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Implementation of inclusive higher education through the use of digital technologies

Implementar una educación superior inclusiva mediante el uso de tecnologías digitales

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Abstract

The article reveals ways to use digital technologies to develop inclusive competence in future teachers. This will contribute to the practice-oriented teaching of students with special educational needs. A review

of modern digital technologies in education is revealed, and digital tools in inclusive higher education are revealed. The main methodological approaches that ensure the effective implementation of digital tools in the educational process of higher education are shown. The conceptual idea of the study is that the formation of inclusive competence in a future specialist through the use of digital technologies will contribute to practice-oriented teaching of students with special educational needs through the use of digital technologies, which is possible by forming a sufficient level of personal, cognitive and activity components. A pedagogical technology was developed, which was aimed at ensuring a sufficient level of inclusive competence of a future teacher for working with children with special needs. An experimental test of the effectiveness of the author's technology for training students was carried out within the framework of the implementation of the special course "Implementation of inclusive higher education through the use of digital technologies". As a result, we observe an increase in the overall coefficient of inclusive competence of students in the experimental groups, which indicates the effectiveness of the developed author's technology.

Keywords: inclusive education, use of digital technologies, inclusive competence of teachers, practice-oriented teaching, students with special educational needs.

Resumen

El artículo revela formas de formar competencias inclusivas en un futuro docente a través del uso de tecnologías digitales, lo que contribuirá a la enseñanza orientada a la práctica de estudiantes con necesidades educativas especiales mediante el uso de tecnologías digitales. Se realizó una revisión de las tecnologías digitales modernas en la educación y se revelaron las herramientas digitales en la educación superior inclusiva. Se muestran los principales enfoques metodológicos que aseguran la implementación efectiva de las herramientas digitales en el proceso educativo de la educación superior. La idea conceptual del estudio es que la formación de la competencia inclusiva en un futuro especialista mediante el uso de tecnologías digitales contribuirá a la enseñanza orientada a la práctica de los estudiantes con necesidades educativas especiales mediante el uso de tecnologías digitales, lo que es posible mediante la formación de un nivel suficiente de componentes personales, cognitivos y de actividad. Se desarrolló una tecnología pedagógica que tenía como objetivo garantizar un nivel suficiente de competencia inclusiva del futuro docente para trabajar con niños con necesidades especiales. En el marco de la implementación del curso especial "Implementación de una educación superior inclusiva mediante el uso de tecnologías digitales", se realizó una prueba experimental de la eficacia de la tecnología del autor para la formación de estudiantes. Como resultado, observamos un aumento en el coeficiente general de competencia inclusiva de los estudiantes en los grupos experimentales, lo que indica la eficacia de la tecnología desarrollada por el autor.

Palabras clave: educación inclusiva, uso de tecnologías digitales, competencia inclusiva del profesorado, aprendizaje orientado a la práctica, estudiantes con necesidades educativas especiales.

Introduction

Modern trends in education development have significantly changed approaches to learning in inclusive and special education. Digital technologies play a key role in ensuring the quality of learning and accessibility of learning for higher education students with special educational needs. An inclusive educational environment is created through the integration of digital tools, where all higher education students, regardless of cognitive, physical, and emotional barriers, have the opportunity to realize their potential.

Professional training of specialists in the field of inclusive education must meet modern requirements and challenges, providing them with the skills and necessary knowledge for effective further work. When training such specialists, it is the use of digital technologies that allows the integration of teaching methods, making them innovative, which contributes to improving the quality of the educational process in higher education. This includes a deep understanding of practical approaches and methodological foundations for the

implementation of digital tools and the technical aspects of their use. The ability to adapt the educational process of higher education to the individual needs of higher education students is one of the main advantages of digital technologies. To create interactive classes, individualized curricula, and adapted materials, teachers can use a variety of digital tools that meet the specific needs of each higher education student, which ensures equal opportunities for all participants in the educational process and contributes to their successful integration into the educational environment (Batsurovska & Kurepin, 2024).

Digital technologies, adapting the learning process to the needs and characteristics of higher education students, allow for its individualization. Meeting the requirements of inclusive learning, digital tools offer a wide range of modes and formats for presenting professional information (Hurenko et al., 2023).

The implementation of inclusive higher education through the use of digital technologies in higher education institutions requires ensuring equal access to education for all students, providing psychological and pedagogical support, support for students with special needs, and free access to the institution's infrastructure.

But, despite state support and the created regulatory and legislative foundation, the practical implementation of inclusive higher education is not taking place actively enough.

We must state that the educational needs of students in higher education are not fully taken into account, in particular from vulnerable groups of the population, such as persons with disabilities; orphans; low-income people; persons deprived of parental care; refugees, persons with limited capacity; victims of domestic violence and human trafficking, etc. Therefore, the problem of implementing inclusive higher education through the use of digital technologies is relevant and necessary today.

Literature Review

Having proven the relevance of implementing inclusive higher education through the use of digital technologies, let's analyze the works of scientists related to solving the problem.

Díaz Puppato et al., (2021) define an inclusive educational environment as one that provides all subjects of the educational process with opportunities for effective self-development and prove that solving the problem of educating young people with special needs is possible by adapting the educational environment to the needs of each participant in the education process, including equipment for the needs of all participants in the premises, methodological variability and flexibility of education, reforming the learning process, and a psychological climate that ensures the full participation of each participant in the educational process. H. Shevchuk (2021), in addition to solving the problem of educating young people with special needs by adapting the educational environment to the needs of each participant in the learning process, including equipment for the needs of all participants in the premises, methodological variability and flexibility of education, and reforming the learning process, emphasizes that in the context of creating an innovative inclusive educational environment, adherence to student-centered learning approaches is the basis for organizing the educational process, and the adaptation of educational activities must meet the capabilities and needs of each participant in the educational process.

Information and communication technologies in modern conditions have significantly changed education, providing participants in the educational process with completely new channels of influence and tools that affect the consciousness of the mass audience in the field of educational services.

Broad prospects for the accessibility of education and improving its quality are opened precisely by modern ICT tools for people with special needs. Therefore, A. Heta et al. (2018) conducted research at different levels of education on ICT support for inclusive learning. This collective study is one of the first attempts to systematize the experience of specialists in the aspect of implementing inclusive higher education through the use of digital technologies.

H. Davydenko (2023) analyzed the state policy of different countries of the world, revealed the theoretical and methodological principles of organizing digital inclusion, developed methodological recommendations for individuals from the most sensitive social groups, which revealed the accessibility of information presented in electronic and digital form, which is a significant methodological assistant for scientists, practitioners, educators working in the fields of the humanities and social sciences, for public activists who participate in the creation of easy-to-perceive content and socially attractive software.

The analysis of software developments and innovative research in the field of e-learning was carried out by A. Alekseeva, O. Antonenko, K. Zhadan & M. Lyfenko (2018) and they proved stable trends in the effectiveness of the implementation of e-learning throughout life, which requires a systematic transformation of the pedagogical and organizational foundations of education in higher education using the example of teaching students with visual impairments. They identified key areas in the field of e-learning education, which serve as a visual illustration of the transformation of education and the accessibility of technological innovations; they identified the main factors of the implementation of e-education in higher education institutions, in particular in the context of inclusion; in the field of e-learning, they identified trends in the development of research in the context of inclusion.

The problem of using digital technologies for work in an inclusive educational environment in the training of specialists in socio-economic specialties was considered by V. Berezan, N. Pakhomova, & V. Pakhomova (2022). The scientists revealed the essence of inclusive education, in the context of inclusive education they determined the role of a teacher, psychologist, defectologist, and speech therapist in working with children with special educational needs, showed the features of socio-pedagogical correctional and educational work with students with special educational needs and the possibilities of using digital technologies in the work of specialists in socio-economic specialties in the context of inclusive education, outlined ways to improve the system of professional training of specialists.

Taking into account the development of relevant guidelines for customers of educational services, H. Kossova-Silina & O. Potamoshnieva (2024) also analyzed the development trends and problems of modern digital technologies of inclusive education in the field of vocational education and considered the current problems of digital inclusion in vocational education institutions. Scientists have proven that "the successful implementation of digital technologies of inclusive education depends on solving certain challenges. It is important to constantly evaluate, study, and implement new initiatives in the field of digital learning and digital inclusion into the educational process, constantly update the educational process through the integration of digital technologies, and ensure the appropriate quality of educational programs and resources."

So, having analyzed the works of scientists related to solving the above problem, we emphasize that scientists have revealed the essence of inclusive education, emphasized the importance of adaptation to the needs of each participant in the educational environment, and the importance of student-centered learning approaches, which are the basis for organizing the educational process, researched ICT support for inclusive education, revealed the theoretical and methodological principles of organizing digital inclusion, determined the role of a teacher, psychologist, defectologist and speech therapist in working with children with special educational needs, showed the features of socio-pedagogical and correctional and educational work with students with special educational needs. However, we see the insufficiency of revealing the ways to implement inclusive higher education through the use of digital technologies.

Purpose of the research. Formation of inclusive competence in the future teacher through the use of digital technologies, which will contribute to practice-oriented teaching of students with special educational needs through the use of digital technologies.

Methodology

To achieve the set goal, a set of research methods was used:

- *Theoretical*: search and bibliographic – to systematize the analyzed source base (psychological, social, pedagogical, methodological); systemic analysis – carried out by the subject of research to clarify the essence of pedagogical phenomena; study of scientific and methodological literature, analysis of the state of development of the problem, Internet resources, experience of leading scientists and practitioners; systematization, induction, deduction –to formulate conclusions;
- *Empirical*: monitoring – at all stages of experimental work to determine the state of development of the problem under study; psychological and pedagogical diagnostics (oral and written survey, in particular using questionnaires) – to identify the level of formation of students' inclusive competence; pedagogical experiment – to test the effectiveness of selected forms of the educational process.

The conceptual idea of the study is that the formation of inclusive competence in a future specialist through the use of digital technologies will contribute to practice-oriented teaching of students with special educational needs through the use of digital technologies, which is possible by forming a sufficient level of personal, cognitive and activity components.

Therefore, the inclusive competence of a future teacher in the context of practice-oriented teaching of students with special educational needs consists of three components: personal (attitudes, motives, interests); cognitive (empirical and theoretical knowledge); and activity (strategies, skills, experience of students). To assess the level of formation of inclusive competence of a future teacher, criteria were developed: personal, cognitive, and activity. The study proposed the following indicators of the formation of inclusive competence of a future teacher through the use of digital technologies: theoretical, psychological, and practical. The coefficients of the formation of inclusive competence and levels were identified.

Experimental work on the formation of inclusive competence in a future teacher through the use of digital technologies to promote practice-oriented teaching of students with special educational needs through the use of digital technologies was carried out during 2022-2023 and covered 132 students of pedagogical specialties at the ascertaining stage. At the formative stage, 168 students were involved in the study.

During the ascertaining stage of the pedagogical experiment, it was found that the coefficient of the formation of inclusive competence of student teachers without specially organized training was low, which indicates the feasibility of its specially organized formation and development of inclusive competence in a future teacher through the use of digital technologies.

Therefore, at the formative stage of the experiment, we developed a pedagogical technology aimed at ensuring a sufficient level of inclusive competence of the future teacher for working with children with special needs. The implementation of the educational technology through the development of classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the Learning Apps web platform – electronic tools – provided for four consecutive stages: diagnostic stage, organizational stage, implementation stage, control and evaluation stage.

To compare the dynamics of the formation of inclusive competence of future teachers as a result of training using traditional methods and the author's technology, student training was organized. Accordingly, the formative stage of the experiment was divided into two substages.

At the first substage of the formative stage of the study, an experimental test of the effectiveness of the author's technology for training students was carried out, which was aimed at ensuring a sufficient level of inclusive competence of the future teacher for working with children with special needs during the study of the special course "Implementation of inclusive higher education through the use of digital technologies". Two samples were created: control and experimental. Based on the results of training using the author's technology and traditional methods, a comparison of the weighted average coefficients of the formation of inclusive competence of undergraduate students was carried out. They increased at the end of the

experiment, respectively, from 47% to 68% in the CG and 83% in the EG. The reliability of the results obtained was established using the Student's t-test. It turned out to be more than the tabular empirical value of the t-criterion, which indicates the effectiveness of the developed technology (temp.=14.49 > ttab. = 1.96). The error does not exceed 5% (0.05).

At the second substage of the formative stage of the study, an experimental verification of the effectiveness of the author's technology for training students of the master's (second) level of higher education for practice-oriented teaching of students with special educational needs through the use of digital technologies within the special course "Implementation of inclusive higher education through the use of digital technologies".

According to all indicators, the coefficient of inclusive competence of respondents has increased significantly. We observe an increase in the overall coefficient of inclusive competence.

Comparison of the weighted average coefficients of the formation of inclusive competence of future teachers through the implementation of educational technology by developing classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic tools before the beginning and end of training using the author's technology allowed us to talk about an increase in the corresponding coefficients to 83%. Using the Pearson χ2 (chi-square) criterion, the reliability of the results obtained was checked, which indicated the presence of significant changes in the studied indicators.

χ2empirical = 65.87 > χ2tabular = 7.81 as shown by the comparison of the values of the Pearson criterion. This indicates the effectiveness of the author's technology. Let's start with what does not exceed 5% (0.05). Thus, the results obtained at both substages of the formative stage of the experiment after the control experimental cut exceeded 70% and amounted to 83%, which indicates the effectiveness of the developed author's technology.

Results and Discussion

Digital tools in inclusive higher education: an overview of modern digital technologies.

The need of the hour is the application of digital technologies. Digital technologies are a tool that allows:

- To take into account the circumstances of each higher education seeker and the individual needs of the individual through the personalization of methodologies and curricula;
- To use online platforms to provide social support and psychological assistance, which is especially important for persons with special educational needs;
- To expand the reach of quality education to vulnerable and remote population groups;
- To quickly analyze and track the effectiveness of various strategies and pedagogical approaches, ensuring constant optimization of the educational process for persons with special educational needs;
- To strengthen the means for linguistic and cultural adaptation of national minorities and persons with special educational needs;
- Easily integrate pedagogical tools, new courses, and resources, creating flexible learning environments for individuals with special educational needs;
- Provide access to courses for acquiring new professional skills, allowing to respond to changes in the labor market;
- Maximize the use of available resources in the education system through digital optimization of administrative and management processes (Hurenko et al., 2017).

Thanks to the introduction of digital technologies in the modern world, the development of education has changed significantly, especially in inclusive education. An inclusive educational environment is created by

the integration of digital tools, where each higher education student has the opportunity to realize their potential, regardless of cognitive, physical, and emotional barriers.

In the training of specialists, the use of digital technologies allows for the implementation of innovative teaching methods that contribute to improving the quality of the learning process. This includes the creation of curricula and interactive individualized lessons. Thus, digital technologies contribute to the development of digital literacy, critical thinking, collaboration, and communication – key competencies of education students (Stratan-Artyshkova et al., 2022).

Digital tools play a key role in ensuring the quality of education for students with special educational needs in modern conditions of education development. Let us consider the impact of the main ones on the quality of inclusive education.

1. Online platforms and virtual classrooms, such as Google Classroom, Moodle, and Microsoft Teams, allow students with disabilities to communicate with teachers and classmates, and access educational materials. This ensures equal conditions for all participants in the educational process, regardless of physical limitations or their place of residence.
2. Assistive technologies, such as specialized keyboards and mice, devices for controlling a computer using gaze, and text-reading software, help students with any disabilities to take an active part in the educational process (Svensson et al., 2019). These technologies increase the effectiveness of learning and allow you to adapt educational materials to the individual needs of each student.
3. Interactive boards, such as SMART Board, allow you to create interactive lessons, which involve students in the learning process in active participation
4. Mobile applications (Duolingo, Khan Academy, ClassDojo) are designed for learning and development, which allow students to complete tasks and study materials independently at a time convenient for them. This is especially important for students with special needs because it allows them to learn according to their abilities and at their own pace (Knysh et al., 2024), which contributes to the development of communication skills, collaboration, and better assimilation of the material.
5. Mindomo and Inspiration – visualization software helps students with special needs to structure information, which makes the learning process more effective and facilitates its work.

The introduction of innovative digital tools in inclusive education provides an individual approach to learning and provides support to students with special educational needs, helps to improve the quality of education, and contributes to the creation of such an innovative inclusive educational environment, where each student of the educational space has the opportunity to realize their potential (Door, 2014).

Methodological approaches that ensure the effective implementation of digital tools in the educational process of higher education.

The introduction of digital technologies into the professional training of specialists requires a scientifically sound and systematic approach. Let us highlight the main methodological approaches that can be used for the effective implementation of digital tools in the educational process:

- the competency-based approach involves the integration of digital technologies into educational programs for the development of professional competencies: collaboration and communication, critical thinking, and digital literacy and is focused on the development of professional competencies in students that are necessary in the modern digital environment for the successful activity of an individual;
- the integrative approach serves to create adaptive and flexible educational programs and consists of combining digital and traditional teaching methods. The use of online courses, interactive platforms, and multimedia resources increases the motivation of students and ensures a variety of teaching methods;

- the project approach for the implementation of educational projects involves the use of digital technologies that allow students to apply the acquired knowledge in practice. This approach contributes to the development of planning and task performance, skills of independent work, cooperation with other project participants;
- a distance approach to organizing the educational process involves the use of digital platforms in remote mode, which allows applicants for educational space to receive education regardless of physical limitations and place of residence. Accessibility and flexibility of learning are provided by online courses, webinars, virtual classes, and interactive educational materials;
- a personalized approach aimed at adapting the educational process to the capabilities of each applicant and his individual needs. The use of digital technologies allows for online assessment, the creation of individualized curricula, and real-time feedback, which contributes to more effective assimilation of the material (McGlynn-Stewart et al., 2018).

The use of such methodological approaches to the implementation of digital technologies in the professional training of specialists contributes to the development of professional competencies in applicants for education and the improvement of the quality of education, allowing adapting the educational process to the capabilities of each applicant and his individual needs. The introduction of digital technologies into the educational process contributes to the formation of skills necessary for successful professional activity in the modern digital world and improves the quality of education (Santos et al., 2023).

The role of digital technologies in the development of key competencies of future specialists in inclusive education.

Digital technologies play an important role in the development of key competencies of future specialists in inclusive education.

Let's consider how digital technologies contribute to the development of key competencies of future specialists in inclusive education:

- Digital literacy is a fundamental competency of future specialists in inclusive education, which includes the ability to effectively use digital resources and tools. The use of various software allows higher education students to develop skills in working with information – text editors, databases, spreadsheets, and presentation programs;
- Cooperation between students depends on digital technologies, which significantly improve the opportunities for cooperation of each individual. The use of platforms for joint work (Slack, Microsoft Teams, Trello) allows you to exchange information, effectively organize teamwork, coordinate joint projects, which promotes interaction in the group and the development of communication skills;
- Critical thinking is improved by applying digital technologies to the educational process of higher education, which contributes to the development of critical thinking, allowing applicants to evaluate, and interpret information from various sources and analyze it. The use of analytical programs (SPSS, Tableau) helps applicants develop data analysis and processing skills, which are important for making informed decisions;
- Communication. Various means of communication are provided by digital technologies (video conferences, e-mail, instant messengers). The use of Zoom and Google Meet – video communication tools allows for webinars consultations, and online classes, which contributes to the development of information presentation skills and effective communication.

Thus, the use of digital technologies in the professional training of inclusive education specialists significantly increases the development of key competencies (Batsurovska & Kurepin, 2024).

The main benefits of using digital technologies are linked to the principles of Universal Design for Learning (UDL): expression and participation/engagement for those pursuing higher education, providing diverse forms of representation (Shuliak et al., 2022).

The text version, which may contain multimedia educational materials, facilitates the perception of information by persons with hearing impairments.

Screen access programs based on speech synthesis technologies speak text and graphic information displayed on the monitor and provide access to the Internet, and popular Windows applications, using a sound card and a built-in speech synthesizer to output the contents of the computer screen to speakers or Braille displays (Hurenko et al., 2017).

Digital tools enable visually impaired students to access higher education on an equal footing with other students.

For individuals with learning disabilities such as dysgraphia and dyslexia, voice recognition and screen reading programs, as well as simple changes to color, font, and line spacing, are important to make learning accessible (Vouglanis, 2023).

To help students with special educational needs receive higher education on an equal footing with other students, virtual assistants and chatbots are being created using artificial intelligence (Mohammed & Watson, 2019), and also for higher education students with significant speech impairments, there are speech synthesizers (Miao et al., 2021). This list is not exhaustive.

Accessible websites and mobile applications focused on the needs of people with special educational needs or certain health limitations.

Digital accessibility in the context of inclusive educational innovation plays a key role in ensuring equal access to digital technologies and services for all, including people with health limitations.

There is a growing awareness of the importance of ensuring digital accessibility for socially sensitive, socially vulnerable segments of the population. This is manifested in the use of mobile applications, web content, and other electronic media in socialization and the educational process during learning.

Public organizations and the private sector of IT companies play an important role in promoting digital accessibility.

An example can be the development of accessible websites and mobile applications of IT companies focused on the needs of people with certain health limitations or special educational needs.

Higher school specialists advise using the English-language BeWarned application, which detects and then signals (automatically analyzing sounds) about potential danger (car horns, screams, dog barking, alarm signals, etc.) in real-time. The application warns the user in case of dangerous situations using light signals and vibration, allowing you to “hear” music, converting music tracks into light signals or vibration using an equalizer, which allows people with hearing impairments to enjoy music visually and tactilely.

Huawei has developed a mobile application for smartphones called Facing Emotions, which can reproduce appropriate sounds, recognize human emotions, and display images on the screen, which will help people with visual impairments better understand the emotions of their interlocutors and receive (Kossova-Silina & Potamoshnieva, 2024).

Analysis of the results of research-experimental work.

The analysis of scientific literature and the experience of practitioners showed that the problem of implementing inclusive higher education through the use of digital technologies in the chosen direction is insufficiently developed.

From the standpoint of the principles and provisions of the theory of philosophy, the preparation of future specialists for practice-oriented training of students with special educational needs through the use of digital technologies was considered as:

- A subsystem of professional training in higher education, the integral result of which is the development of inclusive competence in students;
- A process of professional training in higher education, which takes into account the study of the state of spontaneously formed inclusive competence of practicing specialists about the education of people with special educational needs;
- An axiological component that determines the upbringing and development of inclusive consciousness in students;
- An environment for professional creative self-realization of future specialists.

The didactic prerequisites for practice-oriented training of higher education students to gradually implement inclusive education through the use of digital technologies among children with special educational needs include the implementation of such approaches as:

- *Activity approach* (principles of connecting theory with practice, activity-oriented learning, computerization of learning, designing the education process according to the model of professional activity, life situations, accessibility, activity, feasibility);
- *Competency-based approach* (principle of educational and developmental nature of learning);
- *Personality-oriented approach* (principles of differentiation and individualization).

The principles of feasibility and accessibility are implemented through modification and adaptation.

The principle of the educational and developmental nature of learning is implemented by involving a team of psychological and pedagogical support and ensuring its correctional and developmental orientation.

The methodological foundations include the use of a communicative approach to the implementation of inclusive education through the use of digital technologies.

The conceptual idea of the study is that the formation of inclusive competence in a future specialist through the use of digital technologies will contribute to practice-oriented teaching of students with special educational needs through the use of digital technologies, which is possible by forming a sufficient level of personal, cognitive and activity components.

Thus, the inclusive competence of a future teacher in the context of practice-oriented teaching of students with special educational needs consists of three components:

- *Personal* (attitudes, motives, interests);
- *Cognitive* (empirical and theoretical knowledge);
- *Activity* (strategies, skills, experience of students).

To assess the level of formation of inclusive competence of a future teacher, criteria were developed: personal, cognitive, and activity.

The activity criterion (the presence of strategies, developed skills, and experience in the student) is system-forming in our study.

Additional to our study is the personal criterion (the presence of developed personal traits and personally significant values) and the cognitive criterion (the formation of the necessary knowledge for effective teaching of children with special educational needs).

The study proposes the following indicators of the formation of inclusive competence of a future teacher through the use of digital technologies: theoretical, psychological, and practical.

The coefficients of the formation of inclusive competence and levels are identified:

- 0 – 59% – unformed level;
- 60 – 73% – initial or receptive-reproductive level;
- 74 – 89% – sufficient or independent level;
- 90 – 100% – high or integrative level.

Experimental work on the formation of inclusive competence in a future teacher through the use of digital technologies to promote practice-oriented teaching of students with special educational needs through the use of digital technologies was carried out during 2022–2023 and covered 132 students of pedagogical specialties at the ascertaining stage. At the formative stage, 168 students were involved in the study.

During the ascertaining stage of the pedagogical experiment, it was found that the coefficient of formation of inclusive competence of student teachers without specially organized training was low, which indicates the expediency of its specially organized formation and development of inclusive competence in a future teacher through the use of digital technologies. In particular, the state of formation of inclusive competence in respondents according to the results of the questionnaire according to the theoretical indicator of inclusive competence is (initial level) – 60%, and according to the practical (unformed level) – 54%, which indicates the need to organize appropriate training.

Therefore, at the formative stage of the experiment, we developed a pedagogical technology aimed at ensuring a sufficient level of inclusive competence of a future teacher for working with children with special needs.

The technology outlines pedagogical conditions, is based on the selected conceptual and methodological principles of the study, has an axiological character, and a practical orientation, and includes the updated role of the future teacher by ensuring a sufficient level of inclusive competence of the future teacher for working with children with special needs.

The use of educational technology involves the implementation of methods of comparing versions, semantic associations according to the scheme, symbolic vision, independent construction of concepts, heuristic research, semantic vision, and figurative vision, supplemented by the problem method, case method, project and simulation methods, methods for developing critical thinking and innovative forms, which determines the development of inclusive competence of students in the context of practice-oriented teaching of students with special educational needs through the use of digital technologies.

In virtual and blended learning modes, the possibility of using educational technology was designed by developing classes in the Edmodo virtual learning environment and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic tools. The use of educational technology involved the implementation of effective selected learning tools for organizing asynchronous and synchronous modes of pedagogical interaction.

The results of the study showed that in the formation of inclusive competence, the main integrating and semantic role of the future teacher in the context of practice-oriented teaching of students with special educational needs through the use of digital technologies is performed by the special course “Implementation of inclusive higher education through the use of digital technologies” developed by us, the content of which includes a set of practical material and necessary theoretical material for the formation of personal traits, value orientations, abilities, knowledge, skills, experience of quasi-professional implementation of inclusive higher education through the use of digital technologies. The methodological support of the special course "Implementation of inclusive higher education through the use of digital

technologies" also includes the content of media materials, additional video, graphic and text files, web quests, test tasks, and cases placed in a virtual classroom.

The implementation of the educational technology by developing classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic tools – involved four consecutive stages:

- *The diagnostic stage*, the purpose of which was to determine the level of educational and professional interests of teachers in working with children with special educational needs;
- *The organizational stage* ensured the implementation of the educational technology by developing classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic learning tools; instruction of assistant teachers, selection of methods and types of modification and adaptation of the educational process, drawing up an individual child development program, development of correctional and developmental exercises;
- *The implementation stage* provided for the implementation of the educational process in the context of the introduction of the principles: connection of theory with practice, activity-oriented learning, computerization of learning, design of the educational process according to the model of professional activity, life situations, accessibility, activity, feasibility, educational and developmental nature of learning, differentiation and individualization, feasibility and accessibility, educational and developmental nature of learning;
- *The control and evaluation stage* – a reflexive analysis of the directions of increasing the effectiveness of educational technology.

To compare the dynamics of the formation of inclusive competence of future teachers as a result of training using traditional methods and the author's technology, student training was organized. Accordingly, the formative stage of the experiment was divided into two substages.

At the first substage of the formative stage of the study, an experimental test of the effectiveness of the author's technology for training students was carried out, which aimed to ensure a sufficient level of inclusive competence of the future teacher for working with children with special needs during the study of the special course "Implementation of inclusive higher education through the use of digital technologies". Two samples were created: control and experimental. According to the results of training using the author's technology and the traditional method, a comparison was made of the weighted average coefficients of the formation of inclusive competence of undergraduate students. They increased at the end of the experiment, respectively, from 47% to 68% in the CG and 83% in the EG.

The reliability of the results obtained was established by the Student's t-criterion. It turned out to be more than the tabular empirical value of the t-criterion, which indicates the effectiveness of the developed technology (tempir.=14.49 > ttab. = 1.96). The error does not exceed 5% (0.05).

At the second substage of the formative stage of the study, an experimental verification of the effectiveness of the author's technology for training students of the master's (second) level of higher education for practice-oriented teaching of students with special educational needs through the use of digital technologies was carried out within the special course "Implementation of inclusive higher education through the use of digital technologies".

According to all indicators, the coefficient of inclusive competence of respondents increased.

According to the psychological indicator, the coefficient of inclusive competence of respondents increased (Fig. 1):

- At a high level from 4% to 14%;
- At a sufficient level – from 41% to 48%.

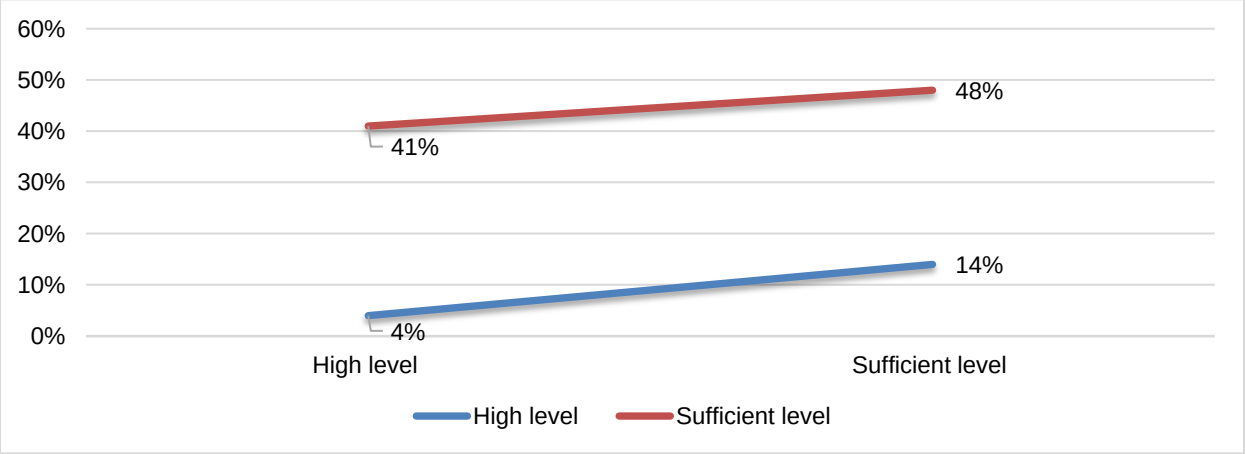

Figure 1. Changes in coefficient of inclusive competence (*psychological indicator*).

According to the theoretical indicator, the coefficient of inclusive competence of respondents increased (Fig. 2):

- At a high level from 4% to 12%;
- At a sufficient level from 42% to 50%.

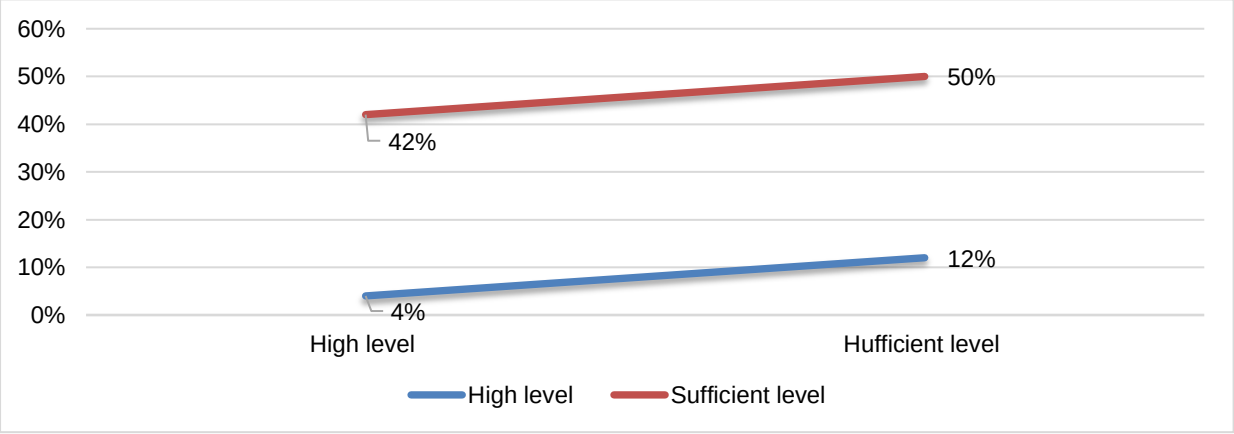

Figure 2. Changes in coefficient of inclusive competence (*theoretical indicator*).

According to the practical indicator, the coefficient of inclusive competence of respondents increased (Fig. 3):

- At a high level from 4% to 13%;
- At a sufficient level from 42% to 49%.

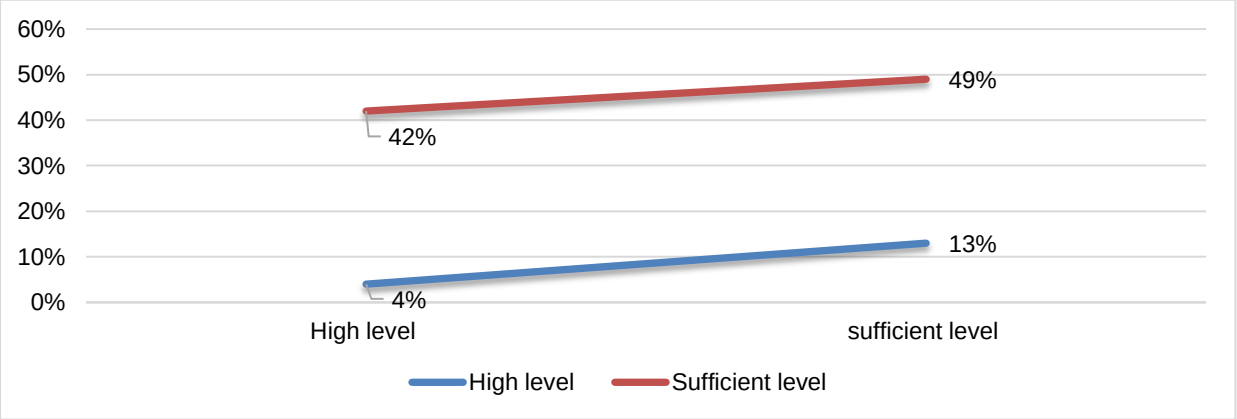

Figure 3. Changes in coefficient of inclusive competence (*practical indicator*).

We observe an increase in the overall coefficient of inclusive competence (Fig. 4):

- At a high level from 4% to 13%;
- At a sufficient level from 42% to 49%.

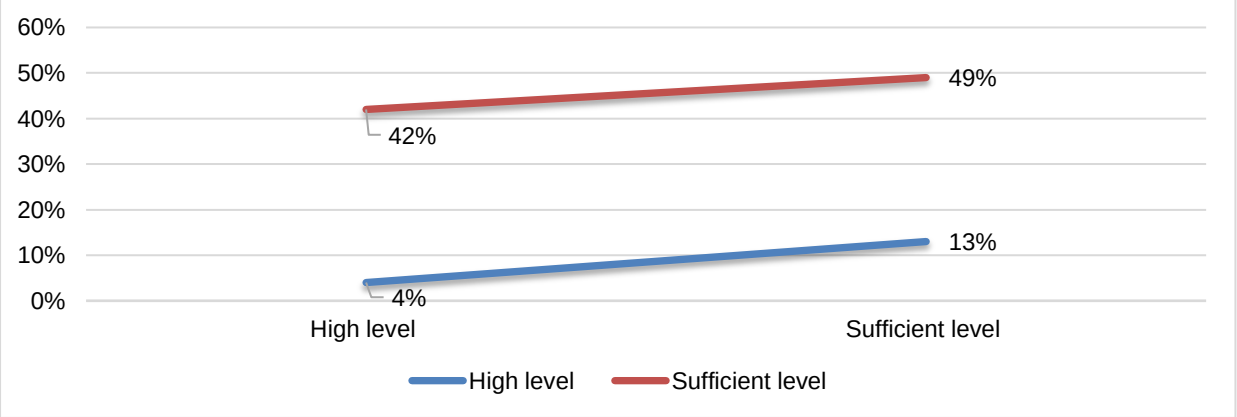

Figure 4. Changes in coefficient of inclusive competence (*overall coefficient*).

Comparison of the weighted average coefficients of the formation of inclusive competence of future teachers through the implementation of educational technology through the development of classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic tools before the beginning and end of training using the author's technology allowed us to talk about an increase in the corresponding coefficients from 68% to 83%.

Using the Pearson χ2 (chi-square) criterion, the reliability of the results obtained was checked, which indicated the presence of significant changes in the studied indicators.

χ2empirical = 65.87 > χ2tabular = 7.81 as shown by the comparison of the values of the Pearson criterion. This indicates the effectiveness of the author's technology. Let's start with what does not exceed 5% (0.05).

Thus, the results obtained at both substages of the formative stage of the experiment after the control experimental cut exceeded 70% and amounted to 83%, which indicates the effectiveness of the developed author's technology.

Conclusions

The ways of forming inclusive competence in a future teacher through the use of digital technologies are revealed, which will contribute to the practice-oriented teaching of students with special educational needs through the use of digital technologies.

An overview of modern digital technologies in education is made, and digital tools in inclusive higher education are revealed. The main methodological approaches that ensure the effective implementation of digital tools in the educational process of higher education are shown. The role of digital technologies in the development of key competencies of future specialists in inclusive education is substantiated; accessible websites and mobile applications focused on the needs of people with special educational needs or certain health restrictions are proposed.

The conceptual idea of the study is that the formation of inclusive competence in a future specialist through the use of digital technologies will contribute to the practice-oriented teaching of students with special educational needs through the use of digital technologies, which is possible by forming a sufficient level of personal, cognitive and activity components.

During the ascertaining stage of the pedagogical experiment, it was found that the coefficient of formation of inclusive competence of student teachers without specially organized training was low, which indicates the feasibility of its specially organized formation and development of inclusive competence in a future teacher through the use of digital technologies.

Therefore, at the formative stage of the experiment, we developed a pedagogical technology that aimed to ensure a sufficient level of inclusive competence of a future teacher for working with children with special needs. The implementation of educational technology through the development of classes in the virtual learning environment Edmodo and web quests on the Zunal web platform, as well as test tasks and additional exercises on the LearningApps web platform – electronic tools – involved four consecutive stages: diagnostic stage, organizational stage, implementation stage, control and evaluation stage.

To compare the dynamics of the formation of inclusive competence of future teachers as a result of training using traditional methods and the author's technology, student training was organized. Accordingly, the formative stage of the experiment was divided into two substages.

At the first substage of the formative stage of the study, an experimental test of the effectiveness of the author's technology for training students was carried out, which aimed to ensure a sufficient level of inclusive competence of a future teacher to work with children with special needs during the study of the special course "Implementation of inclusive higher education through the use of digital technologies". Two samples were created: control and experimental. Based on the results of training using the author's technology and the traditional method, a comparison was made of the weighted average coefficients of the formation of inclusive competence of undergraduate students. They significantly increased at the end of the experiment.

At the second substage of the formative stage of the study, an experimental test of the effectiveness of the author's technology for training students of the master's (second) level of higher education for practice-oriented teaching of students with special educational needs through the use of digital technologies within the special course "Implementation of inclusive higher education through the use of digital technologies".

According to all indicators, the coefficient of inclusive competence of respondents increased significantly. We observe an increase in the overall coefficient of inclusive competence.

Comparison of the weighted average coefficients of the formation of inclusive competence of future teachers through the implementation of educational technology allowed us to talk about an increase in the corresponding coefficients.

Thus, the results obtained at both substages of the formative stage of the experiment after the control experimental section exceeded 70% and amounted to 83%, which indicates the effectiveness of the developed author's technology.

We include a comparative analysis of the features of teaching students with special needs in leading countries in inclusive education in further scientific research.

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