



OPEN ACCESS

EDITED BY

Clifford A. Shaffer,
Virginia Tech, United States

REVIEWED BY

K. Sathish Kumar,
Alagappa University, India
Omar Mahasneh,
Al-Balqa Applied University, Jordan
Niroj Dahal,
Kathmandu University, Nepal
Adam J. Jeffery,
Keele University, United Kingdom

*CORRESPONDENCE

Maxot Rakhmetov
✉ maksot.raxmetov.96@gmail.com

RECEIVED 17 January 2024

ACCEPTED 05 July 2024

PUBLISHED 17 July 2024

CITATION

Rakhmetov M, Kuanbayeva B, Saltanova G,
Zhusupkalieva G and Abdykerimova E (2024)
Improving the training on creating a distance
learning platform in higher education:
evaluating their results.
Front. Educ. 9:1372002.
doi: 10.3389/feduc.2024.1372002

COPYRIGHT

© 2024 Rakhmetov, Kuanbayeva, Saltanova,
Zhusupkalieva and Abdykerimova. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or reproduction
is permitted which does not comply with
these terms.

Improving the training on creating a distance learning platform in higher education: evaluating their results

Maxot Rakhmetov^{1*}, Bayan Kuanbayeva², Galiya Saltanova¹,
Galiya Zhusupkalieva³ and Elmira Abdykerimova⁴

¹Faculty Computer of Physics, Mathematics and Information Technology, Department of Computer Science, Kh. Dosmukhamedov Atyrau University, Atyrau, Kazakhstan, ²Faculty of Physics, Mathematics and Information Technology, Department of Physics and Technical Disciplines, Kh. Dosmukhamedov Atyrau University, Atyrau, Kazakhstan, ³Candidate of Pedagogical Sciences, Faculty of Physics, Mathematics and Information Technology, Department of Physics and Technical Disciplines, Kh. Dosmukhamedov Atyrau University, Atyrau, Kazakhstan, ⁴Faculty of Science and Technology, Department of Computer Science, Caspian State University of Technology and Engineering Named After Sh. Yessenov, Aktau, Kazakhstan

The COVID-19 pandemic has had a profound impact on the world, and one of the many changes it has brought about is the shift to distance learning in Kazakhstan's universities. However, both teachers and students were ill-prepared for this sudden change. In some remote villages, lack of internet access meant that students had no access to online classes at all. To address this issue, universities had to rent foreign platforms, but these platforms had inadequate information security measures in place. To address these challenges, it is necessary to create a robust and secure independent platform for distance learning. This platform will be particularly important for training teachers of "Informatics" in the context of distance learning. This article presents methods and schemes for creating a distance learning platform specifically for training computer science teachers. The introduction of the "Education-Online Platform" discipline at the university has yielded promising results. As a result, a distance learning platform has been created, and this new discipline has been introduced and tested in the educational program of a particular university in the training of future specialists.

KEYWORDS

digital learning, PLATFORM, virtual educational institution, virtual reality, immersive learning, distance learning

1 Introduction

The COVID-19 pandemic precipitated unprecedented disruptions in education systems globally. These disruptions highlighted systemic inequalities within educational landscapes worldwide as schools and other learning spaces closed, affecting learning continuity and exposing disparities. To maintain educational continuity amidst stringent public health mandates, governments and educational authorities pivoted towards distance learning solutions (Meinck et al., 2022). In Kazakhstan, the pandemic's impact was profound. The Ministry of Education and Science of Kazakhstan responded swiftly to mitigate interruptions by implementing a comprehensive strategy for distance learning across all educational levels—a crucial move in a country where education traditionally relies on in-person instruction (Source of the Prime Minister of the Republic of Kazakhstan, 2020). This strategy included deploying digital platforms, enhancing internet connectivity, particularly in underserved regions, and training educators in online teaching methodologies. Despite these

efforts, the transition revealed and sometimes exacerbated existing disparities in technology access and digital literacy, setting the stage for a deeper exploration of distance learning's impacts, challenges, and advancements in Kazakhstan during the pandemic.

The necessity of distance learning during the pandemic introduced significant challenges, particularly around technological access and pedagogical adjustments. In rural areas, many students and teachers faced disadvantages due to poor internet connectivity and a lack of necessary devices (Meinck et al., 2022). The rapid shift to online platforms required both students and teachers to adapt quickly to unfamiliar technologies, impacting the quality of education due to reduced interaction and challenges in assessing student engagement and conducting exams online. Moreover, the shift significantly affected students' psychological and social well-being. Prolonged home confinement and the absence of physical classroom settings increased isolation, stress, and anxiety among students, particularly affecting those with pre-existing mental health issues (American Psychological Association, 2020).

Despite these challenges, the period also catalyzed positive outcomes and innovations in the educational sector, setting the groundwork for potentially transformative changes in education delivery. The swift move to online platforms demonstrated the resilience of Kazakhstan's educational system, while the necessity of distance learning accelerated the adoption of new teaching methods and technological tools. One such tool is DLPlatform, a dynamic, object-oriented distance learning environment designed to enhance the learning process by offering courses and materials to support education at all levels. It provides flexible access to students, teachers, and administrators while offering a comprehensive set of tools for teaching, assessment, and communication.

This study aims to comprehensively assess the implementation and impact of distance learning in Kazakhstan during the COVID-19 pandemic, with a particular focus on the role of platforms like DLPlatform in maintaining educational continuity. By evaluating the effectiveness of the measures taken and exploring the broader impacts on educational outcomes, student engagement, and equity in access to quality education, the study will propose targeted strategies to enhance distance learning systems. It will also explore opportunities for innovation to make distance learning more robust, inclusive, and adaptable to future needs.

2 Literature review

Distance learning refers to the method of delivering education to students who are not physically present in a traditional classroom setting. This educational approach has gained relevance due to its ability to overcome geographical barriers and provide flexible learning options. Historically, distance learning began with correspondence courses in the 19th century and has evolved significantly with the advent of the internet and digital technologies, which have transformed how educational content is delivered and consumed (Masalimova et al., 2022).

During the COVID-19 pandemic, educational institutions around the world rapidly transitioned to online learning, facing both challenges and opportunities. In Iraq, Dijlah University quickly adopted platforms like Google Classroom and Zoom, navigating issues related to accessibility and the digital divide, yet benefiting from increased schedule flexibility and potential educational enhancements (Khudhair et al., 2023). Similarly, the South Eastern University of

Sri Lanka struggled with online delivery and technological access but implemented strategies such as virtual meetings and Moodle-based systems to maintain educational activities (Rameez et al., 2020). Concurrently, a study in China highlighted significant reductions in carbon emissions due to decreased transportation and lower campus energy use, advocating for the continued integration of online education to sustain environmental benefits (Yin et al., 2022). These experiences underline the importance of strategic planning and the potential of hybrid learning models to address future educational disruptions while considering their broader environmental and social impacts (Techakosit and Nilsook, 2018; Petrov and Atanasova, 2020).

The shift to distance learning has introduced several significant challenges. Technological limitations, notably insufficient access to reliable internet and necessary digital devices, have been substantial obstacles, particularly in less affluent areas (Verulava et al., 2023). From a pedagogical perspective, instructors have encountered difficulties in adapting their teaching styles to suit an online format, which has been evident across various disciplines including STEM and language education (Al-Assaf, 2021; Khaled and Malkawi, 2023). Furthermore, the move to online learning platforms has brought about social and psychological challenges, with increased reports of student isolation adversely affecting mental health and academic engagement (El Refae et al., 2021). These issues underscore the complexities involved in transitioning to and implementing effective distance learning systems.

In response to the COVID-19 pandemic, Kazakhstan implemented rapid policy changes to support distance learning, facilitated by the Ministry of Education and Science. Despite the deployment of digital platforms like Zoom and Microsoft Teams and access to extensive electronic resources as noted in (Khibina et al., 2023), challenges such as digital divides and inadequate technical resources persisted. Studies (Movkebayeva et al., 2020; Bokayev et al., 2021) highlighted issues like low engagement levels among students with disabilities and varied satisfaction levels among parents, which correlated positively with parental age and income. Further research (Khibina et al., 2022) on the stress factors for female educators emphasized the importance of adequate technological resources and supportive organizational climates in mitigating stress. These findings suggest critical areas for improvement, including enhancing digital infrastructure, providing comprehensive training for educators, and ensuring all students have equitable access to learning tools, to bolster the efficacy and quality of distance education in Kazakhstan.

There are several papers that underscore the critical integration of technological solutions and innovations in distance learning across various educational contexts, emphasizing the necessity and effectiveness of digital tools and strategies in enhancing learning outcomes. For instance, in Kazakhstan, digital platforms are essential in training foreign language teachers, equipping them with the digital competencies needed to utilize contemporary educational technologies effectively (Shakiyeva et al., 2023). Similarly, studies on primary school teachers highlight the role of technology in fostering e-learning, with platforms like Moodle and Google Meet being pivotal in facilitating effective remote teaching and learning experiences (Stambekova et al., 2021). Additionally, in higher education, the adoption of advanced technological innovations such as virtual and augmented reality, and interactive multimedia during the COVID-19 pandemic showcases a significant shift towards more interactive educational practices (Li et al., 2023). Technical education's adaptation to distance learning also highlights the innovative use of digital tools

to simulate interactive learning environments, addressing the unique challenges of technical subjects (Yi et al., 2020). These studies collectively demonstrate how technological advancements are critical in overcoming geographical and institutional barriers, heralding a transformative shift towards more digitally accessible and effective educational environments globally.

Across multiple studies exploring distance learning, both students and teachers have shared diverse experiences and insights reflecting the complexities of transitioning to and operating within virtual educational environments. Teachers frequently report needing substantial efforts and new skills to manage effective online teaching, often facing challenges such as diminished student engagement and interaction difficulties (Almsaiden and Hussein, 2021). The swift shift to online platforms during the COVID-19 pandemic exacerbated these issues, as many educators found themselves unprepared for the sudden reliance on digital tools (Vorlíček et al., 2023). Students, on the other hand, appreciate the flexibility that distance learning offers, particularly when balancing studies with personal or professional obligations. However, they also encounter significant challenges, such as technical issues, reduced sense of community, and concerns about the inclusivity and accessibility of virtual learning environments, especially for peers with special needs (Vorlíček et al., 2023). Both groups—students and teachers—acknowledge the potential of online learning to maintain educational quality during disruptions but emphasize the need for enhanced technological infrastructure, better training in digital competencies, and more supportive policies to address inclusivity and engagement effectively (Liu et al., 2020; Masalimova et al., 2021).

In connection with the didactic potential of technology for creating a distance learning platform and its integrated use in the educational process, it is necessary to improve the development of educational and methodological materials, educational programs, and new types of textbooks and teaching aids based on the active use of modern computer technologies. Until recently, digital education was almost not considered the main subject of research due to the complexity and multi-meaningfulness of the topic. However, a number of foreign and domestic scientific studies provide opportunities to reveal the essence of digital education (Sadvakassova and Serik, 2017; Uaidullakzy et al., 2022; Kuanbayeva et al., 2024). Additionally, as a result of the analysis of the educational experience of higher educational institutions on the use of distance learning platforms in the training of future computer science teachers of the country, surveys have shown that the future specialists have a high level of information competence and a wide range of modern information and communication technologies, partly due to the internet services included in the platform (Abirov et al., 2022). However, it has also been found that many students and undergraduates lack methodological training in creating digital platforms on their own, despite the significant potential of self-use of various online educational platforms. Thus, it is important for each teacher to have information literacy and the ability to use and create distance education platforms for the organization of comfortable and productive work in a digital environment. We believe that the development of distance education platforms should provide for the training of specialists not only on the part of the state order but also on the part of universities that are able to work in the direction of developing distance learning platforms in accordance with the needs of

universities in training teachers. Therefore, the purpose of our research work is to theoretically justify and practically implement improving the training of future computer science teachers to create a modern distance learning platform. If the training of future computer science teachers in the educational process of higher education is based on the ability to create a distance learning platform, it would meet modern requirements since the creation and use of modern digital platforms require educated and qualified specialists.

While extensive studies have addressed the broader impacts and adaptations of distance learning, there remains a significant gap in specific, methodological research aimed at preparing future computer science teachers to effectively use and develop these platforms. Existing literature largely overlooks the detailed training processes and outcomes necessary to equip these educators with the skills to not only use but also innovate within distance learning environments. Further research is needed to evaluate and refine targeted training methodologies that can enhance the readiness of future computer science teachers, ensuring they are adept at navigating and contributing to the evolution of educational technologies.

3 Methodology

3.1 Background of DLPlatform

DLPlatform is a dynamic, object-oriented distance learning environment designed to enhance the learning process. Developed specifically for universities, it integrates distance learning technologies to offer a comprehensive suite of courses and educational materials. The platform provides four levels of access—teacher, curator, student, and administrator—ensuring a structured and well-defined learning environment. Figure 1 illustrates the system's architecture, outlining the different modules and how they interact to form a comprehensive distance learning platform.

After authorization, students gain access to courses, certificates, and a personal information page. Teachers have access to existing courses, can add new ones, and can evaluate students to track their progress. Figure 2 showcases the user-friendly DLPlatform interface, illustrating its graphical layout, available course categories, and intuitive navigation.

The platform is web-based and built using open-source technology for flexibility and customization. It's accessible from anywhere with an internet connection, scalable to millions of students, and available in Kazakh, Russian, and English. DLPlatform offers a wide range of tools for course creation, outcome evaluation, and communication between students and teachers, providing an efficient environment for the development of educational materials. It is designed with security in mind to protect against unauthorized access and data misuse.

The platform supports an extensive list of user roles, including administrators, teachers, and students, and its intuitive interface simplifies usage for those with minimal technical knowledge. DLPlatform's comprehensive toolset allows for high-quality course creation and a full-fledged educational process in an electronic environment. Developed by Rakhmetov Maxot and copyrighted by the National Institute of Property of the Republic of Kazakhstan, DLPlatform is positioned as an effective, high-quality solution for organizing eLearning.

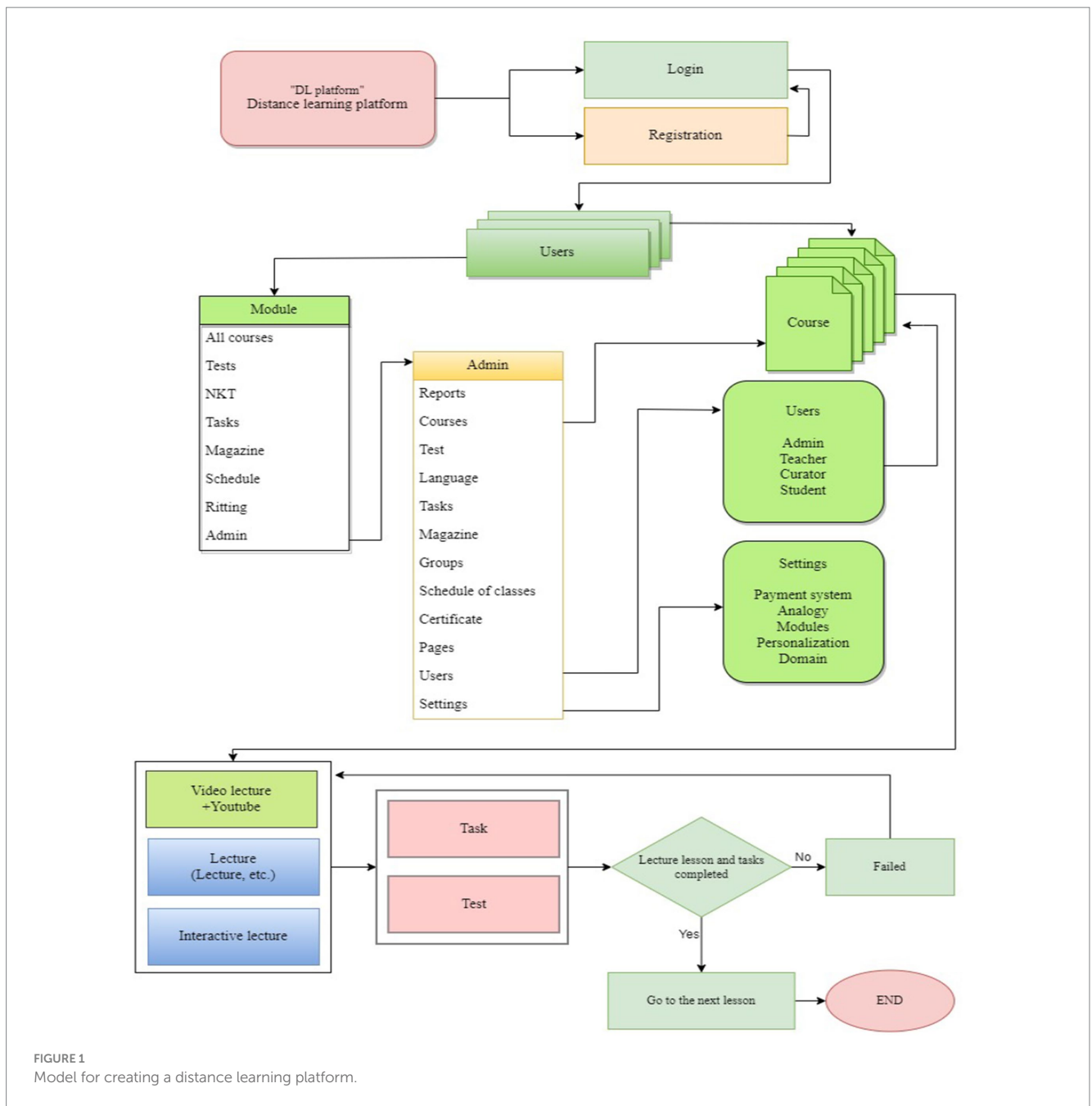


FIGURE 1 Model for creating a distance learning platform.

3.2 Study design and objectives

The study aimed to evaluate the readiness of future computer science teachers to work with DLPlatform. The primary objective was to assess the preparedness of undergraduate students majoring in Informatics from three universities in Kazakhstan. The research focused on evaluating their ability to work with DLPlatform through a controlled experiment. The universities were divided into experimental and control groups based on the elective courses offered in their educational programs. To complement the experiment, a survey was conducted to assess the attitudes and proficiency levels of computer science teachers and students in using distance learning platforms. The survey was designed to capture their experience with online teaching,

their skill set in developing and using distance learning platforms, and their readiness to integrate them into their teaching practices.

3.3 Participant and sampling

The participants comprised students from L. N. Gumilyov Eurasian National University, Kh. Dosmukhamedov Atyrau University, Kazakh National Pedagogical University, and Caspian University of Technology and Engineering. The experimental group included students from the first two universities, while the latter two universities formed the control group. Table 1 provides a detailed breakdown of the student distribution across the two academic

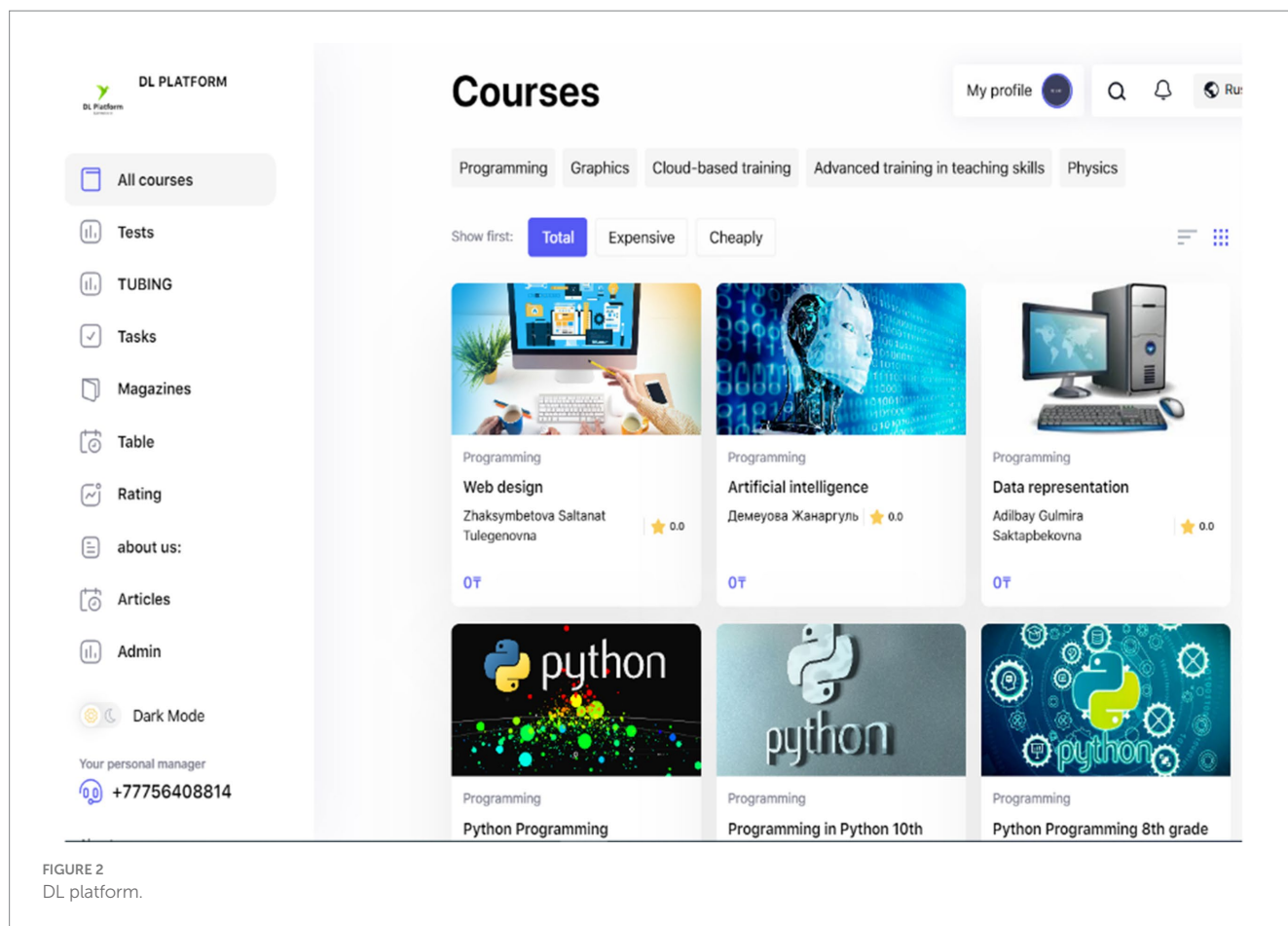


FIGURE 2 DL platform.

TABLE 1 Universities involved in the study.

University	Group	2021–2022	2022–2023	Total
L. N. Gumilyov Eurasian National University	E	22	11	33
Kh. Dosmukhamedov Atyrau University	E	18	21	39
Kazakh National Pedagogical University	C	20	16	36
Caspian University of Technology and Engineering	C	21	20	41
Total-149	E	40	32	72
	C	41	36	77

years. The students were selected based on their elective disciplines and the relevance of these courses to their future profession.

3.4 Formation experiment and data collection

The formation experiment aimed to evaluate a methodology for preparing future computer science teachers to create distance learning platforms. Conducted during the 2021–2022 and 2022–2023 academic years, the experiment involved 149 students majoring in Informatics from different universities in Kazakhstan. The students were divided into an experimental group of 72 and a control group of 77. The experimental group was enrolled in courses titled “Digital Educational Resources in the Subject Area” and “Educational Online Platforms,”

which included independent assignments focused on creating distance learning platforms. The control group did not participate in these courses.

To evaluate the readiness of the participants to work with DLPlatform, a structured assessment was conducted using three levels—high, medium, and low. The assessment criteria were designed to gauge the participants’ pedagogical skills, understanding of distance learning platforms, and ability to develop such platforms in their professional capacity. Surveys and practical tests were used to collect data on these criteria.

The effectiveness of the methodology used in the formation experiment was rigorously assessed through various methods, including observation, surveys, testing, analysis, and generalization. To determine the statistical significance of the results, the chi-square criterion was employed.

3.5 Evaluation criteria

The study evaluated the readiness of future computer science teachers to work with the distance learning platform on a scale of assessment consisting of three levels: high, medium, and low. This assessment helped determine the effectiveness of the distance learning platform in preparing future computer science teachers. The evaluation criteria for the three levels were:

Higher level: The future computer science teacher is characterized by a stable development of training, is defined as a subject of professional activity, pedagogically capable of working with a distance learning platform, and possesses high-level pedagogical skills with the necessary knowledge.

Medium level: The future computer science teacher is pedagogically capable of working with the distance learning platform, but considers the lack and partial formation of some components in the structure of the training.

Low level: The future computer science teacher's training components are not formed in working with the distance learning platform.

These components were used to monitor the quality of knowledge of the future computer science teacher, determine the effectiveness and assimilation of new material, and lead each teacher to self-control over their future professional activities. The results of the experiment served as a basis for further research on the possibilities of forming the readiness of future computer science teachers to develop a distance learning platform through a training experiment.

3.6 Analysis and implications

The results were analyzed to understand the effectiveness of DLPlatform in preparing future teachers. By categorizing the students based on the evaluation criteria, the study aimed to highlight areas for improvement in teacher training programs and suggest ways to enhance the adoption of distance learning platforms in higher education.

4 Results

4.1 Survey findings

The survey revealed that 96% of the surveyed computer science teachers had a positive attitude towards distance learning platforms and were ready to incorporate them into their teaching. However, it

was observed that many school teachers lack the knowledge and skills required to create and utilize distance learning platforms in computer science instruction. Similarly, within higher education, the study affirmed the following findings:

- Prospective teachers do not incorporate distance learning platforms into their classroom activities.
- Teachers do not assign tasks related to the creation of distance learning platform components.
- Future computer science teachers are ill-prepared to develop distance learning platforms.

4.2 The formation experiment

Table 2 shows the indicators before and after the formation experiment. The data shows that before the experiment, both the experimental and control groups had a low level of training and were not ready to create distance learning platforms. After the experiment, there was a significant improvement in the experimental group, with a decrease in the number of students who could not create a distance learning platform and an increase in the number of students who were highly prepared to create one.

Figure 3 shows the changes in knowledge level before and after the formation experiment. The data clearly shows an increase in the number of students with a high level of knowledge, indicating the effectiveness of the methodology used in the experiment.

4.3 Statistical significance of results

The chi-square test is a statistical measure used to determine if there is a significant association between two categorical variables. In our case, the chi-square test was applied to assess the differences between the characteristics of the experimental and control groups before and after the experiment. The formula for calculating the chi-square value is as follows:

$$\chi^2 = \sum \left[(O_i - E_i)^2 / O_i \right] \tag{1}$$

Where:

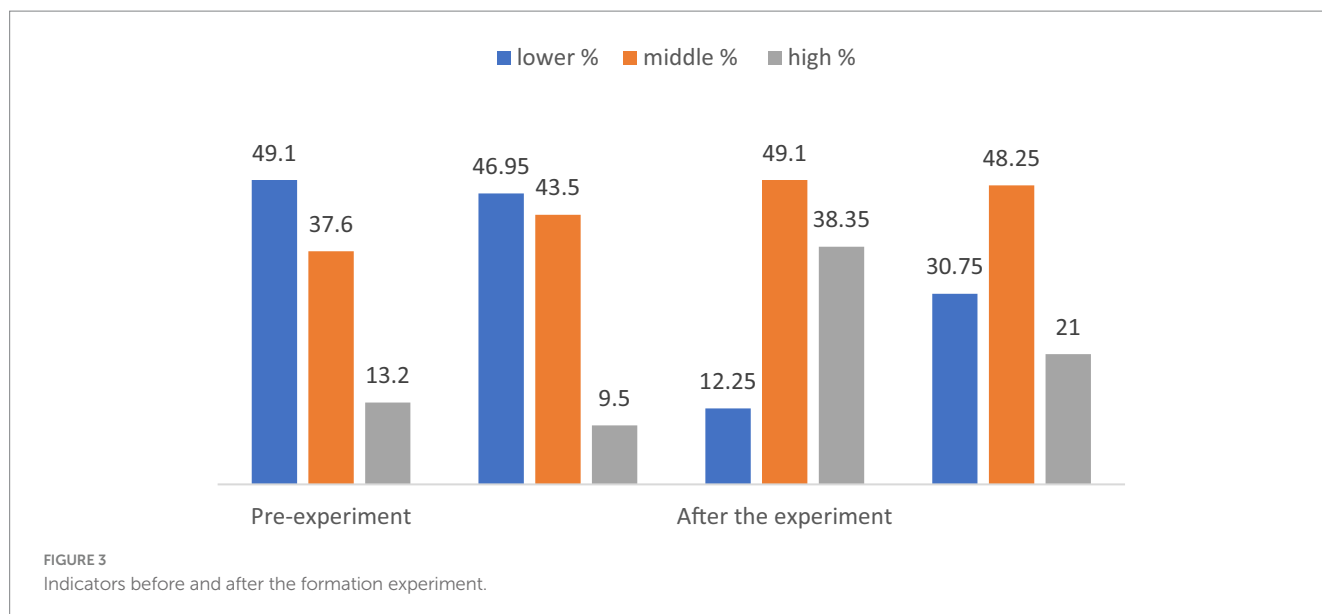
χ^2 is the chi-square value,

O_i is the observed frequency,

E_i is the expected frequency.

TABLE 2 Indicators before and after the experiment.

	Group	Number and percentage of students						
		Number	Lower	%	Middle	%	High	%
Pre-experiment	E	72	35	49,1	28	37,6	9	13,2
	C	77	36	46,95	34	43,5	7	9,5
After the experiment	E	72	9	12,25	36	49,1	27	38,35
	C	77	24	30,75	37	48,25	16	21



The critical value of the chi-square criterion is determined based on the significance level (α) chosen for the test. In this study, a significance level of 0.05 ($\alpha=0.05$) was selected, indicating a 95% confidence level. The critical value for $\alpha=0.05$ is 5.99. Before the experiment, the observed and expected frequencies were calculated for each group, and the chi-square value was determined using the formula. The resulting chi-square value was found to be 0.346. This indicates that there were no significant differences between the characteristics of the experimental and control groups at the start of the experiment. After the experiment, the same calculations were performed, and the chi-square value was found to be 16.66. This value exceeded the critical value of 5.99, indicating a significant difference between the experimental and control groups after the intervention. The higher chi-square value suggests that the methodology used in the formation experiment had a substantial impact on the knowledge and skills of future computer science teachers in developing distance learning platforms. The calculated chi-square value demonstrates that the differences observed between the experimental and control groups are statistically reliable with a confidence level of 95%. This statistical significance strengthens the conclusion that the methodology employed in the experiment effectively enhanced the readiness of future teachers in creating and utilizing distance learning platforms.

5 Conclusion

This study contributes significantly to understanding the adoption and impact of distance learning platforms in higher education, particularly in preparing future computer science teachers. By exploring the effectiveness of a specific training methodology, it advances theoretical frameworks regarding teacher readiness in a digital era. The findings emphasize that targeted training, involving courses and practical assignments, enhances future teachers' abilities to integrate digital tools into their

educational practices. This aligns with the growing body of literature advocating for tailored approaches to teacher training in digital environments.

Key results show that structured training led to a significant increase in the proficiency of future computer science teachers in developing and using distance learning platforms. The chi-square analysis confirmed the statistical significance of these improvements, highlighting the importance of integrating such methodologies into teacher education. These results underscore the necessity of adapting teacher training programs to include specific training for digital competencies, reinforcing the strategic importance of such skills in the evolving educational landscape.

The practical implications of these findings are far-reaching for universities and policymakers. The study suggests that embedding courses focused on digital resources and online platforms in teacher training programs can significantly improve teachers' readiness to develop and use distance learning platforms. Such improvements will not only enhance the quality of online education but also help bridge the digital divide in underserved regions.

However, the study's limitations, such as its focus on specific universities in Kazakhstan, highlight the need for broader research to confirm the generalizability of the findings. Future research should evaluate the long-term impact of this training methodology and explore additional strategies to improve teacher readiness for digital platforms across various educational contexts.

This research adds valuable new insights to the field by demonstrating the tangible benefits of specific teacher training in digital environments. It calls on academics and practitioners alike to prioritize the development of comprehensive training programs that prepare educators for the future of online education. Through actionable and engaged scholarship, the academic community can effectively enhance the readiness of educators and ultimately improve the quality of digital education worldwide.

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.

Ethics statement

The research procedures involving human participants were approved by the Ethics Committee of Kh. Dosmukhamedov Atyrau University. Written informed consent for participation in the study was obtained from all individual participants.

Author contributions

MR: Writing – original draft, Writing – review & editing, Funding acquisition, Investigation. BK: Methodology, Writing – original draft. GS: Software, Writing – original draft. GZ: Formal Analysis, Writing – original draft. EA: Supervision, Validation, Visualization, Writing – original draft.

References

- Abirov, D., Ybyraimzhanov, K., Turkmenbayev, A., Abdykerimova, E., and Kuanbayeva, B. (2022). Innovative features of education in Kazakhstan's lyceum-gymnasium. *Cypriot J. Educ. Sci.* 17, 159–173. doi: 10.18844/cjes.v17i1.6693
- Al-Assaf, D. M. D. (2021). Challenges of distance learning in language classes: based on the experience of distance teaching of arabic to non-native speakers in light of the coronavirus pandemic. *J. Lang. Teach. Res.* 12, 444–451. doi: 10.17507/jltr.1203.15
- Almsaiden, A. H., and Hussein, T. A. (2021). Evaluating the distance learning experience from the point of view of college members and students at Aqaba university college. *Pegem Egitim ve Ogretim Dergisi.* 11(4).
- American Psychological Association. (2020). *Psychological impact of COVID-19*. American Psychological Association. Available at: <https://www.apa.org/topics/covid-19/psychological-impact/> [Accessed May 6, 2024].
- Bokayev, B., Torebekova, Z., Davletbayeva, Z., and Zhakypova, F. (2021). Distance learning in Kazakhstan: estimating parents' satisfaction of educational quality during the coronavirus. *Technol. Pedagog. Educ.* 30, 1–13. doi: 10.1080/1475939X.2020.1865192
- El Refae, G. A., Kaba, A., and Eletter, S. (2021). Distance learning during COVID-19 pandemic: satisfaction, opportunities and challenges as perceived by faculty members and students. *Interact. Technol. Smart Educ.* 18, 298–318. doi: 10.1108/ITSE-08-2020-0128
- Khaled, A., and Malkawi, E. (2023). Stem faculty members' perspectives and challenges towards distance learning and virtual classes during covid-19 outbreak.
- Khibina, N., Salimzhanova, A., and Khibina, Z. (2022). Problems and opportunities of distance learning in the context of the pandemic: case of one University in Kazakhstan. *Proce. Europ. Conf. e-Learn.* 21, 181–191. doi: 10.34190/ecel.21.1.600
- Khibina, N., Salimzhanova, A., Khibina, Z., and Kariyev, A. (2023). Distance learning during the COVID-19 pandemic: stress factors for female school and university teachers in Kazakhstan and Kyrgyzstan. *Europ. J. Contemp. Educ.* 12. doi: 10.13187/ejced.2023.2.493
- Khudhair, A. A., Khudhair, M. A., Musa Jaber, M., Awreed, Y. J., Ali, M. H., Al-Hameed, M. R., et al. (2023). Impact on higher education and college students in Dijlah university after COVID through E-learning. *Comput. Aided Des. Appl.* 20, 2023–2104. doi: 10.14733/cadaps.2023.S12.104-115
- Kuanbayeva, B., Shazhdekeyeva, N., Zhusupkalieva, G., Mukhtarkyzy, K., and Abildinova, G. (2024). Investigating the role of augmented reality in supporting collaborative learning in science education: a case study. *Int. J. Eng. Pedagogy* 14, 149–161. doi: 10.3991/ijep.v14i1.42391
- Li, K. C., Wong, B. T. M., and Chan, H. T. (2023). Teaching and learning innovations for distance learning in the digital era: a literature review. *Front. Educ.* 8:1198034. doi: 10.3389/feduc.2023.1198034
- Liu, Z. Y., Lomovtseva, N., and Korobeynikova, E. (2020). Online learning platforms: reconstructing modern higher education. *Int. J. Emerg. Technol. Learn.* 15:4. doi: 10.3991/ijet.v15i13.14645
- Masalimova, A. R., Khvatova, M. A., Chikileva, L. S., Zvyagintseva, E. P., Stepanova, V. V., and Melnik, M. V. (2022). Distance learning in higher education during Covid-19. *Front. Educ.* 7:822958. doi: 10.3389/feduc.2022.822958
- Masalimova, A. R., Ryazanova, E. L., Tararina, L. I., Sokolova, E. G., Ikrennikova, Y. B., Efimushkina, S. V., et al. (2021). Distance learning hybrid format for university students in post-pandemic perspective: collaborative technologies aspect. *Cypriot J. Educ. Sci.* 16, 389–395. doi: 10.18844/cjes.v16i1.5536
- Meinck, S., Fraillon, J., and Striehl, R. (2022). The impact of the COVID-19 pandemic on education international evidence from the responses to educational disruption survey (REDS). Available from: <http://www.unesco.org/open-access/terms-use-ccbysa-en>
- Movkebayeva, Z., Khamitova, D., Kabdyrova, A., Akhmetova, A., Zholtayeva, G., and Duzelbayeva, A. (2020). An exploratory analysis of socio-LEGAL factors related to the distance education learning environment: the CASE of disabled learners in Kazakhstan. *J. Legal Ethic. Regul. Issues* 23.
- Petrov, P. D., and Atanasova, T. V. (2020). The effect of augmented reality on students' learning performance in stem education. Information (Switzerland) [Internet]. 11(4). Available at: https://www.researchgate.net/publication/340646969_The_Effect_of_Augmented_Reality_on_Students'_Learning_Performance_in_Stem_Education [Accessed May 2023 May 14]
- Rameez, A., Fowsar, M. A. M., and Lumna, N. (2020). Impact of Covid-19 on higher education sectors in Sri Lanka: a study based on south eastern University of Sri Lanka. *J. Educ. Soc. Res.* 10, 341–349. doi: 10.36941/jesr-2020-0132
- Sadvakassova, A., and Serik, M. (2017). Cloud technologies in educational system of Republic of Kazakhstan.
- Shakiyeva, A., Zhorabekova, A., Abilkhairova, Z., Yessimgaliyeva, T., and Makulbek, A. (2023). Methodical system for formation of professional competences of a future foreign language teacher in conditions of distance learning. *Front. Educ.* 8:1186908. doi: 10.3389/feduc.2023.1186908
- Source of the Prime Minister of the Republic of Kazakhstan (2020). Distance learning to continue in Kazakhstan from September 1: "duty classes", provision of textbooks and purchase of computers - Official Information Source of the Prime Minister of the Republic of Kazakhstan. Source of the Prime Minister of the Republic of Kazakhstan. Available at: <https://primeminister.kz/en/news/reviews/distance-learning-to-continue-in-kazakhstan-from-september-1-duty-classes-provision-of-textbooks-and-purchase-of-computers> [Accessed May 6, 2024].
- Stambekova, Z., Zhumabayeva, A., Elmira, U., Karas, K., Nurzhamal, A., and Ryskulova, A. (2021). Training of future primary teachers for innovation in the context of the updated content of education. *World J. Educ. Technol. Curr. Issues* 13, 967–979. doi: 10.18844/wjet.v13i4.6284
- Techakosit, S., and Nilsook, P. (2018). The development of STEM literacy using the learning process of scientific imagining through AR. *Int. J. Emerg. Technol. Learn.* 13, 230–238. doi: 10.3991/ijet.v13i01.7664

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

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.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Uaidullakzy, E., Tautaeva, G., Orazgaliyeva, L., Duissekeyeva, N., Kamiyeva, G., and Seidakhmetov, Y. (2022). Determining the knowledge levels of university students on distance education and the Google meet application programme. *Int. J. Eng. Pedagogy* 12, 75–87. doi: 10.3991/ijep.v12i2.29323
- Verulava, T., Shengelia, K., and Makharashvili, G.. (2023). Challenges of distance learning at universities during the COVID-19 pandemic in Georgia. 10(1): 75–90.
- Vorlíček, R., Stašová, L., Hogenes, M., Janebová, E., and Průchová, Z. (2023). Issues and challenges of inclusion in distance teaching and learning from the perspective of university students and teachers. *Dist. Educ.* 44, 342–361. doi: 10.1080/01587919.2023.2210528
- Yi, C., Xu, X., Chen, C., and Wu, Y. J. (2020). Institutional distance, organizational learning, and innovation performance: outward foreign direct investment by Chinese multinational enterprises. *Emerg. Mark. Financ. Trade* 56, 370–391. doi: 10.1080/1540496X.2018.1545118
- Yin, Z., Jiang, X., Lin, S., and Liu, J. (2022). The impact of online education on carbon emissions in the context of the COVID-19 pandemic – taking Chinese universities as examples. *Appl. Energy* 314:118875. doi: 10.1016/j.apenergy.2022.118875