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The impact of IT tools on students' anxiety and learning outcomes in online education during force majeure

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ABSTRACT

Amidst the force majeure, the paper addresses the significant role of information technology in higher and postgraduate education, focusing on its impact on online learning and on students' anxiety. The study conducted at Shakarim State University in Semey, Kazakhstan, used an experimental design, and the primary data collection method was a survey. A survey involving 240 students across various disciplines, averaging 20 years of age. The control group was studied according to the traditional scheme using basic online resources, while the experimental group used an interactive approach involving IT. Findings reveal a strong digital technology proficiency among respondents (78%), with preferences split between online video conferencing (39%) and recorded videos (45%). Despite a preference for classroom-based learning by some (45%), the majority found online courses effective (68%), highlighting the value of interactive forms (70%). The study demonstrates an average increase in pre- and post-training scores, indicating heightened student motivation through information technology (73.5–79.23). This underscores the efficacy of IT-based curricula in enhancing learning outcomes and student engagement. This finding suggests that the use of the experimental methodology contributed to a reduction in students' anxiety.

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Introduction

The COVID-19 pandemic served as a catalyst for profound transformations within the global education system, particularly in the rapid transition to distance learning. This unprecedented situation necessitated the urgent integration of information technologies (IT) to ensure the continuity of education under emergency conditions. During this crisis, online education emerged as a crucial solution to prevent disruptions in the learning process, thereby introducing new challenges for students, educators, and parents alike. The psychological dimension of this transition, especially student anxiety, warrants dedicated scholarly attention, as elevated stress levels and feelings of isolation may adversely affect academic performance and student motivation. Consequently, it is essential to examine not only the technological implications of IT on the educational process but also its emotional impact on learners, which may have critical consequences for their mental health and ongoing academic engagement.

Spread of COVID-19 is seen as a global force majeure (Anzai et al., 2020; Elavarasan & Pugazhendhi, 2020; Sohrabi et al., 2020). Educational institutions worldwide had to swiftly adapt to online teaching methods, leveraging various digital platforms and tools to ensure the continuity of education (Anzai et al., 2020; Elavarasan & Pugazhendhi, 2020). This has led to a problem in the learning environment

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and intensified discussions about the importance of digital literacy among students and teachers and has also revealed significant disparities in access to technology and the Internet, which has become a challenge for the education systems of many countries.

The prerequisites for this transition are laid in the rapid development of information technologies, which have activated changes in educational paradigms (Amanova, 2022; Anzai et al., 2020). A striking example is the requirement to use various types of information and communication technology (ICT) at various levels of education and in various force majeure situations (Amanova, 2022). ICT in education is a set of instructional materials and technical and instrumental computer technology tools used in the educational process. Instead of using pen and paper, students today utilise various software and tools to create presentations and projects. Compared to a stack of notebooks, the iPad is relatively lightweight; unlike a heavy book, browsing an electronic book is easier (Timotheou et al., 2023). According to the data, there is a perception that integrating ICT into the educational process will improve learning effectiveness and simplify its management (Nyussupova et al., 2022; Umarova, 2020). These tools include virtual and augmented reality, the 3D learning method, cloud computing training, and artificial intelligence (Wang et al., 2021). However, before the pandemic, such technologies were mostly used within individual educational programs, and their implementation to a wide audience required time and resources. In response to the crisis, educational institutions were forced to quickly adapt their methodologies, which raised questions about the effectiveness of online learning and the ease of use of such technologies.

The primary benefit of distance learning is that it is available to a wider range of people and rests on humanism (Anzai et al., 2020). The widespread use of modern information technology has opened the possibility of distance learning to adults, professionals needing training, self-educated people, and students who were unable to receive education for some reason (Sohrabi et al., 2020; Velavan & Meyer, 2020). Learners can manage their time and learn when and where they want without spending money on transportation or other educational resources. One of the most important steps has been the initiation of numerous debates on the organisation of distance learning. The debates aimed to solve a multitude of problems to advance the distance learning process (Sarmurzin et al., 2021). It is also challenging to create and launch multipurpose distance learning management systems, which would enable the learning process to take place entirely in one setting (Dauletov et al., 2019). These management tools help teachers better control the learning process and conduct unbiased assessments of their students' skills and knowledge (Phesa, 2024). During the COVID-19 pandemic and other force majeure cases, distance education's function and role are undergoing significant shifts, and the innovations that pertain to it may vary by country. Thus, studying this topic is highly relevant.

The main problem of this study is the insufficiently studied issue of the impact of information technologies on the emotional state of students in the context of force majeure circumstances, in particular the impact on students' anxiety during the COVID-19 pandemic. This requires a deeper analysis to develop strategies that can alleviate students' stress and anxiety, thereby improving their academic performance. All educational institutions in Kazakhstan were closed during the COVID-19 pandemic, and distance learning replaced traditional educational processes (Seilkhan et al., 2022).

Despite a significant body of research, there are significant gaps in understanding the effectiveness of ICT use in force majeure situations. Most research focuses on technological aspects and does not take into account the emotional state of students, such as anxiety, stress, and problems of social isolation in distance learning environments (Kamble et al., 2022). This is an important aspect, as students' psychological health directly affects their academic performance and motivation to learn (Krasmik et al., 2024). In addition, parents were unprepared for distance education because not all children had access to computers and other technological resources (Sarmurzin et al., 2021). The identified gaps are significant, as understanding the psychological aspects of distance learning, in particular the impact on student anxiety, is critical for developing effective educational strategies in the context of global crises. This study will reveal the relationship between the use of information technology and the emotional state of students, which is necessary for improving the quality of education in the future and optimising distance learning methods in the context of global challenges such as pandemics. The authors of this study aim to fill this gap by analysing the impact of distance learning on student anxiety in Kazakhstan during the COVID-19 pandemic.

The article's practical relevance stems from the fact that information technology opens up new avenues for communication between students and teachers in distance learning through new information methods. The potential for introducing information technology techniques for a higher distance learning level is another vital aspect of the study. This article uses an experimental approach and contains the following sections: Introduction, literature review, methods and materials, discusses ethical issues and limitations, Results section, Discussion and conclusions. This article sheds light on the role of information technology in higher and postgraduate education in light of force majeure situations like COVID-19, contributing to global science.

Literature review

The integration of emerging technologies into everyday life has occurred almost undetected. In emergencies, technology solves important tasks, such as saving the lives of victims through information and communication, resuming communication with employees, and restoring the learning process (Anzai et al., 2020). Therefore, educators pool resources and new technological tools to improve all aspects of education while dealing with crises (Hawkridge, 2022; Setiyowati & Lubis, 2022).

The evolution of information technology in the current era of globalisation and information fosters the creation of increasingly sophisticated learning tools (WHO, 2020). In crisis situations, the role of technology in education is two-sided. The first aspect implies infrastructure, namely gadgets and everything related: phones, computers, cameras, the Internet. Another side is information management throughout the learning process, which includes mitigating consequences for teachers and students, readiness, and reaction (Phesa, 2024). It is possible to continue essential processes through online communication tools like FaceTime, Zoom, Skype, Webex, Slack, Microsoft Teams, WhatsApp, WeChat and others (Phesa, 2024). Technology allows people worldwide to communicate remotely for both personal and educational purposes. During the pandemic, video conferencing applications became more frequent, as shown, for example, by their popularity in US markets (Clement, 2020).

Advanced learning technologies improve learning through visualisation, interactivity, and personalisation of the learning process (Andreev et al., 2020; Gagik, 2020; Hawkridge, 2022). Innovations intensify cognitive activity, allowing students to independently discover, acquire, and construct knowledge and their individual competence in various areas of life (Umarova, 2020). Thus, in a previous study, researchers used contemporary ICT in the training of design students to enhance their knowledge and skills. This approach raised the interest of students in the learning process and increased their capacity to apply knowledge in future practice (Umarova, 2020).

Distance education is important for students who travel abroad. This type of learning is exactly the issue that Kazakh universities have been dealing with in recent years. Distance learning mostly fails to satisfy the needs of students, teachers, and other participants in the educational process. Challenges arise due to numerous problems, namely (Seilkhan et al., 2022) the lack of suitable platforms for online learning, poor access to the Internet and ICT in the country, few methods to improve the effectiveness of distance learning and poor quality of education. Significantly, present efforts in the country aim to address these issues and pave the way for a smooth transition to this system, which has the backing of all institutions and the population at large.

Research has widely addressed the issue of information technology in education and its impact on education. Previous studies have already highlighted the importance of this aspect in information management and learning, particularly in the context of emergencies such as the COVID-19 pandemic (Anzai et al., 2020; Phesa, 2024; Setiyowati & Lubis, 2022; WHO, 2020). Scholars pointed out that modern information technologies, such as video conferencing and online learning platforms, ensure the continuity of the learning process and promote communication between students and teachers (Clement, 2020; Phesa, 2024). Earlier scientific works have also noted that the use of modern technologies can stimulate student cognitive activity and improve the quality of education (Andreev et al., 2020; Gagik, 2020; Hawkridge, 2022). However, the primary findings of one study indicate that teachers exhibit a high level of anxiety or stress due to their use of educational technologies in the classroom (Fernández-Batanero et al., 2021). These studies highlighted such challenges as the limited availability of technology and the Internet, insufficient competence of teachers and students to use online learning, and the quality of

distance education (Seilkhan et al., 2022). These issues have called into question the effectiveness and accessibility of distance learning, especially in countries where infrastructure and resources remain limited. This study aims to meet the mentioned challenges by offering an analysis of a student survey on the effectiveness of using information technology in the educational process during the pandemic and its impact on student anxiety. The novelty of the study lies in the comprehensive analysis of the impact of information technologies not only on the effectiveness of the educational process, but also on the emotional state of students in force majeure conditions, in particular during the COVID-19 pandemic.

Educational context

Kazakhstan has been actively working on the Digital Kazakhstan program for 2018–2022 (Seilkhan et al., 2022). However, there were several issues with distance learning during the quarantine. First, most villages lacked mobile internet access, and some larger suburbs had slow connection speeds. Second, some educators, particularly older teachers, could not provide sufficient educational and instructional resources for the subject due to their lack of IT skills. Third, providing ICT was expensive and time-consuming, necessitating extra-budgetary funding. Fourth, the insufficient availability of electricity in certain regions of Kazakhstan hindered the educational process.

Nevertheless, the aforementioned issues directly affect the quality of education in Kazakhstan; after all, video lectures or videos and ICT cannot replace a live instructor and face-to-face communication. The development of research skills among students is crucial. In particular, students should work on research projects under the guidance of research supervisors in the lab (Kozhabekov et al., 2019; Sarmurzin et al., 2021). For effective distance education, it is necessary to employ the same platform for all participants. For instance, a home-grown platform can fit the country's education system and keep information safe. Domestic platforms also ensure data protection and security (Ruipérez-Valiente et al., 2020). Kazakh teachers and students use Bilimland, Google Classroom, MOODLE, Univer, Platonus, Canvas, Daryn.online, Coursera, ZOOM, Microsoft Teams and other online platforms and courses (Ruipérez-Valiente et al., 2020). The advantages of e-learning platforms are their low cost and ease of installation. The leading domestic distance learning platforms are Daryn.online and Bilimland.

Theoretical basis of the study

The theoretical foundation of this research is based on several key approaches related to the impact of information technologies on education in crises and their integration into the educational process. The Technology Acceptance Theory explains how and why individuals accept or reject new technologies (Velicia-Martin et al., 2021). This study helped to understand how students and teachers adapt to the use of remote learning platforms and video conferencing tools, as well as their attitudes towards these innovations. By assessing factors such as the convenience and usefulness of technology, we can identify which tools gain popularity and how they influence student motivation and learning activities.

Constructivist theory emphasises the active role of students in the learning process, particularly in constructing knowledge through the use of technologies (Alismaiel et al., 2022). Modern information technologies help students not only acquire knowledge but also actively engage with it through digital resources, learning platforms and practical applications. This approach is especially crucial in distance learning, where self-directed learning plays a key role.

The theory of pedagogical adaptation emphasises the importance of flexibility in teaching methods and resources in the context of force majeure circumstances, such as a pandemic (Obidovna, 2023). This involves not only the implementation of new technologies but also the adaptation of curricula to the new situation, enabling both students and teachers to swiftly adjust to changes and minimise potential negative outcomes, such as a decrease in motivation for learning or social isolation. Cognitive load theory helps to understand how technologies influence the learning process, either enhancing or complicating it (Kennedy & Romig, 2024). In distance education, it is crucial that technologies do not overwhelm students but, on the contrary, assist them in more easily mastering the material. The use of video conferencing and interactive tools in tasks can structure the learning process and make it easier to understand and utilise. Thus, the theoretical framework of this study integrates contemporary concepts of

information technology in education with psychological-pedagogical theories that explain the impact of information technology on learning in crisis situations.

Problem statement

The motivation to write this article follows from the awareness of a relevant problem, namely, the use of information technologies in higher and postgraduate education during force majeure caused by the COVID-19 pandemic and its impact on student anxiety. The introduction of information technologies has become necessary to ensure the continuation of the educational process and maintain the quality of education in remote conditions. The study aims to examine and analyse the role of IT in higher and postgraduate education in light of force majeure and its impact on student anxiety in Kazakhstan. The research hypothesis is that the introduction of new information technologies in higher and postgraduate educational institutions of Kazakhstan in the context of force majeure will increase student motivation and positively affect their emotional state. The research questions are as follows: Which online platforms are most popular among students in the distance learning process? How effective do students consider the digital learning tools used? Does the use of IT affect students' academic performance? What is the impact of IT learning on student motivation and engagement? How do IT tools affect students' anxiety levels during learning?

Research objectives:

- Identify popular platforms and applications for distance learning.
- Analyse the impact of IT use on students' digital literacy.
- Evaluate the effectiveness of distance learning through IT based on student motivation and learning outcomes.
- Determine the impact of innovative educational technologies on the level of student anxiety.

Methods and materials

Research design

The study was implemented as an experiment with the division of participants into control and experimental groups to assess the impact of information technology on distance learning in the context of force majeure in Kazakhstan. The study used two main tools for data collection: structured online learning and a questionnaire. The experimental intervention consisted of the implementation of online learning using digital tools, while the control group was taught using the traditional methodology. Structured learning was part of the intervention, i.e. it was the main component of the study.

The questionnaire, in turn, was used as a tool to collect data on students' experiences and evaluate the effectiveness of distance learning. The questionnaire was created by the participating teachers. It included questions with multiple-choice answers on a 4-point Likert scale. The survey was administered online using Google Forms.

Participants

Shakarim State University in Semey, Kazakhstan, was the location of the survey. The study selected 240 students from different disciplines (80 students in music, 80 in philosophy and 80 in literature) to ensure representativeness and to compare the effectiveness of traditional and distance learning among students of different specialties. The choice of 240 students for the study was driven by the desire to ensure sufficient statistical power to detect significant differences between groups and ensure sample representativeness. This number made it possible to create equal groups of 80 students from each discipline, which made it possible to compare the effectiveness of distance learning among students of different specialties. These disciplines were chosen because they represent different areas of the educational process and have significant differences in the ways of learning the material - from creative to theoretical.

This number of participants reduces possible errors and ensures the reliability of the results, since with more data, it is possible to achieve a more accurate generalisation of the findings to the population. In addition, 240 students is a sufficient number to conduct a comparative analysis without excessively increasing the workload of researchers and ensuring high quality data collection.

The students were selected based on their academic status: they had to be second-year students in order to compare the experience of traditional learning in the first year with the experience of distance learning in the second year. This allowed us to obtain diverse data on the impact of IT on students in different learning environments. The sample was voluntary, which ensured the ethics of the study, as students were able to decide whether they wanted to participate in the research. This allowed for honesty and openness in providing answers. However, this approach could have a potential bias, as voluntary participation could have attracted students who were more inclined to technology or, conversely, less interested in traditional teaching methods.

The study included music, philosophy, and literature teachers. The selection process included criteria of experience and qualifications to ensure high-quality teaching and support for students during the research. Teachers also had to be permanent employees of the university, which ensured their familiarity with students and teaching methods. The role of teachers in the study was multifaceted: they not only created questionnaires for data collection, but also interacted with participants, helped organise the online learning process, and evaluated the effectiveness of learning in each group. Since the teachers knew their students well, their influence on the learning process was significant. They were able to correctly assess how changes in teaching methods would affect the results, given the students' previous experience. However, their potential influence on learning outcomes could also be a source of bias, as their familiarity with the participants could lead to subjective assessment and emotional attitudes toward students. Given their longstanding cooperation with certain groups, they may have had higher expectations or a tendency to evaluate the results positively, which could be an influential factor in interpreting the data. Detailed information about the study participants, including students and faculty, is shown in Table 1.

A sample size of 240 students and three instructors was determined to ensure the representativeness and reliability of the obtained results (Althubaiti, 2023; Hennink & Kaiser, 2022; Lakens, 2022). The sample size was calculated to provide a 95% confidence level, meaning the results would accurately reflect the actual situation within the selected population (students and instructors of the university). A sample size of 240 students and six instructors is sufficient to achieve the objectives of this study (Althubaiti, 2023; Lakens, 2022). It ensures the necessary level of reliability, accounts for variability among students from different specialisations, and allows for an objective comparison of traditional and distance learning (Hennink & Kaiser, 2022; Lakens, 2022). These factors collectively render the research results relevant and reliable for evaluating the implementation of blended learning at Shakarim State University.

Table 1. Participant information.

Category	Characteristics
Number of students	240
Average age	20 years
Year of study	2nd year of study
Gender distribution	Male: 100 Female: 140
Gender and major distribution	**Music: 35 males/45 females** **Philosophy: 40 males/40 females** **Literature: 25 males/55 females**
Number of instructors	6
Average age	40 years
Gender distribution	Male: 4 Female: 2
Gender and major distribution	**Music: 2 males/0 females** **Philosophy: 1 male/1 female** **Literature: 1 male/1 female**
Instructors' educational background	Master's degree or higher
Years of teaching experience	From 8 years of experience

Procedure

Students were invited to participate in a 6-month distance learning course using innovative technology. They studied their major disciplines according to the course syllabus. The research instrument included both a structured online learning environment and a questionnaire. University professors taught the subjects. The classes were held online once a week (2 hours) through the following tools: Google Forms, Google Meet, Google Class, WhatsApp and YouTube. Table 2 shows the use of IT for online learning in times of force majeure.

The learning process was organised in such a way that students were divided into two groups: the experimental group and the control group. University instructors conducted classes for both groups, but with some differences in the approaches to teaching. The control group (120 students) followed a traditional scheme, combining online learning with conventional methods. They received lectures in PDF files or links to learning materials and watched recorded video lectures on YouTube. Students in this group completed assignments based on the material they had read and uploaded their work to online platforms. The experimental group (120 students) also studied online, but with an interactive approach. They participated in discussions on forums and chats on various platforms (WhatsApp, Google Meet), actively engaging with instructors and peers to discuss the learning material. They also completed group assignments, collaborated online on projects and presentations, and participated in interactive quizzes and games to reinforce the material.

Tools such as Google Meet were used to conduct video conferences and online classes, where instructors delivered lectures and practical sessions. Google Classroom served as the primary platform for uploading learning materials, assignments and homework. Google Forms created surveys and tests to assess students' knowledge levels. WhatsApp was used for chat-based discussions and information exchange between students and instructors, as well as for rapid communication regarding academic tasks. YouTube was utilised for recording lectures and educational videos, allowing students to review the material at their convenience.

Although digital tools ensured the continuity of the educational process under emergency circumstances, their use was accompanied by a range of limitations. Among the primary challenges were technical malfunctions and unstable internet connectivity, which significantly affected the quality of online sessions conducted via Google Meet. Some students exhibited limited digital literacy, leading to difficulties in navigating Google Classroom and completing assignments independently. Moreover, platforms such as WhatsApp, employed for continuous communication, occasionally resulted in information overload and distractions from core instructional content. The use of YouTube as a source of lectures also constrained opportunities for interaction, which proved particularly detrimental for students with visual-kinesthetic learning styles, who require active engagement for effective knowledge acquisition.

It is important to note that university professors were involved in teaching both the experimental and control groups. They provided training using the aforementioned online tools, as well as managed the process of submitting assignments, discussions, and grading. The teachers maintained regular contact with students and monitored the progress of each of them, which allowed them to maintain the level of quality of education throughout the course. The teachers used these platforms to deliver lectures, conduct practical lessons, accept homework assignments, and communicate with students. In turn, the students used IT to attend classes and complete their homework. Before the onset of online distance learning, the teachers primarily informed students about the discipline's content, objectives, learning requirements, and homework and uploaded learning materials to platforms. The teachers mostly adhered to a predetermined schedule while teaching online. The distance learning process used a rich variety of interactive forms of online learning, and the teachers were generally proficient in how the

Table 2. IT in distance learning.

Variable	Platform	Method of use
IT	Google Forms	Completing the questionnaire
	Google Meet	Online video/audio conferencing
	Google Class	Homework
	WhatsApp	Student-teacher communication
	YouTube	for watching/recording videos

online platform worked. The courses were well-structured, and the overall plan of learning activities was well-organised. Therefore, all students had completed their course assignments according to the schedule by the end of the semester.

Data collection

Using a questionnaire (Appendix A), the authors analysed the role of IT in higher and postgraduate education in light of force majeure learning. The questions on the role of IT in learning and the quality of distance learning were grouped into three blocks. The grouping of questions into three blocks facilitated a comprehensive examination of students' perceptions and experiences regarding the role of IT in learning, as well as the effectiveness of distance learning amidst force majeure circumstances (Timotheou et al., 2023).

Block 1, Analysis of Online Platforms and Digital Literacy Effectiveness, had four questions with four answer options. The students were required to select one of the suggested answers that best matched their opinions. Block 2, Analysis of Distance Learning Content, had five statements with four answer options. Similarly, the students were required to select an answer based on their opinions. Block 3, IT-Assisted Distance Learning Efficiency and Effectiveness, had five items with two to four answer options. The survey was divided into two parts: before and after the training, students completed Block 3 (to assess IT-Assisted Distance Learning Efficiency and Effectiveness). After the online training, the students also completed all three questionnaire blocks using the Google Forms platform. The survey was administered by the teachers and lasted about 30 minutes.

The correlation coefficient was used to assess the questionnaire's reliability. The methodology was reliable because the obtained value was not less than 0.75. The coefficient of concordance was chosen to test the methodology's validity. Since the coefficient only accepts values greater than 0.6, the methodology appears highly valid.

To analyse the impact of technology on student anxiety, the Social Interaction Anxiety Scale (SIAS) was utilised (33). The scale consisted of 16 items. Cronbach's alpha was 0.91, and the validity was 0.37 with a *p*-value of less than 0.01 in relation to psychological flexibility. Therefore, the scale is a valid and reliable indicator for assessing social anxiety.

Data analysis

The frequency of student responses to the questionnaire was processed in SPSS (a statistical program) by assigning the highest score of 1 (4/4 = 1) 'very good' and 0.8 (3/4 = 0.8) 'good'. Percentages calculated for the answer to each question or statement from the questionnaire reflect the proportion of a certain answer among the total number of participants. Converting the responses to percentages is one of the ways to descriptively analyse survey data. This analysis showed the distribution of answers to each question, as well as a general idea of how students perceived different aspects of learning.

Descriptive statistical analysis was used to analyse the effectiveness of learning. For each of the three subjects (Music, Philosophy, Literature), a grade point average (GPA) showed the general knowledge of students before and after IT-based learning. In addition, a standard deviation (SD) was calculated for each subject. It indicated the spread of values from the mean. Descriptive statistical analysis revealed how the average grades changed before and after the intervention for each of the considered subjects. The variability level of these grades was also determined.

To analyse the impact of innovative technologies on students' anxiety levels, linear regression was employed. The linear regression model was chosen to determine the influence of learning type on students' anxiety levels while controlling for other variables such as age, gender, and baseline anxiety. Survey results using the Social Interaction Anxiety Scale (SIAS) compared scores between the control and experimental groups. The regression model took the following form:

$$\textbf{SIAS Score} = \beta 0 + \beta 1 \times \textbf{Group} + \beta 2 \times \textbf{Age} + \beta 3 \times \textbf{Gender} + \beta 4 \times \textbf{Baseline Anxiety} + \epsilon,$$

where Group is the independent variable representing the type of learning (0 for the control group, 1 for the experimental group).

Ethical principles

The school administration approved the design and completion of this study. Before the research activity began, a protocol was developed and adhered to by all participants and administrators. The study was conducted in compliance with ethical principles that guarantee the confidentiality and anonymity of student data (Purvis & Crawford, 2024). First of all, all participants voluntarily agreed to participate in the study and provided written informed consent, which meets the requirements of research ethics. In addition, each participant was clearly informed about the purpose, methods and possible consequences of participating in the study.

Data confidentiality was ensured in such a way that the personal information of the participants was not available to other study participants or third parties. To protect anonymity, all data collected through questionnaires were processed in an anonymous form. All data obtained were encrypted and stored in a secure environment, to which only the authors of the study had access.

Limitations

Since this experiment involved only one higher education institution (HEI) in Kazakhstan, the results are impossible to generalise to all HEIs in the country. Furthermore, the sample size was small enough to determine the actual value of incorporating innovative technology and methods into modern teaching. It is necessary to design a study with a more extensive and diverse sample with an equal distribution of men and women. Additionally, it is essential to observe the behaviour of other variables, such as educational level and student engagement. Future studies may also include a broader range of variables.

Results

The first question of the questionnaire aimed to identify the most popular applications or platforms used for teaching students in the context of online learning. Figure 1 presents a visual representation of the various applications and platforms that were reported by respondents. The most popular application was WhatsApp. The reason is that students can communicate with one another and seek assistance from teachers—WhatsApp has had a significant impact on the speed of feedback and helped to build mutual support in the group.

The second most popular platform was YouTube (25%), reflecting the importance of video lectures and access to recorded materials. YouTube contributed to a better understanding of complex material through visualisation. Google Forms, which occupies 10%, was used less, due to its limited functionality, focused more on testing and surveys than on full-fledged learning. Google Meet and Google Classroom received the same score of 15%, reflecting their role in video conferencing and organising the learning process. They helped to structure the learning process, provide access to materials, and organise regular interaction between participants. Thus, the platforms used by the EG intensified the learning process and contributed to the improvement of academic results through interactivity, structured learning, and

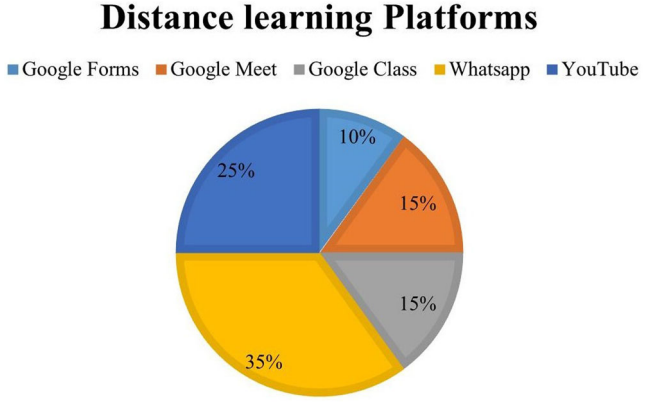

Figure 1. Popular platforms for student distance learning organization and delivery.

Table 3. Survey results in the experimental and control groups.

			Control group			Experimental group			
Block	Answer options	Overall result	Music	Philosophy	Literature	Music	Philosophy	Literature	P-value
Analysis of online platforms and digital literacy effectiveness	Very good	8%	1%	1.5%	1.5%	1%	2%	1%	$p < 0.05$
	Good	53%	6%	10%	7%	10%	10%	10%	$p < 0.05$
	Neutral	30%	6%	5%	6%	5%	4%	4%	$p < 0.05$
	Bad	9%	2%	1%	2%	2%	1%	1%	$p > 0.05$
Analysis of distance learning content	Almost always	15%	1.5%	2.5%	3%	2%	3%	3%	$p > 0.05$
	Often	69%	10%	12%	13%	12%	10%	12%	$p < 0.05$
	Occasionally	15%	3%	3%	3%	1%	1%	4%	$p < 0.05$
	Never	1%	1%	0%	0%	0%	0%	0%	$p > 0.05$
IT-assisted distance learning efficiency and effectiveness	Almost always	21%	4%	3%	4%	3%	4%	3%	$p < 0.05$
	Often	49%	7%	7%	6%	9%	10%	10%	$p < 0.05$
	Occasionally	24%	4%	4%	4%	4%	4%	4%	$p > 0.05$
	Never	6%	1%	2%	1%	1%	0%	1%	$p > 0.05$

real-time feedback. The CG had access to video materials, but this approach did not provide the required level of interactivity.

Table 3 shows the results of the responses to all three blocks. A p-value < 0.05 indicates a statistically significant difference, whereas a p-value > 0.05 indicates a lack of statistically significant difference. A large proportion of students (61%) thought the platform they chose for their distance learning was 'good' or 'very good'. The respondents (63%) admitted that they improved their digital literacy due to online platforms. They also noted (78%) that they received the same high marks during distance learning based innovative technology. Regarding the most effective methods of teacher-student interaction, 39% of students preferred online video conferences with presentation materials. At the same time, 45% preferred pre-recorded.

Most students (54%) said they almost always or very often check the teacher's resources on the online platform for distance learning. A large proportion of students (84%) understand the course objectives, assignments, homework requirements, and grade types used in distance learning, and 80% 'almost always' or 'often' had access to online resources on the platforms as required by the learning objectives. More than half of the students (58%) thought that the distance learning format was effective in dealing with and mastering the complexities of each subject. The students (63%) believed that the assignments provided by the teacher online were useful, exciting, and motivating.

Distance learning courses were 'almost always' or 'often' effective for 68% of the students; 70% indicated a variety of interactive forms, methods, and technologies in teaching. Most of the students (73%) considered it important that teachers used the knowledge control method. The use of assessments affects the desire of students to learn educational materials. Most students (87%) indicated that teachers actively interacted with them. Overall, the students highly appreciated the quality of online learning. However, the responses to the last question of the questionnaire showed that 45% of students preferred classroom learning.

Regarding domain-specific differences, a clear positive trend was observed in the experimental group (EG) among music students: 10% of respondents rated the effectiveness of online platforms as 'good', compared to only 6% in the control group (CG). When analysing the content of distance learning, 12% of EG participants reported 'frequent' engagement with the materials, whereas in the CG this figure stood at 10%. The effectiveness of the IT-based approach is further supported by the increased proportion of 'frequent' responses in the EG (9%) compared to the CG (7%). For students in music-related disciplines, where audiovisual content plays a critical role, videoconferencing, demonstrative tasks, and multimedia resources provided a deeper immersion into the subject matter.

In the discipline of Philosophy, EG students also demonstrated a higher level of satisfaction: 10% provided positive evaluations, mirroring the CG figure; however, the EG displayed a lower proportion of neutral and negative responses, indicating a more stable perception of the learning experience. The content of distance education—particularly discussions and debates facilitated through Google Meet—proved effective, with 12% of EG students interacting with learning materials 'frequently'. These findings confirm that Philosophy, as a discipline, benefits from interactivity, dialogical engagement, and critical discussion, all of which are well-supported by digital platforms.

The most significant impact of digital tools was observed among students studying Literature. Compared to the CG, where 7% provided positive evaluations, 10% of participants in the EG rated IT tools as effective. Furthermore, the highest level of access to distance learning content was reported among EG literature students, with 12% stating they 'frequently' utilised the resources. The effectiveness of IT tools in this group can be attributed to the extensive capabilities of multimedia: analytical text reading, video-based interpretations, online discussions and reflective activities—all of which contributed to improved educational quality.

IT effectiveness

Comparing the responses to Block 3 before and after IT-assisted training (Table 4) revealed considerable improvements in student motivation to learn. By scrutinising the data collected from pre- and post-IT training, researchers discerned discernible shifts in students' attitudes and levels of engagement with the learning material. Before the introduction of IT-assisted learning, students' average scores were lower: 73.8 for music students, 75.2 for philosophy, and 71.6 for literature. After taking the course using IT tools, all three groups showed an increase in average scores: 80.1 for musicians, 78.5 for philosophers, and 79.1 for writers. This increase indicates that the benefits of IT significantly improved student motivation.

There is also an increase in the standard deviation in all groups after IT training (for example, in the music group—from 4.21 to 6.19), which indicates a greater diversity in the perception of the new learning format among students: although the overall level of assessment improved, students' opinions became more variable due to different levels of adaptation to technological tools. The statistical increase in scores confirms the effectiveness of digital methods in distance learning, particularly in conditions of force majeure circumstances.

Effect size indicators (Cohen's d) allow us to assess the strength of the impact of IT-supported learning on student outcomes. Cohen's d values above 0.8 are considered large effects, indicating significant changes in outcomes. Music students had a very large effect ($d = 1.21$), indicating a significant improvement in learning outcomes after the introduction of IT tools. Literature students also showed the greatest growth—their effect size indicator is 1.46, indicating a strong positive impact of new approaches to learning. Philosophy students had a moderate effect ($d = 0.64$), but also indicating positive dynamics. As can be seen from the table, all three groups of students showed improvement after implementing innovative approaches, but the degree of impact varied. This suggests that the nature of the discipline affects the perception and effectiveness of digital educational technologies. Overall, the calculated effect sizes confirm that IT-assisted learning significantly improved student outcomes, with a particularly notable impact in areas where digital tools and subject content need to be better combined.

The comparison of the two surveys shows that the IT-based curriculum effectively teaches subjects and motivates students. Furthermore, the improvement in average scores and motivation confirms the capability of new teaching techniques to attract the attention of students. The responses to the questionnaire demonstrate that the distance learning process proved the effectiveness of IT in overcoming force majeure and improving teaching.

Alongside the observed positive developments, it is important to account for a range of uncontrolled factors that may have influenced the reliability of the results. In particular, participants may have possessed varying levels of digital literacy at the outset of the experiment, which could have affected their ability to adapt to IT tools. Student motivation also varied and was not subject to control. Additionally, socio-domestic conditions—such as access to devices, the quality of internet connectivity, and the

Table 4. Statistical analysis of student responses to block 3 before and after IT-assisted training.

Survey	Subject	Number of students	sd	Value	Cohen's *d*
Before IT-assisted training	Music	80	4.21	73.8	
	Philosophy	80	4.23	75.2	
	Literature	80	4.19	71.6	
After IT-assisted training	Music	80	6.19	80.1	**1.21**
	Philosophy	80	6.15	78.5	**0.64**
	Literature	80	6.10	79.1	**1.46**

Table 5. Results of linear regression analysing the impact of innovative technologies on students' anxiety.

Variable	Coefficient (β\beta$\beta$)	Standard deviation	t-statistic	p-value
Constant (β0)	15.45	2.78	5.56	<0.001
Group	−2.34	0.85	−2.75	<0.01
Age	0.12	0.10	1.15	0.25
Gender	1.56	0.78	2.00	0.05
Basic level of anxiety	0.85	0.15	5.67	<0.001

availability of an adequate learning environment at home—were not assessed, yet may have had a significant impact on the effectiveness of interaction with the platforms.

Student anxiety

The linear regression analysis (Table 5) indicated that the use of innovative technologies and interactive tasks in education significantly reduces students' anxiety levels. Other variables, such as age, had a lesser impact, while gender and baseline anxiety levels also exerted some influence on the outcomes. Age was included as a standard demographic variable that could potentially influence students' emotional responses to learning situations (Santos et al., 2021). Gender was considered a variable that, according to previous studies, may be related to anxiety levels: studies have noted that women are more likely to exhibit higher levels of social anxiety (Khesht-Masjedi et al., 2019). Baseline anxiety levels (measured before the start of the learning intervention) were added as a control variable to assess the impact of the IT training itself in isolation, regardless of individual baseline student characteristics.

The constant (β0): This coefficient represents the average level of anxiety measured by the SIAS scale for the control group when all other variables are zero. A high significance level ($p < 0.001$) indicates that this baseline anxiety level is statistically significant. The group coefficient is negative, indicating that students in the experimental group had a 2.34-point lower anxiety level on the SIAS scale compared to the control group. This result is statistically significant ($p < 0.01$), suggesting a positive impact of innovative technologies on reducing student anxiety. The coefficient for age is small and positive, indicating that anxiety levels increase slightly by 0.12 points with each year of age. However, this result is not statistically significant ($p = 0.25$), indicating that age does not significantly influence anxiety levels in this study. The positive gender coefficient indicates that one gender has a higher anxiety level by 1.56 points. This result approaches statistical significance ($p = 0.05$), suggesting a potential difference in anxiety levels between genders. The high and positive coefficient of baseline anxiety indicates a strong correlation with the final anxiety level, increasing it by 0.85 points for each unit increase in baseline anxiety. This result is statistically significant ($p < 0.001$), underscoring the importance of considering baseline anxiety levels in data analysis.

However, it is important to consider possible variables that could have influenced the level of anxiety of students. These include psycho-emotional state outside of education (e.g., family circumstances, health, social conflicts), the degree of previous preparation for working with IT, the level of motivation to participate in the program, as well as personal attitude towards distance learning. These factors were not included in the regression model but could have had an indirect effect on the outcome variable. In addition, the teaching characteristics of individual teachers, communication style or support could have had a possible effect, which should also be taken into account in further research.

Discussion

In the context of the theoretical perspective, the results of the current study can be viewed through the prism of the theory of technological acceptance and integration of IT into the educational process. According to Csavdari et al. (2021), the adaptation of educational programs to distance learning is necessary to ensure the effectiveness and interactivity of modern education. Incorporating technology into learning not only facilitates access to learning materials but also activates students, improving their motivation to learn and engagement in the process (Tsytsiura & Wanquan, 2020). Each teacher uploaded the lesson materials on the learning platform or self-created groups on Messenger to help students prepare for the lesson (Tsytsiura & Wanquan, 2020). The authors identified and analysed effective mobile

applications used for educational purposes in higher educational institutions of the People's Republic of China: Classroom, DingTalk, Superstar Online, free MOOC and Wisdom Tree are the platforms and tools used by teachers from Chinese universities for distance learning. The results of this study show that WhatsApp is the most popular application. Student responses to the questionnaire show a high appreciation of their chosen online learning platforms, indicating a positive attitude towards using these tools. Preference is given to those platforms that provide ease of use, accessibility, and convenience, which directly correlates with the main factors of technology acceptance theory: perceived usefulness and convenience (Velicia-Martin et al., 2021). This is also confirmed by the increase in digital literacy (63%) and the high assessment of the quality of online learning (68–87%).

It is crucial to achieve a higher level of quality, efficiency, and effectiveness in online learning and traditional or blended forms (Li, 2019). The results of the analysed study show a significant positive impact of synchronous web teaching and visual-creative learning on creativity. Accordingly, the combination of synchronous web teaching with visual-creative learning considerably improves creativity. In the current study, as shown by the values of standard deviation, students of various majors scored an average of 73.5 points before IT learning and 79.23 points after IT learning. The results, which show positive dynamics in students' attitudes towards IT-supported learning (increased average scores in all groups, decreased anxiety), confirm the flexibility of the educational process during crisis situations. This demonstrates the ability of students and teachers to adapt to new conditions, as well as the effectiveness of integrating technologies into curricula to overcome challenges associated with force majeure circumstances, and is consistent with the principles of the theory of pedagogical adaptation (Obidovna, 2023).

Published studies have discussed the issue of organising and implementing distance learning in general education institutions in conditions of force majeure (Gagik, 2020). The authors concluded that in the context of force majeure, distance learning remains the best alternative method of teaching. Nevertheless, it fails to completely replace the traditional classroom learning system (Gagik, 2020). About 97.7% of parents who took part in the survey held the same opinion, pointing out that distance learning not only hinders socialisation but also causes serious health and psychological problems. The results of the current study are in line with the above conclusions. According to the survey results, students highly appreciated the quality of organising and conducting distance learning. At the same time, the students were asked whether they would prefer distance or classroom learning, considering the environment, learning intensity, the effectiveness of educational resources, interactive forms, and learning outcomes. In this case, 45% of students preferred classroom forms of learning. However, in terms of anxiety assessment, students in the experimental group exhibited a 2.34-point lower anxiety level on the SIAS scale compared to the control group, indicating a positive impact of innovative technologies on reducing student anxiety. Regression analysis showed that interactive technologies statistically significantly reduced anxiety ($\beta = -2.34$), which is consistent with cognitive load theory (Kennedy & Romig, 2024).

The results of the study are in line with previous findings on the importance of integrating digital platforms into education, which is especially relevant in force majeure situations, as was the case during the COVID-19 pandemic. According to studies conducted in other countries, such as Russia, distance learning has become an important tool for ensuring continuity of education during crisis situations (Andreev et al., 2020). However, the results from China also show that while distance learning has advantages, particularly in terms of flexibility and accessibility, it cannot completely replace traditional forms of education that provide more direct contact between students and teachers (Aimaganbetova et al., 2020; Gagik, 2020). This study also confirms that the effective use of information technology can reduce academic anxiety, which is important for maintaining students' psycho-emotional state, especially in distance learning. The results of the study show that students are actively engaged in the learning process: 84% understand the learning objectives, 80% have constant access to online resources, 63% note the motivational nature of the tasks. These data indicate that students not only consume knowledge, but also interact with the educational content, forming understanding through personal experience. This is consistent with the constructivist approach, according to which students independently construct knowledge through active activity in interaction with the environment (Alismaiel et al., 2022).

A Kazakh study examined the use of ICT in Kazakh higher education institutions. The authors analysed the benefits of ICT for students and proposed potential solutions to problems encountered during ICT implementation (Andekina & Anartayeva, 2022). A survey involving a small student population was the

main tool of the study. The findings showed that 43% of students thought their universities had sufficient digitalisation (Andekina & Anartayeva, 2022); 40% remained neutral. However, 17% of respondents were unhappy with their ICT equipment, indicating that HEIs must fix this issue to maintain their competitive edge (Andekina & Anartayeva, 2022). The results of the current study support the conclusions of the previously reviewed study. However, in this paper, 78% of respondents rated their experience with digital technologies as excellent. Additionally, 58% of students noted that distance learning was effective for overcoming difficulties and mastering the complexities of each subject.

Another study (Fernández-Batanero et al., 2021) examined the academic anxiety of students during the COVID-19 pandemic. The study was conducted among students attending morning classes and student groups attending afternoon sessions. Data collection involved a closed survey where respondents were presented with five alternative response options. The results indicated that the level of academic anxiety among daytime students was 77.75%, whereas among afternoon students, it was 81.05%. The difference in academic anxiety between regular and non-standard student groups existed but was not statistically significant. In this study, linear regression demonstrated that the use of innovative technologies and interactive tasks in education significantly reduces students' anxiety levels.

Although the study demonstrated an overall positive effect of IT tools on reducing student anxiety, the findings should be interpreted with caution due to potential alternative explanations. Specifically, the reduction in anxiety may not solely be attributed to the use of IT, but also to students' prior experience with digital technologies, their individual confidence levels, or the professionalism of the instructor in fostering a supportive learning environment. Additional contributing factors may include the presence of social support and the nature of the academic subjects themselves, which vary in their adaptability to online formats. Furthermore, external variables such as students' financial situations, internet connectivity quality, and access to technological devices may have significantly influenced their distance learning experience. The use of self-report surveys in the study also introduces the possibility of subjective bias, while variability in responses highlights the role of individual circumstances. These considerations underscore the necessity for further research that includes controls for confounding variables to more accurately assess the impact of IT on educational outcomes.

Conclusions

The study addressed the issue of using information technologies in the field of higher and postgraduate education, particularly in distance learning during the COVID-19 pandemic. The study's theoretical framework emphasises that information technologies in education enhance the interactivity of learning by creating new opportunities for material acquisition, as outlined in the theory of learning technologies. The study's findings support the theoretical assumptions that using information technologies in education significantly improves the effectiveness of the learning process and student motivation. A survey showed that most respondents highly appreciated the experience of working with digital technologies and noted the effectiveness of the online training format. Analysis of the results showed that the use of information technologies increases student motivation to learn. According to the standard deviation values, students of various majors scored an average of 73.5 points before IT learning and 79.23 points after IT learning.

Furthermore, the results of the analysis indicate a reduction in students' anxiety levels due to the use of innovative technologies, which aligns with theoretical models that suggest digital tools can help reduce stress and anxiety in the learning process. Students in the experimental group exhibited an anxiety level that was 2.34 points lower on the SIAS scale compared to the control group. This decrease suggests that students who were taught using the new approach experienced less social anxiety and stress, which may indicate an improvement in the comfort of the learning environment and better adaptation to the online format.

Thus, the study confirms that information technology-based curricula are effective for teaching subjects and motivating students to learn. This conclusion opens up new perspectives in the field of higher education, especially in the face of force majeure circumstances such as the COVID-19 pandemic. The findings also highlight the importance of developing and using information technology in the educational process. Furthermore, the results of linear regression indicate that the use of innovative

technologies in education significantly reduces students' anxiety levels. Educational institutions can implement long-term policies to address students' anxiety during digital learning through a series of strategic measures aimed at creating a comfortable, supportive and predictable learning environment. First, it is important to provide stable and accessible technical support for all students, including training in basic digital skills, support in using platforms and timely resolution of technical issues. This will reduce frustration related to ignorance or technical difficulties, which often cause stress. Second, it is necessary to implement pedagogical approaches focused on students' emotional well-being: regular feedback, a clear course structure, accessible instructions for tasks, as well as an individualised approach to assessment can reduce anxiety related to uncertainty and academic pressure. Another important aspect is the integration of psychological support into the digital environment: this can be access to online consultations, stress resistance training, support groups, or even relaxation and self-reflection exercises built into the learning modules. All of these measures taken together can ensure not only a reduction in anxiety, but also an overall improvement in the quality of the educational process in digital learning environments.

The practical value of the paper lies in important conclusions for improving the distance learning process based on information technologies. Based on the findings of this study, several practical recommendations can be proposed to enhance the integration of information technologies into distance education. First, educational institutions should design online courses that prioritise increasing student motivation and reducing anxiety. It is essential to incorporate interactive elements, maintain consistent feedback mechanisms, and provide flexible learning opportunities to mitigate stress associated with changes in the educational environment. Second, educational policymakers and administrators should consider investing in innovative technologies as a key strategy for ensuring continuity of education during crises such as pandemics. Such investments would facilitate rapid adaptation to unforeseen circumstances and help maintain a stable learning process. Furthermore, the results of the study highlight the critical importance of supporting students' psychological well-being as an integral component of effective educational planning.

The scientific value of the study is the fact that it brought new data and generalisations about the impact of information technologies on higher education.

Future research should focus on refining pedagogical strategies that effectively reduce student anxiety and enhance academic performance in the context of distance learning. To achieve this, it is essential to equip educators with the necessary competencies for the effective integration of information technologies into the instructional process. This includes ongoing professional development and access to up-to-date resources and digital tools. Finally, continued scholarly investigation into the efficacy of pedagogical approaches and methodologies in online education is imperative, alongside the development of innovative technological solutions aimed at optimising remote learning environments.

Recommendations

Based on an analysis of the contemporary distance education in Kazakhstan, the study offers the following recommendations: 1) Each citizen of the country should have access to digital technology and the Internet, especially high-speed and affordable Internet; 2) The Republic of Kazakhstan must establish a unified domestic learning platform; and 3) An effective distance learning methodology must be developed by analysing international distance learning experience.

Ethical approval

The authors declare that the work is written with due consideration of ethical standards. The study was conducted in accordance with the ethical principles approved by the Human Experiments Ethics Committee of Shakarim State University of the City of Semey (Protocol No. 232 of 10.05.2023).

Informed consent

All the participants gave their written informed consent.

Disclosure statement

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Data availability

Data will be available upon request.

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Appendix A.

Questionnaire

Which online platform do you use most often for distance learning?

- Google Forms
- Google Meet
- Google Class
- WhatsApp
- YouTube

Block 1: Analysis of Online Platforms and Digital Literacy Effectiveness

1. Please rate the learning platform

Very good	4
Good	3
Neutral	2
Bad	1

2. How well do you understand the platform you have chosen for distance learning?

Very good	4
Good	3
Neutral	2
Bad	1

3. How would you rate the innovative technology in distance learning?

Very good	4
Good	3
Neutral	2
Bad	1

4. What method of teacher interaction during a distance learning session, in your opinion, works best?

Audio recording of the lesson	4
Video recording of the lesson	3
Online audio conferences	2
Online video conferences	1

Block 2: Analysis of Distance Learning Content

1. I look through the teacher's resources before learning.

Almost always	4
Very often	3
Occasionally	2
Never	1

2. I fully comprehend the disciplines' learning objectives, assignments, homework requirements, and grade types.

Almost always	4
Very often	3
Occasionally	2
Never	1

3. I am comfortable accessing the online resources required to meet your learning objectives.

Almost always	4
Very often	3
Occasionally	2
Never	1

4. I can effectively study any discipline online.

Almost always	4
Very often	3
Occasionally	2
Never	1

5. I find the teacher's tasks useful and interesting. They encourage my desire to learn more.

Almost always	4

Very often	3
Occasionally	2
Never	1

Block 3: IT-Assisted Distance Learning Efficiency and Effectiveness

1. I believe that using information technology to organise online courses in a distance learning format is effective.

Almost always	4
Very often	3
Occasionally	2
Never	1

2. It is necessary to use interactive forms and technologies in online learning.

Almost always	4
Very often	3
Occasionally	2
Never	1

3. I need surveys, essays, and online tests to learn the material better.

Almost always	4
Very often	3
Occasionally	2
Never	1

4. The teacher interacts well with me.

Almost always	4
Very often	3
Occasionally	2
Never	1

5. Which type of learning is more suitable and pleasant for you: distance or classroom?

Distance learning	2
Classroom learning	1