CUTTING-EDGE EDUCATIONAL TECHNOLOGIES AND THEIR INFLUENCE ON RESEARCH IN THE ERA OF DIGITALISATION

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Abstract: This study is relevant in the context of the rapid development of the modern educational environment, where digital technologies are becoming a vital tool for improving the quality of education and developing students' scientific competencies. The introduction of digital platforms allows for individualising the educational process, providing access to a wide range of information resources, promoting students' active involvement in research, and developing critical thinking necessary for competitive research activities in the modern world. The aim of this study is to assess the impact of the latest learning technologies on research activities in the context of the digitalisation of education, focusing on the analysis of current trends in the use of innovative technologies to improve the efficiency of teaching and research, as well as to identify new opportunities for the development of education. The study used general scientific research methods such as literature analysis, comparative analysis, methods of generalisation, and systematisation to assess the impact of innovative teaching technologies on the development of research skills of teachers using digital platforms in comparison with traditional teaching methods. Expert evaluation was also used to collect the necessary data. The total number of respondents (Total = 20 people) was randomly divided into two groups according to the following criteria: Group 1 teachers used digital platforms and web resources for teaching, and Group 2 teachers used traditional theoretical and methodological approaches. Based on the data obtained, weighted average expert assessments were calculated, and a one-sample t-test was conducted in the JASP software (One-Sample T-Test tool) to determine the impact of innovative teaching technologies on student skills development. The study found that teachers who used digital technologies (Group 1) showed significantly higher results in developing analytical thinking, independent knowledge acquisition, technical skills, data management, and multimedia materials than teachers who used traditional teaching approaches (Group 2). In particular, the statistically significant differences we found confirm the advantage of digital technologies in developing relevant skills among students compared to traditional teaching methods. Based on the results of the analysis, digital technologies create a favourable environment for active learning and developing practical skills critical for conducting high-quality and efficient research activities. They help to increase analytical thinking, independent knowledge acquisition, and technical skills and enhance the ability to work with large amounts of data and multimedia materials.

Keywords: Educational technologies, Digitalisation, Research, Educational process, Innovations

1 Introduction

Innovative learning technologies are now vital in transforming research activities, changing approaches to collecting, analysing, and disseminating information and contributing to a revolution in how we collaborate and innovate. This is especially true in Asia, where web portals, voice services, text messaging, online communities, mobile services and interactive video conferencing set a new standard for sharing knowledge and research results (Zhang et al., 2016). Integrating these technologies significantly increases the efficiency and productivity of scientific research. They allow researchers to find, analyse, and interpret data quickly and collaborate effectively locally and internationally. In addition, such integration facilitates the creation of new forms of collaboration and innovative approaches to addressing global challenges through research. In the context of the rapid development of online learning, implementing these technologies covers a wide range of tools, including computer and telecommunication technologies. These tools provide interactive interaction between participants in the educational process and facilitate access to large amounts of knowledge through specialised computer programs, web platforms, virtual environments and electronic resources (Batista et al., 2020), which not only improves the quality of learning but also increases the effectiveness of research through convenient and accessible exchange of data and ideas between members of the scientific community.

The paper aims to analyse the impact of innovative learning technologies on research activities in the context of the digitalisation of education. The article seeks to reveal current trends and achievements in using digital platforms and web services to improve the efficiency of teaching and research. The study's objectives are to consider the impact of information technologies and the new opportunities that these technologies open up for cooperation between research teams, increasing access to knowledge and creating conditions for the innovative development of the educational process in the modern digital environment.

2 Literature review

The main features of modern education are the formation and development of a humanistic paradigm that emphasises the importance of the value and dignity of each person in order to increase their activity, freedom and independence. Many researchers, including Biliakovska and Binytska (2023), Bykov and Leshchenko (2016), Dettori et al. (2018), Kyrychenko (2018), have devoted their research to the improvement and implementation of innovative technologies for personality-oriented learning within this paradigm. In this context, it is also essential to take into account the priority of using advanced learning technologies; in particular, interactive learning tools allow the development of communication skills, teamwork and the ability to express thoughts, intrinsic motivation and creativity (Braievska, 2024; Borysenko et al., 2023; Dhivya et al., 2023; Lin & Wang, 2021; Semenets-Orlova et al., 2023). In addition, these technologies contribute to the development of analytical and cognitive activity (Semenets-Orlova et al., 2022), critical thinking, information literacy, communication skills, self-motivation and self-management (Nikukar, 2024), as well as technical skills, including mastering the methodology, techniques and methods of research activities (Horielov, 2012), which are essential for the efficiency and quality of research activities.

In order to achieve a high level of creativity in the educational process and research activities, it is essential to use elements of creative personality development such as problem-solving, situational modelling, and strategic approaches. These approaches, according to Lüy et al. (2024), Ryoke and Wierzbicki (2007), and Papanis (2020), use forms and methods of organising the educational process, such as business and role-playing games, micro-teaching methods and modelling educational projects, online conferences and seminars, independent work of students and pedagogical practices, which helps both in research and professional activities. In addition, in the current conditions of rapid development of online learning, according to Siddiq et al. (2024), in the information society, there is a need to introduce innovative educational technologies (Byrkovych et al., 2023) in particular, distance learning technologies, including the use of computer and telecommunication technologies, provide interactive interaction between participants in the educational process (Ambe et al., 2024; Garlinska et al., 2023; Nikitenko & Kovalenko, 2024; Rebukha & Polishchuk, 2020).

Thus, innovative learning technologies are critical tools for modernising the educational process and research activities. According to Saif et al. (2022), the latest technologies improve the learning process by creating an electronic environment that harnesses the power of technology and communication to develop specific skills. In addition, they include the use of computer programs, online resources, virtual environments, e-platforms and other innovative tools aimed at improving access to knowledge and increasing the effectiveness of learning and

research (Batista et al., 2020; Popov et al., 2021; Raja & Lakshmi Priya, 2022).

3 Research methods

The following general scientific research methods were used in the study: literature analysis, which was used to theoretically substantiate the critical aspects of the development of innovative teaching technologies; method of generalisation and systematisation, which was used to identify and analyse innovative teaching technologies and the formation of research skills; comparative analysis, which was employed to identify the quality of the skills acquired by students who used digital technologies and traditional methods of teaching.

In addition, expert assessments were used based on the formation of two research groups: control and experimental. Group 1 – lecturers of the Faculty of Management and Marketing of S. Kuznets Kharkiv National University of Economics (10 people) and Group 2 - lecturers of the Faculty of Economics and Business Management of Kryvyi Rih National University (10 people). The groups are distributed so that Group 1 uses digital platforms and web resources to learn the educational material during the educational process. Group 2 uses traditional theoretical and methodological approaches to teaching. Based on the obtained values, weighted average expert assessments were calculated in Excel using the AVERAGE function and a one-sample t-test was conducted in JASP using the T-Test tool to identify the impact of innovative learning technologies on the skills developed by students through the use of specialised digital platforms and web services.

4 Research results

In today's world of rapid digitalisation of education, innovative learning technologies are becoming a critical factor in determining the efficiency and quality of the educational process. The development of technology opens up new opportunities for improving teaching methods and research activities. In particular, personality-oriented educational technologies help adapt curricula to students' needs, ensuring active participation and involvement in research activities. The personality-oriented approach to digital education involves:

- Development of individual and cognitive abilities through the introduction of adaptive learning platforms, such as SmartSparrow or DreamBox, which adapt to individual student needs by offering personalised content and tasks, as well as e-textbooks and interactive materials that promote deeper understanding and engagement of students in the learning process.
- Formation of individual (subjective) experience involves using online platforms such as Google Classroom or Microsoft Teams for collaborative work on projects and exchanging knowledge and experience among students during scientific experiments and research.
- Realising potential and personal educational goals through self-monitoring platforms, such as Moodle or Blackboard, offer self-assessment and personal progress tracking, as well as digital tools for career counselling (Handshake, LinkedIn Learning, etc.).

Given that personality-oriented learning puts personal development at the centre of the educational process, its application enables students to achieve high results in research activities, applying the acquired individual cognitive abilities, identifying and using personal experience, the results of self-knowledge and self-realisation, as well as the culture of life for effective management of personal and professional development. Instead, interactive teaching methods allow you to create a dynamic learning environment that improves the exchange of knowledge and experience between participants in the educational process. By using interactive learning technologies such as Nearpod, Padlet, or Socrative, educational programmes develop communication skills, teamwork, and expression of opinions, creating a favourable emotional environment for students. In addition, these technologies increase interest in learning and intrinsic motivation and actively unleash students' creativity, contributing to the development of in-depth knowledge of the educational material and critical and scientific thinking.

Technologies for forming a creative personality are critical in the modern information society, as they aim to develop intellectual and creative thinking and the ability to innovate and implement innovative ideas. When applying relevant digital tools (Crello, Crayola Art-Studio, Music Crab, Chrom Music Lab, etc.) in the educational process, it is essential to avoid strict regulation of student activities, promoting the organisation of the educational process with elements of creativity using digital platforms and tools.

In addition, to achieve a certain level of creativity in the educational process, it is advisable to use such technologies to form a creative personality, such as a problem-search approach, situational modelling, and a strategic approach. The primary skills formed when interacting with digital technologies include originality of thinking, independence in acquiring new knowledge, versatility in applying the acquired knowledge, speed in solving non-standard situations, and the ability to find and offer new solutions that differ from existing or previously proposed ones.

The introduction of distance and media learning technologies as innovative tools in the educational process ensures the availability of knowledge and resources regardless of the location of students, creating new opportunities for research and sharing results. They include modern tools and technical solutions for the effective conduct of the educational process with remote access to educational resources, namely personal computers, network equipment, servers for video conferencing, and software for learning management and interaction between participants in the educational process. In turn, the information and communication technology provides the necessary bandwidth for uninterrupted access to web resources and web services (e.g. Google Classroom, Classdojo, Edmodo, etc.) in synchronous and asynchronous modes, including software for people with special needs. In addition, web-based resources for distance learning (e.g. PhET Interactive Simulations, Labster, Kahoot!, PubMed Central, etc.) include teaching materials, curricula, video and audio lectures, multimedia materials, practical exercises, virtual laboratories, simulators, tests, business games, digital libraries and other resources to support the learning process and meet learning objectives.

The results of analysing case studies in digital education and innovative teaching technologies formed the skills necessary for conducting research activities (Table 1).

Based on the analysis, two groups of experts were involved: Group 1 – lecturers from the Faculty of Management and Marketing of the Kharkiv National University of Economics named after S. Kuznets (10 people) and Group 2 – lecturers from the Faculty of Economics and Business Management of the Kryvyi Rih National University (10 people). It should be noted that in Group 1, digital platforms and web resources are used in the educational process to master the educational material. In contrast, in Group 2, the teacher used traditional theoretical and methodological approaches to teaching.

As part of the study, expert teachers assessed the level of skills acquired by students based on their research activities in writing term papers and diploma papers on a scale from 0 to 100 points, taking into account their current academic performance and their own experience of communicating with students. The results of calculating the average weighted expert assessments in Excel using the "AVERAGE" function are shown in Figure 1.

Table 1. Impact of innovative teaching technologies on developing research skills

Skills	**Features**	**Means**
Analytical thinking	Ability to critically evaluate information, identify patterns and conclude.	MATLAB, R, Excel
Independent acquisition of knowledge	Ability to find, analyse and use new information to solve research problems.	Coursera, edX, Google Scholar
Originality of thinking	Ability to generate new ideas and approaches to solving scientific problems.	MindMeister, Miro, Trello
Communication skills	Ability to effectively communicate research results and collaborate with other researchers.	Slack, Zoom, Microsoft Teams
Ability to work in a team	Ability to collaborate on research projects and solve problems together.	Asana, Monday.com, Basecamp
Project management skills	Ability to plan, organise and monitor the implementation of research projects.	Microsoft Project, Jira, Trello
The speed of solving tasks	Ability to respond quickly to changes and uncertainties in the research process.	Notion, Evernote, OneNote
Technical skills	Proficiency in modern digital tools and platforms required for research.	Python, Jupyter Notebook, SPSS
Skills in working with large amounts of data	Ability to collect, analyse and interpret large amounts of data for research.	Hadoop, Spark, Tableau
Skills in using multimedia materials	Ability to create and use video, audio and other multimedia materials for research presentation and educational purposes.	Camtasia, Adobe Premiere Pro, Audacity

Source: compiled by the author based on Braievska (2024), Borysenko et al. (2023), Dhivya et al. (2023), Lin & Wang (2021), Nikukar (2024), Raja & Lakshmi Priya (2022), Semenets-Orlova et al. (2023)

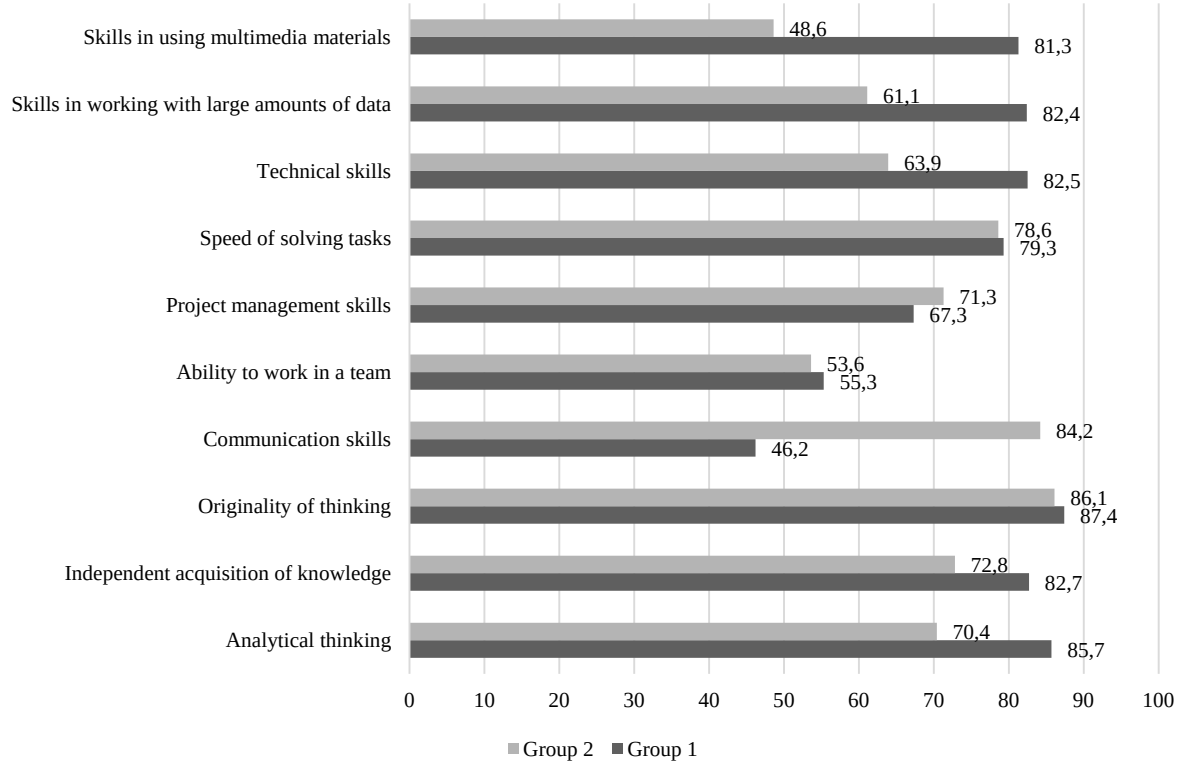

Figure 1. Assessment Results of Students' Skills in Using Digital Technologies and the Traditional Approach to the Learning Process
Source: compiled by the author

A comparative analysis of students' skills using digital technologies and the traditional approach to the learning process shows a significant gap between the scores in each group. Students who use digital technologies demonstrate a high level of analytical thinking (Group 1 = 85.7; Group 2 = 70.4), which indicates the effectiveness of digital methods in developing analytical skills. They are also better at acquiring knowledge independently (Group 1 = 82.7; Group 2 = 72.8), which can be explained by access to a wide range of online resources. In addition, the originality of thinking in both groups is high, but students using digital technologies still have a slight advantage (Group 1 = 87.4; Group 2 = 86.1). At the same time, the traditional approach to learning provides better development of communication skills (Group 1 = 84.2; Group 2 = 46.2), which emphasises the importance of verbal interaction in the learning process. The ability to work in a team is almost the same in both groups (Group 1 = 55.3; Group 2 = 53.6), which indicates that one approach has no significant advantage over the other. Project management skills are better developed among teachers using the traditional methodology (Group 1 = 71.3; Group 2 = 67.3), which may result from a more structured approach to project activities. However, the skills in using multimedia materials are significantly better among those teachers who use digital technologies (Group 1 = 81.3; Group 2 = 48.6), which reflects the effectiveness of digital tools in this area. Digital technologies contribute to developing analytical, technical, creative, data and multimedia skills, while the traditional approach is more

effective in developing communication and project management skills.

In the course of the study of critical aspects of modern education and innovations in the educational process, it is essential to compare the effectiveness of digital technologies and the traditional approach in modern higher education institutions. A one-sample t-test in the JASP software (One-Sample T-Test tool) was used to assess students' skills acquired through digital technologies objectively. This statistical method of analysis allowed us to identify the nature of the impact of innovative teaching technologies on the skills developed by students through the use of specialised digital platforms and web services. Based on preliminary expert opinions in two groups, the t-test compares the average values of the sample data with theoretical or standard indicators that determine students' abilities and competencies in various aspects of the curriculum. The results of the One Sample T-Test presented in Table 2 allow us to determine how effectively digital technologies contribute to developing specific skills compared to traditional teaching methods.

Table 2. Determining the impact of innovative teaching technologies on developing students' research skills

One Sample T-Test						
						95% CI for Mean Difference
	t	df	p	Mean Difference	Lower	Upper
Group1						
Analytical thinking	29.109	9	< .001	85.700	80.303	∞
Independent acquisition of knowledge	14.816	9	< .001	82.700	72.468	∞
Originality of thinking	29.757	9	< .001	87.400	82.016	∞
Communication skills	10.303	9	< .001	46.200	37.980	∞
Ability to work in a team	7.403	9	< .001	55.300	41.607	∞
Project management skills	10.848	9	< .001	67.300	55.927	∞
The speed of solving tasks	14.222	9	< .001	79.300	69.079	∞
Technical skills	17.614	9	< .001	82.500	73.914	∞
Skills in working with large amounts of data	16.009	9	< .001	82.400	72.965	∞
Skills in using multimedia materials	17.835	9	< .001	81.300	72.944	∞
Group 2						
Analytical thinking	12.444	9	< .001	70.400	60.030	∞
Independent acquisition of knowledge	10.609	9	< .001	72.800	60.222	∞
Originality of thinking	36.791	9	< .001	86.100	81.810	∞
Communication skills	38.273	9	< .001	84.200	80.167	∞
Ability to work in a team	7.389	9	< .001	53.600	40.302	∞
Project management skills	10.887	9	< .001	71.300	59.295	∞
The speed of solving tasks	24.187	9	< .001	78.600	72.643	∞
Technical skills	9.639	9	< .001	63.900	51.748	∞
Skills in working with large amounts of data	7.765	9	< .001	61.100	46.675	∞
Skills in using multimedia materials	7.308	9	< .001	48.600	36.409	∞
Note. For the Student t-test, the sample mean difference d gives the location difference estimate.						
Note. For the Student t-test, the alternative hypothesis specifies that the mean is greater than 0.						
Note. Student's t-test.						

Source: compiled by the author

Based on the results of a one-factor t-test between two groups of students using digital technologies (Group 1) and a traditional approach (Group 2) in the learning process, a comparative analysis of their skills was carried out. Group 1 showed a statistically significant higher level in many skills than Group 2. In particular, Group 1 teachers demonstrate significantly better results in analytical thinking ($t = 29.11$, $p < 0.001$), independent knowledge acquisition ($t = 14.82$, $p < 0.001$), technical skills ($t = 17.61$, $p < 0.001$), skills of working with large amounts of data (difference in mean = 16.01, $p < 0.001$) and skills of using multimedia materials (difference in mean = 17.84, $p < 0.001$). On the other hand, Group 2 teachers showed significantly better results in communication skills ($t = 38.27$, $p < 0.001$). Although both groups have similar levels of teamwork skills ($t_{Group\ 1} = 7.4$; $t_{Group\ 2} = 7.39$, $p < 0.001$) and project management skills ($t_{Group\ 1} = 10.85$; $t_{Group\ 2} = 10.887$, $p < 0.001$), the advantage in certain aspects of skills is determined by the type of teaching approach used. The analysis of the t-test results shows that teachers who use digital technologies in the teaching process have higher scores in many skills compared to those who follow a traditional approach. Thus, the primary thesis of the study is confirmed, as the results indicate the significance of the impact of digital technologies on the development of relevant research skills among students.

5 Discussion

According to Nikitenko and Kovalenko (2024), the complexity of distance education is due to the possibility of introducing 5G digital technologies. These technologies include the fifth generation of wireless networks, which make it possible to deploy devices densely and provide direct interaction between different satellites, reduce energy consumption, use enhanced connectivity to Internet resources, and provide rich multimedia learning experiences (Nikitenko & Kovalenko, 2024).

According to Nikukar (2024), using the latest flipped classroom method and introducing innovative teaching technologies in research activities is possible. This teaching method allows students to listen to online lectures or read literature in their free time. Then, during classes, they do engaging exercises and puzzles according to the material they have studied, developing logical thinking and creating an excellent learning atmosphere that encourages them to study new material more thoroughly (Nikukar, 2024). At the same time, Papanis (2020) emphasises the importance of teaching in small portions that can be digested by the learner (the so-called portioned microlearning). This model was evaluated during distance learning at the University of Democritus, Greece (Papanis, 2020).

Popov et al. (2021) studied the peculiarities of applying innovative technologies in the work at nuclear power plants.

They determined that the introduction of artificial intelligence helped to reduce the time spent by employees at the workplace, increase the efficiency of plant management, and reduce the cost of electricity consumed for the operation of the plant and electronic devices. Station personnel can train and develop professionally remotely using innovative technologies in conditions close to natural and safe for participants (Popov et al., 2021).

During the COVID-19 pandemic, Raja & Lakshmi Priya (2022) evaluated the use of virtual reality and artificial intelligence tools to improve the quality of education in a changing academic environment. They found that this significantly improved the quality of higher education programmes. The introduction of innovative technologies such as remote meetings, online exams, virtual reality, and augmented reality can improve the quality of education. However, according to their observations, with age, teachers have mixed opinions about incorporating virtual reality trends into their daily routines. After surveying 140 education professionals from different parts of India, they concluded that teachers agree with integrating virtual reality and augmented reality to improve the quality of education. The analysis showed that students from rural areas need help getting to grips with the technology.

The evaluation of innovative technologies at Ternopil National Economic University concluded that the technically correct organisation of distance learning maintains a balance between theoretical and practical training of specialists. The students communicated in a distance format on the online platform Moodle. However, Rebukha and Polishchuk (2020) concluded that the virtual educational environment must partially replace the direct learning contact between teachers and students in the classroom.

Recent advances in information technology, supported by high-speed internet, have removed territorial barriers to communication (Saif et al., 2022). As Semenets-Orlova et al. (2022) note, Russia's war against Ukraine has spurred the development of innovative technological processes. However, this does not reduce the need for higher education institutions to develop their capacity using digital tools. Education development creates new opportunities for developing human potential in social media (Semenets-Orlova et al., 2022).

The effective use of information technology is highly appreciated not only in education but also in agriculture. For example, a study of China's agricultural Sector over the past 30 years has identified seven models of information dissemination. These technologies facilitate the growth of various crops and milk production by introducing intelligent plant and animal care methods, which will help transfer knowledge to future generations (Zhang et al., 2016).

Thus, based on the results of the comparative analysis between students using digital learning technologies (Group 1) and the traditional approach (Group 2), digital tools significantly impact the development of skills required for research activities. Students who use digital learning technologies demonstrate a higher level of analytical thinking, independent knowledge acquisition, technical skills, working with large amounts of data and using multimedia materials compared to those who use the traditional approach, which is confirmed by statistically significant differences in mean values and t-test results ($p < 0.001$). On the other hand, students with a traditional approach showed an advantage in communication skills. Thus, digital technologies create a favourable environment for active learning and development of student skills, which are critical for conducting high-quality and effective research activities in the modern world.

6 Conclusions

Innovative learning technologies are significantly changing modern education in the context of digital transformation; in particular, the personality-oriented approach is a critical aspect aimed at individualising learning and adapting curricula to each student's unique needs and capabilities. Interactive learning technologies designed to create a dynamic learning environment support the active exchange of knowledge and experience between participants in the educational process. These tools contribute to developing communication skills, working in a team, and creating a favourable emotional environment for learning. In addition, using digital technologies opens up new opportunities for distance learning and research. They allow students to access learning resources anywhere and anytime, contributing to the flexibility and accessibility of the educational process.

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