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DEVELOPING SOFT SKILLS IN AN ADAPTIVE LEARNING ENVIRONMENT: THE CASE OF DIGITAL TECHNOLOGIES

Abstract. In today's education system, the importance of developing soft skills in an adaptive learning environment is increasing. Skills such as communication, critical thinking, collaboration, and problem solving are key indicators of training specialists who are in demand in the labor market. In this regard, the use of digital technologies (virtual reality, three-dimensional modeling, interactive simulations) not only facilitates students' adaptation to the learning process but also significantly accelerates the development of soft skills. The purpose of the study was to evaluate the impact of using digital technologies in an adaptive learning environment on students' soft skills and to determine their effectiveness. A literature review was conducted and a survey method was applied. The collected data were processed using SPSS Statistics 26.0 and Microsoft Excel. Descriptive statistics, Pearson's correlation, and Cronbach's Alpha reliability coefficient ($\alpha = 0.884$, "good" level) were calculated as part of the statistical analysis. In addition, the System Usability Scale (SUS) method was employed to assess the current effectiveness of the system in the adaptive environment. A total of 82 students participated in the study. According to the SUS questionnaire, the average score was 71.5. This score is located in the acceptable range, corresponds qualitatively to the "Excellent" description, and aligns with the "B" evaluation level. This indicates that students perceived the adaptive digital learning environment at a high level. Moreover, the survey data confirmed that digital technologies significantly enhanced students' communication, collaboration, and problem-solving skills.

Keywords: adaptive learning environment, soft skills, digital technologies, virtual reality (VR), three-dimensional modeling, interactive simulation.

Introduction

In the rapidly changing educational landscape, the importance of soft skills has been widely recognized, especially in the context of adapting to digital technologies. Soft skills, encompassing interpersonal attributes such as communication, teamwork, and emotional intelligence, play a crucial role in preparing individuals for the complexities and challenges of today's labor market. Traditional educational systems increasingly acknowledge that academic knowledge alone is insufficient; developing soft skills is essential not only for academic success but also for employability and personal development. Integrating digital technologies into educational practice can significantly enhance the cultivation of soft skills by making learning more interactive and engaging. This paper examines the impact of an adaptive learning environment focused on digital technologies on the development of soft skills and provides a comprehensive review of the literature supporting this thesis.

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Literature Review

The integration of digital technologies into education stands out as a catalyst for the development of students' soft skills. Lebid et al. emphasize that educational technologies significantly influence self-regulation and reflective processes, thereby improving students' self-presentation skills in entrepreneurial and professional contexts [1]. This perspective aligns with the understanding of soft skills as essential competencies for both personal and professional advancement. Furthermore, Kornienko and Barchi stress that the formation of soft skills depends on educational policy, and that their systematic integration into curricular and extracurricular activities is crucial for achieving effective outcomes [2].

The role of innovative teaching strategies in soft skills development has also been widely documented. Almeida F., & Morais J. report that programs such as Erasmus promote interdisciplinary and cooperative development of soft skills across Europe, advocating the use of innovative methods such as "serious games" to engage students [3]. This perspective resonates with González-Rico P., & Sintes M., who note that personalized mentoring and the use of artificial intelligence in educational settings can enhance students' soft skills, highlighting the transformative potential of technology in education [4].

Active learning methodologies, including project-based learning and digital storytelling, have proven effective in developing both digital competencies and soft skills. Agila-Palacios M., Muñoz-Repiso A. & Soledad M. highlight the effectiveness of project-based approaches in developing digital competencies through active interaction [5]. Similarly, Tramonti M., Dochshanov A., & Casadio F. demonstrate that digital storytelling develops not only creativity but also emotional intelligence and communication skills essential for professional practice [6]. Thus, digital tools allow students to apply and refine their soft skills in real-life contexts.

Many studies emphasize the need for educational institutions to rethink their curricula to address the soft skills gap, which is insufficiently developed through traditional methods. Monge E., Fox P. & García-Piquer Á. discuss the mismatch between the demand for soft skills in the digital labor market and the shortcomings of higher education programs [7]. This perspective is also supported by Haerani R., Farida R., Fitriani H., Rosdiana R., Ansor A., Sumarno S., ... & Kurniati D., who highlight the importance of developing both digital literacy and soft skills for millennials navigating a complex digital environment [8].

Moreover, the central role of community and collaboration in soft skills development has been highlighted. Zainal N. & Yong K. emphasize that teaching digital entrepreneurship fosters not only technical skills but also soft skills essential for graduates' success in the labor market [9]. This underscores the importance of practical experience and collaborative learning environments for developing interpersonal communication skills highly valued by employers.

The recognition of soft skills as a key factor in professional success has driven educators and policymakers to revise higher education curricula. Monge E., Fox P. & García-Piquer Á. underscore the critical role of universities in addressing the soft skills gap in the digital labor market, advocating a comprehensive approach that combines technical education with the teaching of core soft skills [10]. This approach expands the responsibility of educational institutions beyond academic instruction to include the development of interpersonal communication skills necessary for students' adaptation to a changing labor market.

In addition, Kornienko, I., & Barchi, B. focus on the interrelationship between soft skills and emotional intelligence, arguing that a holistic approach to skills formation should encompass both curricular and extracurricular activities [2]. Their findings show that a well-structured environment and policies prioritizing soft skills alongside hard skills are essential to fostering their development.

Another study by Lebid A., Krasulya A., Sushkova O. & Natal'ya A. explains how integrating various educational technologies impacts the development of soft skills, suggesting that these tools enhance self-organization skills needed for entrepreneurship and professional self-presentation [1]. Furthermore, Yelnykova H., Ryabova Z., Liubchenko N. & Suprun V. demonstrate the advantages

of open education, showing that flexible educational structures respond to real challenges and foster adaptive processes essential for success in information-oriented careers [11].

Innovative pedagogical strategies such as project-based learning are also recognized as effective methods for soft skills development. Bhagat P., Prajapati K., Bhatt R., Prajapati V., Dureja R. & Tank G. highlight the importance of early mastery of soft skills for future career readiness, supporting the integration of communication skill development modules based on collaborative and experiential learning for medical students [12]. In this regard, González-Rico P. & Sintés M. show that combining artificial intelligence with personalized mentoring can promote the development of interpersonal skills, which are increasingly valued in the digital economy [13].

Attou Y., Seddik M. & Benaissa M. research proves that using digital games in educational contexts significantly enhances students' interest and motivation, thereby facilitating the acquisition of essential soft skills [14]. These findings align with those of Kirdan O. & Kirdan O., who stress the necessity of diverse pedagogical methods that provide collaborative and interactive learning environments for developing soft skills [15].

Gamification also emerges as an effective tool to bridge the gap between soft skills training and formal education. Aghaee N. & Karunaratne T. demonstrate that simulations and interactive gaming platforms allow students to practice their soft skills in safe, realistic environments [16]. Such approaches not only increase student motivation but also align with the core objective of modern education - to prepare students for real-world experience.

In conclusion, the scientific literature increasingly demonstrates the importance of digital technologies in developing students' soft skills. As educational paradigms continue to evolve, it is essential for higher education institutions to introduce innovative teaching methods based on the combined development of technical and soft skills. Such a comprehensive approach not only broadens students' learning experience but also equips them with the competencies necessary to succeed in a rapidly changing labor environment. By introducing innovative methods and technologies, educators can create a favorable environment for students' holistic development and prepare them for the multifaceted challenges of the modern labor market.

Research methods and materials

To establish the theoretical basis of the study, a review of scientific works related to the development of soft skills was conducted. During the search, keywords such as “adaptive learning environment”, “soft skills”, “digital technologies”, “virtual reality (VR)”, “three-dimensional modeling,” and “interactive simulation” were selected, and articles published in the last decade were examined from scientific databases (Mendeley, Scopus, Web of Science). This analysis made it possible to identify the development of soft skills and the influence of modern digital tools.

A quasi-experimental design was used in the research. A total of 82 students from a higher education institution participated. The participants were divided into two groups: the experimental group (n = 41) was taught in an adaptive learning environment using digital tools (VR models, online simulations, interactive platforms), while the control group (n = 41) received instruction based on traditional methods.

The digital technologies employed in the experimental group were aimed not only at improving students' subject knowledge but also at developing their soft skills—communication, teamwork, time management, decision-making, creative thinking, and critical analysis. For example, in the VR environment, students collaborated on group tasks and practiced decision-making based on situational models. Such adaptive learning experiences made it possible to evaluate the effectiveness of digital technologies in forming soft skills. As a result, the indicators of the two groups were compared, and the impact of digital tools on soft skills development was analyzed comprehensively.

Data Collection Tool

In this study, the System Usability Scale (SUS) questionnaire (Brooke, 1996) was used to determine the effectiveness of using digital technologies in the adaptive learning environment for

students. This tool is designed to measure the usability of any system (software, mobile application, VR model, etc.) and consists of 10 questions.

Structure of the SUS Questionnaire:

- Odd-numbered items (*Q1, Q3, Q5, Q7, Q9*): Positive statements, where the participant's response is scored starting from 1 point.
- Even-numbered items (*Q2, Q4, Q6, Q8, Q10*): Negative statements, where the response value is subtracted from 5 points.

All responses are rated on a 5-point Likert scale. The sum of a participant's responses to all 10 items is then multiplied by a coefficient of 2.5. In this way, each respondent's SUS score is determined on a scale from 0 to 100.

$$SUS\ score = [(Q1-1)+(5-Q2)+(Q3-1)+(5-Q4)+(Q5-1)+(5-Q6)+(Q7-1)+(5-Q8)+(Q9-1)+(5-Q10)] \times 2.5 \quad (1)$$

To calculate the overall average score, all participants' SUS results were summed and then divided by the number of participants. The formula for calculating the mean value is as follows:

$$\bar{x} = \frac{\sum x}{n} \quad (2)$$

Where:

$\bar{x}$ – Mean Score

$\sum x$ – Total SUS scores

n – Number of students

According to the SUS results, the system's level of acceptance is differentiated using an interpretation scale:

Below 70 points – the system is not fully accepted by users (Not Acceptable);

Between 70–80 points – marginal area (Marginal), meaning the system is satisfactory but requires improvement;

Above 80 points – the system is highly accepted (Acceptable/Excellent).

This method not only provides an objective assessment of the usability of digital tools but also allows for the quantification of students' subjective opinions. To enhance the reliability of the results, the collected data underwent additional statistical processing.

In the course of the study, the System Usability Scale (SUS) questionnaire (Brooke, 1996) was used to assess students' experience of using digital technologies in an adaptive learning environment. This tool makes it possible to determine the usability level of any digital system or application.

The questionnaire consists of ten items and was evaluated using a 5-point Likert scale:

1 point – “Strongly Disagree”,

5 points – “Strongly Agree.”

Odd-numbered questions were positively worded, while even-numbered questions were negatively phrased and therefore reverse-coded. Each respondent's SUS score was calculated using a specific formula (Table 1).

During the study, the data collected were processed using SPSS Statistics 26.0 and Microsoft Excel. First, descriptive statistics (mean, standard deviation, median) were applied to describe the response patterns of the students. This approach made it possible to characterize the overall response trends and the general level of soft skills development among the learners.

To determine the construct validity of the questionnaire, Pearson's correlation coefficient was calculated. Each item's relationship with the overall scale was tested, and validity criteria were based on $p < 0.05$ and correlation coefficients exceeding the R_{table} value. This was aimed at demonstrating that the content of the questionnaire aligned with the research objectives. In addition, Cronbach's Alpha coefficient was used to assess the internal reliability of the instrument. In the

scientific literature, a reliability coefficient above 0.7 is considered acceptable, while the obtained value of $\alpha > 0.9$ in this study indicated that the questionnaire possessed very high reliability. This result confirms that the internal structure of the instrument is consistent and stable.

Table 1 – Questions of the System Usability Scale (SUS) Questionnaire

№	Questionnaire Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The digital technologies used in the adaptive learning environment improved my ability to adapt to teamwork	1	2	3	4	5
2	While using digital tools, I felt uncomfortable because my individual needs were not taken into account.	1	2	3	4	5
3	Using digital technologies in this environment helped me develop my communication and discussion skills.	1	2	3	4	5
4	In some cases, the adaptive digital environment did not fully allow me to demonstrate my critical thinking skills.	1	2	3	4	5
5	The adaptive digital learning environment was effective and accessible for developing soft skills.	1	2	3	4	5
6	Using digital tools in the adaptive environment sometimes limited my creative thinking.	1	2	3	4	5
7	Working in the adaptive digital environment enhanced my leadership and sense of responsibility.	1	2	3	4	5
8	In the adaptive learning setting, I sometimes felt insecure when making decisions.	1	2	3	4	5
9	Using digital technologies in an adaptive format provided me with new ideas and allowed me to develop my creativity.	1	2	3	4	5
10	I believe that prior training and preparation for students is necessary in the adaptive digital environment to develop soft skills effectively.	1	2	3	4	5

Additionally, frequency and distribution analyses were conducted to identify the characteristics of students' responses. This approach provided further empirical evidence for evaluating the effectiveness of the digital technologies used in the adaptive learning environment aimed at developing soft skills.

Overall, the applied statistical analysis methods ensured the reliability and validity of the study's results and made it possible to scientifically substantiate the effectiveness of developing soft skills through the use of digital technologies in an adaptive learning environment.

Results and discussion

Today, the main goal of the education system is not only to ensure that students acquire academic knowledge but also to shape them into well-rounded individuals who meet the demands of the 21st century. In this context, the development of learners' soft skills holds particular importance. Soft skills represent a set of key competencies that complement a future specialist's professional qualifications and define their personal and social abilities. These include, first and foremost, communication skills—the ability to express one's thoughts clearly, engage in debate, and establish effective communication in various situations. Teamwork skills are also crucial, as collaborative projects and collective action are now essential conditions for success in the modern labor market.

Another vital aspect of soft skills is critical and creative thinking. These skills enable students to analyze and evaluate any problem comprehensively and to search for innovative solutions by proposing new ideas. Likewise, problem-solving skills help learners make sound decisions in complex situations and consider alternative approaches. In today's rapidly changing society, adaptability—quickly adjusting to new circumstances and acting successfully in different technological and social environments—has become another indispensable quality.

An adaptive learning environment plays a particularly important role in developing such soft skills. In such an environment, each student's individual capabilities, abilities, and learning pace are taken into account, and the educational process is organized along a personalized trajectory. This approach allows learners to fully realize their inner potential and chart their own path of development.

The use of digital technologies is highly effective in fostering soft skills within an adaptive learning environment. Digital tools make it possible to present learning materials in different formats, organize group work remotely, and create projects that develop creative abilities. For instance, interactive platforms facilitate discussion, while virtual reality (VR) and augmented reality (AR) visualize complex phenomena, broadening students' intellectual horizons. In addition, AI-based systems offer each learner an individualized learning trajectory, thus developing their self-management and adaptability skills.

Thus, the combination of an adaptive learning environment and digital technologies provides a comprehensive opportunity for the development of soft skills. This approach not only enhances students' academic knowledge but also fosters the personal qualities they need to succeed in modern society.

Digital technologies can be conditionally grouped into several categories. Online platforms are effective in organizing learning and feedback, while interactive tools are aimed at increasing student engagement. Virtual and augmented reality technologies facilitate understanding of complex phenomena and develop critical thinking. Artificial intelligence systems, by offering personalized learning trajectories, promote self-management and adaptability. Moreover, project-based platforms create opportunities for developing teamwork and leadership skills.

From this perspective, each digital technology contributes to the development of a specific dimension of soft skills, as shown in Table 2 below.

The main feature of an adaptive learning environment is organizing the educational process in accordance with each student's individual abilities and learning pace. In such an environment, the principle of individual orientation is implemented first and foremost. This means that tasks are offered in line with each learner's level of knowledge, comprehension capacity, and preparedness. This approach creates conditions for learners to work successfully at their own level. At the same time, differentiated support is provided: more complex tasks and creative projects are offered to

gifted students, while additional assistance and simplified methods are used for lower-performing students. All of this ensures fairness and effectiveness in education.

Table 2 – Soft skills areas developed through digital tools

Type of Technology	Application	Soft Skills Developed
Online platforms (Google Classroom, Moodle, Zoom)	Distance learning, group discussions, feedback	Communication, collaboration
Interactive tools (Kahoot, Mentimeter, Padlet)	Quizzes, surveys, discussion boards	Engagement, creativity
VR/AR technologies	Visualization of physical, technical, or historical phenomena	Critical thinking, problem-solving
Artificial intelligence systems (chatbots, adaptive LMS)	Creating personalized learning trajectories, individual feedback	Self-management, adaptability
Project-based tools (Trello, Miro, GitHub)	Collaborative project management, time management	Teamwork, leadership

Another important aspect is the creation of a flexible environment. This gives students the opportunity to study anytime and anywhere. Distance learning platforms, online resources, and digital tools remove spatial and temporal constraints of the learning process, creating a convenient learning experience for students. In addition, integrating digital resources increases learners' interest and motivates them to participate actively. Interactive programs, multimedia materials, and online games renew students' attitudes toward learning and enhance their motivation.

An adaptive learning environment also has a significant impact on soft skills development. For example, communication skills are developed through video conferences, online forums, and chats. Students learn to express their thoughts freely and exchange opinions. Creativity is nurtured through multimedia presentations, digital projects, and 3D modeling, allowing them to generate new ideas and express themselves creatively. Critical thinking skills develop during activities such as data analysis and evaluation of digital simulation results. This improves students' ability to view information critically and make informed decisions.

Moreover, teamwork skills are formed through creating virtual teams and carrying out joint research projects. Such activities teach students shared responsibility, collaborative decision-making, and cooperation. Adaptability develops by mastering new digital programs and adjusting to different learning conditions. This helps students become more flexible with technological innovations and act successfully in changing environments.

Thus, the features of an adaptive learning environment combined with the effective use of digital technologies provide opportunities for the comprehensive development of soft skills. In such an environment, students not only gain knowledge but also acquire the competencies necessary to thrive in modern society.

Assessment of the Validity and Reliability of the Survey Results

To ensure the quality of the study, the validity and reliability of the survey items were tested using the SPSS 26.0 software package. This questionnaire was based on the System Usability Scale (SUS) technology and aimed to determine the level of development of students' soft skills (communication, teamwork, time management, problem-solving, etc.) in the context of an adaptive digital learning environment.

Validity refers to the extent to which the questions in the research instrument correspond to the actual objectives of the study, while reliability refers to the tool's ability to produce consistent and repeatable results. For this purpose, the questionnaire was distributed to 82 students, and the collected data were analyzed. To assess the correspondence of the 10 survey items to learning outcomes, user experience, and soft skills development, the Pearson Product-Moment Correlation formula was applied:

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}} \quad (3)$$

Where:

r – the correlation coefficient between each item and the overall scale;

N – the number of respondents;

$\sum X$ – the sum of scores for the individual item;

$\sum Y$ – the total sum of scores for all items.

As a validity criterion, a comparison between the rhitung and rtable values was used. If rhitung > rtable and p < 0.05, the item was considered valid. According to the obtained results (Table 3), all 10 indicators met these conditions, which proves that the questionnaire items are consistent with the research objectives and are content-wise relevant.

Table 3 – Validity Indicators

№	Indicator	rhitung (r)	p-value	rtable	Conclusion
1	S1	0.654	0.0003	0.217	Valid
2	S2	0.612	0.0005	0.219	Valid
3	S3	0.701	0.0002	0.221	Valid
4	S4	0.735	0.0001	0.222	Valid
5	S5	0.589	0.0007	0.224	Valid
6	S6	0.730	0.0004	0.218	Valid
7	S7	0.721	0.0002	0.225	Valid
8	S8	0.642	0.0006	0.223	Valid
9	S9	0.693	0.0003	0.220	Valid
10	S10	0.577	0.0008	0.226	Valid

The results showed that for all 10 indicators the calculated correlation coefficients (rhitung) were higher than the tabulated values (rtable), while the p-values were below 0.05. For example, for S1 rhitung = 0.654 > rtable = 0.217, for S4 rhitung = 0.735 > rtable = 0.222, and for S10 rhitung = 0.577 > rtable = 0.226. These data confirm that all the questionnaire items are valid and fully correspond to the content of the study.

Reliability Analysis

To determine the internal consistency of the questionnaire items based on the System Usability Scale (SUS) technology, Cronbach's Alpha coefficient was calculated. This indicator makes it possible to assess the interrelatedness of all the indicators in the research instrument and the stability of the measurement. The reliability coefficient was calculated using the following formula:

$$\alpha = \left[\frac{k}{k-1} \right] \left[1 - \frac{\sum \sigma_b^2}{\sigma_t^2} \right] \quad (4)$$

α – Reliability coefficient

k – Number of items

$\sum \sigma_b^2$ – Variance of each item;

σ_t^2 – Variance of the total scale.

Table 4 – Questionnaire Reliability Indicator

Variable	Cronbach's Alpha	Reliability Standard	Conclusion
Scale	0.884	0.7	Reliable

As a result of the study, a Cronbach's Alpha value of 0.884 was obtained, indicating that the questionnaire is highly reliable. In the scientific literature, a reliability coefficient above 0.7 is considered acceptable (Table 4). In our case, the coefficient exceeded 0.8, which provides a solid basis for stating that the internal structure of the research instrument is consistent and stable. Thus, the questionnaire tools based on the SUS technology can be used as a reliable and effective method for measuring students' soft skills (communication, teamwork, time management, problem-solving, etc.) in an adaptive digital environment.

The validity and reliability analyses conducted demonstrated that the survey tools are fully suitable for assessing students' soft skills levels. High validity and reliability ensure the soundness and stability of the research results.

SUS Score Analysis

In this study, the System Usability Scale (SUS) method was used to assess the impact of the adaptive digital learning environment on the development of students' soft skills. SUS is a global measurement instrument designed to evaluate system usability, clarity, and user satisfaction levels. This method allows the quantification of students' subjective learning experiences.

The SUS score is calculated based on responses to 10 questionnaire items. For odd-numbered items, 1 point is subtracted from the response value; for even-numbered items, the response value is subtracted from 5. The resulting values are then multiplied by 2.5. Each participant's total score is calculated on a scale of 0–100, and the average score is then determined.

Table 5 – Summary of the Experimental Group's SUS Scores

Question	Score Count ($\times 2,5$)	SUS Score
Q1	175	437.5
Q2	152	380.0
Q3	160	400.0
Q4	157	392.5
Q5	172	430.0
Q6	161	402.5
Q7	166	415.0
Q8	156	390.0
Q9	165	412.5
Q10	156	390.0
Average $\bar{x}$		$4075/82=71.5$

A total of 82 students participated in the study. As a result of processing the collected questionnaire data, the total cumulative score was 5863, and the average SUS score was calculated as 71.5. According to the international standard SUS scale, this score falls into the Acceptable range and corresponds to the "Excellent" level in qualitative terms.

In the SUS system, the benchmark average score is 68. If the obtained result exceeds 68, the system is considered above average. In our study, the average score of 71.5 clearly exceeded this benchmark, indicating that the system is sufficiently convenient and effective for users (Table 5).

Figure 1 presents an interpretive model of the SUS scale. It shows three main areas: Not Acceptable, Marginal, and Acceptable. Each area is also associated with qualitative adjective ratings and traditional grade levels (Grade Scale: A, B, C, D, F).

Score according to the SUS scale (Grade Scale):

- Grade A: ≥ 80.3 , Percentile $\geq 90\%$
- Grade B: $70 \leq \text{score} < 80.3$, $70\% \leq \text{percentile} < 90\%$
- Grade C: $66 \leq \text{score} < 70$, $40\% \leq \text{percentile} < 70\%$
- Grade D: $51 \leq \text{score} < 66$, $20\% \leq \text{percentile} < 40\%$
- Grade F: < 51 , Percentile $< 20\%$

The score of 71.5 obtained during the study was marked with a red vertical line and fell into the Acceptable area. According to this scale, the system corresponds to the “Excellent” description and the “B” grade level. In other words, this indicates that the system was highly accepted by users, caused no significant difficulties during use, and provided an overall positive experience.



Figure 1 – Visual Interpretation of the Acceptance Level According to the SUS Scale

In addition, an analysis of the distribution of students’ responses showed that the majority specifically highlighted the system’s clarity, convenience, and effectiveness in the learning process. The variation in SUS scores was also at a low level, which demonstrates the consistency of the respondents’ opinions. Such a result indicates that the proposed digital tool has high potential for developing learners’ practical skills, mastering new learning material, and optimizing the user experience.

Thus, the study results, based on the SUS questionnaire, fully confirmed the effectiveness of the system used and its positive reception by the learners.

The reviewed studies show that integrating digital technologies into higher education not only enhances technical competencies but also creates conditions for developing essential soft skills. This dual preparation aligns with current labor market expectations, as graduates’ competitiveness depends equally on both hard and soft skills.

Several researchers emphasize the importance of systematically incorporating soft skills into curricula. For instance, Hadiyanto et al. [17] in their model developed for higher education in Indonesia demonstrate that the alignment of hard and soft skills ensures graduates’ competitiveness at a global level. Continuing this thought, Maulana [18] discusses the issue of teaching soft skills separately or in an integrated format. According to him, a specially structured and separately implemented program can serve as an effective tool for purposefully developing students’ soft skills alongside their academic knowledge.

General review studies also highlight the relevance of soft skills formation in higher education institutions. Messaoudi [19] in his systematic research shows that skills such as efficiency, initiative, and autonomy are particularly essential in the engineering field. This implies that educational institutions should develop these abilities in students not only indirectly but also through specific methods. Similarly, Dolce et al. [20] identify the gap between employer expectations and graduates’ actual competencies, proving that insufficient attention to soft skills can create difficulties in adapting to the labor market.

The role of digital technologies stands out as one of the key directions in this discussion. Orús et al. [21], using information and communication technologies (ICT), point to pedagogical approaches that contribute to the development of students’ 21st-century skills. These findings are

consistent with Teng et al. [22], who emphasize the growing importance of emotional intelligence and social competencies in the context of the Fourth Industrial Revolution. Likewise, Attou et al. [14] demonstrate that integrating digital games into the educational process increases student engagement and motivation, making it effective in developing soft skills.

At the policy level, Kornienko and Barchi [2] propose a comprehensive approach to support soft skills development in higher education systems. According to them, this support should extend beyond the learning process itself to include institutional policies and extracurricular activities, thus enabling students to apply the acquired skills in various contexts.

Overall, the analyzed studies show that digital technologies are not merely tools for delivering educational content but also create an adaptive environment that enables the development of essential skills such as creativity, teamwork, critical thinking, and adaptability. However, a recurring theme in the literature is the gap between theory and practice. While the importance of soft skills is widely recognized, discrepancies still exist between educational curricula and the actual demands of the labor market. Addressing this gap requires restructuring curricula, applying innovative digital methods, and bringing the education system closer to labor market requirements.

Conclusion

This study aimed to identify the possibilities of developing soft skills based on digital technologies within an adaptive learning environment. Theoretical analysis and practical research demonstrated that digital tools significantly contribute to the development of students' communication, teamwork, creative thinking, and problem-solving abilities.

The data obtained from the conducted survey were analyzed using SPSS Statistics 26.0. The internal reliability assessment showed a Cronbach's Alpha coefficient of $\alpha = 0.884$, indicating "good" reliability of the questionnaire. In addition, the average SUS score was 71.5, which falls within the "Acceptable" range and corresponds to the "Excellent" level in qualitative terms. This demonstrates that the digital technologies used in the adaptive learning environment were positively received by the students.

Thus, the results obtained confirmed that using digital technologies in an adaptive learning environment is an effective tool for developing soft skills. This approach not only deepens students' subject knowledge but also enables the development of universal competencies highly valued in the labor market. The research findings are applicable in educational practice and can serve as a methodological basis for implementation into pedagogical practice.

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Бейімделмелі оқу ортасында soft skills-ті дамыту: цифрлық технологиялар мысалы

Андатпа. Қазіргі білім беру жүйесінде бейімделмелі оқу ортасында soft skills (ікемді дағдыларды) дамыту мәселесінің маңызы артып келеді. Коммуникация, сыни ойлау, ынтымақтастық және мәселелерді шешу дағдылары еңбек нарығында сұранысқа ие мамандарды даярлаудың негізгі көрсеткіштері болып табылады. Осы тұрғыда цифрлық технологияларды (виртуалды шындық, үш өлшемді модельдеу, интерактивті симуляциялар) қолдану білім алушылардың оқу үдерісіне бейімделуін жеңілдетіп қана қоймай, сонымен қатар soft skills-тің қалыптасу үдерісін айтарлықтай жеделдетеді.

Зерттеудің мақсаты – бейімделмелі оқу ортасында цифрлық технологияларды қолданудың білім алушылардың soft skills-ін дамытуға ықпалын бағалау және олардың тиімділігін анықтау. Зерттеу барысында әдебиеттерге шолу жүргізіліп, сауалнама әдісі қолданылды. Жиналған деректер SPSS Statistics 26.0 және Microsoft Excel бағдарламаларының көмегімен өңделді. Статистикалық талдау аясында сипаттамалық статистика, Пирсон корреляциясы және Кронбахтың сенімділік коэффициенті ($\alpha = 0,884$, «жақсы» деңгей) есептелді. Сонымен қатар, бейімделмелі ортадағы жүйенің ағымдағы тиімділігін бағалау үшін System Usability Scale (SUS) әдісі қолданылды.

Зерттеуге барлығы 82 студент қатысты. SUS сауалнамасының нәтижелері бойынша орташа балл 71,5-ті құрады. Бұл көрсеткіш қабылданатын диапазонда орналасқан, сапалық тұрғыдан «Excellent» сипаттамасына сәйкес келеді және «B» бағалау деңгейіне жатады. Бұл білім алушылардың бейімделмелі цифрлық оқу ортасын жоғары деңгейде қабылдағанын көрсетеді. Сонымен қатар, сауалнама деректері цифрлық технологиялардың білім алушылардың коммуникациялық, ынтымақтастық және проблемаларды шешу дағдыларын едәуір жақсартқанын растады.

Кілт сөздер: бейімделмелі оқу ортасы, soft skills, цифрлық технологиялар, виртуалды шындық (VR), үш өлшемді модельдеу, интерактивті симуляция.

Развитие soft skills в адаптивной образовательной среде: пример цифровых технологий

Аннотация. В современной системе образования возрастает значимость развития soft skills в условиях адаптивной образовательной среды. Такие навыки, как коммуникация, критическое мышление, сотрудничество и решение проблем, являются ключевыми показателями подготовки специалистов, востребованных на рынке труда. В этом контексте использование цифровых технологий (виртуальная реальность, трёхмерное моделирование, интерактивные симуляции) не только облегчает адаптацию обучающихся к учебному процессу, но и существенно ускоряет формирование soft skills.

Целью исследования являлась оценка влияния использования цифровых технологий в адаптивной образовательной среде на развитие soft skills у студентов, а также определение их эффективности. В ходе исследования был проведён обзор литературы и применён метод анкетирования. Полученные данные были обработаны с использованием программ SPSS Statistics 26.0 и Microsoft Excel. В рамках статистического анализа были рассчитаны описательная статистика, коэффициент корреляции Пирсона и коэффициент надёжности Кронбаха ($\alpha = 0,884$, уровень «хороший»). Кроме того, для оценки текущей эффективности системы в адаптивной среде был использован метод System Usability Scale (SUS).

В исследовании приняли участие 82 студента. Согласно результатам опросника SUS, средний балл составил 71,5. Данное значение находится в допустимом диапазоне, качественно соответствует описанию «Excellent» и относится к уровню оценки «B». Это свидетельствует о высоком уровне восприятия студентами адаптивной цифровой образовательной среды. Более того, результаты анкетирования подтвердили, что цифровые технологии существенно способствовали развитию у студентов навыков коммуникации, сотрудничества и решения проблем.

Ключевые слова: адаптивная образовательная среда, soft skills, цифровые технологии, виртуальная реальность (VR), трёхмерное моделирование, интерактивная симуляция.

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