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Modeling the development of pedagogical competence in higher education educators amid the digitization of the contemporary world

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In today's rapidly evolving educational landscape, possessing digitalization competency is paramount for educators, as it enables them to effectively navigate the digital realm and engage with students in innovative ways. The global digitization of education contributes to a transformation in the context of competencies for higher education instructors. The objective of the current study is to ascertain the impact of this model on the development of competencies in contemporary educators and the enhancement of their skills. The research sample comprised 84 educators from the Karaganda Buketov University, who were categorized into two groups: control and experimental. Measurements of critical thinking levels (Critical Thinking Test Level I, CTT-I) and digital literacy (DigCompEdu CheckIn1) were administered to both groups before and after the program. Participants in the proprietary module constituted the sample of educators in the experimental group. The correlation of results indicates significant differences between the groups' indicators before and after the module implementation. The positive dynamics of dependent variables resulting from the model implementation attest to the effectiveness of the current program in the context of developing educators' critical thinking ($p = 4.03$ for critical thinking) and ($p = 1.42$ for digital literacy). In other words, the implementation of the model for the development of professional competencies among educators, based on the examined educational institution in Kazakhstan, enhances the critical thinking and digital literacy of educators. The practical application of this research lies in implementing this module as part of a systematic approach to competency development for educators in universities.

KEYWORDS

critical thinking, digital literacy skills, educators, pedagogical competencies, professional competence of educators

1 Introduction

The 21st century has witnessed revolutionary changes in all aspects of life, with education being no exception. The digital revolution and the general transition to a digital society exert a significant influence on educational processes, necessitating educators to adapt to new challenges. The contemporary educator must possess novel competencies and the ability to employ digital technologies in teaching (Benade, 2017).

One of the key factors driving changes in the activities of contemporary educators is the process of digitizing education. Global challenges, such as the coronavirus, have led to a widespread shift to hybrid forms of learning and the utilization of available digital technologies (Sulaiman and Ismail, 2020). Consequently, modern higher education has become more interactive and accessible, thanks to digital technologies. Students now have the opportunity to study materials not only within the university but also at home or even while traveling. This necessitates a reevaluation of the role of educators (Perifanou et al., 2021). They are no longer just bearers of knowledge but mentors contributing to the development of self-learning skills and critical thinking in students. Technologies have had a substantial impact on the professional orientation and preparation of educators, providing access to a vast array of educational materials and assisting in the development of innovative teaching and assessment methods (Oliveira et al., 2019).

The advent of digital information exchange has acquired significant importance in contemporary educational contexts. A broad spectrum of tools available to all educational stakeholders offers an unlimited resource for the synthesis, analysis, and processing of information (Rubach and Lazarides, 2021). On the flip side, the proliferation of the Internet and digital information sources introduces a range of challenges associated with security. Open access to diverse media necessitates the establishment of a rational and coordinated internet usage system by students. Consequently, educators must instruct students on discerning reliable sources from unreliable ones, critically evaluating information, and employing it to address tasks and problems (Caena and Redecker, 2019).

The contemporary educator must be a proficient user of digital tools and platforms, possessing the knowledge of utilizing electronic resources for educational purposes and integrating them into their practice. In this context, there is a compelling need for educators to possess sufficient digital competencies. A deficient resource base and a low level of digital literacy currently serve as barriers to the effective education of the modern youth (Nouri et al., 2020).

The cultivation of digital competencies is accompanied by the development of other skills, with several aspects identified as crucial for the 21st-century university educator, evolving in accordance with contemporary educational needs (Jawad et al., 2021). Specifically, the enhancement of creativity and innovation in the approach to work is emphasized. Creative thinking is indispensable for the advancement of innovations and pioneering teaching methods. Educators who promote creativity teach their learners to think unconventionally and find alternative solutions, contributing to the creation of stimulating learning environments and the development of problem-solving skills, which are essential in life (Borodina et al., 2019).

A pivotal determinant for the 21st-century educator is the ability for self-learning and self-reflection. This skill enables educators to adapt their practices to the changing needs of students, thereby enhancing the quality of education (Sudargini and Purwanto, 2020). A critical aspect assumes particular significance—the ability for critical thinking. In the context of dealing with vast amounts of data, essentially considering digitization, educators' critical thinking determines their capacity to analyze information used in their work. The modern educational landscape is saturated with new technologies, pedagogical theories, and various teaching approaches. Educators must be capable of critically evaluating this information, discerning facts from pseudo-scientific theories, and selecting the best teaching methods for their learners (Akramova and Akramova, 2021).

Educators are increasingly incorporating principles from programs like the "DigCompEdu" by the European Commission, which emphasizes enhancing pedagogical competence, particularly in digital competencies. This includes information and data literacy, effective communication using digital tools, collaboration and digital collaborative development, digital creativity skills, digital security and confidentiality, and adaptability and problem-solving skills in the digital domain.

The current research lacks immediate urgency and empirical data, highlighting the need for a focus on pedagogical competence, particularly in handling digital competencies like internet usage. The success and failure of internet integration in education have been discussed (Wagiran et al., 2022; Triyono et al., 2023), along with the levels of digital competency required (Mutohhari et al., 2021; Astuti et al., 2022). Existing studies point to several knowledge gaps, including the need to assess educators' digital competence levels, identify specific skills required, understand challenges in integration, explore effective training strategies, and consider contextual factors. Addressing these gaps can lead to improved digital readiness among educators in higher education, particularly in Kazakhstan.

The contemporary educational process is relatively slow in taking measures to develop the necessary competencies among educators. The evolving environment indicates that in some regions, there is an insufficient allocation of resources for timely responsiveness (Chernobai and Tashibaeva, 2020). Examining the state of Kazakhstan, it is notable that concerted efforts to adapt the activities of university educators to current challenges are insufficient. Many educators lack adequate preparation in the realm of digital technologies. This implies a deficiency in the requisite knowledge and skills to utilize digital technologies for teaching and instruction (Kurmankulova et al., 2022; Shamshatova, 2022). Therefore, it is recommended to integrate programs into the educational process aimed at enhancing digital literacy and other crucial competencies of educators. These programs should encompass training in the fundamentals of digital technologies, as well as the development of critical thinking and creativity in the digital environment. The main problem of this study is the insufficient development of digital competences among educators, particularly in the context of higher education in Kazakhstan. This is highlighted by the fact that many educators lack adequate training in digital technologies, which hinders their ability to effectively integrate these tools into learning and teaching.

2 Literature review

2.1 Pedagogical competence

In the scholarly literature, there exists a range of scientific definitions for the concept of "pedagogical competencies." Derkach and Kuzmina (1993) regard pedagogical competencies as the

amalgamation of a teacher's skills, wherein the educator, as the subject of pedagogical influence, structurally organizes scientific and practical knowledge distinctively for the optimal resolution of pedagogical tasks. In her works, Markova (1983) defines pedagogical competencies as "the ability and readiness to perform personal professional activities." On the other hand, Zeer conceptualizes competence as the aggregation of knowledge, skills, and experience, reflected in theoretical and applied preparedness for their implementation at the level of functional proficiency. In general, scholars define it as a set of skills and knowledge that educators apply at the level of their teaching activities (Zeer et al., 2005).

The framework developed by Trilling and Fadel is described in "21st Century Skills: Learning for Life in Our Times," and it highlights the importance of critical competencies like creativity, critical thinking, communication, and teamwork for success in the modern world. The Future of Jobs Report 2023 expands on this framework and provides insightful information about how these skills are changing in the workforce. Developing a culture of creativity and adaptability, encouraging interdisciplinary collaboration, and giving priority to skill development through customized training programs are all necessary for incorporating these insights into organizational practices. Through adherence to these principles, organizations can efficiently equip their workforce to handle the ever-changing demands of the modern workplace, guaranteeing their continued relevance and competitiveness (Trilling and Fadel, 2012).

In the contemporary world, educators must be open to diverse cultures and ready to collaborate with students from different countries and backgrounds. Special attention should be given to the English language as a source of international knowledge and experience exchange. A teacher should diligently focus on acquiring proficiency in a foreign language to facilitate communication with colleagues or students from diverse cultural backgrounds. Adaptability and flexibility are important competencies for the modern educator. They should be prepared for changes and able to adapt to the needs of various students and different learning styles. Additionally, critical thinking skills should be highlighted as a separate competency.

2.2 Critical thinking and digital literacy skills

According to Halpern (2013), critical thinking involves the analysis, evaluation, and interpretation of information to form judgments. This approach emphasizes the rational and logical nature of critical thinking, as well as its orientation towards reaching well-founded conclusions. Lau (2011) defines critical thinking as a process of analyzing and evaluating information to form one's judgment. Considering this, the author points out that critical thinking is an integral part of creativity and effective information exchange. Critical thinking is a crucial skill for educators as it enables them to effectively utilize digital technologies and contribute to the development of critical thinking in students (Kozikoglu, 2019), especially when dealing with the implementation of large datasets in student work. The ability to identify, organize, and critically evaluate information is one of the key competencies of the 21st century (Instefjord and Munthe, 2017).

University education is constantly evolving, and one of the key components of this process is the pedagogical competencies of educators. A modern university instructor must not only be a master of their subject but also an expert in the digital world (Jabbarov, 2018). Digitalization has significantly influenced the evolution of these competencies. Digital tools enable educators to pay more attention to individualizing instruction and developing critical thinking and problem-solving methods. At the same time, digital systems also provide the opportunity to gather more data on students' success, aiding educators in more precisely shaping the learning process (Nurmanov and Jabbarov, 2017). Finally, digital transformation has contributed to the growth of interactivity and globalization in university education. Educators must develop their communication skills, work with students from different corners of the world, and be adept at using social networks and other tools for collaborative learning and idea exchange (Sidiqova, 2020).

Digital skills comprise a range of knowledge, capabilities, and proficiencies essential for the efficient utilization of digital technologies. They encompass both foundational skills such as using computers and the internet, as well as more advanced skills like creating digital products, critically evaluating the information on the internet, and safely employing digital technologies (Basilotta-Gómez-Pablos et al., 2022). Digital technologies have expanded the possibilities of pedagogical activities. University educators now employ electronic platforms for teaching, video lectures, interactive materials, and other tools, making education more accessible and engaging (Zabolotska et al., 2021). Alongside these opportunities arises the need for proficiency in digital skills, including working with web platforms, creating multimedia materials, and effectively interacting with students in an online environment (Arnold and Gagnon, 2020).

The literature highlights the uneven development of digital skills among participants in the educational process. The authors of the article Morze et al. (2018) conducted a study examining the level of digital competency among learners and educators in Ukraine. The research revealed that the majority of learners and educators have a low level of digital competency. The authors argue that this is related to a range of factors, with the primary one being insufficient preparation of educators in teaching digital competency. Instefjord and Munthe (2017) conducted a study exploring the practice of integrating professional digital competency into teacher education across four universities in Finland. The research indicated that there are various approaches to integrating professional digital competency into teacher education.

These competencies are enriched by incorporating principles from programs such as "DigCompEdu" by the European Commission, emphasizing enhancing pedagogical competence, particularly in digital competencies. This includes information and data literacy, communication skills using digital tools, collaboration and digital collaborative development, digital creativity skills, digital security and confidentiality, and adaptability and problem-solving skills in the digital domain.

2.3 Research objectives

Based on the obtained data, we observe that there are several crucial competencies inherent to the 21st-century educator. Faced with the task of preparing the younger generation for life in an ever-changing world, the contemporary educator identifies two key

strategic directions: the development of critical thinking and digital literacy skills (Vachkova et al., 2022). Therefore, we propose to delve more deeply into these skills in the current work.

Critical thinking is an essential skill for participants in the educational process. Firstly, it aids students in better understanding and memorizing study materials, thereby enhancing the efficiency of the learning process. The distinctions between facts and opinions, argumentation, and justification can be grasped by students through the cultivation of developed critical thinking. Secondly, critical thinking contributes to the development of creativity and problem-solving skills. The ability to seek solutions, articulate positions, and solve problems becomes key in the contemporary world, where innovations and creativity are highly valued (López-Meneses et al., 2020).

The modern world is inundated with information and technologies. Digital literacy has become a mandatory competency for educators. It encompasses more than just the capacity to operate computers and the internet; instead, it entails a comprehension of digital tools and their capabilities. Digital literacy enables educators to effectively utilize online resources for teaching, engage learners in active learning, and develop research skills. It equips students for existence in a digital information society, where essential elements encompass digital security awareness and comprehension of digital risks (Murkatik et al., 2020).

Therefore, the choice of critical thinking and digital literacy skills for the development of educators is justified since these competencies not only help in better understanding information and solving problems but also prepare students for life in the modern world, where knowledge and understanding are key to success.

The current research aims to determine the impact of the model on the development of competencies for the modern educator and the enhancement of their skills. To achieve this, the following objectives were implemented:

1. Implement a model for the development of professional competencies for educators at the Karaganda Buketov University.
2. Measure the effectiveness of this model in the context of the dynamics of critical thinking and digital literacy indicators before and after its implementation.

In the context of this research, the following hypothesis was formulated:

H0: H0: The current model for the development of professional competencies will not have an impact on the critical thinking and digital literacy of educators.

The alternative hypothesis stated:

> *H1*: The current model for the development of professional competencies will enhance the critical thinking and digital literacy of educators.

3 Methodology

3.1 Study design

Based on the analyzed literature, two competencies were identified, particularly characteristic of higher education institution educators. Specifically, these competencies pertain to creative thinking and digital literacy skills.

The research comprises several consecutive stages (Figure 1).

In the first stage, the level of creative thinking and the state of digital competencies of educators were initially analyzed in preparation for testing.

In the second stage, a model for the development of these competencies was implemented based on an experimental sample of respondents.

During the third stage, educators underwent retesting to assess the dynamics of these competencies.

The fourth stage involved analyzing the obtained results and identifying grounds for confirming the formulated hypotheses.

3.2 Sampling

A random sample was utilized for participation in the research. Invitations to participate in the study were sent to 161 educators at the Karaganda Buketov University. Teachers were given 1 week to process the information and provide consent to participate in the research. Subsequently, approval letters were received from 94 educators. Thus, the research sample consisted of 84 educators from the Karaganda Buketov University (Table 1). The respondents were then divided into two groups of 42 individuals each: a control group and an experimental group.

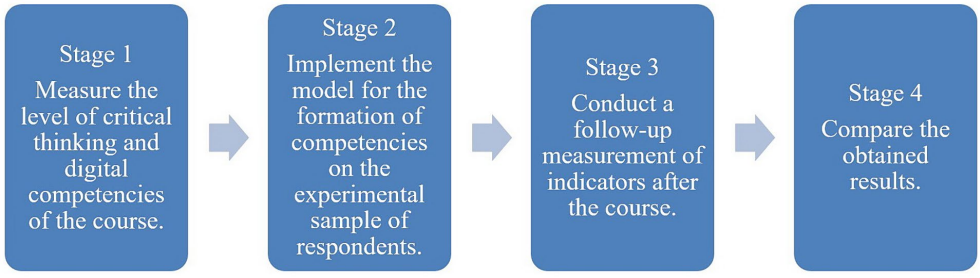

FIGURE 1
Stages of the conducted research.

TABLE 1 Characteristics of respondent sample.

	Parameter	Control group, *n*	Experimental group, *n*
Experience	Up to 2 years	12	11
	2–5 years	13	12
	6–10 years	8	10
	Over 10 years	6	5
	Ph.D. Student	3	4
Academic degree	Ph.D. Candidate	27	29
	Doctor of Sciences	15	13
Academic titles	Senior Researcher	14	18
	Associate Professor	18	13
	Professor	10	11
Gender	Women	20	21
	Men	22	21
Age	Up to 28 years	5	6
	29–40 years	9	8
	41–50 years	10	10
	51–60 years	7	8
	Over 60 years	11	10

Based on the total number of teachers employed in this university, the overall margin of error does not exceed $p = 4.76$. Therefore, the sample is relevant for the current research.

The sample size meets statistical requirements, and the margin of error is within acceptable limits. Furthermore, the division into control and experimental groups allows for a comparative analysis, which improves the study's validity. As a result, the selected sample adequately meets the requirements for a thorough analysis of the research objectives.

3.3 Procedure

The developed module for the experimental sample of educators consisted of two directions for developing the respective competencies. The study was conducted from January to June 2023 and lasted about 6 months in total. In total, the program lasted for 25 weeks. Sessions involved both online and offline formats. There was one session per week, lasting 1 h. A total of 10 online sessions and 15 offline sessions were conducted.

To develop the digital components, the principles of the "DigCompEdu" program of the European Commission were employed as a foundation. Specifically, certain themes aimed to enhance the following aspects:

1. Information and data literacy.
2. Communication skills using digital tools.
3. Collaboration and digital collaborative development.
4. Digital creativity skills.
5. Digital security and confidentiality.
6. Adaptability and problem-solving skills in the digital domain.

The sessions aimed at developing critical thinking involved the use of various methods and techniques for fostering critical thinking. These methods were blended within a single lecture and were applied based on the topic. Overall, a range of activity formats were introduced and utilized depending on the lecture. The themes of the critical thinking lectures primarily centred around the pedagogical process and education.

Doctoral degree holders in computer science, educational methodologists, and psychologists were engaged in teaching the modules (Table 2).

During the sessions, practical training sessions were conducted on the use of certain digital tools. Computer equipment, headphones, etc., were employed to carry out specific tasks. The module plan was coordinated among the engaged scholars in the fields of pedagogy, psychology, and informatics from 15 universities in Kazakhstan. In general, the expert opinions of professors endorsed the utilization of this module within the scope of the research.

According to the established provisions, the model for developing competencies among university educators has the following structure (Figure 2).

The obtained tools and methods addressed the teaching needs of each proposed topic. Educators were also assigned 5 homework assignments related to preparing presentations or writing on specified topics.

3.4 Survey

To assess critical thinking, the Critical Thinking Test Level I (CTT-I) was administered, comprising five subscales. Digital literacy skills were evaluated using the DigCompEdu CheckIn1 tool. Additionally, a post-module questionnaire consisting of four questions was administered to the experimental group to gauge satisfaction and perceived effectiveness. To determine the level of required indicators, two methodologies were applied. The first methodology measured the level of critical thinking among educators. The Critical Thinking Test Level I (CTT-I) (Yeh, 2003) comprised a total of five subscales:

TABLE 2 The topics within the module for developing teachers' competencies.

Topic 1 "Searching for Reliable Sources of Information on the Internet"	Topic 6 "Analysis and Evaluation of Educational Videos"	Topic 11 "Creation and Evaluation of Online Courses"	Topic 16 "Advantages of Virtual Travel for Learning"	Topic 21 "Virtual Laboratories for Science and Technology Education"
Topic 2 "Identifying Fake News and Disinformation"	Topic 7 "Developing Skills in Analyzing Graphics and Images in the Media"	Topic 12 "Managing an Educational Blog or Website"	Topic 17 "Using Webcams and Audio Recordings for Online Classes"	Topic 22 "Using Virtual Reality in Education"
Topic 3 "Measures to Preserve Personal Information on the Internet"	Topic 8 "Using Social Networks for Teaching and Communicating with Students"	Topic 13 "Analysis and Selection of Electronic Textbooks and Educational Apps"	Topic 18 "Implementing Interactive Online Tests and Surveys to Assess Students' Knowledge"	Topic 23 "Creating Multimedia Presentations for Teaching and Facilitating Communication"
Topic 4 "Distinguishing Between Primary and Secondary Sources of Information"	Topic 9 "Ethical Aspects of Technology Use in Education. Collaborating with Colleagues Using Digital Tools"	Topic 14 "The Impact of Digital Tools on Broadcasting and Communication Skills of Students"	Topic 19 "Using Interactive Boards in Lessons"	Topic 24 "Assessing and Selecting Educational Apps for Interaction with Students"
Topic 5 "Using Online Tools to Create Educational Materials"	Topic 10 "The Influence of Digital Media on Student Development"	Topic 15 "Using Multimedia in Lessons"	Topic 20 "Means of Remote Communication with Students and Colleagues"	Topic 25 "Collaborating with Colleagues Using Digital Tools"

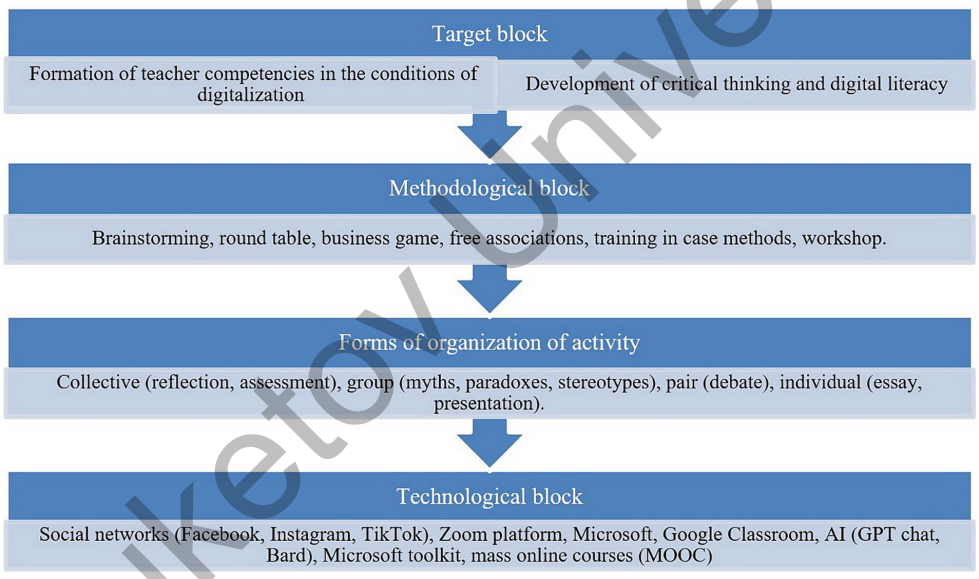

FIGURE 2
Model for developing competencies of university educators.

3.4.1 Recognition of assumptions

Participants had to identify assumptions underlying statements. An assumption is a statement that is not explicitly asserted but is implied.

3.4.2 Induction

In this subtest, participants had to make inferences based on data.

3.4.3 Deduction

Respondents had to draw conclusions from two or more statements. Deduction is the process of logically deriving conclusions from data.

3.4.4 Interpretation

Teachers had to understand the meaning of a statement.

3.4.5 Evaluation of arguments

In this subtest, participants had to assess the strength of an argument.

Each subscale included 5 multiple-choice questions. The total score for each subscale was 5; thus, the overall score for the test was 25.

To assess digital competencies, the DigCompEdu CheckIn1 tool was chosen. Developed by the European Union's Science Centre (Redecker and Punie, 2017), DigCompEdu aims to identify teachers' needs in digital competencies. DigCompEdu categorizes teachers' digital competencies into six different areas:

3.4.6 Professional engagement

This focuses on teachers being aware of their competencies in using digital technologies for communication, collaboration, and professional development.

3.4.7 Digital resources

It assesses the potential of digital resources and the ability to search, create, and use these resources.

3.4.8 Teaching and facilitating

Determining the ability to manage and organize the use of digital technologies in the teaching and learning process.

3.4.9 Assessment

Indicating how digital technologies enhance the learning of students taught by the teacher.

3.4.10 Empowering learner agency

It includes the ability to use digital technologies to enhance inclusion, and personalization, and actively engage students in learning.

3.4.11 Fostering learner digital competence

It evaluates how teachers help their learners use digital technologies creatively and responsibly.

The research methodology is based on a quantitative approach. For each of the 21 competencies in the tool, there is a statement. Participants must choose one of the five answer options that best reflects their position on this statement on the Likert scale. Scores range from "No, I do not do this at all" to "Yes, I do this extensively." Each task is scored from 0 to 4 points, resulting in a total of 84 points.

After completing the testing, representatives of the experimental group were provided with a questionnaire consisting of 4 questions, which aimed to determine the satisfaction and effectiveness of the developed program according to the respondents themselves:

1. Are you satisfied with the course you have completed?
2. Do you believe that this module has enhanced your critical thinking?
3. Do you believe that this module has enhanced your digital literacy skills?
4. Do you consider such a module effective in the context of enhancing the competencies of a modern educator?

The survey involved a closed form of responses using "yes" or "no."

Critical thinking indicators measure abilities such as recognizing assumptions, drawing inferences, drawing logical conclusions, interpreting data, and evaluating arguments. Digital competency indicators assess proficiency in areas such as professional engagement, resource utilization, technology-based teaching, assessment enhancement, learner agency empowerment, and student digital competence development. Measuring parameters include Likert scale responses that indicate the level of proficiency or engagement, with examples such as identifying implicit assumptions in statements and effectively using digital resources for teaching.

3.5 Data analysis

The reliability and validity of the questionnaires were assessed using established statistical measures. Item discrimination, task difficulty indices, and Cronbach's alpha coefficient were calculated to ensure the reliability of the instruments. Statistical tools such as the Shapiro–Wilk test were employed to assess data normality. Subsequently, correlation analysis and one-way ANOVA were conducted to examine relationships between variables and compare group means.

According to the reliability and validity analysis of the scale, as calculated by the author (Yeh, 2003), item discrimination ranged from 0.20 to 0.77, with a mean of 0.47; task difficulty indices (mean percentage correct) ranged from 0.36 to 0.89, with a mean of 0.61; internal consistency was 0.76. From this, it can be concluded that the questionnaire is a reliable tool for measuring the level of critical thinking.

Both questionnaires were assessed for reliability using Cronbach's alpha criterion. Six repeated measurements were taken for each of the questionnaires. According to the results, the average values were determined for each, amounting to 0.915 (critical thinking test) and 0.856 (digital literacy test). Thus, both questionnaires are reliable and optimal for the current research.

The Shapiro–Wilk test (significance level 0.05) was employed to check the normality of data distribution.

3.6 Statistical tools

After each assessment stage, the obtained results were compared, and a correlation analysis was conducted to examine the relationship between the dependent variables (investigated pedagogical competencies) and the independent variable (competence formation model).

The analysis utilized the Pearson correlation coefficient in SSPS 2016. Additionally, a one-way analysis of variance (ANOVA) was performed.

SPSS was used for data analysis because of its user-friendly interface and comprehensive statistical capabilities, which included correlation analysis to investigate relationships between variables and one-way ANOVA to compare group means.

3.7 Limitations

Limitations of the study include the use of a sample from a single university, limited digital tools in the competency development module, and potential biases associated with self-assessment scales. The study involved a large sample of educators from a single university. The developed program incorporated a limited number of digital tools and methodologies for fostering critical thinking. The potential for respondents to enhance their qualifications outside the experiment was not taken into account. The selected scales assumed self-assessment.

3.8 Ethical issues

Ethical considerations included informed consent, confidentiality, voluntary participation, and presentation of findings in a general format. All participants were informed about the experiment's conditions via email. Each result remains confidential. All testing occurred under the observation of the university administration and with their consent. Participation in the research was voluntary for all respondents. The research findings are presented in a general format.

TABLE 3 Correlation analysis of respondents' answers (before the program).

	Critical thinking		Digital literacy	
	Experimental group	Control group	Experimental group	Control group
Mean	12.92857143	13.33333333	42.54761905	40.95238095
Variance	6.409407666	5.593495935	28.30255517	25.75377468
Observations	42	42	42	42
df	41	41	41	41
F	1.14586794		1.098967259	
P(F < =f) one-tail	0.332465112		0.381996131	
F critical one-tail	1.681644228		1.681644228	

TABLE 4 Correlation analysis of respondents' answers (after the program).

	Critical thinking		Digital literacy	
	Experimental group	Control group	Experimental group	Control group
Mean	15.35714286	13.28571429	54.42857143	41.11904762
Variance	3.844947735	5.721254355	88.05574913	18.69279907
Observation	42	42	42	42
df	41	41	41	41
F	0.672046285		4.710677561	
P(F < =f) one-sided	0.103734242		1.20905E-06	
F critical one-sided	0.594656101		1.681644228	

TABLE 5 One-way ANOVA (critical thinking).

Source of variations	SS	df	MS	*F*	*p*-value	*F* crit
Between groups	90.10714	1	90.10714	18.83865	4.03E-05	3.957388
Within groups	392.2143	82	4.783101			
Total	482.3214	83				

4 Results

Before the implementation of the author's module, an analysis of the current state of critical thinking and digital competence characteristics was conducted (Table 3).

Based on the obtained results, we can see that respondents have a nearly identical average level for both indicators. In the context of critical thinking, it is noteworthy that the lowest results were demonstrated in the blocks related to argument assessment and deduction. The lowest score for completing the test in both groups was 9.

On the other hand, concerning the definition of digital skills, it should be noted that educators, while acknowledging their participation in the online learning environment, demonstrated low scores in the context of data protection and the diversity of these technologies (question 1 «I use different digital communication channels for different purposes» and questions 6 «I effectively protect sensitive content»). Based on the correlational analysis, it is noteworthy that the selected samples are at a similar level of development in both competencies (Table 4).

After the implementation of the program, a noticeable dynamic change in the mean scores of the respondents was observed. Specifically, regarding critical thinking, the participants increased their scores from 12.92 to 15.35. Meanwhile, digital skills improved by almost 12 points. Shifts also occurred in the control group of educators, although they were significantly smaller (up to 1 point) for each of the domains.

In general, educators reported relatively high scores in the context of using digital technologies in their work. Question 2 "I use digital technologies to work together with colleagues inside and outside my school" averaged 3.75 points across respondents. Scores significantly increased in the subtests of argument assessment and deduction (only 8 respondents in the experimental group made errors in these blocks, compared to 17 in the pre-program assessment). Overall, there is a substantial improvement in performance indicators, especially in the dynamic context of the control group. In both measurements, the critical *F* is significantly lower than the calculated *F*.

According to the Shapiro–Wilk criterion, the level of normality in the distribution of the sample is 0.8461. With a significance level of 0.05 and a sample size of 84, the critical value for the Shapiro–Wilk criterion is 0.0558. Therefore, the distribution of values is close to normal.

Significant shifts in the data of the experimental group are also emphasized by the ANOVA test (Tables 5, 6).

TABLE 6 One-way ANOVA (digital literacy).

Source of variations	SS	df	MS	*F*	*P*-value	*F* crit
Between groups	3720.012	1	3720.012	69.69672	1.42E-12	3.957388
Within groups	4376.69	82	53.37427			
Total	8096.702	83				

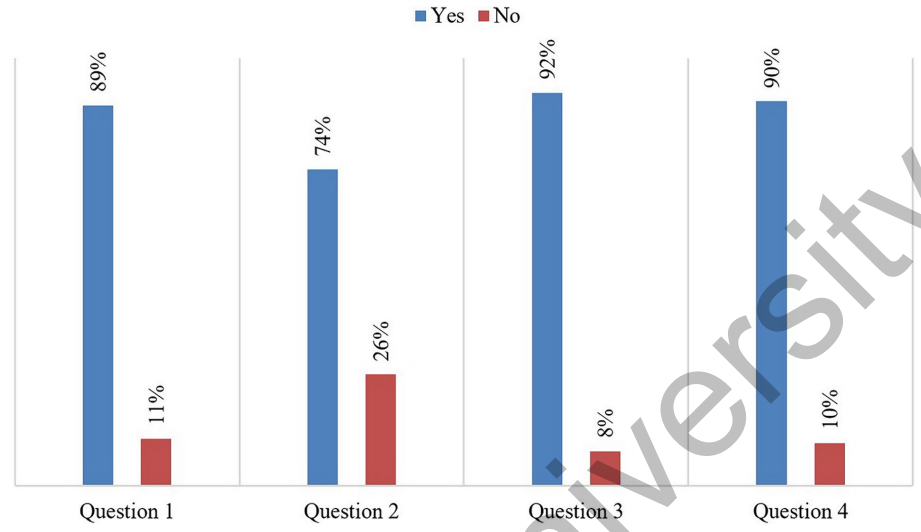

FIGURE 3
Survey results of teachers in the experimental group after the module.

The positive dynamics of the dependent variable resulting from the implementation of the model indicate the effectiveness of the current program in the context of developing critical thinking skills in educators.

The significantly higher difference is demonstrated in the context of improving the digital literacy skills of the respondents. The *F* value deviates more than 20 times from the critical value, indicating a substantial impact of the model for developing professional competencies on the enhancement of the studied skills.

The satisfaction survey of teachers revealed that the vast majority of respondents consider this module effective in improving the skills under study. Interestingly, in the context of performance dynamics, teachers note greater effectiveness, particularly in digital skills. Additionally, almost all respondents acknowledge the potential of the model for further implementation (Figure 3). As a result, we observe the rejection of the null hypothesis in the current study. Therefore, it can be asserted that, according to the alternative hypothesis, the developed model and technology have a positive impact on competence development. In other words, the implementation of the model for the formation of professional competence among educators in the investigated educational institution in Kazakhstan enhances critical thinking and digital literacy skills.

5 Discussion

The global digitization of education underscores the high importance of studying and implementing digital competencies. Falloon's (2020) study demonstrated that the digital competency of educators is a crucial factor in the successful integration of digital technologies in education. Educators with high digital competence better understand the potential of digital technologies for teaching and can use these technologies effectively and responsibly (Falloon, 2020). Hence, in the present module, emphasizing the acquisition of digital literacy skills in both learning and practical applications held significant importance. The data obtained suggests a prudent recommendation for higher education institutions to approach the implementation of digital technologies with caution, aiming to minimize potential drawbacks and enhance positive outcomes. The research indicated that digital transformation has both positive and negative implications for higher education. Higher education institutions should adopt digital technologies with caution to minimize adverse effects and maximize positive outcomes (Akour and Alenezi, 2022).

Basilotta-Gómez-Pablos et al. (2022) conducted a strategic analysis to identify key directions in research and practice concerning digital competencies of educators in higher education. They observed that the majority of studies in this field focus on defining and characterizing educators' digital competencies, as well as developing models and frameworks for their enhancement. In the context of the current study, it was also found that there is a need for broader research on the impact of educators' digital competencies on teaching and learning, along with the development of tools and methods for assessing these competencies. The results of the present study underscore the importance of educators' digital competencies for the effective utilization of digital technologies in the educational process and the creation of an innovative learning environment. The study by Zabolotska et al. (2021) also provides several recommendations for

developing teachers' digital competencies, including ensuring educators have access to necessary resources and support, designing professional development programs for teachers in the field of digital technologies, fostering a learning culture that encourages educators to experiment with digital technologies and share their experiences with others.

Teachers exhibit varying levels of digital competence, with the majority expressing a positive attitude toward the use of technology in education. However, researchers also note that some prospective educators lack knowledge and skills in specific areas, such as creating digital educational resources and assessing students' digital literacy (Vachkova et al., 2022). The authors of the article provide several recommendations to enhance the digital competence of future educators. They propose integrating the study of digital technologies into all teacher training programs, providing future educators with opportunities to develop practical skills in working with digital technologies in the educational process, supporting prospective educators in designing and implementing innovative educational activities using digital technologies, and creating an environment in higher education institutions that fosters the professional development of educators in the field of digital competence (McGarr and McDonagh, 2019).

On the other hand, much less research focuses on the development of other skills, particularly critical thinking. Educators themselves believe it is important to create a classroom atmosphere conducive to critical thinking. This involves establishing an environment in which students feel comfortable asking questions, expressing their thoughts, and challenging the status quo. Research findings indicate that educators are obligated to teach critical thinking, but they require greater support from university administrators, and students need more opportunities to develop these skills (Bezanilla et al., 2019). The results of Erdoğan's (2020) study showed a significant positive correlation between critical thinking skills and reflective thinking in future high school mathematics educators (Erdoğan, 2020). This implies that future high school mathematics educators with higher critical thinking skills also possess higher reflective thinking skills. The study also revealed that critical thinking skills are significant predictors of reflective thinking. This means that critical thinking skills explain 24% of the variance associated with reflective thinking skills. Similar research was conducted as part of Ekici's work (Ekici, 2017). At the beginning and end of the study, all participants completed the California Critical Thinking Dispositions Inventory (CCTDI) to assess their tendencies toward critical thinking. CCTDI is a self-report questionnaire consisting of 64 items measuring six dimensions of critical thinking dispositions: open-mindedness, analytical thinking, inquisitiveness, skepticism, confidence in reasoning, and the search for truth. The research results indicated that the experimental group had significantly higher CCTDI scores at the end of the study compared to the control group. This suggests that participation in the online practice community had a positive impact on the inclination toward critical thinking in future educators. Within the scope of the current research, positive dynamics of critical thinking associated with the implementation of a specific improvement model were also identified.

The findings highlight the importance of digital competencies and critical thinking skills among educators in higher education. Supported by previous research, the study demonstrates how higher digital competence improves technology integration in the classroom. Additionally, identify areas where educators may require assistance with digital competence and emphasize the importance of critical thinking skills in educator training programs. Overall, the findings highlight the need for comprehensive strategies to improve educators' digital and critical thinking skills.

6 Conclusion

Contemporary education is undergoing profound transformations due to global digitization. This necessitates a reconsideration and updating of competencies for higher education educators so that they can better meet the demands of modern learners.

The developed model involves the use of techniques for developing critical thinking and digital skills. Before the program and after its completion, both groups of participants underwent measurements of their levels of critical thinking and digital literacy. The participants in the author's module were educators from the experimental group. The analysis of the results revealed significant differences in the indicators between the groups after the implementation of the new teaching model. The correlational analysis yielded the following results: for critical thinking ($r = 4.03$) and digital literacy ($r = 1.42$). The satisfaction survey of the educators indicated that the overwhelming majority of respondents consider this module effective in improving the skills under study. Interestingly, regarding the dynamics of characteristics, educators emphasize the significant effectiveness of digital skills. This suggests that the implementation of the model successfully enhances the level of critical thinking and digital literacy among educators.

Based on the research findings, it is clear that implementing this model to cultivate professional competencies among educators in Kazakhstani higher education establishments positively contributes to the advancement of critical thinking and digital literacy among educators. This provides an opportunity for universities to introduce similar educational programs to prepare educators capable of effectively interacting with modern students and successfully adapting to the rapidly changing educational environment. For researchers investigating the impact of digital transformation on educators' competencies in higher education, it is crucial to delve deeply into contemporary educational trends, keeping abreast of the latest technologies and methods. Exploring alternative models Leveraging artificial intelligence or virtual reality, alongside competencies like emotional intelligence and self-reflection, holds promise for future research.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving humans were approved by Ethics Committee of Karaganda Buketov University (Protocol No 64 of 13.06.2023). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ZK: Conceptualization, Data curation, Writing – original draft. NM: Formal analysis, Funding acquisition, Writing – review & editing. IS: Investigation, Methodology, Writing – review & editing. ZG: Validation, Visualization, Writing – review & editing. AM: Project administration, Resources, Writing – review & editing. AU: Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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