

The Impact of Education Management Digitalisation on the Quality of Student Learning

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ABSTRACT The study presents an analysis of the educational process model based on a web application for creating a custom work schedule by adding individual events or modules. The study focuses on the distance learning process that took place in 2021 and involved 358 students from the first and fourth years of three universities in the Republic of Kazakhstan. Participants were interviewed about their readiness to learn using digital management tools, their average annual academic performance was analyzed, and their assessment of the importance of the resources they allocate to achieving learning outcomes using digital management was studied. The study found that there were no significant differences in the understanding of key aspects of educational service quality and the impact of digital management on learning between first- and fourth-year students with different levels of performance. The results of the study can be utilized to develop proprietary models for digitalizing education management, creating additional modules to automate educational activities, and introducing new tools to enhance digital interaction capabilities.

KEYWORDS student learning; digitalization; educational services; education management; quality of education.

I. INTRODUCTION

A contemporary university is considered a social system using big data and other technologies of the Industry 4.0 revolution applied for digitalization in a university structure, teaching process, and project activity [1-3]. Digitalization in education creates a capable system to ensure high-quality training of the specialists, demanded both by business and society, appreciating the principles of sustainable development, minimization of environmental damage and the use of such education technologies as modelling, augmented and virtual realities [4, 5].

In this work, digitalization refers to the conversion of information related to the organization and execution of the educational process into digital form [6]. The key roles in this system have instructors and students [7]. Teachers' use of technology affects the quality of students' teaching [8]. Along with developing and implementing digitalization of the educational process, it is essential to monitor the students and educational process qualities, identify existing learning problems, and their solving.

Researchers have previously examined the processes of

education management digitalization, which enables the enhancement of academic management quality and the elevation of education seekers' proficiency [9-11]. The educational service consistently evolves and improves [12]. Therefore, a new paradigm for digital technology development is their introduction into the educational system [13-15], which contributes to improving the quality of current student learning by expanding the information and educational environment and ensuring its accessibility [16, 17]. Industry 4.0 trends require adequate adaptation of the education industry, which must be aimed at training high-quality human resources [3, 18, 19]. In this case, digitalization is not just a trend of the time but an effective tool that allows for the improvement of knowledge through proper organization and management [20].

Considering the above, the study aims to research the impact of digitalization through the prism of the perception of digital innovations by students of higher educational institutions (HEIs) to further the digital transformation of education quality.

- Examine existing educational process models using digital tools that impact the quality of the educational

process.

- Determine students' readiness for digital education management by analyzing the implemented education digitalization model.

II. LITERATURE REVIEW

In this work, digitalizing the educational process means implementing modern information and communication technologies (ICT) in all areas of its realization. Integrating online learning, didactics, and education management within an HEI is an essential component of the digitalization process in education. It facilitates optimizing educational activities to attain the highest possible positive outcomes. In educational activities, digitalization is sometimes viewed as an optimization of the educational process [21] or as a tool for managing and marketing [22]. Considering digitalization as a process and a tool creates confusion in understanding the object of the final impact. According to the model [13], digitalization is considered a technology that enables students in the educational process to acquire key competencies. This viewpoint is supported by other researchers [14, 23] who focus on digital leadership while taking into account the requirements of Industry 4.0. Such a point of view allows for distinguishing between digitalisation and digital transformation as a transition from one to the other.

The possibility of implementing this view is confirmed by the following: the education management digitalization is considered a multi-level, step-by-step process [24] that involves the introduction of information and communication technologies in teaching and learning, the optimization of administrative infrastructure, and the transformation of organizational and support areas [22, 25]. Digital transformation, which arises from the digitalization background, requires not only an improvement in the digital knowledge level from educational process participants [26] but also provides advantages in increasing the competitiveness of educational institutions [7, 27].

Education management digitalization is not a digital transformation of the entire education sphere. The diverse impact of the education management digitalization has been studied particularly in terms of the development of acquired competencies and skills among students [13, 28]. This research also analyzed student engagement in the digital organization of educational processes [25], and explored interactions between universities in the context of digitalization [29]. The latter aspect may even influence the direction of regional policy development [19, 30] or bring about fundamental changes in the labour market, blurring the distinction between production and scientific spheres [27, 31].

Digitalization in education, also known as digital transformation, encompasses every facet of the educational process, integrating education, science, and management into a unified model [32]. At the intersection of these educational spheres within the specified model [33], particular bifurcation points emerge, facilitating transitions to various educational activities through databases and knowledge bases [34]. This foundation enables the nation as a whole to construct an educational platform that, through interactive means, disseminates information about educational events and shares management expertise.

The majority of digitalization models for the educational process are based on platforms like Moodle [35] or Google Classroom [36]. These platforms connect educational

institution websites, interactive libraries, repositories of academic works, and other web applications to enhance the independent study opportunities for learners. Both Moodle and Google Classroom serve as the core of the educational management model, with all educational and administrative activities conducted using their internal tools.

Nevertheless, when researching digitalization models in education, contradictions emerge, indicating a lack of information in this field. For instance, the paper highlights the necessity of considering the negative impact of digitalization on the educational process model [37]. Challenges also arise in defining limitations and criteria for evaluating educational process models based on digital content [38] due to imperfections in the legal framework regulating digitalization in educational activities [39]. A view of higher education services as credentials for its consumers explains why engaging students as subjects in assessing higher education quality are impossible [39]. The parameters of the cumulative performance indices of higher education are predetermined by assessment subjects, giving at least 396 assessment variants of higher education quality. This raises doubts about the assessment's validity unless they are well-considered and all stakeholders have their vision of higher education quality based on their convictions and preferences [38].

The author [40] suggests using university ranking indicators to determine criteria for higher education quality, such as student and graduate proficiency; the level of teaching materials; the level of scientific achievements; qualifications of the teaching staff; the development level of the university material and technical base; the level of digitalization of the educational process; international academic mobility; the number of international scholarship programs; innovation; citation; and the level of educational services. Other experts state that the criterion for higher education quality is the formation of the professional competencies of a critically thinking person, able to study independently and solve complex interdisciplinary and interprofessional social, economic, and environmental problems in a coordinated and mutually beneficial interaction with others [39], students' perceptions of the learning process [41]. The research quality on education digitalization still needs improvement and further elaboration [23]. The article [42] studied the impact of using virtual reality and social media for learning on student performance. They developed a questionnaire to survey the impact of digitalization on various aspects of student learning, such as resources (inputs) needed to produce results (outputs) of higher education. Unfortunately, the specified works did not provide an analysis of the practical application of the model or the particular components of the algorithm for implementing the education management digitalization. This limitation hinders the development and implementation of customized models by individual educational institutions.

III. METHODOLOGY AND METHODS

A. SAMPLE

Three hundred fifty-eight students took part in the study, with an average age of 19.2, who studied in the first and fourth years of the leading universities in the Republic of Kazakhstan (The Kazakh National Agrarian University, Abai Kazakh National Pedagogical University, Al-Farabi Kazakh National University) selected by a method of simple randomization, in which the success rate was higher than C-. The respondents were not differentiated by gender and speciality because those

data did not affect the study results. The surveys were conducted online. Each selected survey participant received a notification letter about their voluntary participation in the study.

The choice to study students in their program's first and fourth years is based on the fact that these are the first and last years for higher education students who obtain a bachelor's degree. Readiness to work in the digital space after completing their education varies among higher education graduates. By the fourth year of education, it becomes possible to assess the contribution of the specific components, including the educational process digitalization and the student's readiness to embrace digital innovations and work in the rapidly changing environment of Industry 4.0.

B. PREREQUISITES AND STEPS

To enhance the educational process in 2021, amid the COVID-19 pandemic's quarantine measures, the web application was created, featuring an interactive interface that allows users to create their own work schedules by adding individual events (modules) based on the educational process schedule. When designing the modular interface, several key requirements were taken into consideration:

- Ensuring the creation of control element constructors and their corresponding event-handling functions;
- Developing window web forms, which serve as fragments of the user interface, each with its own behaviour logic and functionality within the browser context;
- Implementing mechanisms for data input, transmission, and reception for window web forms.

Working with the web application is linked to the Moodle educational platform [43]; however, it is the web application that serves as the foundation of the educational process model (see Fig. 1). This is where the transition from digitization to digital transformation occurs, as new processes are added to the education management in HEI. This integration allows for various features, including real-time prompts about participant workloads when creating events during the workday. Additionally, users can directly access the electronic library or request the opening of specific electronic manuals at designated times, facilitating additional training or knowledge verification.

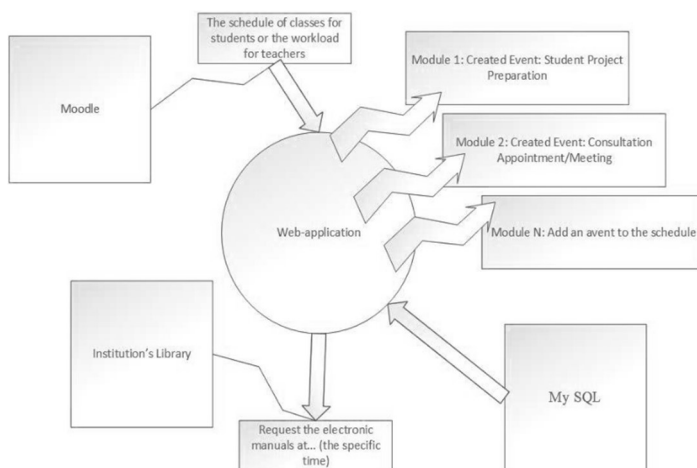


Figure 1. Model of the educational process based on the web application for creating your own work schedule by adding individual events (modules).

The implementation of the modular interactive system interface in the web environment is based on the creation of objects and templates within an isolated namespace, including the window manager and the window interactive interface class.

The task of implementing a method for creating an interface of a modular interactive system in the web environment was addressed using the following algorithm:

Step 1: A JavaScript window manager object is created that:

- Stores a collection of generated web forms along with their components and settings.
- Offers a high-level API for manipulating web forms and data through client control elements.
- Ensures web form interaction with the DOM model of the web document.
- Provides preliminary visualization of active processes on forms.
- Implements a drag-and-drop mechanism for control elements.

Step 2: A Window Interactive Interface class is created, encapsulating the following properties:

- An instance of the web-form class that includes a method for sending an AJAX request to the server and functionality for processing the server's response.
- The web form object can accommodate both simple sets of fields and include tabs or tables.
- Web forms have methods for modifying the external interface and facilitating interaction between themselves and their components.

Step 3: The module with the window manager and the window interactive interface class is connected to the web application.

Step 4: On the server side, PHP classes are created for communication with the window manager of the web system.

The model of the educational process digitalization, considering the specified algorithm, involves the creation of a modular interactive system. This system includes windows with interactive forms, a manager for window management and integration with the Moodle system, a My SQL database containing information related to the educational process, and communication with the educational institution's scientific library.

The research on the influence of education management digitalization on the quality of student learning was conducted through the use of questionnaires and the processing of results using methods of mathematical statistics. The study used a questionnaire regarding the readiness for online learning in the middle of the academic year (see Table 1), developed based of the research approach [44].

Table 1. Questionnaire on readiness for online learning

Question	1	2	3	4	5	6
1. Do you enjoy online learning?						
2. In your opinion, are you able to organise your study time on your own?						
3. Rate how much you like the electronic schedule web application.						
4. How often do you use the electronic schedule web application to organise your studies?						
.....						
9. Are you ready to independently organise your study load?						
10. Evaluate how useful the web application is for organising the educational process.						

Students rated the items on a 6-point Likert scale (1 – strongly disagree, 6 – strongly agree). This allowed for assessing students' learning readiness using digital management. At the end of the academic year, after the session, a survey was conducted using the scale proposed by the authors [42]. It allowed for assessing the importance of inputs and outputs of higher education with digital education management. Responses were assessed on a 7-point Likert scale (1 – least important, 7 – most important). Such classification is connected with the need to clarify the questions after the pilot study. According to the regulatory legal acts of the Republic of Kazakhstan, students who do not score the required number of points are automatically expelled from the HEI. The student must monitor his achievements and optimize his educational process to meet the requirements. Some correlation between the utility of a digital tool and student success is worth noting. That is, to research the connection between the effectiveness of digital tools and the success of students, which will allow the digital transformation of the educational process.

Since the administration of the HEI provided the study participants with demographic characteristics, only the second part of the author's questionnaire was used. Ultimately, the student's average annual grades for the academic year were used, assessed according to the five-point system. The reliability and validity of the questionnaires were ensured following the approaches of research [42, 44].

C. DATA ANALYSIS

The statistical processing of the results was done by using IBM SPSS software. The statistical value of the differences between the groups of respondents in the answers to the questionnaire questions was compared by the Student's t-test and Pearson correlation.

D. LIMITATIONS

The study was conducted within the Republic of Kazakhstan and with students in the first- and fourth years of study. Hence, a general sample was formed of students who had just come to study at the university after high school and those already studying for the fourth year. The limitations of the study included the subjectivity of students' self-assessment of their knowledge when answering certain questions (e.g., regarding their readiness to independently organize their educational process) and the association of assessment with the average score. In future research, it may be beneficial to rank students based on their level of success.

E. ETHICS

The ethical issues implied anonymity affirmation. The students were initially chosen based on their years of study. Afterwards, a random students from this sample was selected to participate in an anonymous survey. All respondents' verified consent to participate in the research.

IV. RESULTS

After introducing education management digitalization, the first was a survey of students regarding their readiness to study online. Therefore, the survey reveals that first-year students are significantly less prepared to study shown in Table 2.

Table 2. The assessment results on readiness for learning in an online format based on the survey proposed in the study [44]

Construct	I year of study	IV year of study	t	p
Computer/internet self-efficiency	3.72±0.65	4.02±0.78	0.788	>0.05
Self-directed learning	3.02±1.10	4.14±0.98	2.233	<0.05
Leamer control	2.05±1.15	3.89±1.09	2.141	<0.05
Motivation for learning	2.35±1.02	3.85±1.21	2.331	<0.05
Online communication self-efficiency	3.11±0.97	3.24±0.69	1.296	>0.05

The above fact can be explained by the higher adaptation of fourth-year students to online learning, to study at a higher education institution in general, and other reasons. Statistically significant differences are observed between Self-directed learning, Learner control, and Motivation for learning. These results indicate the need for more thorough preparation regarding teaching among first-year students and a higher level of teacher support.

After the session at the end of the academic year, the average annual results of students were summarized and presented in Table 3.

Table 3. Average annual results of students

Explanation of assessment, % of participants	Assessment	Assessment Explanation of assessment % of participants By the years of study	
		I year of study	IV year of study
A (4.0)	Perfectly	1.13%	7.18%
A- (3.67)		5.65%	6.63%
B+ (3.33)	Fine	18.08%	23.20%
B (3.0)		20.34%	21.55%
B- (2.67)		22.03%	19.34%
C+ (2.33)	Satisfactorily	22.03%	15.47%
C (2.0)		10.73%	6.63%
Average score of all students		2.78	4.09

In this study, the average annual results of fourth-year students were significantly higher than those of first-year students. Several reasons can explain this. Mainly, that is the peculiarity of the sample, the need for more adaptation to teaching first-year students using digital management and insufficiently developed skills in the online learning environment. To research possible reasons for the lower score of first-year students, we compared the assessment results with the student's readiness for online learning conducted in the middle of the academic year. The results are demonstrated in Table 4.

Table 4. The relationship between academic performance over the year and readiness for online learning

Construct	Average annual students of first year of study score	Average annual students of fourth year of study score
Computer/internet self-efficiency	0.74*	0.63*
Self-directed learning	0.84*	0.71*
Leamer control	0.70*	0.67*
Motivation for learning	0.82*	0.75*
Online communication self-efficiency	0.61*	0.67*

Two aspects of student learning can explain the reasons for the good results. Successful students who study subjects, have deep knowledge of the topic and are also well prepared for online learning master the learning process using digitalization of education management faster. Students with a lower readiness rate have lower grades for the academic semester. Therefore, digital management of education administration necessitates the development of students' online learning skills and self-motivation to learn. Increasing students' digital competence, readiness, and motivation to learn using digital applications can improve their academic performance.

To study the impact of digitalization introduction on learning management, a questionnaire survey of students was conducted [42], and correlations between academic performances were investigated. The results are displayed in Table 5.

Table 5. Results of the student survey on the importance of specific outputs and inputs of higher education using digital management

Question 1: "From the perspective of university student, please rate the importance of each of following outputs that you can achieve when education management in the university made using digitalization and it develops with time challenges on a scale 1 – less important; 7 – most important"				
Survey by areas	I year of study	IV year of study	t	p
Overall learning-oriented outputs (Lo)	4.40	4.47	0.566	>0.05
Degree / qualifications	3.88	4.25	1.215	
Grades	3.95	4.52	1.365	
Work portfolio	4.11	4.66	1.085	
Feedback	5.12	5.21	0.588	
Employability	4.45	4.48	0.385	
Career prospects	4.87	4.68	0.658	
Overall knowledge transfer-oriented outputs (Kto)	4.87	4.96	0.853	>0.05
Internships	4.87	4.96	0.878	>0.05
Cognitive outputs (Co)	5.01	5.09	0.656	
Knowledge/understanding	4.89	4.93	1.385	
Experience	5.12	5.24	0.968	>0.05
Overall skills (Sko)	4.90	4.97	0.784	
Project management skills	4.85	4.52	1.625	
Team work / team management skills	5.11	4.98	0.635	
Problem solving skills	4.72	4.93	1.245	
Intrapersonal skills	4.32	4.85	1.587	
Practical skills	5.05	5.12	1.322	
Presentation skills	5.32	5.41	0.968	>0.05
Overall psychological outputs (Po)	5.08	5.11	0.585	
Confidence	4.41	4.85	1.212	
Satisfaction	5.17	5.32	1.322	
Professionalism	5.11	5.31	1.252	
Effort	5.21	5.05	1.325	
Patience	5.21	4.98	1.221	
Enthusiasm	5.03	4.82	0.968	
Willingness	4.98	5.32	0.958	
Independence	5.09	5.12	0.745	
Question 2: "From the perspective of university student, please rate the importance (1 – less important; 7 – most important) of each of following inputs that you can achieve when education management in the university made using digitalization and it develops with time challenges"				
Time (T ₁)	5.74	5.56	1.212	>0.05
Resources (facilities) (R ₁)	5.32	5.44	0.968	>0.05
Financial resources (money) (FR ₁)	4.78	4.82	0.789	>0.05
Overall cognitive inputs (C ₁)	5.35	5.29	0.857	>0.05
Knowledge	5.18	5.05	0.985	

Overall Skills (SK ₁)	5.35	5.29	0.938	>0.05
Time management skills	5.15	5.06	1.022	
Organisational skills	4.95	4.58	1.365	
Work-life balance	4.78	4.96	1.352	
Social skills	5.25	5.12	0.974	
Work ethics	5.21	5.17	0.658	>0.05
Overall support (SU ₁)	5.58	5.48	0.752	
Staff support	5.17	5.20	0.968	
Peer support	5.21	5.35	0.696	
Family support	4.98	4.85	0.857	>0.05
Overall psychological inputs (P ₁)	5.32	5.41	1.110	
Motivation	5.15	5.14	0.356	
Engagement	5.21	5.32	0.695	
Persistence	5.17	5.05	1.210	
Enthusiasm	5.32	5.22	1.214	
Curiosity	5.02	4.95	1.396	
Critical thinking	4.98	5.14	1.285	
Effort	5.32	5.08	1.235	

The survey results show no statistically significant differences between the scores of first- and fourth-year students on all indicators. Consequently, first- and fourth-year students with different levels of readiness for online learning and academic performance equally assess the importance of the inputs and outputs aspects of learning using digital management of education.

Further, the study was conducted based on Table 5, considering the data from Table 2 and Table 3. The study of the relationship between students' assessments of the impact of digitalization on education management that considers the challenges of the developing world and the average annual grades obtained for the academic year shows the following results shown in Table 6.

Table 6. Correlations between the grade and the importance of outputs and inputs of higher education for students

Outputs	First year of study	Fourth year of study
Overall learning-oriented outputs (Lo)	0.58*	0.61*
Overall knowledge transfer-oriented outputs (Kto)	0.67*	0.71*
Cognitive outputs (Co)	0.72*	0.64*
Overall skills (Sko)	0.62*	0.66*
Overall psychological outputs (Po)	0.65*	0.64*
INPUTS		
Time (T ₁)	0.71*	0.69*
Resources (facilities) (R ₁)	0.64*	0.62*
Financial resources (money) (FR ₁)	0.44	0.41
Overall cognitive inputs (C ₁)	0.63*	0.65*
Overall Skills (SK ₁)	0.71*	0.73*
Overall support (SU ₁)	0.62*	0.67*
Overall psychological inputs (P ₁)	0.73*	0.77*

The correlation results indicate that the assessment of first- and fourth-year students depend on almost all outputs and inputs except for financial resources (money). The outcomes demonstrate that planning the educational process for first-year students is necessary, allowing them to adapt more effectively to learning with digital management of learning process management. Improving the skills and readiness for learning using digital management and technologies and enhancing self-learning skills should help improve first-year students' academic performance.

V. DISCUSSION

The study results show that for the effective use of digital management in the educational process, it is necessary to build an educational process considering students' readiness to study in such conditions. Consequently, digital transformation is possible when the educational institution has been digitalized, and the educational process participants have sufficient digital competence. In this regard, we align with articles [8, 37], emphasizing that educational institutions should incorporate such a process into their educational model to ensure the quality of education. However, the realities of the educational process also underscore the importance emphasized by researchers [5, 45] that any model of digitalization in education must rely on highly qualified academic personnel.

The results obtained from the study provide reasons to question the scepticism expressed by some researchers [46] regarding the educational process digitalization. The research results affirm that both first-year and fourth-year students positively acknowledge the skills they have acquired while using the web application. They also demonstrate creativity in organizing the educational process and exhibit independence in managing their educational workload, as evidenced by the results of knowledge assessments. However, it is worth considering the perspective [47] that the acquired knowledge and independent work skills are valuable when applied in practical settings, extending beyond the boundaries of the educational process. The abovementioned enable adequate perception of digital transformations and use them to improve educational and communication levels.

The results obtained in our study contradict the findings of previous research conducted [28-48], which suggested that digitalization may lead to the strengthening of authoritarian management within educational institutions and create distance between teachers and students. We posit that the identified issues are not inherent to digitalization itself but rather stem from an inadequately chosen model of digitalization for the educational process and slow down digital transformation processes. This model relies on a standardized set of management tools and lacks the provision of autonomy for teachers and students in addressing certain matters.

However, research results revealed the students' insufficient readiness for the first year of self-study activities and underestimated their importance. In contrast, self-study activity is an essential factor in education quality assurance it is necessary to consider this fact when planning the educational process and gradually introduce tasks for self-training and creative lessons for students. Accordingly, improving education management based on digitalization should prioritise the promotion of independent student work and the development of relevant skills, emphasizing interaction and mutual interest, a viewpoint supported by researchers [16].

The obtained results are in line with other studies, particularly digitalization in university education shall be organized based on the strategies of active maintenance of this process, its visualization, interactive support [49] and the creation of appropriate conceptual models [50]. Implementing these tasks is only possible with appropriate material and technical support for the educational activity. This was pointed out by both groups of respondents and emphasized the importance of the motivational factor in education.

The necessity and significance of a systemic approach as the basis of the education services quality assurance in

education management digitalization were stated by students and instructors [4, 51]. The results of our study indicate that students need to fully realize the role of scientific research in the educational process, which calls for upgrading curricula and course programs aimed at the active engagement of students in the research activity.

The difficulties uncovered in organizing independent work through the web application, as revealed during the survey of first-year students, suggest the need for the introduction of a support module into the analysed management digitalization model. This module could take the form of a chat with a virtual assistant responsible for directing queries to the appropriate database entries or forwarding questions to teachers or administrative representatives who can provide written support. In any case, the presented model of the educational process, based on the web application for creating personalized schedules by adding individual events (modules), should not remain static. It is through surveys of students and teachers that additional modules can be developed and the necessary tools for expanding the possibilities of digital interaction can be introduced.

VI. CONCLUSIONS

Existing models of digitalization in the educational process remain an underexplored area. Comprehensive analyses are scarce, and available materials suggest that numerous educational institutions rely on fundamental platforms and services for managing the educational process and conducting educational activities. As a result of the conducted research, it was found that students with a higher level of motivation mostly have higher average grades, so it is worth conducting additional classes for those with a slightly lower level of motivation.

The digitalization of the management of the educational process provides many advantages and opportunities for students. Still, it requires the formation of self-education skills, improvement of digital competence, the ability to use digital tools for educational purposes, set goals, and time management.

First-year students have a low level of readiness to study using the digitalized management of education administration, and lower average annual academic grades, while fourth-year students have a higher readiness to learn online and a higher academic performance. Accordingly, there are strong relationships between readiness indicators for learning and academic success ($r=0.61-0.84$).

Problems that significantly negatively impact the digitalization process of education management and the quality of students' learning primarily arise due to the students' unpreparedness to study with digital education management and irrationally planned educational processes.

The scientific novelty of the study is in the assessment by students of different courses and varying levels of academic success of the resources (outputs) they devote to digital management training and learning results (inputs). First-year students evaluate resources and outcomes similarly to fourth-year students, but the results of academic performance and readiness for online learning have a statistically significant difference. This necessitates the search for learning tools and methods of digitalization of education management that will meet students' readiness for online learning, gradually becoming more complex and not too simple at the same time.

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