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Larysa Shevchuk*
Doctor of Pedagogical Sciences, Professor
Hryhorii Skovoroda University in Pereiaslav
08401, 30 Sukhomlynskoho Str., Pereiaslav, Ukraine
https://orcid.org/0000-0002-8405-1168

Andrii Hryhorenko
Postgraduate Student
Hryhorii Skovoroda University in Pereiaslav
08401, 30 Sukhomlynskoho Str., Pereiaslav, Ukraine
https://orcid.org/0000-0001-6856-9840

Oksana Shevchuk
Postgraduate Student
Mykhailo Dragomanov Ukrainian State University
02000, 9 Pyrohova Str., Kyiv, Ukraine
https://orcid.org/0009-0003-1901-690X

Simulation training in higher education: Assessment of perceived effectiveness and students' readiness to develop professional competencies

Abstract. The relevance of the topic is due to the need to introduce simulation technologies into the professional training of future specialists in the context of digitalisation of education and increased requirements for practical competence, which is confirmed by empirical data: 94.22% of surveyed students reported that the use of simulation complexes enhances the effectiveness of learning, and 97.77% positively evaluated the learning process in electronic simulation environments. The aim of the study was to identify the factors that influenced students' readiness to use simulation software packages within the electronic educational environment of higher education institutions. The empirical base (methods) was formed on the results of an online survey in which 450 students from Ukrainian universities participated on a voluntary basis. The study analysed students' attitudes toward simulation technologies, their learning preferences, and their level of readiness to use software simulation systems in the learning process. The results showed that e-learning using simulation systems was effective under the following conditions: realistic training scenarios; the possibility of repeatedly practicing practical actions without the risk of errors in a real environment; adaptation of the educational process to the level of student preparation; increased motivation due to interactivity and gamification. At the same time, it was found that the conclusions regarding the development of professional competencies were based primarily on students' self-evaluations, and therefore required further empirical verification using objective diagnostic tools. The practical significance of the results consisted in the possibility of using them to modernise educational programs and to improve the electronic educational environment of higher education institutions

Keywords: software modelling complexes; learning process; adaptive educational strategies; electronic educational environment

INTRODUCTION

The issue of latent knowledge retention has become increasingly significant, as a substantial proportion of acquired theoretical information is not transformed into practical application and, therefore, remains unused. This

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**Corresponding author (sheld65l@gmail.com)*

leads to the gradual loss of educational outcomes over time. The contemporary stage of higher education development is characterised by the intensification of digital transformation processes, the expansion of interactive learning formats, and the transition to competence-based training models. Under such conditions, the educational environment requires tools that ensure active engagement, continuity of learning, and the possibility of safe experimentation with professional tasks. Simulation-based digital environments provide conditions for practising functional actions in close-to-real situations, supporting gradual skill development, self-regulation, and adaptive learning trajectories.

An analysis of scientific sources showed that simulation tools are one of the most effectively described types of interactive technologies in the literature, widely used in virtual educational environments. In the context of professional training for future vocational teachers, simulations provide the opportunity to recreate professionally oriented situations, perform actions in safe conditions, and model operations that require special equipment or access to production resources in the real educational process. I. Kos (2024) believed that simulation complexes allow complex processes to be reproduced in a visual form, model parameters to be varied, the consequences of decisions made to be analysed, and actions to be corrected in real time. The use of such tools supports active interaction between students and educational material, promotes the development of operational thinking, professional skills, and digital competence. D. Antoniuk *et al*. (2023) emphasised that the relevance of simulation technologies increased significantly during the COVID-19 pandemic and wartime conditions, when flexible and immersive learning formats became essential.

J. Dron (2022) noted that the advancement of computer technologies and digital communication networks has facilitated the spread of simulation software and business games across higher education. V. Ahuja (2024) emphasised the central role of modelling in enhancing the learning experience. The scientist argued that the impact of simulation-based learning on business education is particularly significant, encompassing research on business simulation games, computer-based simulations, and their influence on skills development, learning processes, and overall performance. A. Binsztok *et al*. (2022) described simulation modelling as an experimental method that enables the analysis of real systems while avoiding risks inherent in real-world processes. Research by I. Buil *et al*. (2019) and O. Chernikova *et al*. (2020) demonstrated the significance of simulation environments in developing collaborative problem-solving and team interaction. T. Peters, & P. Stamp (2021) and V. Chernenko *et al*. (2021) additionally noted the improvement of communication and organisational competences gained through participation in simulated professional situations.

The primary aim of the study was to analyse the effectiveness of simulation-based learning in higher education and its role in the development of students' professional competencies. In accordance with this aim, the research examined students' attitudes toward the use of simulation software in virtual learning environments, taking into consideration both its advantages and the challenges associated with its implementation. Furthermore, attention was given to the organisation of individual and group learning formats involving simulation technologies, with an emphasis on their pedagogical potential. The study also investigated the degree of students' readiness to apply simulation-based learning in their future professional activities, focusing on the formation and manifestation of relevant competencies.

MATERIALS AND METHODS

The study was based on a mixed-methods approach, combining qualitative and quantitative methods to assess the effectiveness of simulation-based learning in higher education. At the first stage, a theoretical analysis of scientific sources and previous research was carried out to determine the main principles of integrating simulation software into educational practice. The works of (Chernikova, *et al*., 2020; Sakun *et al*., 2020; Chernenko *et al*., 2021) were reviewed to establish the conceptual framework of the study. The second stage involved empirical research, which included a survey conducted among 450 respondents, comprising bachelor's, master's, and postgraduate students from Mykhailo Drahomanov Ukrainian State University, Hryhorii Skovoroda University in Pereiaslav, and International European University. The survey was carried out between October and December 2024 in an online format using the platforms Google Forms and Microsoft Forms. The data collection was conducted through anonymous questionnaire-based surveying, without requiring respondents to provide personal identification details. The purpose of the survey was to determine students' attitudes toward simulation-based learning, assess their level of motivation, and evaluate the perceived effectiveness of simulation tools in a blended learning environment.

The study incorporated expert evaluations of students' readiness to integrate simulation-based learning into their future teaching practices. The experts included university professors with specialist knowledge in the fields of pedagogical innovations, digital education and instructional technologies. The evaluations focused on the following criteria:

1) theoretical preparedness – understanding the principles and applications of simulation software;

2) practical competence – ability to operate, implement and integrate simulation tools into the educational process;

3) digital competence – familiarity with digital learning environments and adaptability to simulation technology-enhanced teaching.

Statistical analysis of the collected data was carried out using both descriptive and inferential methods. In particular, Pearson's correlation coefficient (for normally distributed variables) and Spearman's rank correlation coefficient (for non-parametric data) were applied to determine the relationships between students' motivation, their perceived effectiveness of simulation software, and their readiness to apply these tools in professional contexts. Correlation coefficients were calculated between the dependent variable – students' willingness to integrate simulation tools into professional practice – and a number of independent variables, such as: level of digital competence; field of study; year of study; previous experience with modelling/simulation software. The correlation coefficient was selected depending on the nature of the distribution of each variable: (1) for normal distribution, Pearson's correlation coefficient (r) was used, which allows assessing the linear dependence between variables; (2) for deviations from normality or in the case of ordinal variables, Spearman's correlation coefficient (ρ) was used, which allows monotonic dependencies to be measured.

The computation is based on the regression equation presented in Formula (1), which includes the constant term and four independent variables-digital competence, previous modelling experience, field of study, and year of study-each weighted by its corresponding regression coefficient

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \varepsilon, \qquad (1)$$

where Y – students' readiness to integrate simulation tools; β_0 – constant; β_i – regression coefficients; x_1 – level of digital competence; x_2 – field of study; x_3 – year of study; x_4 – previous experience with simulation software; ε – model error. This formula is used to model the relationship between multiple explanatory variables and students' readiness to use simulation tools, allowing for an assessment of the individual contribution of each predictor while controlling for the effects of the others. On this basis, a multiple linear regression model was constructed to estimate the combined influence of digital competence, prior experience, and academic characteristics on readiness and to evaluate the predictive capacity of the proposed model. The study adhered to ethical research standards, ensuring anonymity and voluntary participation (Ethical Code of a Scientist of Ukraine, 2009).

RESULTS AND DISCUSSION

The use of simulation modelling in educational practice

A review of international and domestic experience in the use of software simulation complexes in an educational context reveals a clear and consistent trend: there is growing scientific interest in the integration of gaming technologies and simulations at the level of higher education. The introduction of new teaching technologies, starting with game-based learning integrated into lectures and practical classes for training management specialists, as well as the rapid development of information and communication technologies (ICT), according to A. Negahban (2024), required the transformation of higher education and greater use of business computer games as innovative teaching technologies. In addition, the European Social Simulation Association (n.d.) holds annual conferences, seminars and congresses, and publishes the electronic journal JASSS. The work of I. Buil *et al*. (2019) demonstrated that the use of games and simulations has a variety of positive effects in numerous applications, including improving student performance, interaction between learners in groups, and motivation to learn. The distinctive feature of simulation modelling as a research method is that it enables the conduct of computer experiments, whereby the researcher can "fix" the desired variables, influencing and changing only some of them. Furthermore, simulation modelling fosters the development of students' genuine interest in their future profession. The use of imitation modelling in the context of professional situations represents an effective and methodologically sound technique that is highly relevant in the present day. Situational modelling (business games) is a method based on recreating certain situations in special laboratory conditions in order to solve complex problems or for educational purposes that may arise in real systems. The concept of "situation" is quite multifaceted and is defined differently depending on the area of its use. N. considers a situation as a system of conditions external to the subject that motivate and mediate its activity (Chepelieva *et al*., 2025).

According to S. Korolyuk & N. Kononets (2022), the analysis of a specific situation is an in-depth and detailed study of real or artificial circumstances, carried out with the aim of identifying characteristic properties. The simulation method involves immersing individuals in fictitious conditions that mimic real-life scenarios for the purpose of training or assessment. According to S. Korolyuk & N. Kononets (2022), high-quality simulation consists of three main structural components: a carefully designed working model of the professional environment, which offers a wide range of options for behaviour and interaction with other people; a modelling process designed to promote the development of intuition and the search for alternative, non-standard solutions to problems; the presence of a mentor who uses a "skifolding" strategy, characterised by the gradual withdrawal of assistance from the teacher as the student progresses in their independent work. G. Kravchuk & T. Shevchuk (2019) believed that this method should be used in training future managers, as it develops applicants' analytical thinking and systematic approach to problem solving, allows them to distinguish between correct and incorrect management decisions, select (and formulate) criteria for finding the optimal solution, teaches how to establish business and professional contacts, make collective decisions and resolve conflicts. The educational environment, when active learning methods are used, in particular software simulation complexes, where they reflect the essence of the future profession and shape the professional qualities and competencies of specialists, is a kind of testing ground where students can practise their professional skills in conditions close to real life. A deep and broad analysis of the actions of student teachers, which is carried out during the summing up, reduces the likelihood of repeating mistakes in real professional activity. This helps to reduce the time it takes for a young specialist to adapt to the full performance of their professional activities.

This ability determines the expediency and necessity of using software modelling complexes in training, in the process of which the student must perform actions similar to those that may occur in their professional activities. L. Uryvskyi *et al*. (2022) believed that modern computer modelling is a means of: communication between people (exchange of information, computer models and programmes), understanding and cognition of phenomena in the surrounding world (computer models of the solar system, atoms, etc.), training and practice (simulators), optimisation (selection of parameters). Since its inception, computer modelling has penetrated many fields of science, among which economics, ecology and the military sphere traditionally occupy the first place (in some models, they are closely intertwined). According to O. Prigunov & Y. Yavorska (2023), most modern business simulators have a variety of tasks, which makes the learning process more universal. However, the developers of these games and researchers focus most of their attention on the methodological support of certain disciplines in the economic fields of research, in particular the specialities of accounting and auditing, economic theory, finance and credit, business economics, management, etc.

The use of a computer-modelled learning system gives students the opportunity to experiment with new models of behaviour in a competitive environment, confront their fears, master new approaches to problem solving, and develop strategies that can be applied in real professional contexts. According to V. Senadheera *et al*. (2024), the basis of the modelling system should be a model of the object's activity, developed on the basis of analytics of the current situation in the relevant industry. In the process of game-based learning, participants will have to perform actions to solve management tasks in various aspects of the object's activities (development and implementation of strategies, construction of development programmes, infrastructure management, etc.). The mathematical model should demonstrate the consequences of the decisions made by the participants. A. Haleem *et al*. (2022) believed that this approach to professional training is more realistic than a set of separate questions on the topic under study, which are considered without any connection to reality. Technological advances in education have made life easier for students. Instead of pen and paper, students today use a variety of software and tools to create presentations and projects. When using computer modelling in the learning process, real professional fragments of activity and interpersonal relationships of specialists engaged in it are reproduced, and students are provided with the outlines and contexts of their future professional activity.

L. Sakun *et al*. (2020) believed that these tools promote the integration of theoretical knowledge with practical application, improving the overall learning process and ensuring the development of the necessary professional competencies. The use of software modelling complexes in the training of vocational education students involves the conceptualisation of a system that distinguishes between group, individual and individual-group lessons, in combination with the sphere of independent learning (work) of students. This system is based on identifying the prevailing cycles of educational activity management, as well as determining the degree of influence of electronic learning tools on the effectiveness of learning. Group classes using software modelling complexes can take place without feedback or with partial feedback. These are lecture-style classes, where the teacher unilaterally conveys information and makes adjustments to the content and form of its presentation (feedback) based solely on visual or associative factors. Practical and laboratory classes are conducted in groups with more pronounced feedback when using software modelling complexes. The process of individual student classes using software modelling complexes takes place under the supervision and participation of the teacher with feedback. These can be classes with a student individually or as part of a group, when they fall into the category of individual and group classes. The process of independent learning using software modelling complexes should be viewed as a process of self-organisation (self-governance) without the participation of a teacher. The actual learning process is mixed, in which the above types of processes occur. O. Chernikova *et al*. (2020) believed that electronic learning tools should integrate the entire system of basic principles, methods, content, and the above-mentioned organisational and technological features of the learning process.

Assessment of the effectiveness and students' attitudes towards simulation tools in education

This study focuses on industry-specific software developed for modelling technical processes and production situations. This software is used in the training of future teachers at vocational and technical educational institutions specialising in engineering and technology. These include programmes such as FluidSIM, Factory I/O, Tinkercad, AutoSIM and Simulink, which facilitate the modelling of pneumatic, electrical, electronic and automated systems. The results of a comparative analysis of specialised software for training (SST) future teachers in terms of competence, adaptability and interactivity are presented in Table 1. The initial attempt to assess the effectiveness of the implementation of the SPE was based on a survey of students and teachers to find out the frequency of use of simulation environments, the types of software used and subjective assessments of its impact on learning. In the first stage of the study, respondents were surveyed about their attitudes towards the use of simulation tools in the electronic educational environment (Table 2), which made it possible to ascertain the level of awareness of students about the relevant tools, determine their readiness to work with such technologies, and identify key expectations and barriers associated with their use.

Table 1. Comparative characteristics of specialised software for use in vocational and pedagogical training

SST	Developed professional competencies	Possibilities of adaptation to the pedagogical context	Level of interactivity/ complexity
FluidSIM	- Technical design - Systems thinking - Analysing the logic and control of pneumatic and hydraulic systems	- Ability to model real automation schemes - Visualisation is available to explain the logic of operation - Suitable for developing STEM competences	High (medium level of difficulty)
Factory I/O	- Spatial imagination - Understanding of production processes - Interaction with PLCs	- Virtual factories allow you to explain industrial automation - Used in conjunction with controllers (Siemens, Allen-Bradley) - Ideal for professional training in the field of mechatronics	High (high level of complexity)
Tinkercad	- Electronics basics - Prototyping - Visual programming	- Designed for beginner and intermediate levels - Ideal for teaching the basics of digital electronics and Arduino - Can be used in schools and VET centres	Medium (low-medium level of difficulty)
AutoSIM	- Modelling of automated systems - PLC programming - Testing of technical scenarios	- Creation of models for training in industrial automation - Availability of simulation and test modes - Suitable for creating professional cases	High (medium-high level of difficulty)
Simulink	- Mathematical modelling - Cyber-physical systems - Management of technical objects	- Basic MATLAB training required - Great opportunities for engineering education and research - Can be used in the training of technical teachers	Very high (high level of complexity)

Source: developed by the authors

Table 2. Survey results on students' attitudes towards the use of simulation tools in a virtual learning environment

No.	Respondent statement	Share of positive responses, %	Interpretation of results
1	The use of simulation complexes in virtual learning offers clear advantages	94.22%	Indicates a high level of general support for simulation-based learning
2	Positive attitude towards e-learning	96.6%	Confirms the acceptability of digital learning formats
3	Effectiveness of self-directed learning using simulation complexes	98%	Demonstrates that simulations promote student autonomy
4	Necessity of considering students' individual characteristics when applying simulation complexes	98.8%	Highlights the requirement for personalisation within simulation-based learning
5	Importance of accounting for psychophysiological characteristics in simulation-based learning	97.55%	Underlines the significance of adaptive learning systems
6	Simulation complexes should model a professionally oriented learning environment	99.11%	Confirms the need for professionally relevant simulation scenarios
7	Positive attitude towards the use of mobile technologies	97.11%	Indicates readiness for mobile-supported learning formats
8	Overall effectiveness of learning in electronic simulation environments	97.77%	Reinforces the relevance and demand for simulation-enhanced learning

Source: developed by the authors

It turned out that 94.22% of the respondents believe that the use of simulation complexes in virtual environment learning, as well as the implementation of their adaptive capabilities in professional training, brings undoubted benefits (1). A positive attitude towards e-learning was expressed by 96.6% of students (2). In the opinion of 98% of students, the organization of the process of independent learning during individual and individual-group classes using simulation complexes is effective (3). The overwhelming majority of students, namely 98.8%, believe that the necessary implementation of teaching professional cycle disciplines by means of simulation complexes depends on the individual characteristics of students (4). For 97.55% of respondents, it is mandatory to take into account the psychophysiological characteristics of students during training in a simulation environment (5). 99.11% of the respondents believe that simulation complexes should be built to simulate a professionally oriented learning environment (6). 97.11% of respondents show a positive attitude towards the use of mobile technologies in the educational process (7). In general, 97.77% of respondents consider the learning process in electronic simulation environments to be effective, which confirms the relevance of the topic of the chosen study (8). The results of the survey are presented in Figure 1. At the same time, these results not only demonstrate general support for simulation training, but also indicate the need for a more in-depth analysis of the factors that shape students' willingness to integrate simulation tools into their professional activities. With this in mind, an additional analytical stage was introduced to ensure consistency between the stated research objective and its empirical results.

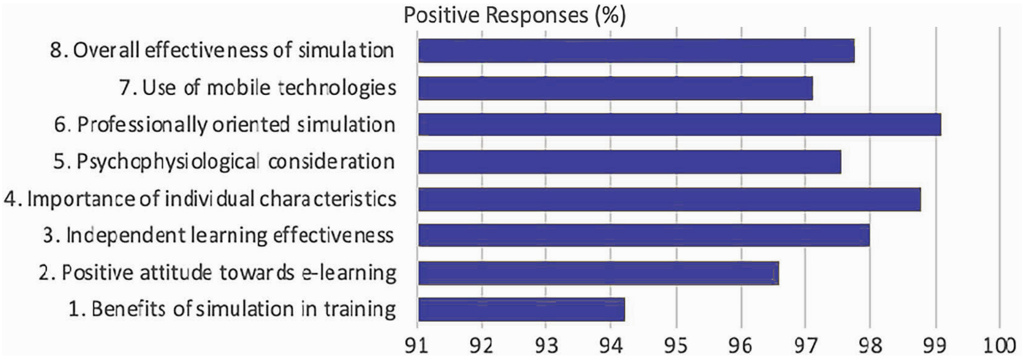

Figure 1. Results of the survey of respondents' attitudes towards the use of simulation tools in the electronic educational environment

Source: developed by the authors

Correlation and regression analysis of factors influencing students: Readiness to use simulation tools

To clarify the factors influencing students' readiness to integrate simulation tools into their professional activities, a correlation analysis was performed, followed by multiple regression modelling. This analytical procedure made it possible to identify not only the nature and strength of the relationships between variables, but also to assess the contribution of each factor to the overall predictive model. The results of the correlation analysis showed: (1) a high positive correlation between the level of digital competence and readiness to use simulation tools ($r/\rho \approx 0.62$-0.68; $p < 0.01$); (2) a moderate positive correlation between previous experience with modelling programmes and willingness to use them ($r/\rho \approx 0.48$-0.55; $p < 0.05$); (3) a low or statistically insignificant correlation for the variables "field of study" and "year of study" ($p > 0.05$). The results of the correlation analysis demonstrated statistically significant positive associations between these variables, which were subsequently integrated into the overall interpretation of the research findings. These results indicate that students' readiness to integrate simulation learning depends most on their digital competence and experience with relevant tools (Table 3).

Table 3. Correlation and regression analysis results for factors influencing students' readiness to use simulation-based learning tools

Predictor (Independent Variable)	Correlation with Readiness (r / ρ)	Significance (p)	Standardised Regression Coefficient (β)	Interpretation
Digital Competence Level	$r = 0.65$	$p < 0.01$	$\beta = 0.47$	Digital competence substantially increases readiness to use simulation tools
Previous Experience with Modelling/Simulation Software	$r = 0.52$	$p < 0.05$	$\beta = 0.35$	Prior experience with simulation tools increases readiness and lowers technological barriers.
Year of Study (Bachelor/Master/ Postgraduate	$\rho = 0.18$	$p > 0.05$	$\beta = 0.09$	Readiness does not increase with academic progression
Field of Study (pedagogical vs. non-pedagogical specialisation)	$\rho = 0.14$	$p > 0.05$	$\beta = 0.12$	Readiness does not depend strongly on academic specialisation

To verify the predictive power of independent variables and determine their contribution to the variability of the dependent variable, the multiple linear regression method was used. To demonstrate the practical application of the multiple linear regression model employed in this study, a sample calculation of the predicted readiness level was performed for a hypothetical student profile. By multiplying the value of each predictor by its estimated coefficient and summing these products together with the constant term, an estimated readiness score ($\hat{Y}$) can be obtained for an individual learner. The step-by-step calculation is summarised in Table 4 and Figure 2.

Table 4. Calculation of the predicted readiness level based on the multiple linear regression model

Parameter	Variable Value	Coefficient (β)	Product β · X
Constant (β_0)	-	0.05	0.05
Digital Competence (X_1)	4	0.47	1.88
Previous Modelling Experience (X_2)	3	0.35	1.05
Field of Study (X_3)	1 (pedagogical)	0.12	0.12

Table 4. Continued

Parameter	Variable Value	Coefficient (β)	Product β·X
Year of Study (X_4)	3	0.09	0.27
Σ (sum of products)	-	-	3.37

To illustrate the relative influence of each predictor in the regression model, Figure 2 presents the standardised regression coefficients (β). The diagram enables a clear comparison of how the analysed factors relate to students' readiness to use simulation-based learning tools.

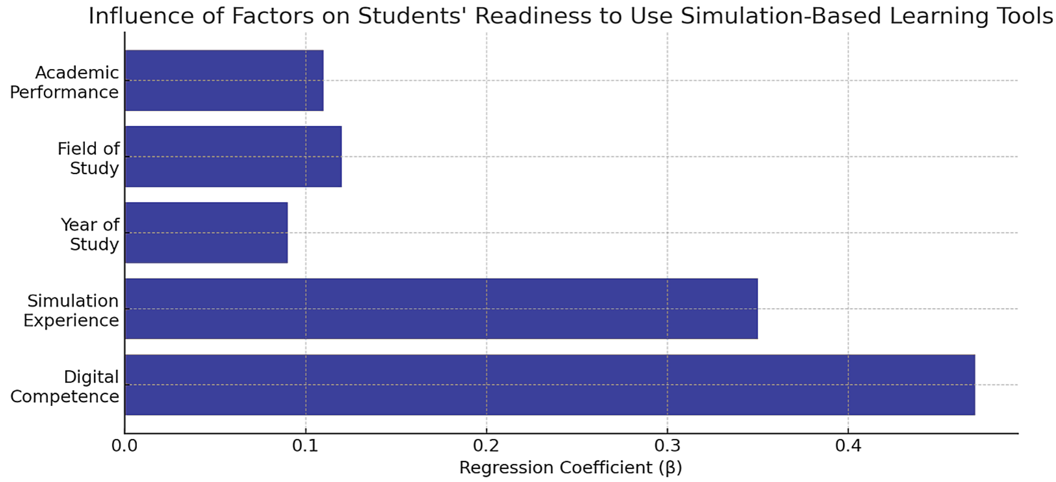

Figure 2. Influence of key factors on students' readiness to use simulation-based learning tools
Source: developed by the authors

The results obtained in this study indicate a consistently positive attitude of students toward simulation-based learning within the electronic educational environment, as well as a high evaluation of its effectiveness in blended learning formats (with over 94-99% across key indicators). Overall, these findings are aligned with current scholarly discourse, in which simulation and modelling tools are viewed as significant means of strengthening practice-oriented training, fostering learner autonomy, and developing higher-order professional competencies. The outcomes of the present research correlate with the meta-analysis conducted by A. Alharbi *et al*. (2024), who demonstrated that simulation-based learning contributes not only to increased learner motivation but also to measurable and sustained improvements in academic performance, provided the instructional sequence is methodologically structured. This underscored the pedagogical importance of a well-designed learning cycle incorporating briefing, interactive practice, debriefing, and reflective integration-an approach consistent with the conclusions drawn from the received data regarding the need for purposeful pedagogical orchestration of simulation environments. In the field of engineering education, the findings of A. Negahban (2024) revealed a systematic shift from traditional laboratory practice towards digital simulations and immersive learning environments. The author emphasised that these transformations necessitate adequate institutional support, including technical infrastructure and lecturer preparedness. This observation corresponds with the authors' results, which identify digital competence as a key individual factor influencing students' readiness to employ simulation tools.

The research conducted by D. Meronda *et al*. (2025) on virtual laboratories confirmed that simulation environments impact not only motivational aspects of learning but also cognitive outcomes, including enhanced analytical reasoning and conceptual understanding. These conclusions are in agreement with the high levels of readiness for independent work in simulation-based environments recorded in the study. The work of D. Llanos-Ruiz *et al*. (2025) concerning VR applications in higher education highlights the capacity of immersive technologies to support the understanding of complex concepts and facilitate practical engagement. However, the authors emphasise that learning outcomes are contingent upon alignment between VR activities and intended educational objectives. This clarifies why the respondents particularly valued simulation environments that closely emulate real professional contexts. Research by M. Mohammadi *et al*. (2025) in blended learning settings demonstrates a direct relationship between the use of interactive digital tools and increased academic engagement and intrinsic motivation. The authors' findings corroborate this tendency while also suggesting that the strength of these effects may vary depending on disciplinary field and level of study. In the domain of business education A. Velez & R. Alonso (2024) showed a shift from evaluating simulation tools based on general usefulness toward assessing their impact on specific learning outcomes, such as decision-making, entrepreneurial reasoning, and collaborative competence. The conclusions of the research align with this perspective, particularly in regard to the significance of realistic scenario-based learning for developing professional readiness. The study by M. Feijoo-Garcia *et al*. (2024) demonstrated that combining simulation-based learning with argumentative practices enhances students' capacity to integrate evidence-based reasoning in engineering design processes. This supports the assertion regarding the necessity of integrating both technical and methodological components in the design of simulation-based instruction.

Further, research by M. Kurtz *et al*. (2025) suggested that simulation environments hold considerable potential for developing social-emotional learning and collaborative capacities, which is particularly relevant for the preparation of future educators. At the same time, M. Ali (2025) noted that the effectiveness of simulations is influenced by the level of feedback and the cognitive complexity of the tasks involved. This observation indicated the relevance of applying hierarchical or structural modelling in the next stage of the authors' research to more precisely identify the predictive role of digital competence, prior experience and disciplinary background in students' readiness to implement simulation technologies. Taken together, the synthesis of empirical findings and current international research confirms that simulation-based technologies contribute to increased learning motivation, facilitate the transition from theoretical knowledge to practical application, and support the development of professional competencies. Future research should focus on deepening the modelling of readiness factors, including digital literacy, prior learning experiences, and curriculum-specific characteristics.

CONCLUSIONS

The study identified the key factors associated with students' readiness to use simulation tools in a virtual educational environment. The survey results demonstrated a consistently high level of students' positive attitudes towards simulation-based learning, as well as towards the use of mobile and digital technologies in professional training. The correlation analysis revealed a statistically significant positive relationship between students' level of digital competence and their readiness to use simulation tools ($r = 0.65$, $p < 0.01$), indicating a moderate to strong association. A moderate positive correlation was also found between previous experience with simulation or modelling software and readiness to use such tools ($r = 0.52$, $p < 0.05$). These findings suggest that higher levels of digital competence and prior practical experience contribute to increased readiness for the integration of simulation-based learning.

The multiple regression analysis confirmed the predictive role of these factors. Digital competence showed the strongest contribution to the model ($\beta = 0.47$), followed by previous experience with simulation tools ($\beta = 0.35$). In contrast, variables related to the field of study ($\beta = 0.12$) and the year of study ($\beta = 0.09$) demonstrated weak and statistically insignificant effects, indicating that readiness does not substantially depend on academic specialisation or level of study.Overall, the explanatory power of the regression model indicates that the included predictors account for a meaningful portion of the variability in students' readiness to use simulation tools. At the same time, the presence of unexplained variance suggests the need for further research to examine additional pedagogical, organisational, and psychological factors influencing readiness for simulation-based learning. The results obtained can be used to gain a deeper understanding of which student characteristics correlate with their readiness to integrate simulation tools into the learning process. Further research could focus on expanding the model with additional variables, analysing different educational contexts, or using mixed methods to comprehensively study the factors that influence the use of simulation technologies in professional training.

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CONFLICT OF INTEREST

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Лариса Шевчук
Доктор педагогічних наук, професор
Університет імені Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
https://orcid.org/0000-0002-8405-1168
Андрій Григоренко
Аспірант
Університет імені Григорія Сковороди в Переяславі
08401, вул. Сухомлинського, 30, м. Переяслав, Україна
https://orcid.org/0000-0001-6856-9840
Оксана Шевчук
Аспірант
Український державний університет імені Михайла Драгоманова
02000, вул. Пирогова, 9, м. Київ, Україна
https://orcid.org/0009-0003-1901-690X

Симуляційне навчання у вищій школі: оцінка сприйнятої ефективності та готовності студентів до розвитку професійних компетенцій

Анотація. Актуальність теми зумовлена необхідністю впровадження імітаційних технологій у професійну підготовку майбутніх фахівців в умовах цифровізації освіти та підвищених вимог до практичної компетентності, що підтверджується емпіричними результатами: 94,22 % опитаних студентів відзначили підвищення ефективності навчання при використанні симуляційних комплексів, а 97,77 % – позитивно оцінили навчальний процес у електронних симуляційних середовищах. Метою дослідження було виявлення чинників, що впливали на формування готовності студентів до використання імітаційних програмних комплексів у межах електронного освітнього середовища закладів вищої освіти. Емпірична база ґрунтувалася на результатах онлайн-анкетування, у якому взяли участь 450 студентів українських університетів на добровільних засадах. У ході дослідження аналізувалися ставлення здобувачів освіти до імітаційних технологій, їхні навчальні уподобання, а також рівень готовності до застосування програмно-симуляційних комплексів у навчальному процесі. Отримані результати показали, що електронне навчання із використанням симуляційних систем було ефективним за таких умов: реалістичність навчальних сценаріїв; можливість багаторазового відпрацювання практичних дій без ризику помилок у реальному середовищі; адаптація освітнього процесу до рівня підготовки студентів; підвищення мотивації завдяки інтерактивності та гейміфікації. Водночас було встановлено, що висновки щодо розвитку професійних компетентностей ґрунтувалися переважно на самооцінках здобувачів освіти, а тому потребували подальшої емпіричної перевірки з використанням об'єктивних методик діагностики. Практичне значення отриманих результатів полягало у можливості їх застосування для модернізації освітніх програм та вдосконалення електронного освітнього середовища закладів вищої освіти

Ключові слова: програмно-моделюючі комплекси; процес навчання; адаптивні освітні стратегії; електронне освітнє середовище