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Individualization of the Education of Future Natural Sciences Teachers in the Context of Covid-19

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ABSTRACT

In early 2020, the traditional form of full-time education has become unacceptable, which has made the educational system to change dramatically. Educators had to find new ways and tools for transferring knowledge to students. The aim of this work was to study the impact of the individualization of education on the effectiveness of educational services provided to Natural Sciences teachers in the context of Covid-19. The study involved semi-structured interviews, as well as close-ended questionnaires. The analysis of variance, Cohen's coefficient and Statictica software application were also used. It was found in the sample of future natural sciences teachers that the individualization of education can promote higher efficiency of distance learning. This requires skillful handling of a wide variety of didactic materials and educational resources, their adaptation to the individual capabilities of the student, his or her expectations of learning and didactic goals. It was found that the individualization of education helps students to feel less overload, stress, tension, lack of time. They learned to plan and self-organize, their self-motivation and responsibility for the completed work increased.

KEYWORDS: educational platform, digital educational space, online learning, individual learning, cloud technologies.

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Individualización de la formación de los futuros profesores de Ciencias Naturales en el contexto de la Covid-19

RESUMEN

A principios de 2020, la forma tradicional de educación a tiempo completo se ha vuelto inaceptable, lo que ha hecho que el sistema educativo cambie drásticamente. Los educadores tenían que encontrar nuevas formas y herramientas para transferir conocimientos a los estudiantes. El objetivo de este trabajo fue estudiar el impacto de la individualización de la educación en la efectividad de los servicios educativos brindados a los profesores de Ciencias Naturales en el contexto de la Covid-19. El estudio involucró entrevistas semiestructuradas, así como cuestionarios cerrados. También se utilizó el análisis de varianza, el coeficiente de Cohen y el software Statictica. Se encontró en la muestra del futuro de los profesores de Ciencias Naturales que la individualización de la educación puede promover una mayor eficiencia de la educación a distancia. Esto requiere un manejo hábil de una amplia variedad de materiales didácticos y recursos educativos, su adaptación a las capacidades individuales del alumno, sus expectativas de aprendizaje y objetivos didácticos. Se encontró que la individualización de la educación ayuda a los estudiantes a sentir menos sobrecarga, estrés, tensión, falta de tiempo. Aprendieron a planificar y autoorganizarse, aumentó su automotivación y responsabilidad por el trabajo terminado.

PALABRAS CLAVE: plataforma educativa, espacio educativo digital, aprendizaje en línea, aprendizaje individual, tecnologías en la nube.

Introduction

The global pandemic declared on March 11, 2021, which was caused by the rapid spread of Covid-19, was the factor that made the education system to search for alternative forms of learning (Li et al., 2021). The teachers had to develop new learning strategies (Treve, 2021). The use of distance learning turned out to be the most effective of them in view of the need to reduce physical contact between participants in the process (Akyuz, 2022). The technologies (satellite, audio and video, graphics, digital, multimedia, artificial intelligence, cloud technology (Hu, 2021), digital whiteboard (Reguera & Lopez, 2021), which teachers had to quickly learn to use in distance learning (e-learning, online learning) (Akyuz, 2022), mobile learning (Matzavela & Alepis, 2021), have proved their positive effect on learning outcomes (Treve, 2021), moreover, they individualize the learning process (Hu, 2021). Digital

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educational platforms have been created and used for this purpose. They provide students with access to educational materials (texts and videos of lectures, assignments for independent work, videos of laboratory practicals), the opportunity to conduct group discussions remotely, take exams, and so on. Distance learning has a number of advantages, in addition to limiting contacts between students and teachers during lessons. For example, it is cost-effective, flexible. It provided the opportunity to attract different lecturers, regardless of their location (Tamura et al., 2021), which diversified learning. It also reduces learning costs and reduces the negative impact on the environment (Treve, 2021).

Distance learning provides an opportunity to individualize the educational process (Matzavela & Alepis, 2021). That is, students have access to lectures, which is not limited in time and number of views. This allows learning the material both synchronously and asynchronously, studying at a pace and schedule that is convenient for students, based on their individual abilities and personal goals (Adedoyin & Soykan, 2020). Distance learning gives students a certain independence in their studies. In turn, it promotes interactivity, motivates and controls the student (Akyuz, 2022). In addition to developing skills, this type of learning promotes the development of individual abilities and talents of students (Treve, 2021). This form of education also takes into account individual preferences for forms of presenting information (text, audio, video, infographics, games, movies, etc.). Despite the individualization of learning, distance learning provides students with the same content and volume of information.

Despite the large number of studies on the implementation of educational process in the context of Covid-19, the issue of the organization of the educational process of future natural sciences teachers remains poorly studied. The study of the natural sciences requires special attention because of a practical constituent element aimed at developing students' practical skills. It was carried out in the laboratories of educational institutions in traditional education.

The aim of this work was to study the impact of individualization of the educational process on the effectiveness of distance learning in the context of Covid-19. The aim involved the following research objectives:

1. Determine the dependence of the level of students' academic achievements on the number of students in the group during the first wave of the pandemic in the spring of 2020.

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2. Develop and implement the education individualization principles for students studying natural sciences in pedagogical educational institutions.

3. Identify the impact of the developed education individualization principles on the students' perception of online learning, its convenience, efficiency, and effectiveness.

1. Literature review

Many researchers studied the impact of the pandemic on the education in different countries around the world. For example, in the United States, the researchers studied the impact of the transition to distance learning and individual education plans (Cosgrove, 2021), and the development of practical skills of technical students (Jain et al., 2021).

Along with the advantages of distance learning as a form of individualization of education, there are a number of disadvantages (Akyuz, 2022). For example, the student's ability to receive a quality education during a pandemic depended on the level of development of the country in which he or she was at the time. The economic problems of students' families also had a greater impact on their learning outcomes. The student's success in distance learning depends on the availability of the necessary hardware, its quality, and speed of the Internet (Day et al., 2021). Besides, the effectiveness of learning depends on the students' individual skills to work with the ICT required for online learning. Individual stress resilience and the ability to overcome feelings of isolation from society also have an impact on learning outcomes (Akyuz, 2022). The reason is that the pandemic disrupted the usual course of students' learning and caused their uncertainty about the future (Hadar et al., 2020). Negative manifestations of distance learning include delayed feedback or an excessive number of letters and important messages during the day, thus causing additional stress for students and teachers (Adedoyin & Soykan, 2020).

Virtual classes in Zoom, CiscoWebex, BigBlueButton, Hangou (Falfushynska et al., 2021), Google Classroom, Google Meet, YouTube Live, Facebook Messenger (Reguera & Lopez, 2021), Canvas, Blackboard (Nuere & de Miguel, 2021), Edmodo, Moodle and Microsoft teams did not allow to translate 100% laboratory practicals and practical content into a virtual format, as they have a special interactive nature (Jain et al., 2021). The conduct of laboratory and practical classes, teaching practice, internships caused the greatest uncertainty (Jayasuriya, 2021). Therefore, teachers solved this problem in different ways.

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Some recorded videos of their own laboratory practicals, or prepared a presentation at Power Point (Adeleke & Gao, 2021), while others tried to postpone the practical part to a safer period when students can return to the laboratory (Han & Sa, 2021). Teachers also tried to replace laboratory practicals that required the presence of students in the laboratory with one that could be realized at home. Alternatively, the laboratory practicals were reduced to the analysis and processing of the results of the experiment, which were sent to students. Laboratory practicals using simulators were also the case (Tamura et al., 2021). Teachers also considered project-based learning as one of the ways out, but it is not able to fully compensate for the lack of student-teacher and student-student interaction, as well as physical presence in laboratories and work with the necessary equipment. Instead of teaching practice, researchers (Ivanova, 2021) offer online observations of videos of lessons conducted at school. At the same time, students had to keep a diary of observations, and then discuss the lesson in an online meeting with classmates under the teacher's guidance.

The inability to work in educational institutions has impacted most of all the effectiveness of students' studies in majors that require a large proportion of practical work, being physically present in laboratories (Treve, 2021). The use of virtual laboratories in the educational process can prepare students for the practical performance of work, but cannot replace it (Adedoyin & Soykan, 2020). Some teachers have transferred, for example, a chemistry laboratory to their kitchen and the kitchen of their students (Kidd & Murray, 2020).

The pandemic has also made adjustments in the form of teaching practice for pedagogical higher educational institutions. When schools and universities are closed, it becomes impossible to practically train students of pedagogical educational institutions to work at school. One way out (Carrillo & Flores, 2020) is to watch video lessons taken in real classrooms before the pandemic. This prepared students for the realities of their future profession.

For successful distance learning, the educational process must include the following components: multimedia class on the air, prepared homework and exam assignments, the ability to share learning resources, knowledge and skills, the ability to virtually simulate learning, practice, internships, perform virtual laboratory practicals, use online libraries (Yao et al., 2021). All this requires various technical means: smartphone, computer, television,

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radio. An effective assessment system should be created in order to effectively control the knowledge and skills of students acquired in this way. It should include a course question bank and an automatic system for evaluating answers, analysing grades and keeping statistics.

Individualization of online learning is one of the educational innovations (Han & Sa, 2021). They involve student-teacher interaction and significantly differ from traditional lectures. The individual form of work became the most effective during the pandemic (Day et al., 2021).

To effectively implement online teaching and learning methods in the educational process, teachers must have a positive attitude towards it, which was found to depend on the following factors: gender, major, degree, country, experience of traditional and virtual teaching and online teaching (Shambour & Abu-Hashem, 2021). Teachers must also have the skills to effectively manage the students' individual learning through distance tools. For example, researchers (Treve, 2021) emphasize pedagogical, social, technical and managerial competencies of teachers. However, the efficiency of distance learning depends on the ability of both students and teachers to work with the necessary technologies. It is important for teachers to realize that the student group is not homogeneous, so the teaching methods introduced in it should take into account the individual peculiarities of each student (Kwiatkowska & Wiśniewska-Nogaj, 2021). Conducting classes is not just a process of disseminating information, it is a set of student-centred actions.

The result in distance learning can be achieved if personalized learning is conducted according to individual instructions developed in conformity with the academic level of students, which will promote students' interest in learning and their motivation, as well as provide feedback (Treve, 2021). Although there is another opinion (Carrillo & Flores, 2020) that cooperation, communication, group discussion, etc. are key components of effective online learning. However, those students who were active in acquiring new knowledge, developing skills and abilities were successful, while students were less successful if teacher activity was dominant (Carrillo & Flores, 2020). The most effective model of teacher cooperation with students is when the teacher plays the role of facilitator.

Personalized learning is one aspect of online learning practice, along with contextualized, social, formative and integrated ones. It must have clearly defined goals and

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objectives, be consistent and flexible, and be constantly evaluated (Carrillo & Flores, 2020). Nevertheless, many teachers have complained that no effective assessment methods have been found during the distance learning pandemic (Ferretti et al., 2021; Adedoyin & Soykan, 2020).

It is difficult to get honest independent answers from students to test questions if they have the opportunity to use sources of information. The use of information technology in addressing this issue is poorly studied (Zhao, 2019). There were some attempts to use the latest information technology in the design of individual learning of students based on the student's portrait (academic achievement, interest and desire to learn), and assessment through intelligent systems. Individualization of learning is also based on the student's portrait, taking into account his or her individual educational needs (Zhao, 2019).

Traditional lectures were not found productive in distance learning (Kidd & Murray, 2020). Therefore, teachers try to attract students with more active teaching methods. For example, they use collective discussions of educational assignments, games, participation in quizzes, intellectual competitions. The way students perceive independent learning was studied, and attention was paid to online practice simulation. The unexpected transition to distance learning made all participants in the educational process to convert their homes into offices for work and study. Learning outcomes depended on their ability to organize themselves, especially in the presence of all family members who have their own needs and plans.

The experience of the pandemic demonstrated the need to take measures at all levels to prepare current and future teachers for productive professional work in emergencies (Darling-Hammond & Hyler, 2020, Hadar et al., 2020). This applies both to future natural sciences teachers (Ponomareva, 2021; Biletska et al., 2022), philology (Boyko et al., 2021), and others.

All steps towards individualization of learning taken in a hurry during a pandemic, can take place in the long run (Treve, 2021), provided careful planning and design (Carrillo & Flores, 2020). All the challenges that arose during the pandemic can be turned into new opportunities in the future (Adedoyin & Soykan, 2020). In general, the pandemic is called a catalyst for the introduction of new forms of education. A number of online educational libraries containing a variety of educational resources, from books to videos, such as

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readtogether.hk (Treve, 2021) and educational networks (Yang, 2022) have been set up to help teachers to use new forms of learning.

2. Methods

The study was conducted in three stages:

The first phase, which lasted from April to June 2020, involved studying the experience of distance learning, which was necessitated by the Covid-19 pandemic instead of the traditional full-time education. Semi-structured interviews were conducted with teachers who teach natural sciences in pedagogical educational institutions. The analysis of the answers to the questions asked to the teachers identified the teaching methods that were most often used during the first wave of the pandemic. According to the teachers, it was established which methods and approaches to teaching, in their opinion, had the best effect in the study of natural sciences. Besides, a survey of students was conducted in order to study their attitude to online learning and its effectiveness.

The second stage, which began in September 2020, involved a pedagogical experiment. The experimental group practiced individualized online learning of students. The control group studied remotely, but in groups.

The third stage involved a survey of students to find out their attitude to online learning and to determine the relationship between the form (individually, collectively), and the resultant academic achievements. It was determined what learning outcomes the students of the experimental and control groups achieved, followed by their comparison. It was also found what results were achieved in case of having more time to prepare for distance learning, as well as the problems that have not yet been solved.

The sample consisted of 28 teachers. One of the criteria for their selection was the condition of teaching natural sciences in pedagogical educational institutions of higher education. They had different teaching experiences (from 3 to 25 years). They belonged to different age groups (from 27 to 60 years). There were teachers who did not have online teaching experience until March 2020. There were teachers who had little online learning experience. The sample also included 147 students who studied in the 2nd-4th years of study of the first (bachelor's) level majoring in Secondary Education (Physics), Secondary Education (Geography), Secondary Education (Biology), Secondary Education (Chemistry).

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All students studied on a full-time basis before the pandemic. The average age of students was 19 years.

The research team developed a series of questions for the interview. They provided for obtaining demographic and educational information about the teacher. The questions also concerned the subjects taught in April-June 2020, the approaches, strategies, methods and resources that were used and considered by the respondents to be effective. The interview provided free answers to the protocol questions, as well as the formulation of additional non-protocol questions in order to clarify the information received. An audio recording of the interview was made, which was then encrypted, processed and stored in encrypted form.

Besides, the research team developed a questionnaire for student surveys, which contained the following sections of close-ended questions: demographic and educational data about the student; attitude to the resources used, methods and approaches to learning during the pandemic; the degree of achievement of personal didactic goals, and the degree of difficulty of learning during a pandemic. The answers were evaluated on the Likert scale, where 1 is a very low level, and 5 is high. The questionnaire met all ethical standards. Sufficient time was allotted to answer the questions of the questionnaire. The survey was free and anonymous.

Mathematical data processing methods and Statistica software were also used.

3. Results

The sample data were obtained according to the information provided by the teachers during the interview (Table 1).

The results of the interview conducted in June 2020 with the teachers of the sample and the most frequent answers received are presented in Table 2.

Interviews with teachers showed that the transition to distance learning necessitated by the spread of coronavirus has caused everyone anxiety and stress. Teachers had to reformat the whole educational process in a short time. However, many of them did not have online teaching experience and sufficient digital literacy to implement it. Therefore, the first weeks of online learning were chaotic, teachers focused on their own capabilities, rather than on the individual capabilities and educational needs of students. There was no time to find out what hardware students had before learning online. The main problems were the lack of

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sufficient ICT and speed Internet, and insufficient digital literacy of both students and teachers.

Table 1. Sample description

Teachers	Gender, persons	Female	Male
		19	9
	Average age, years	42	47
	Teaching experience, years	14	16
	People have online teaching experience	2	1
	Total, persons	28	
Students	Gender, persons	Female	Male
		123	24
	Average age, years	19	19
	Major, persons	Secondary education (Physics)	13
		Secondary education (Biology)	61
		Secondary education (Chemistry)	24
		Secondary education (Geography)	49
	Total, persons	147	

Table 2. The results of the interview with the teachers and the most frequent answers received

Question	The most frequent answers	Number
Did you conduct a survey of students on their individual technical abilities, didactic requests, expectations and digital literacy before to the introduction of online learning?	I found out the technical capabilities of each student, the availability of a computer, tablet, smartphone	5
	I found out the accessibility of the Internet	7
	I found out students' preferences regarding the forms of presenting information (text, video, presentation, etc.)	1
	I found out whether students had an idea of educational platforms	3
What problems and difficulties arose during the urgent introduction of distance learning?	Technical problems (lack of high-speed Internet for teachers and students, lack of ICT with sufficient characteristics for such work, etc.)	21
	Lack of sufficient digital literacy in the course teacher	23
	Lack of sufficient digital literacy among students	27
	Decreased students' motivation	22

	Inability to observe the immediate reaction of students to the material presented and adjust the form of presentation in accordance with the perception	26
	Lack of feedback or untimely feedback	24
	Lack of opportunity to assess students' real knowledge, as remoteness allows for dishonesty	19
What educational platforms, social networks and messengers were used during online learning?	Digital educational space of the university	21
	E-mail	27
	Google Classroom	16
	Zoom	22
	Moodle	23
	Google Meet	24
	Blackboard	18
	YouTube	25
	Facebook	19
	Viber	24
	Telegram	15
	Skype	10
Did you have to change the curriculum because of the transition to distance learning?	Yes, I had to replace the topics of laboratory practicals because of the impossibility of performing them in the context of distance learning	15
	I had to postpone laboratory practicals until the pandemic ends	12
	No, the physical performance of laboratory practicals (excursions) was replaced by the performance of virtual laboratory practicals (virtual excursions and eyewitness stories)	20
	No, we were recording their performance of laboratory practicals and obtaining data, while students had to perform their calculations	23
	No, the impossibility of performing practical work in the laboratory was compensated by performing similar work at home	10
What new teaching methods had to be used during distance learning?	Traditional lectures on an educational platform	25
	Video of the lecture (practical classes, laboratory practicals, etc.)	24
	Interactive teaching methods (projects, cases, work in pairs, work in small groups, individual work, conversations, discussions, role-playing games, etc.)	16

Teachers tried to quickly adapt traditional teaching methods to teaching online. Therefore, the texts of the lectures were sent by e-mail, posted on one of the educational platforms or read during an online meeting. This instantly reduced students' motivation.

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They tried to postpone laboratory practicals and practical work to the post-quarantine period. Later, they began to make videos of lectures, practical works, laboratory practicals, use virtual laboratory practicals, use Internet resources to diversify information and forms of its presentation.

The interview revealed a pattern between student performance and their number in the group. Figure 1 shows the dependence of the student academic performance level on the number of students in the group.

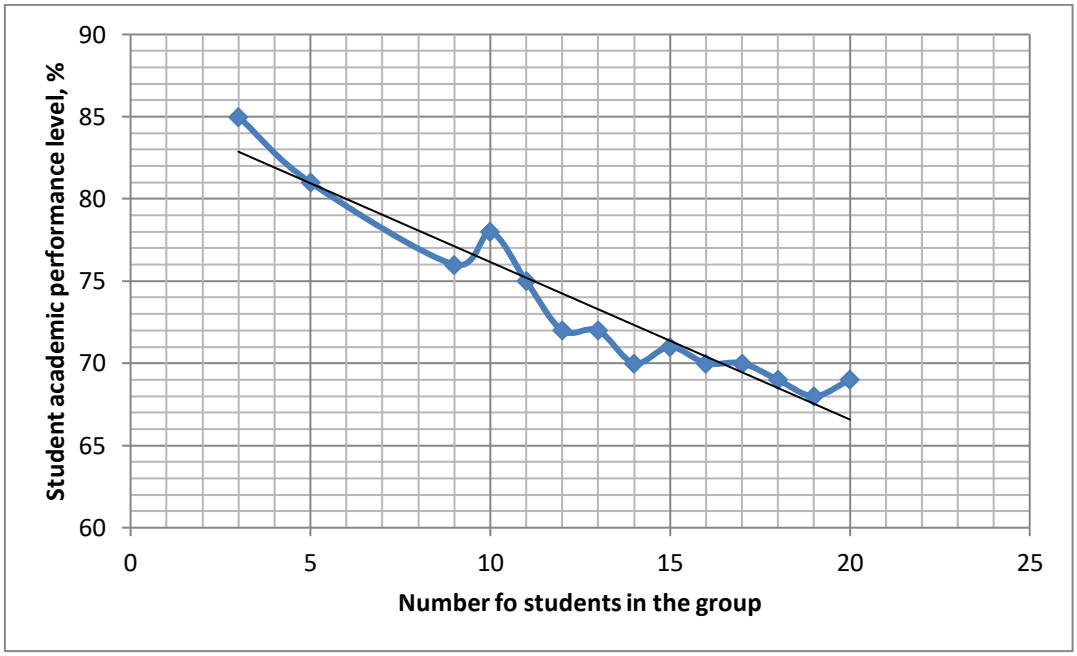

Figure 1. The dependence of the student academic performance level on the number of students in the group

As Figure 1 shows, the fewer students a teacher works with at a time online, the better they learn the material. An online learning strategy was built on this pattern and tested experimentally.

In the second stage of the study, the process of distance learning in the control group was not interfered with. In the experimental group, teachers were invited to conduct training on the following principles:

1. Study of individual capabilities of each student, their preferences for teaching methods, didactic goals and expectations.

2. Development of didactic materials and educational resources that would take into account the individual capabilities and expectations of students.

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3. Use of active student-centric teaching methods. Changing the teacher's role from a leader to an assistant. Partial transfer of responsibility for planning the educational process and its results to the student.

4. The teacher should build the learning process so that students not only use the information that the teacher provided, but also create new ones.

5. The time for the online meeting is distributed as follows: the time allotted for the study of the subject by a group of students is divided equally among all students. For example, 12-15 minutes were allotted for each student for three classes lasting 90 minutes, which should be held for a group of 20 students. During this time, the teacher can provide advice on issues that the student encountered during the processing of materials sent in advance to the student in the form he or she prefers. At the same time, the teacher can check and assess the level of student performance in learning new material and identify gaps in student knowledge. So, having gathered information on all students in the group, the teacher obtained a general picture of students' perception of educational material, can review it, and provided additional, or if necessary, conducted a collective online lesson to address issues that have caused difficulties for most students.

6. The material provided to each student may differ in the form of presentation, but must correspond to the curriculum of the subject. Each student must perform all planned types of work and obtain all the competencies provided by the curriculum.

7. On average, a student spends a maximum of 2 hours in a synchronous study during a weekday. Besides, each student spend approximately 3 to 6 hours studying asynchronously.

Table 3 provides the results achieved through this form of distance learning, which aimed to individualize the learning process.

The results of the survey showed that the introduction of an individualized approach to learning in the context of Covid-19 contributes to the growth of distance learning by students. Yes, students have gained online learning experience, improved their technical support to be able to study remotely. At the end of the experiment, all students were sufficiently adapted to online learning.

The results of the survey showed that the introduction of an individualized approach to learning in the context of Covid-19 contributes to increased appreciation of distance learning by students. The students have gained online learning experience, improved their

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hardware to be able to study remotely. At the end of the experiment, all students were sufficiently adapted to online learning. The students of the control group had sufficient digital literacy, and the students of the experimental group had a high level of the latter. Individualization of learning promoted the improvement of students' ability to self-organize and independently plan their own time to a high level (for comparison, the control group students reached only the middle level). Students that studied with the use of an individual form rated the level of distance learning as sufficient. They were satisfied with the quality of online learning, gained self-confidence. Students did not feel the lack of time to study due to the ability to plan time and individualized approach of teachers to the educational process. At the same time, the individualization of education has led to the development of creative abilities of students, developed their research skills.

The intergroup variance d, determined by the heterogeneity of the sample, namely the introduction of individualized learning in the context of Covid-19 in different educational institutions included in the sample, ranged from 286 to 1,354. The standard deviation from the mean of the same evaluation parameter in different educational institutions of the sample was different. Intergroup and intragroup variances, which describe the fluctuations of these groups determined by the random factors not taken into account, are not equal, which indicates that the null hypothesis is not valid.

In the studies conducted in the experimental group, Cohen's d was 1.0, which indicates a high effect of individualization of learning in the context of Covid-19. In the control group, d was 0.6, which indicates an average effect.

4. Discussion

According to this study, the individualization of education has a number of advantages over online group work. For example, the teacher has the opportunity to observe the student's reaction to the material, assess the degree of assimilation of new information, etc. The researchers stated that teachers consider online learning impersonal (Kidd & Murray, 2020). They cannot see the students' reaction during the lecture and present the material accordingly. Therefore, teachers often used individual online lessons with students to achieve didactic goals and maintain personal contact.

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Table 3. The results of the survey of students on learning in the context of Covid-19

Questions	Average score on the Likert scale			
	At the beginning of the first stage of the study	After the first stage of the study	After the second stage of the study	
			Control group	Experimental group
Assess your experience with ICT and educational platforms before the pandemic.	2	3	4	4
Assess your understanding of e-learning.	1	3	4	5
Did you adapt quickly to online learning?	1	3	4	4
Assess the level of your hardware required for the transition to distance learning.	2	3	4	4
Assess your digital literacy to study online without difficulty.	2	3	4	5
Assess your ability to plan your own study time?	2	3	3	5
Assess the effectiveness of distance learning.	2	3	3	4
Assess your satisfaction with the quality of online learning.	2	3	3	4
Assess the feeling of self-confidence during online learning.	2	3	3	4
Is there enough time to communicate with classmates?	2	2	3	4
Is there enough time to fulfil your curriculum?	2	1	2	4
Have you started to think more creatively through online learning?	2	3	3	4
Do you think that online learning develops the researcher skills?	2	3	3	4
Do virtual laboratory practicals and field trips make up for the lack of real laboratories during online learning?	1	2	3	4
Does online learning contribute to the development of practical skills?	1	2	3	4
Are your individual features taken into account during online training?	1	1	2	4
Can online learning give better results than full-time studies?	1	2	2	4
Do you feel free to express your thoughts during online learning?	2	3	3	4
Have you become less stressed with the transition to distance learning?	2	2	2	4
Do you feel an increased social cohesion among the students in your group?	1	2	2	3
Do you think that distance learning helps to reduce stress, anxiety and fear about learning outcomes?	1	2	2	4
Average value:	2 Low level	3 Medium level	3 Medium level	4 Sufficient level

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One of the effects of online learning is the blurring line between personal and professional. The survey of students conducted in this paper showed their increased satisfaction with online learning, which was promoted, among other things, by the individualization of education. However, there are other opinions in the scientific literature. A survey of students who studied online showed that if they could return to full-time study, they would not want to study online, despite the fact that students highly appreciated all the efforts that the teachers made to prepare for online classes, and despite the experience of distance learning teachers (Day et al., 2021). The students themselves were more successful in learning during the pandemic if they had online learning experience before it.

A survey of 116 students majoring in Natural Sciences from the Eastern Province of Saudi Arabia (Bawaneh, 2021) found the medium level of student satisfaction with e-learning and virtual classes. However, it varies from subject to subject. The study also showed that the university lacks the infrastructure required for online learning, innovative learning models and the necessary competencies for teachers and students. The vast majority of students believe that electronic and virtual classrooms are the most suitable for learning during a pandemic. However, most of them, in the absence of extreme conditions, prefer traditional forms of learning. There were also students who thought that money for online education was wasted. In contrast to students majoring in Philology and Linguistics, the vast majority (57%) are completely satisfied with the quality of online learning (Boyko et al., 2021).

An interview conducted in this study found that natural sciences teachers were forced to change the way they presented their teaching materials. For example, they made videos of laboratory practicals, used virtual laboratories. Researchers (Day et al., 2021) found that geography teachers, for example, where a number of excursions were planned, had to replace them with virtual tours during the pandemic. However, such a replacement resulted in the video and sounds only kept in memory as the impression of "visiting" the place. Another way to explore places of interest is to introduce them through photos, videos and stories of those who have already visited them.

According to a survey (Reguera & Lopez, 2021), the use of digital whiteboards in online learning in a pandemic makes the learning more dynamic, helps students understand abstract concepts, involves students in online learning.

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Matzavela and Alepis (2021) explored how individual features such as gender affect students' preferences for learning methods. It was established that girls like game methods of learning more than boys. However, gender does not affect the attitudes towards mobile learning, it was positive in 25% of women and 22% of men.

The motivation of students requires that the content of educational material was relevant, and the learning process itself must be conducted in a social context. Learning activities should be based on active methods, and gaining knowledge related to the arrangement and use of information should evoke appropriate emotions in students (Dumulescu et al., 2021).

Conclusions

The 2020 pandemic caused by Covid-19 demonstrated the failure of the education system to provide services in extreme situations. The study conducted in this paper showed that the teachers' steps taken in the first days of the imposed quarantine restrictions were chaotic and ineffective. Teachers of Natural Sciences, which involve a number of practical works and laboratory practicals in their curricula, experienced the greatest difficulties. They require the presence of students in laboratories.

The proposed individualization of education was one of the highly effective ways to train future natural sciences teachers in terms of distance. The individualization promoted the growth of students' ability to self-organize and plan their own time. The learning process did not cause stress, instilled confidence in students. Students did not feel the lack of time to study, while highly appreciating the quality of education. Individualization of education contributed to the development of creative abilities and research skills of students.

This study can be useful to researchers and teachers in re-evaluating and improving the quality of educational services, both in emergencies and in distance learning after the pandemic. The promising area is the development of unified systems for assessing the level of adaptability of students to study in extreme conditions, as well as assessing the productivity of the forms of learning used under these conditions.

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