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AUTOMATED ASSESSMENT SYSTEMS IN CLOUD ENVIRONMENTS FOR THE FORMATION OF FUTURE PROFESSIONALS' DIGITAL COMPETENCE

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ABSTRACT

The relevance of the study stems from the imperative to enhance the digital competencies of future professionals through the implementation of contemporary assessment technologies. The purpose of this research was to examine the impact of automated assessment systems within a cloud-based environment on the development of students' digital skills.

The investigation used an experimental method, incorporating online assessments utilizing the adapted DigComp 2.1 framework, alongside questionnaires and content analysis. The control group engaged studied using traditional methods, while the experimental group utilized a cloud-based system based in Google Workspace: Google Classroom for course management, Google Forms with automatic assignment checking, and Google Sheets for analysing results. The results showed that digital competence in the experimental group increased by 9.0 points (from 60.2 to 69.2), in the control group — by 3.2 points (from 59.2 to 62.4). The largest increase in the experimental group was recorded in digital communication, content creation, and safety in the digital environment, with each area reflecting an impressive increase of 9 points. According to the survey, 87% of students felt confident in working with cloud services, 83% realized their strengths and weaknesses, and 81% rated quick feedback as a motivating factor.

It is concluded that cloud-based automated assessment effectively promotes the development of digital skills: self-control, communication, analytical thinking, and confidence. The scientific novelty lies in the comprehensive analysis of the automated assessment's impact on various components of digital competence.

Prospects for further research include the integration of adaptive systems and the study of the long-term effects of digital platforms on learning outcomes.

Keywords: *Automated Assessment, Cloud Technologies, Digital Competence, Future Professionals, Higher Education, Educational Platforms, Information Technologies.*

1. INTRODUCTION

In contemporary society, digitalization permeates every facet of professional activity. Higher education is actively incorporating digital technologies into the educational process. Future professionals must be equipped with contemporary tools to facilitate effective professional activity. Digital competence stands as one of the paramount skills for professionals in the 21st century. Its cultivation is becoming a pivotal objective of educational policy across numerous nations.

According to the European Commission study [1], 90% of jobs in the EU require basic digital skills. At the same time, only 54% of Europeans have the necessary level of digital competence. The situation is similar in Ukraine: according to the Ministry of Digital Affairs, only 53% of citizens have basic digital literacy. In light of the aforementioned considerations, this

underscores the significance of digital training even at the educational stage.

Cloud services offer open access to digital resources, serving as a foundational element for education, communication, and the evaluation of knowledge. Automated assessment systems are being utilized across educational institutions in various nations. These sophisticated tools leverage algorithms, data analytics, and cloud-based environments. Such innovations facilitate rapid, objective, and adaptive testing of student knowledge.

Automated assessment systems are changing the role of the teacher. They optimize testing time, increase assessment accuracy while reducing subjectivity. Students receive real-time feedback, which significantly enhances their engagement in the learning process.

World experience underscores the efficacy of such solutions. In Finland, the Netherlands, and the USA, cloud-based assessment systems have become the standard. They integrate with learning platforms that meet the digital demands of the time. Comparing the experiences of various nations enables discerning the strengths and weaknesses inherent in their implementation strategies. The above analytical approach facilitates the adaptation of best practices to the specific context of Ukraine.

In Ukraine, the digital transformation of education is still in progress. Some universities are beginning to implement automated grading systems; however, their adoption remains limited. It is imperative to investigate the impact of such systems on the development of digital competencies. Additionally, it is crucial to ascertain their adaptability to contemporary educational demands.

The purpose of the study is to analyse the impact of automated assessment systems in cloud environments on the development of digital competence of future professionals.

The purpose of this study is to examine the influence of automated assessment systems within cloud environments on the enhancement of digital competencies among future professionals.

Empirical objectives.

— to study the experience of implementing automated assessment in leading countries;

— to conduct an experiment using a cloud-based assessment system in an educational environment;

— to compare the experiment results with international practices and formulate conclusions.

The use of an automated assessment system in a cloud-based environment is justified both theoretically and practically. This approach aligns with the requirements of education digitalization and contributes to the development of digital competencies, particularly self-monitoring, reflection, and autonomy. Cloud services such as Google Workspace offer accessibility, adaptability, and scalability without significant costs, which is crucial for institutions with limited resources. Integration with mobile devices and LMS platforms creates a unified learning environment focused on practical digital skills. Empirical results have confirmed the effectiveness of the approach: students in the experimental group demonstrated a significant increase in digital competence. Specifically, 87% of participants reported increased confidence in using cloud services, while 81% noted higher motivation due to prompt feedback. Therefore, the selected approach is relevant, effective, and suitable for implementation in higher education.

2. LITERATURE REVIEW

In the digital age, education is rapidly moving towards cloud-based formats and automated assessment. Many nations are incorporating intelligent assessment systems into the educational framework, which, according to numerous scholars, significantly contributes to the cultivation of digital competencies essential for contemporary professionals. At the same time, there exists a divergence of opinion regarding the efficacy and challenges associated with automated assessment. These automated evaluation services act as a pivotal intersection point between knowledge and digital ethics [2]. The researchers [3] focus on the use of cloud technologies to improve e-learning in universities. The authors focus on the benefits of integrating cloud services into a learning management system (LMS), in particular scalability, flexibility, and resource savings. At the same time, they note that automated assessment systems included in such platforms ensure transparency of the learning process and reduce the assessment subjectivity.

The authors [4] concur that automated assessment facilitates instant feedback, which significantly enhances the learning experience. At the same time, [5] underscores the necessity of addressing the technical and ethical dimensions associated with the implementation of such systems. The authors highlight the risks associated with insufficient digital readiness of students and teachers.

The reference [6] emphasize that cloud services are actively used not only for storing information, but also as a tool for assessing educational achievements. The authors underscore the objectivity and flexibility of such assessment, which contributes to the personalization of the educational process. However, according to [7], the effectiveness of such platforms depends on the users' digital literacy. Furthermore, the researchers [8] add that the successful implementation of cloud-based assessment is only possible if there is a robust digital infrastructure and teacher training.

The authors [9] explore the potential of e-learning in educational and business environments. From their perspective, automated assessment plays a groundbreaking role in the digital educational space, providing unbiased monitoring of knowledge. However, the use of mobile access to cloud services raises a plethora of challenges, particularly in the area of data protection and ensuring assessment accuracy [10].

Further analysis of literature shows that the authors [11] consider automated assessment as a means of shaping students' digital responsibility. The authors emphasize that such systems contribute to the development of self-reflection and independence in learning. At the same time, the researchers [12] caution that economic factors can affect the quality of cloud technology implementation, especially in conditions of financial instability of universities. According to [13], cloud-based assessment systems ensure the constant availability of tests and results. Against this backdrop, the authors [14] believe that this allows students to track their progress in real time. Notably, the above approach contributes to the formation of self-control, responsibility, and digital independence skills [14]. As the researchers [13] elucidate, cloud-based assessment systems guarantee the perpetual accessibility of evaluations and outcomes. Hence, this facilitates students in monitoring their advancement in real time. Such an approach fosters the development of self-control, accountability, and digital autonomy skills [13].

The reference [15] analyse cloud-based e-learning and note that automated assessment systems can scale without loss of quality. However, it is acknowledged that implementing such systems requires significant investment in technical support and personnel training. Accordingly, a similar opinion is expressed by [16], emphasizing that automation of assessment reduces the workload on teachers, but may create risks of losing a personal approach to students.

Further, authors analyse educational cloud platforms and note that automated testing systems promote digital autonomy for students. At the same time, the researchers [18] emphasize that such systems should serve not only as assessment tools, but also as effective learning tools that promote the development of analytical thinking and form readiness for digital transformations. As a matter of fact, automated assessment systems integrate with mobile devices, allowing to assess knowledge in real time. Such solutions form the skills of digital mobility, adaptability, and independence [19]. For instance, [19] indicate that engaging in active interaction with the system contributes to the development of digital competence in practice.

Thus, a majority of studies affirm the efficacy of automated assessment within a cloud-based environment, particularly in the cultivation of digital competencies. That being said, other researchers draw attention to the challenges associated with technical support, digital literacy, and ethical aspects of using such technologies. The consensus on the benefits of assessment automation contrasts with the debate about its impact on traditional learning processes and teacher-student interactions.

3. METHODS AND MATERIALS

Preparatory stage. The aim of the study was to determine how the use of an automated assessment system in a cloud-based environment affects the development of digital competence in future professionals. Two groups of second-year students majoring in Information Technology participated in the study. To ensure comparability of results, both groups were formed from students with a similar level of basic digital skills (determined through a preliminary survey).

The cloud-based automated assessment system Google Workspace for Education was chosen, which includes Google Classroom, Google Forms providing the auto-checking, and Google Sheets for processing results. For the goals of the experiment, tasks with basic and advanced levels of complexity were prepared, covering different components of digital competence: information search, use of online services, basic security, and analytical thinking.

As can be seen, the automated evaluation system was implemented with using Google Workspace services. The assignments were created using Google Forms, equipped with automated grading features utilizing the designated answer keys.

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The Google Classroom platform was used as an environment for course management, assignment distribution, results collection, and progress analysis. Data were automatically transferred to Google Sheets, where formulas were used to calculate average values, compare results, and build charts of changes in digital competence.

Process diagram: Start → Create assignment → Submit via Google Classroom → Student response → Auto-check in Google Forms → Save to Sheets → Analyse and visualize.

The technical characteristics of the automated assessment system in the cloud environment are presented in Table 1.

Table 1: Technical characteristics of an automated assessment system in a cloud environment

Parameter	Value
Platform	Google Workspace for Education
Tools	Google Classroom, Google Forms, Google Sheets
Task types	Single choice, multiple choice, short answer
Number of tests	5
Number of participants	36 students (two subgroups)
Average execution time per test	8 minutes
Average manual review time	~12 minutes per test
Verification time in the automated system	<1 minute per test
Reducing verification time	approximately 80%
Results saving format	Google Sheets (.xlsx)
Type of analytics	Statistical analysis, graphs, pie charts
Data protection	Google Account Authentication + cloud encryption

*Elaborated by the authors.

Figure 1 presents the architecture of the implemented automated assessment system based on the use of Google Workspace cloud services. The system includes components for student interaction with tasks, automatic checking of answers, followed by a further analysis of results.

Basic procedure. The training program extended over a duration of six weeks within the discipline "Information culture". The control group was trained with a traditional form of assessment (oral surveys, written tests, manual checking by the teacher). The experimental group worked with an automated system in a cloud environment. All training materials were identical in content, only the approach to assessment differed.

Before implementing the cloud-based assessment system, a comparative analysis of four popular platforms (Google Classroom, Moodle, MS Teams, Zoom) was conducted based on the criteria of speed of implementation, adaptability of tasks, level of automation, analytics, integration, security, and need for IT resources (Table 2).

Drawing upon the analysis results, Google Workspace was selected, which provides:

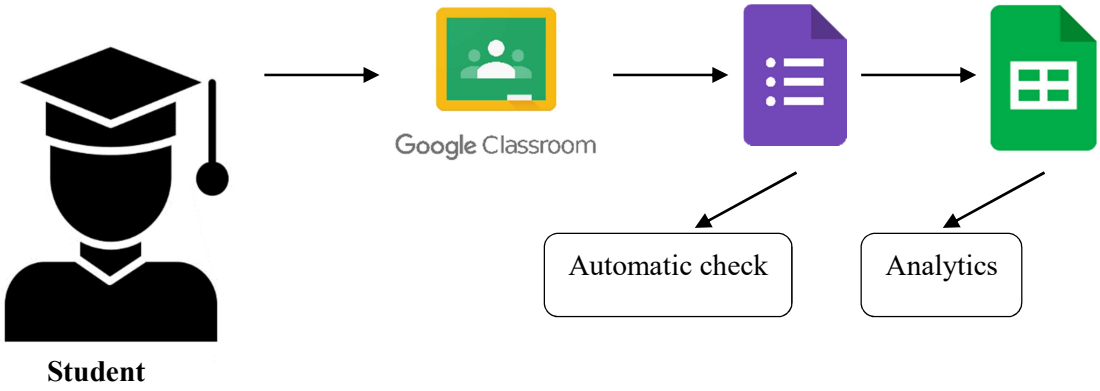

Figure 1: Architecture of an automated assessment system in cloud environment

*Elaborated by the authors.

Table 2: Comparative characteristics of cloud assessment platforms

Criterion	Google Classroom	Moodle	MS Teams	Zoom
Speed of implementation	High	Medium	Medium	High

Task adaptability	Medium	High	Medium	Low
Evaluation automation	High	High	Medium	Low
Results analytics	Medium	High	Medium	Low
Integration with other services	High	Medium	High	Medium
Data security	High	Medium	High	High
Need for IT resources	Low	High	Medium	Low

*Elaborated by the authors.

— high speed of implementation without complex configuration,

— automation of verification in Google Forms,

— component integration (Forms, Classroom, Sheets),

— high level of security through Google authorization,

— the ability to scale without the need for local infrastructure.

Thus, the utilization of Google Classroom, Google Forms, and Google Sheets in our experiment is attributed to their numerous advantages, as well as their accessibility for students who possess no specialized IT training. Despite being less adaptable than Moodle, Google Workspace turned out to be the most appropriate for the conditions of a Ukrainian educational institution with limited resources.

Data collection. Before the commencement of the experiment, both groups underwent an entrance test of digital competence using the adapted DigComp 2.1 model. After completing the course, retesting was conducted. For additional qualitative assessment, an online questionnaire with a Likert scale (15 statements) and open-ended questions was used. The questionnaire was developed taking into account the five components of digital competence: information literacy, digital communication, content creation, safety in the digital environment, and technical skills.

Results processing. The test results were analyzed quantitatively using averages, charts, and basic statistical methods (t-test for independent samples). Qualitative data from the survey were interpreted using content analysis, which allowed us to identify subjective attitudes towards cloud-based assessment.

Research methods:

1. Experimental method. This method was employed to evaluate the hypothesis regarding the impact of automated assessment within a cloud-based environment on the enhancement of students' digital competence. The experiment involved dividing the sample into control and experimental groups, which studied the same course content but with different assessment models. The control group used traditional forms of knowledge testing, while the experimental group used an automated system in Google Workspace. A comparative analysis of the results across various groups elucidated the influence of the technological instrument on educational outcomes.

2. Testing. To objectively measure the level of digital competence of students before and after the experiment, standardized testing was used according to the adapted DigComp 2.1 model. The test covered five key components: information literacy, digital communication, digital content creation, digital safety, and technical problem solving. The test results were analysed utilizing the Student's t-test for independent samples, which enabled us to discern statistically significant changes.

3. Survey. An anonymous online survey was conducted to collect students' subjective evaluation of the effectiveness, convenience, and motivational impact of the automated grading system. The questionnaire contained 15 statements formulated on a Likert scale (from 1 to 5), covering all five areas of digital competence. This method made it possible to gain insights into the emotional and motivational aspects of students' interaction with the digital environment.

4. Content analysis. To gain a deeper understanding of students' individual experiences, open-ended responses from a questionnaire were analysed, in which participants described the benefits and challenges they encountered when using cloud-based assessment. Content analysis enabled us to identify recurring themes, summarize key positive and negative impressions, and supplement quantitative results with qualitative observations.

Sample. The study encompassed a cohort of 36 second-year students majoring in Information Technology, aged between 18 and 20 years (comprising 20 males and 16 females). With the overall number of 64 students, this sample guarantees a representative reflection of the course demographic. To minimize the impact of age and gender differences, a stratified sample was used,

within which two equal groups of 18 people were formed with a similar level of initial digital skills (determined by entrance testing). Prior to the study, no participant had any experience with automated cloud systems.

Tools:

— Cloud-based assessment system: Google Classroom + Google Forms (automatic testing, feedback).

— Questionnaire for assessing digital competence (adapted from DigComp 2.1).

— Online survey examining experiences and perceptions of digital assessment.

— Statistical tables for processing quantitative results.

Research design. The study employed an experimental design involving a control group and an experimental group. The sample included 36 second-year students majoring in Information Technology (20 males and 16 females), aged between 18 and 20. The groups were formed using stratified sampling, taking into account the initial level of digital competence based on the adapted DigComp 2.1 framework. None of the participants had prior experience with automated cloud-based systems.

Over a period of six weeks, the students studied the course "Information Culture." The experimental group used an automated assessment system based on Google Workspace (Google Classroom, Google Forms, Google Sheets), while the control group relied on traditional methods (oral questioning, written tests, manual grading). The educational content was identical in both groups; the only difference lay in the assessment format.

Pre- and post-course testing of digital competence was conducted, along with a questionnaire using a Likert scale. The quantitative data were analyzed using Student's t-test for independent samples, and the open-ended responses were analyzed using content analysis.

4. RESULTS

The study of the impact of automated assessment systems in a cloud environment on the formation of digital competence was conducted among two groups of students: control (traditional assessment) and experimental (cloud automated assessment). To assess the level of digital competence, an adapted DigComp 2.1 model with five components was used: information literacy, digital communication, content creation, safety in digital environment, and technical skills.

The investigation into the influence of automated assessment systems within a cloud-based environment on the development of digital competence was conducted among two cohorts of students.

For quantitative analysis of the results, an integral indicator of digital competence (Digital Competence Index, DCI) was calculated, which takes into account five main components according to the DigComp 2.1 model:

C_1 — information literacy
C_2 — digital communication
C_3 — digital content creation
C_4 — safety in the digital environment
C_5 — solving technical problems

The index was calculated using the arithmetic mean formula as follows:

$$DCI = \frac{C_1 + C_2 + C_3 + C_4 + C_5}{5}$$

This allowed for standardization of results and comparisons between groups before and after the experimental intervention. Based on this index, average increases in values were also calculated and graphical representations depicting the dynamics of these changes were constructed. To test the statistical significance of the changes, the Student's t-test for independent samples was used, which allowed detecting the difference between the control and experimental results with a confidence level of 95%. The measurement error did not exceed ±1.2 points.

Tables 3 and 4 show the results of digital competence testing in the control and experimental groups accordingly.

Table 3: Results of digital competence testing in the control group

Component	Initial testing	Final testing	Difference
Information literacy	62	66	+4
Digital communication	60	63	+3
Content creation	59	62	+3
Safety in the digital environment	57	60	+3
Solving technical problems	58	61	+3
Overall GPA	59.2	62.4	+3.2

*Elaborated by the authors.

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Table 4: Results of digital competence testing in the experimental group

Component	Initial testing	Final testing	Difference
Information literacy	63	72	+9
Digital communication	61	70	+9
Content creation	60	69	+9
Safety in the digital environment	58	67	+9
Solving technical problems	59	68	+9
Overall GPA	60.2	69.2	+9.0

*Elaborated by the authors.

Control group. Students demonstrated a moderate increase in their level of digital competence. The overall increase was +3.2 points, with the greatest improvement noted in the area of information literacy (+4 points).

Experimental group. Participants showed significant growth in digital skills across all components. The total increase was +9.0 points. The most significant advancement was observed in digital communication skills, content creation, as well as safety in the digital environment — each exhibiting an increase of +9 points.

Comparison of groups. As we can see, all indicators of the experimental group outperformed those of the control group. This demonstrates the effectiveness of the automated assessment in a cloud environment as a tool for building digital competence.

Figure 2 presents the results of the digital competence level before and after the experiment in CG and EG.

For instance, the changes in the level of digital competence characterized by an enhancement in each component are shown in Figure 3. As can be seen, the increase in all components in the experimental group was +9 points, whereas in the control group it was only +3–4 points.

Student survey. The survey yielded the results as follows: 83% of students in the experimental group noted the convenience of cloud testing, 78% noted the speed of feedback, and 71% noted an enhanced sense of autonomy.

The survey was conducted anonymously via Google Forms, which guaranteed the openness of responses. The questionnaire was completed by all 18 participants of the experimental group (Table 5).

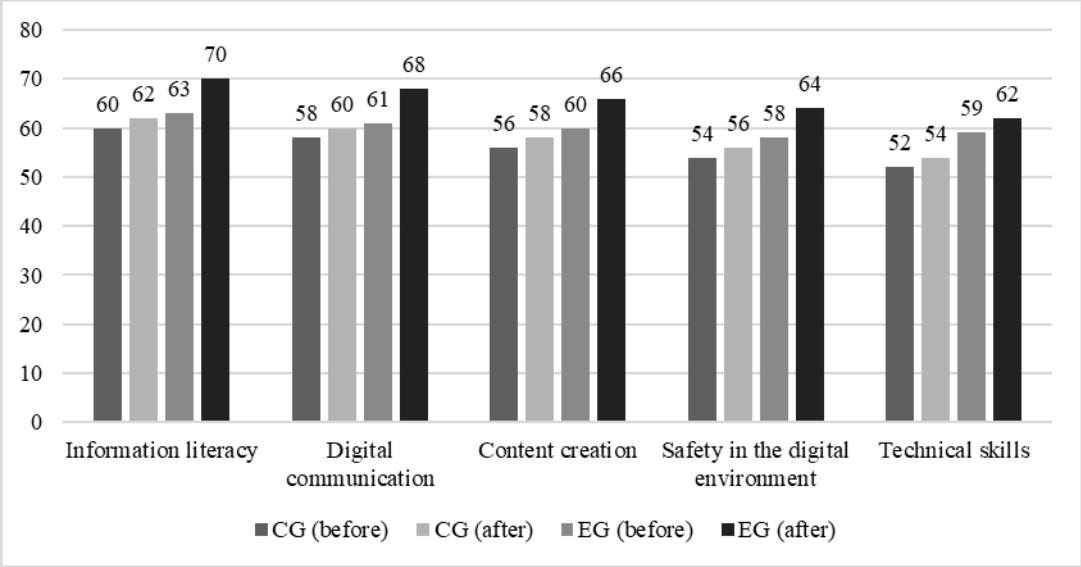

Figure 2: Level of digital competence before and after the experiment in CG and EG

*Elaborated by the authors.

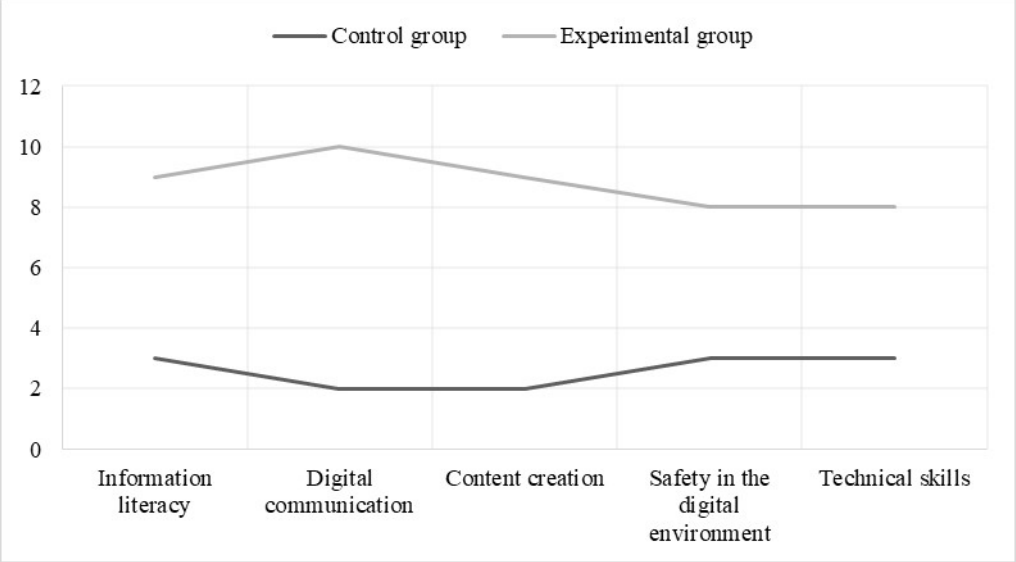

Figure 3: Dynamics of digital competence growth broken down by its constituent components.

*Elaborated by the authors.

Table 5: Detailed survey results (Likert scale)

No.	Statement	Average score (1–5)	Percentage of those who agree is 67
1	Confidence in working with cloud services	4.5	87
2	Awareness of strengths and weaknesses	4.3	83
3	More frequent use of digital tools	4.1	74
4	Motivation through quick feedback	4.4	81
5	Cloud-based assessment is more efficient than traditional assessment	4.2	83

*Elaborated by the authors.

Additional questionnaires enabled us to ascertain how students in the experimental group evaluated their own advancements in digital competence. The findings were compelling. In fact, the highest level of agreement was with the statement "I feel more confident working with cloud services" — 87% of respondents chose "4" or "5" on the Likert scale. This indicates a significant increase in digital confidence.

The second most endorsed assertion was, "Automated assessment facilitated my comprehension of my strengths and weaknesses" — 83%. This means that students have begun to critically evaluate their results, which corresponds to the "self-reflection" element of digital competence.

Also, 81% of respondents noted that quick feedback motivated them to study more actively. This confirms the increase in engagement in the learning process.

Further, 74% of respondents mentioned they started using digital tools for self-study more often. This demonstrates the transfer of skills from the educational environment to personal practice. Another 83% agreed that automated assessment is more effective than traditional assessment.

The average score for all statements was 4.3 out of 5, indicating a high subjective assessment of the effectiveness of cloud assessment.

Analysis of open-ended responses showed that students most often noted three advantages:

1. Speed of obtaining results.
2. Ability to independently analyse errors.
3. Convenience and clarity of the interface.

As far as the difficulties are concerned, students most often mentioned technical issues — internet failures or accidentally closing a tab. However, the majority indicated that even in such circumstances, the system permitted the testing to proceed.

The subjective evaluation of the effectiveness of cloud assessment by the students in the experimental group is presented in Figure 4.

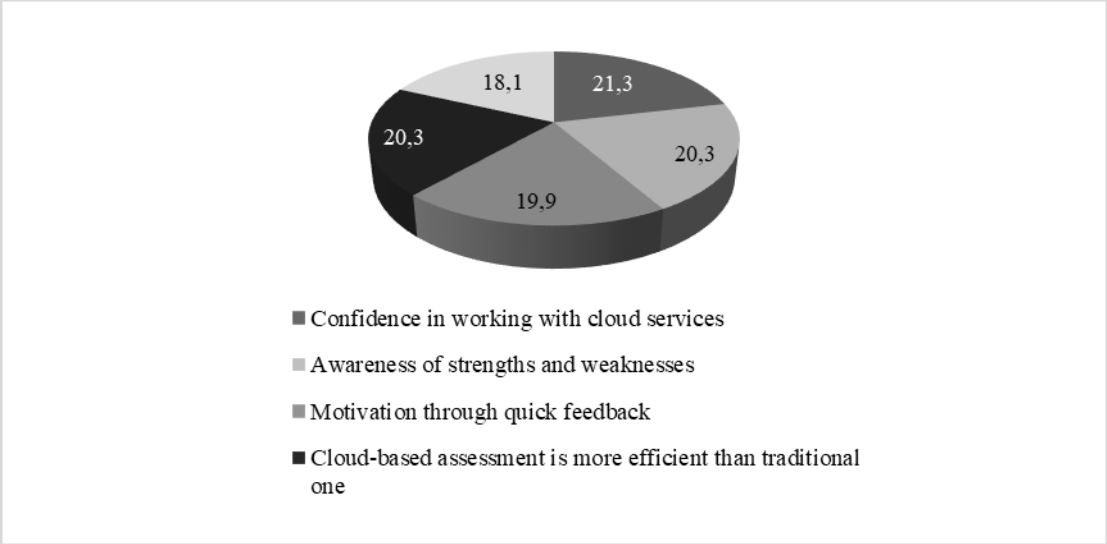

Figure 4: Subjective evaluation of the cloud-based assessment effectiveness (experimental group).

* Elaborated by the authors.

Notably, the greatest increase in content creation and digital communication in the experimental group indicates the effectiveness of practice-oriented tasks performed in the cloud environment. Instant feedback and visualization of progress stimulated deeper student engagement.

5. DISCUSSION

The results of the study align with contemporary international approaches to the digital transformation of education, while also revealing certain distinctions.

The European Commission [1], in its report, emphasizes the need to enhance the digital competence of EU citizens. In this context, automated assessment is recognized as a tool for conducting large-scale digital testing. This confirms that cloud-based systems can support strategic educational goals at the European level.

European Schoolnet [20] provides a roadmap for integrating cloud technologies into the educational process, focusing on infrastructure, teacher support, and assessment systems. The findings of this study confirmed the effectiveness of such systems, provided that appropriate methodological support is available.

The authors of [21] analyze the phenomenon of digital culture in Ukrainian education and emphasize that digital competence is not merely a skill, but a new educational identity. The data obtained on increased digital confidence support this claim.

Researchers [22] developed a model of automated assessment with predictive capabilities and argue that machine learning in assessment improves accuracy and enables personalization. Although such technologies were not used in the current study, automated assessment alone demonstrated a positive effect.

The publication [23] states that the use of cloud services in education enhances student engagement and the quality of educational interaction. Specifically, assessment automation encourages more active use of digital tools, which corresponds with the findings of this research.

The authors of [24] stress that the combination of cloud services, IoT, and e-learning has a strong impact on the development of digital skills. In this experiment, only cloud-based assessment was used, yet it still ensured steady growth in digital competence without the involvement of IoT.

In the study [25], it is demonstrated that digital communication is a fundamental component of digital competence. This was the category in which the experimental group showed one of the most significant improvements (+14%). The results support the conclusions of [25], according to which digital communication forms the foundation of digital competence.

Scholars [26] emphasize that technology only makes sense when it carries pedagogical value. This study found that automated assessment does

indeed have educational value when combined with reflection and analysis of results.

In [27], the authors present the architecture of a cloud platform for testing, highlighting that automation enables real-time monitoring of learning outcomes. The observed increase in digital skills during the experiment is fully consistent with this concept.

Researchers [28] examine the formation of professional competencies in computer science and argue that assessment should be frequent, flexible, and automated. This study confirmed the effectiveness of such a model in developing digital competence.

The obtained results generally support the findings of previous studies, while also presenting some unique features.

In line with the European Commission's position [1], the authors of this study consider cloud technologies a key tool for the digital transformation of education. Researchers [29] state that cloud technologies serve as an innovative foundation for the development of digital educational environments in higher education institutions and contribute to building the digital competence of future professionals. At the same time, the United Nations [30] cautions that despite the positive impact of cloud solutions on the growth of the digital economy, unequal access to data across countries may hinder the implementation of global educational initiatives.

The authors support the conclusions of [28] that assessment should be frequent, automated, and flexible—this methodology proved effective. However, unlike in [22], no predictive algorithms were used in this study, so their effectiveness was not evaluated.

The study [24] analyzed the effects of IoT integration with cloud services, whereas this experiment used only a cloud-based environment. Nonetheless, the outcomes remained positive.

5.1. Recommendations

Based on the findings derived from the analysis, it is advisable to more extensively implement automated assessment systems within a cloud-based environment to facilitate the development of digital competence. It is imperative to provide methodological training for teachers, technical support, and student access to digital platforms. Also, it is expedient to combine automated assessment with reflective tasks to enhance the educational effect and increase student engagement.

6. CONCLUSIONS

The results of the study validate the effectiveness of automated assessment in a cloud environment as a means of cultivating the digital competence of future professionals. A comparative analysis of the experimental and control groups demonstrated significantly higher rates of digital skills growth in students who studied using cloud-based assessment platforms. In the control group, the increase in digital competence was only +3.2 points (from 59.2 to 62.4), while in the experimental group it was +9.0 points (from 60.2 to 69.2). The most significant advancements within the experimental group were noted in the realms of digital communication, content creation, and the safety in the digital environment, with each area reflecting an impressive increase of 9 points. In addition, 87% of students noted confidence in working with cloud services, 83% became more aware of their strengths and weaknesses, and 81% indicated the motivational effect of quick feedback.

The scientific novelty of the study lies in the combination of quantitative and qualitative analysis as regards the impact of automated assessment systems in the cloud environment on digital competence.

The technical contribution of the study is the implementation of an automated workflow for digital assessment without the involvement of external programming tools. The system allowed to reduce the time spent on testing by more than 70%, ensure adaptability of the learning process and instant analytical feedback.

The practical value lies in the possibility of adapting the proposed model for use in higher education institutions. The findings derived from this study can serve as a foundation for the enhancement of training programs, developing digital infrastructure, and improving the educators' skills. The proposed tools can be integrated into Moodle, Google Classroom, or Microsoft Teams platforms.

Further research is needed to examine the long-term effect, the effectiveness of adaptive systems with predictive capabilities, their application in other academic disciplines, and their integration with additional digital tools.

REFERENCES:

[1] Digital Skills and Jobs Platform: Report on digital skills in Europe [online] *European Commission*, 2023 [Accessed 21 April 2025]. Available from: https://digital-skills-jobs.europa.eu

[2] Guidelines on the Development of Open Educational Resources Policies [online] *UNESCO*, 2022 [Accessed 21 April 2025]. Available from: https://unesdoc.unesco.org

[3] A. Ali, and A. Alourani, "An Investigation of Cloud Computing and E-learning for Educational Advancement", *International Journal of Computer Science and Network Security*, Vol. 21, No. 11, 2021, pp. 216-220. https://doi.org/10.22937/IJCSNS.2021.21.11.30

[4] J. M. García-Vandewalle García, M. García-Carmona, J. M. Trujillo Torres, and P. Moya Fernández, "Analysis of Digital Competence of Educators (Digcompedu) in Teacher Trainees: The Context of Melilla, Spain", *Technology, Knowledge and Learning*, Vol. 28, 2023, pp. 585-612. https://doi.org/10.1007/s10758-021-09546-x

[5] P. Wolfschwenger, B. Albaner, O. Kastner-Hauler, and B. Sabitzer, "The Value of Cloud-Based Learning Environments for Digital Education", *2020 IEEE Frontiers in Education Conference (FIE)*, Uppsala, Sweden, 2020, pp. 1-5. https://doi.org/10.1109/FIE44824.2020.9274223

[6] H. Eljak, A. O. Ibrahim, F. Saeed, I. A. T. Hashem, A. Abdelmaboud, H. J. Syed, A. W. Abulfraj, M. A. B. Ismail, and A. Elsafi, "E-learning-based Cloud Computing Environment: A Systematic Review, Challenges, and Opportunities", *IEEE Access*, Vol. 12, 2023, pp. 7329-7349. https://doi.org/10.1109/ACCESS.2023.3339250

[7] L. H. Sillat, K. Tammets, and M. Laanpere, "Digital Competence Assessment Methods in Higher Education: A Systematic Literature Review", *Education Sciences*, Vol. 11, No. 8, 2021, 402. https://doi.org/10.3390/educsci11080402

[8] Y. Zhao, A. M., Pinto Llorente, and M. C. Sánchez Gómez, "Digital Competence in Higher Education Research: A Systematic Literature Review", *Computers & Education*, Vol. 168, 2021, 104212. https://doi.org/10.1016/j.compedu.2021.104212

[9] O. Zawacki-Richter, V. I. Marín, M. Bond, and F. Gouverneur, "Systematic Review of Research on Artificial Intelligence Applications in Higher Education – Where are the Educators?", *International Journal of Educational Technology in Higher Education*, Vol. 16, 2019, 39. https://doi.org/10.1186/s41239-019-0171-0

[10] M. Bond, K. Buntins, S. Bedenlier, O. Zawacki-Richter, and M. Kerres, "Mapping Research in Student Engagement and Educational Technology in Higher Education: A Systematic Evidence Map", *International Journal of Educational Technology in Higher Education*, Vol. 17, 2020, 2. https://doi.org/10.1186/s41239-019-0176-8

[11] Y. J. A. Khasawneh, H. Y. Jarrah, R. S. Alsarayreh, and M. A. S. Khasawneh, "The Role of Cloud Computing in Improving the Performance of School Principals" [online] *Eurasian Journal of Educational Research*, Vol. 107, 2023, pp. 110-125. [Accessed 21 April 2025]. Available from: https://ejer.com.tr/manuscript/index.php/journal/article/view/1440

[12] M. Slupczynski, K. A. Mat Sanusi, D. Majonica, R. Klemke, and S. Decker, "Implementing Cloud-based Feedback to Facilitate Scalable Psychomotor Skills Acquisition" [online] *Proceedings of the Third International Workshop on Multimodal Immersive Learning Systems (MILeS 2023), CEUR Workshop Proceedings*, Vol. 3499, 2023, pp. 8-20. [Accessed 21 April 2025]. Available from: https://ceur-ws.org/Vol-3499/

[13] Y. A. Ishchenko, T. H. Kharchenko, I. V. Myhovych, I. A. Didkivska, and O. M. Viktorina, "Modelo de mejora de la cualificación para profesores de filología sobre el uso de tecnologías en la nube en la actividad pedagógica", *Apuntes Universitarios*, Vol. 12, No. 3, 2022, pp. 199–215. https://doi.org/10.17162/au.v12i3.1111

[14] V. Omelyanenko, I. Semenets-Orlova, O. Khomeriki, L. Lyasota, Y. Medviedieva, "Technology Transfer Management Culture (Education-based Approach)". *Problems and Perspectives in Management*, Vol. 16, Issue 3, 2018, pp. 454-463. http://dx.doi.org/10.21511/ppm.16(3).2018.36

[15] L. Yade, and A. D. Gueye, "Remote Practical Work Environment Based on Containers to Replace Virtual Machines", *2022 IEEE Global Engineering Education Conference (EDUCON)*, Tunis, Tunisia,

IEEE. 2022, pp. 1285-1290. https://doi.org/10.1109/EDUCON52537.2022.9766480

[16] P. Parini, S. N. Rahmi, F. G. Bili, and A. Ayaka, "Implementation of a Cloud-based E-learning System for Integrated Learning in Higher Education" [online] *Journal of Computer Science Advancements*, Vol. 2, No. 6, 2024, pp. 420-433. [Accessed 21 April 2025]. Available from: https://journal.ypidathu.or.id/index.php/jcsa/article/view/1625

[17] S. Tadeja, D. Janik, P. Stachura, M. Tomecki, K. Książczak, and K. Walas, "MARS: A Cross-Platform Mobile AR System for Remote Collaborative Instruction and Installation Support Using Digital Twins", *2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, Christchurch, New Zealand, 2022, pp. 373-380. https://doi.org/10.1109/VRW55335.2022.00083

[18] W. Wu, and A. Plakhtii, "E-learning Based on Cloud Computing", *International Journal of Emerging Technologies in Learning (iJET)*, Vol. 16, No. 10, 2021, pp. 4-17. https://doi.org/10.3991/ijet.v16i10.18579

[19] M. Zhylin, A. Tormanova, Y. Poplavska, M. M. Chernov, and O. Druz, "Study of digital approach in education and psychology among selected users in Ukraine", *Multidisciplinary Reviews*, Vol. 6, 2024, 2023spe007. https://doi.org/10.31893/multirev.2023spe007

[20] Cloud computing in education: A roadmap for implementation. Brussels: European Schoolnet [online] *European Schoolnet*, 2020 [Accessed 21 April 2025]. Available from: https://www.eun.org

[21] L. G. Gavrilova, and Y. V. Topolnyk, "Digital Culture, Digital Literacy, Digital Competence as the Modern Educational Phenomena", *Information Technologies and Learning Tools*, Vol. 61, No. 5, 2020, pp. 1-14 https://doi.org/10.33407/itlt.v61i5.1744

[22] V. Lahoti, and A. Raut, "Automated Assessment Generation and Student Performance Prediction in E-learning System", *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, Vol. 8, No. 2, 2022, pp. 58-65. https://doi.org/10.32628/CSEIT228213

[23] A. P. Singh, P. Rahi, I. Singh, and V. Yadav, "Revolutionizing Remote Collaboration: A Comprehensive Review of Cloud-based Real-time Platforms to Secure Teams" [online] *SNSFAIT*, 2024, pp. 120-129. [Accessed 21 April 2025]. Available from: https://ceur-ws.org/Vol-3774/Paper9.pdf

[24] U. O. Matthew, J. S. Kazaure, and N. U. Okafor, "Contemporary Development in E-learning Education, Cloud Computing Technology & Internet of Things", *EAI Endorsed Transactions on Cloud Systems*, Vol. 7, Issue 20, 2021, pp. 1-20. https://doi.org/10.4108/eai.31-3-2021.169173

[25] R. Miltchev, and N. Chehlarova, "Development of Digital Competencies and Skills in the Field of Use of Cloud Services and Electronic Communication" [online] *Science, Engineering & Education*, Vol. 5, No. 1, 2020, pp. 41-50. [Accessed 21 April 2025]. Available from: https://mmu2.uctm.edu/see/node/jsee2020-1/7_20-07_p_41-50.pdf

[26] S. Timotheou, O. Miliou, Y. Dimitriadis, S. Villagrá Sobrino, N. Giannoutsou, R. Cachia, A. Martínez Monés, and A. Ioannou, "Impacts of Digital Technologies on Education and Factors Influencing Schools' Digital Capacity and Transformation: A Literature Review" [online] *Education and Information Technologies*, Vol. 28, Issue 6, 2023, pp. 6695-6726. [Accessed 21 April 2025]. https://dl.acm.org/doi/abs/10.1007/s10639-022-11431-8

[27] M. Tokovska, T. Šeben Zaťková, and Ľ. Jamborová, "Digital Competencies Development in Higher Education Institutions: A Mixed Methods Research Study", *Emerging Science Journal*, Vol. 6, Special Issue, 2022, pp. 150-165. https://doi.org/10.28991/ESJ-2022-SIED-011

[28] R. K. Raj, M. Sabin, J. Impagliazzo, D. Bowers, M. Daniels, F. Hermans, N. Kiesler, A. N. Kumar, B. MacKellar, R. McCauley, S. W. Nabi, and M. Oudshoorn, "Professional Competencies in Computing Education: Pedagogies and Assessment", *Proceedings of the 2021 ITiCSE Working Group Reports (ITiCSE-WGR '21)*, 2021, pp. 133-161. https://doi.org/10.1145/3502870.3506570

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[29] S. P. Stetsyk, and O. A. Harbar, "Cloud Technologies as an Innovative Basis for the Development of the Digital Educational Environment of a Higher Education Institution", *Scientific Journal of the Mykhailo Dragomanov Ukrainian State University. Series 2. Computer-oriented learning systems*, Vol. 23, No. 30, 2024, pp. 84-92. https://doi.org/10.31392/UDU-nc.series2.2024.23(30).08

[30] Digital economy report 2021: Cross-border data flows and development. UNCTAD [online] *United Nations*, 2021 [Accessed 21 April 2025]. Available from https://unctad.org/webflyer/digital-economy-report-2021