weights or scores to different indicators based on their relative importance. This allows for the calculation of an overall score or rating that reflects the level of digitalization within the institution. The scoring system should be transparent, consistent, and align with the assessment objectives and indicators.

Piloting and Refining the Framework

Before implementing the assessment framework across the institution, it is advisable to pilot it in a smaller sample or pilot group. This allows for testing the effectiveness and feasibility of the framework and identifying any potential issues or areas for improvement. Based on the pilot findings, the framework can be refined and adjusted to ensure its reliability and validity.

4.2. Factors and indicators considered in the framework

The assessment framework for determining the degree of digitalization within (higher) education institutions consider a range of factors and indicators that reflect the comprehensive nature of digital integration. These factors and indicators provide a holistic view of the institution's digitalization efforts and enable a thorough evaluation of its progress and effectiveness.

Integral quantitative indicator of digitalization degree

The table below presents the Integral Quantitative Indicator (IQI) for assessing the degree of digitalization within (higher) education institutions. The IQI is a comprehensive measure that combines various factors and indicators to provide an overall quantitative assessment of digital integration efforts.

This Integral Quantitative Indicator provides a numerical value that represents the degree of digitalization within the (higher) education institution. A higher IQI score indicates a higher level of digital integration and readiness, while a lower score suggests areas for improvement and further development. The IQI serves as a valuable tool for educational leaders to monitor progress, benchmark against industry standards, and prioritize strategic initiatives to enhance digitalization efforts.

INTEGRAL QUANTITATIVE INDICATOR
OF DIGITALIZATION DEGREE

№	QUANTITATIVE INDICATOR / 100	VALUE
1.	Percentage of the university territory covered by WiFi.	
2.	Percentage of the lecturers meeting the criteria of the European Digital Competence Framework for Trainers.	
3.	Percentage of the lecturers covering level A1 (Newcomer), A2 (Explorer), B1 (Integrator), B2 (Expert) C1 (Leader), C2 (Pioneer).	
4.	Percentage of the lecturers having university computers with microphone and camera.	
5.	Percentage of the lecturers having personal computers with microphone and camera.	
6.	Percentage of the lecturers who having internet connection at home.	
7.	Percentage of the students having personal computers with a microphone and camera.	
8.	Percentage of the students having internet connection at home.	
9.	Percentage of the lecturers having a profile in a system for automatic citations registration.	
10.	Percentage of the classrooms equipped with interactive presentation systems (IPS).	
11.	Percentage of the lecturers trained how to use IPS.	
12.	Percentage of the lecturers using IPS in their lectures and workshops.	
13.	Percentage of the lecturers who create and use digital resources in their lectures and workshops.	
14.	Percentage of the lecturers trained to use an asynchronous distance learning system.	
15.	Percentage of web-based courses.	
16.	Percentage of web-based courses with video lectures.	
17.	Percentage of interactive multimedia teaching materials.	
18.	Percentage of virtual labs *.	
19.	Percentage of the students using e-learning resources.	
20.	Percentage of the lecturers trained to use a synchronous distance learning system.	
21.	Percentage of the lecturers maintaining regular contacts with their students in social networks.	
	ABSOLUTE VALUE (TOTAL):	
	RELATIVE VALUE = (ABSOLUTE VALUE) / n :	

Notes:
1. The Indicators marked with (*) are mandatory only for the higher schools with engineering majors.
2. **n** is the number of indicators valid for the accredited higher education institution.

Figure 2. Quantitative indicator of digitalization degree

Integral qualitative indicator of digitalization degree

The table below presents the Integral Qualitative Indicator (IQI) for assessing the degree of digitalization within (higher) education institutions. The IQI is a comprehensive measure that considers qualitative aspects and expert judgments to provide an overall assessment of the institution's digital integration efforts.

In this IQI assessment, each factor and its corresponding indicator have been qualitatively evaluated by experts based on their knowledge and understanding of the institution's digitalization efforts.

№	QUALITATIVE INDICATOR	YES	NO
1.	Does the university have a Centre for Information and Computer Services?		
2.	Does the speed of the university's connection to the Internet enough?		
3.	Does the university apply cloud technologies?		
4.	Does the university have a website?		
5.	Is the web site protected against cyber-attacks?		
6.	Is the web site dynamic?		
7.	Is the web site navigation intuitive?		
8.	Is the web site informative and attractive?		
9.	Does the university web site offer basic administrative services online		
10.	Is personal data on the website protected?		
11.	Does the university have a "Students" information system?		
12.	Does the university have a "PhD Students" information system?		
13.	Does the university have a "Teachers" information system?		
14.	Does the university have an "Alumni" information system?		
15.	Does the university have a "Publications" information system?		
16.	Does the university have an anti-plagiarism system?		
17.	Does the university have a Centre of Innovative Educational Technologies?		
18.	Is there a research team at the university working in the field of innovative educational technologies?		
19.	Are interactive tables used at the university?		
20.	Are interactive information boards used at the university?		
21.	Does the university have a Distance Learning Centre?		
22.	Does the university have a system for asynchronous distance learning?		
23.	Does the university exchange e-learning resources with other universities?		
24.	Does the university offer massive open online courses?		
25.	Are the e-learning resources of the university reachable through different devices?		
26.	Does the university have a system for synchronous distance learning?		
27.	Are the ADL and SDL systems integrated?		
28.	Does the university use blended learning?		
29.	Does the university use CAD systems? *		
30.	Are 3D scanners and 3D printers used at the university? *		
31.	Does the university use augmented, virtual and mixed reality?		
32.	Are robots used at the university?		
33.	Is artificial intelligence used/studied at the university?		
34.	Does the University use Internet of Things?		
35.	Does the University use Internet of Everything?		
36.	Is the university present in social networks?		
37.	Does the university use innovative educational technologies in the education of students with special educational needs?		
38.	Is the use of ICT-based innovative educational technologies taken into account in the attestation of teachers?		
39.	Does the university have a long-term plan for digital transformation?		
TOTAL:		?? YES	?? NO

Note:
1. The Indicators marked with (*) are mandatory only for the higher schools with engineering

Figure 3. Qualitative indicator of digitalization degree

The qualitative factors in the assessment are evaluated based on whether certain criteria are met, resulting in a "yes" or "no" determination. This simplifies the evaluation process, provides a straightforward indication of the presence or absence of specific criteria and provides a basis for targeted improvement strategies. Assessment focuses on the presence or absence of key qualitative factors related to digitalization.

5. Benefits and challenges of digitalization in education

Digitalization has brought about transformative changes in the field of education, offering both significant benefits and unique challenges. Understanding these advantages and obstacles is crucial for educational institutions and stakeholders as they navigate the digital landscape. Here are some key benefits and challenges associated with digitalization in education:

5.1. Benefits

Enhanced Access to Education: Digitalization has expanded access to education by breaking down geographical barriers. Online learning platforms and resources allow students to participate in courses and programs regardless of their physical location, making education more inclusive and accessible.

Personalized Learning. Digital tools and adaptive learning platforms enable personalized learning experiences tailored to individual student needs. Through intelligent algorithms and data analysis, students can receive customized content, pace their learning, and receive targeted feedback, promoting better engagement and academic success.

Rich Multimedia Resources. Digitalization has enriched learning materials with multimedia resources such as videos, simulations, and interactive content. These resources enhance understanding, engagement, and retention, making the learning process more dynamic and immersive.

Collaboration and Global Connections. Digital tools facilitate collaboration among students and educators, fostering connections beyond the classroom. Online platforms enable virtual teamwork, global discussions, and cross-cultural exchanges, preparing students for a globally interconnected world.

Efficient Administrative Processes. Digitalization streamlines administrative tasks, reducing paperwork and automating processes such as registration, grading, and reporting. This improves efficiency, reduces administrative burdens, and allows educators to focus more on teaching and student support.

5.2. Challenges

Technological Barriers. Unequal access to technology and reliable internet connectivity can create a digital divide, limiting the benefits of digitalization.

Digital Literacy Skills: Digitalization requires students and educators to possess adequate digital literacy skills.

Pedagogical Adaptation. Integrating digital technologies into teaching practices requires a shift in pedagogical approaches. Educators need training and support to

adapt instructional strategies, create engaging online learning environments, and effectively integrate digital tools into the curriculum.

Data Privacy and Security. The use of digital platforms and online resources raises concerns about data privacy and security. Educational institutions must prioritize the protection of sensitive student information and ensure compliance with relevant data protection regulations.

Continuous Technological Advancements. Rapid advancements in technology necessitate continuous adaptation and professional development for educators. Staying updated with new tools, platforms, and instructional methodologies can be a challenge, requiring ongoing training and resources.

Recognizing the benefits and challenges of digitalization in education allows educational institutions to harness its full potential while addressing potential drawbacks. By embracing digitalization strategically and thoughtfully, educational stakeholders can maximize the benefits, overcome challenges, and create inclusive, engaging, and effective learning environments for all learners.

6. Conclusion

The digitalization of (higher) education institutions hold immense potential for transforming the learning landscape and improving educational outcomes. The benefits of digitalization, such as enhanced access, personalized learning, rich multimedia resources, collaboration, and streamlined administrative processes, are evident. However, challenges related to technological barriers, digital literacy skills, pedagogical adaptation, data privacy, and continuous technological advancements must be addressed to ensure equitable and effective digital integration.

To determine and enhance the degree of digitalization in (higher) education institutions, it is crucial to develop comprehensive assessment frameworks that consider both qualitative and quantitative factors. These frameworks should encompass various aspects such as infrastructure, curriculum integration, availability of digital tools and resources, student engagement, administrative systems, and quality factors. By evaluating these factors, educational leaders can gain insights into the institution's digital readiness, identify areas for improvement, and make informed decisions to enhance the digital learning environment.

Recommendations for future research and practice

Further research is needed to explore the impact of digitalization on student learning outcomes and academic achievement. Longitudinal studies can provide valuable insights into the effectiveness of digital tools, instructional practices, and their correlation with student success. The development of standardized digital literacy frameworks and competency-based assessments can help educational institutions ensure that students and educators possess the necessary skills for effective digital integration.

Investigating the potential of emerging technologies such as artificial intelligence, virtual reality, and augmented reality in enhancing digitalization efforts.

Understanding their applicability, benefits, and challenges can guide institutions in adopting these technologies strategically. Continual research and evaluation are required to identify best practices for integrating digital tools and resources across various disciplines and educational levels. Case studies and collaborative research efforts can provide valuable insights into successful implementation strategies.

Strengthening data privacy and security measures to protect student information and ensure compliance with relevant regulations. Research on effective data governance and ethical considerations in the digitalized education landscape is vital. Fostering partnerships between academia, industry, and government agencies to leverage resources, expertise, and funding for digitalization initiatives. Collaborative efforts can facilitate innovation, resource-sharing, and the development of effective policies and practices.

Promoting professional development programs and training opportunities for educators to enhance their digital literacy skills and pedagogical competencies. Providing ongoing support and resources can empower educators to effectively integrate digital tools and instructional strategies into their teaching practices.

Addressing these research areas and implementing the recommendations, (higher) education institutions can advance their digitalization efforts and create dynamic, inclusive, and student-cantered learning environments. The continuous enhancement of digitalization practices will contribute to the holistic development of learners, preparing them for the digital age and enabling them to thrive in a rapidly evolving world.

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