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Interactive whiteboards: a key tool for inclusive education

Інтерактивні дошки: ключовий інструмент інклюзивної освіти

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Abstract

The article examines the conditions for the successful implementation of inclusive education in the educational environment, elucidates the issue of influence on the development of education seekers, and highlights the main reasons that cause difficulties in working with children with special educational problems. The essential properties of the concept of "interactive whiteboard" are shown, the educational potential and advantages of the interactive whiteboard are revealed, and the necessity of using interactive whiteboards in an inclusive educational environment is proven. The Smart Notebook software for interactive whiteboards is analyzed, and the possibilities of use by teachers in an inclusive educational environment are shown. The most effective online resources and programs for interactive whiteboards for creating new products on the respective platforms are highlighted. The interaction principles between teachers and children with special educational needs are

Анотація

У статті розглянуто умови для успішного впровадження інклюзивної освіти в освітньому середовищі, з'ясовано питання впливу на розвиток здобувачів освіти, виокремлено основні причини, що викликають утруднення у роботі з дітьми з особливими освітніми проблемами. Показано суттєві властивості поняття «інтерактивна дошка», розкрито освітній потенціал та переваги інтерактивної дошки та доведено необхідність використання інтерактивних дошок в інклюзивному освітньому середовищі. Проаналізовано програмне забезпечення Smart Notebook для інтерактивних дощок та показано можливості використання педагогами в інклюзивному освітньому середовищі. Виокремлено найдієвіші онлайн ресурси, програми для інтерактивних дошок для створення нових продуктів на відповідних платформах. Описано принципи взаємодії педагогів і дітей з особливими освітніми потребами. Під час

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described. During the study, the effectiveness of the formation of professional readiness of future specialists to use an interactive whiteboard for work in an inclusive educational environment was checked experimentally. We see the existing advantages in the experimental group over the control group after the experiment, which indicates the effectiveness of the implemented pedagogical system.

Keywords: interactive boards, inclusive educational environment, pedagogical system, professional readiness of specialists, pupils, students.

дослідження дослідно-експериментальним шляхом перевіряли ефективність формування професійної готовності майбутніх фахівців до використання інтерактивної дошки для роботи в інклюзивному освітньому середовищі. Бачимо наявні переваги в експериментальній групі над контрольною після проведеного експерименту, що говорить про ефективність впровадженої педагогічної системи.

Ключові слова: інтерактивні дошки, інклюзивне освітнє середовище, педагогічна система, професійна готовність фахівців, учні, студенти.

Introduction

Digital transformation is one of the directions of education development all over the world. It is based on the formation of information and digital competencies in all participants of the educational process, on the integration of digital technologies into the educational process, which forms a new reality – an educational and digital environment of interaction and support of learning in an inclusive educational environment, in which the role of the teacher changes from a consumer of electronic resources to a guide for learners to a safe digital world and the developer of digital content. This requires the teacher to use and master digital gadgets, a computer, and an interactive whiteboard (Streletska & Halepa, 2022).

The problem of implementing an inclusive approach in education, which has been actively discussed in the world in recent decades, is quite complex and important. Organization of an inclusive space through the use of interactive whiteboards in an inclusive educational environment will ensure the possibility of equal access to education services and will create a comfortable individual trajectory for self-realization and self-development of each individual, regardless of the individual's abilities, health status, social position, opportunities and other human differences (Demchenko, 2018).

In educational institutions of all types, inclusion has a social aspect both for all participants in the educational process and for persons with special educational needs, including society as a whole and family members in particular. Appropriate models of behavior of persons with special educational needs are demonstrated by the social activities of participants in the educational environment, which motivate the purposeful use of new skills and knowledge and personal development.

Partner interaction, which is important for persons with special educational needs – subjects of the educational process and other students of education and promotes the formation of friendly relations between students of the educational process, which leads to a tolerant attitude to human differences, a natural perception of a person as he is, in Ovita acquirers develop sensitivity and readiness for mutual assistance and interaction. Digital gadgets, computers, and interactive whiteboards are necessary, interesting, and interactive for the modern generation of education seekers. They are a valuable assistant in the educational space and for the teacher, who is the main figure in the educational process. The socialization of students in the educational space and the educational process itself is realized with the help of partner interaction of psychological and pedagogical support specialists, a tutor, and a teacher. It is unacceptable that the teacher is not always competent in the field of digital technologies, which forms a new reality – an educational-digital environment of interaction and support of learning in an inclusive educational environment (Bakhmat, 2020).

We see an urgent problem, given the theoretical and methodological justification of the use of an interactive board during the construction of the educational process in a higher education institution, in the preparation of specialists for the implementation of digital technologies, which form a new reality – an educational-digital environment of interaction and support of learning in an inclusive educational environment So, the social significance and relevance of the outlined problem, the insufficient level of methodical and theoretical development led to the choice of such a direction of research.

The development of innovative technologies in the quality training of future specialists is currently an urgent issue of theory and teaching methods in the educational process. Based on this, we considered the following questions in the article regarding the use of interactive whiteboards as a key tool of inclusive education:

- Appropriate conditions for the successful implementation of inclusive education in the educational environment, clarifying issues of influence on the development of education seekers, the main reasons that cause difficulties in working with children with special educational problems;
- The content of an inclusive educational environment and its significance for modern education;
- Essential properties of the concept of "interactive whiteboard" and the need to use interactive whiteboards in an inclusive educational environment;
- Online resources (interactive tools), and interactive whiteboard programs to create new products on relevant platforms and use existing ones in an inclusive educational environment.
- The educational potential of the interactive whiteboard in an inclusive educational environment for students and teachers;
- Advantages of the interactive whiteboard in training specialists to work in an inclusive educational environment;
- Principles of interaction between teachers and children with special educational needs.

Literature Review

Various aspects of the problem of finding out the features of using interactive whiteboards and digital technologies that form a new reality – an educational digital environment of interaction and support of learning in an inclusive educational environment were reflected in the scientific work of teaching scientists. In particular, O. Demchenko (2018) substantiated the issue of training future specialists in the psychological and pedagogical profile and proved the importance of special education when working with children with special educational needs. Ways of improving the professional readiness to work in an inclusive educational space of members of a multidisciplinary team of teachers are shown. The essence of inclusive competence is analyzed as a scientific category. The innovative educational training of future organizers of inclusive education is shown regarding the training of students, and then the experience of the institution of higher education as a flagship of the professional development of a teacher when working with children with special educational needs is presented.

The purpose of I. Kostikova's (2018) research is to justify the principles of using an interactive whiteboard in general secondary education institutions in the process of learning a foreign language for students. The scientist defined the concept of "interactive board", characterized exercises with an interactive board for the development of speech and a foreign language, disclosed the means of an interactive board, analyzed the advantages of using an interactive board in learning a foreign language with students, revealed the principles and named the main advantages of using an interactive board for the development of foreign language and speech singled out the most important exercises and gave a description of the most effective exercises for the interactive board.

The theoretical and methodological principles of using an interactive whiteboard as a digital learning tool were substantiated in the process of designing and conducting a modern class by N. Streletska, & D. Halepa (2022). The researchers traced the genesis of the content of the concept of "interactive whiteboard", revealed the categorical apparatus of the study, presented the educational characteristics of manufacturers of interactive whiteboards of different generations, substantiated the possibilities of using interactive whiteboard tools, clarified the classification of interactive additional online tools, proposed a system of methodological techniques that justify the possibility of using interactive whiteboard tools. It is proved that "the technological structure of an interactive whiteboard is a digital complex, the change or improvement of the main components of which – technical and software, can determine the appearance of its new generation".

L. Tokar (2022), the ways of implementing interactive technologies in the inclusive educational space and the necessary methods of training future teachers of preschool education institutions to work in the inclusive educational space are considered. The characteristics of the future teacher and his professional competencies are given. The essence of the concept of "interactive learning" and the requirements for the use of interactive technologies in preschool education institutions are highlighted. The ways of developing

the creative abilities of future teachers are described, and the technologies of cooperation (partnership) are singled out as the most acceptable in working with children.

M. Turner-Cmuchal, & S. Aitken (2016) identified the key components of effective inclusive education tools that should be taken into account to spread ICT tools and overcome the digital divide: large-scale educational programs for children with special educational needs; support, and financing by the state; promotion and support of inclusive education at the level of educational institution and community.

Research by scientists demonstrates the need for creating a high-quality, inclusive environment for children with special educational needs and the impact of ICT on the development of such children. The researchers showed ways to improve the professional readiness to work in an inclusive educational space of members of a multidisciplinary team of teachers, analyzed the essence of inclusive competence, revealed the principles and main advantages of using interactive whiteboards, presented the educational characteristics of manufacturers of interactive whiteboards of different generations, substantiated the possibilities of using interactive whiteboard tools, specified the classification of interactive whiteboards additional online tools, a system of methodical techniques is proposed, key components of effective tools for ensuring inclusive education are highlighted. However, the topic of using interactive whiteboards in an inclusive educational environment and their impact on the formation of a specialist for such an environment, which became the subject of our study, remains insufficiently disclosed.

Purpose of the research: to reveal the peculiarities of the use of interactive whiteboards in an inclusive educational environment and to verify the effectiveness of the system of forming the professional readiness of future specialists to use an interactive whiteboard for work in an inclusive educational environment.

Even though various aspects of the professional training of specialists are constantly in the circle of scientific interests of scientists, the issue of the application of innovative technologies, in particular the use of interactive whiteboards in education, is not given enough attention. In addition, the relevance of the identified problem is enhanced by several contradictions between:

- The public order for the training of teachers capable of innovative activities in the educational process, and the insufficient focus of higher education institutions on solving this problem;
- The objective need to prepare specialists for the use of interactive whiteboards in education and its insufficiently effective implementation in practice in higher education institutions;
- The necessity of forming the readiness of teachers to use innovative technologies and the lack of development of content-methodical provision of such training.

Therefore, the objective need to solve the specified problem, its insufficient theoretical and practical development, and the need to overcome the specified contradictions determined the choice of the topic of the article.

Methodology

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

- ***Theoretical methods*** – analysis of psychological, philosophical, methodical, and pedagogical literature, the study of program documents, special literature, pedagogical experience, and methodological materials of higher education institutions on the problem of using interactive whiteboards in an inclusive educational environment; methods of systematic, comparative, retrospective analysis to compare the views of scientists on the problem of using interactive whiteboards in an inclusive educational environment, to determine the conceptual and categorical apparatus of research – consideration of theoretical research questions; system analysis when using interactive whiteboards in an inclusive educational environment;
- ***Empirical methods*** – prognostic (generalization of independent characteristics, expert evaluations), diagnostic (surveys, questionnaires, interviews), observational (self-assessment, self-observation, observation) for the formation of professional readiness of specialists to use interactive whiteboards in an inclusive educational environment, experimental (pedagogical experiment) to check the level of determination and readiness of future professionals to use interactive whiteboards in an inclusive educational environment;

– ***Methods of mathematical statistics*** – based on the establishment of quantitative indicators of the evaluation of the phenomenon under study – for the analysis of the obtained results and confirmation of their probability.

During the study, the effectiveness of the formation of the professional readiness of future specialists to use an interactive whiteboard for work in an inclusive educational environment was verified by research and experiment, which was confirmed by the positive dynamics of quantitative changes and qualitative changes in indicators of the levels of professional readiness of future specialists to use an interactive whiteboard to work in an inclusive educational environment. The environment in the experimental group compared to the control group.

The purpose of the experiment was that the process of training future specialists to use an interactive whiteboard for work in an inclusive educational environment would be effective, provided it is considered an innovative pedagogical system, which is characterized by the following structural components: environmental (inclusive educational environment); technological (methods, forms, means, and technologies of education); substantive (the content of educational activities in an inclusive educational environment); the target (tasks and goals); subject-subject (subject-subject relations and interaction of a teacher, pedagogue, student, pupil).

To study the formation of future specialists for the use of interactive whiteboards for work in an inclusive educational environment, a survey of pedagogical workers was conducted – 166 teachers, of which 99 respondents are future specialists for work in an inclusive educational environment, 35 respondents are teachers of an inclusive class; 24 respondents are teacher assistants; 2 respondents are student assistants; 6 respondents are defectologists.

We obtained existing advantages in the experimental group over the control group after the experiment. This indicates the effectiveness of the implemented pedagogical system on the respondents' professional readiness to use the interactive whiteboard for work in an inclusive educational environment.

The experiment was conducted at Kamianets-Podilskyi National Ivan Ohiienko University, Dragomanov Ukrainian State University, Pavlo Tychyna Uman State Pedagogical University, and National University of Life and Environmental Sciences of Ukraine. The conduct of the experiment is permitted by the scientific councils of the universities in order not to violate ethical considerations in institutions of higher education.

Results and Discussion

Appropriate conditions for the successful implementation of inclusive education in the educational environment clarifying issues of influence on the development of education seekers, are the main reasons that cause difficulties in working with children with special educational problems.

Modern trends in education require the creation of an inclusive educational environment of appropriate conditions to influence the development of students with special educational problems and for the successful implementation of inclusive education in the educational environment:

– Ensuring access (unobstructed) to the premises and buildings of the educational institution for children with visual impairments and with disorders of the musculoskeletal system;
– Application of personally oriented teaching methods in the educational process of children with special educational problems;
– Provision of individual technical educational and methodical necessary means of education.

In an inclusive educational environment, the professional activity of a teacher-tutor requires support for the following issues:

– Formation of knowledge about ways of implementing inclusive education and the basic principles of its organization;
– The role of the psycho-pedagogical support team;
– The specifics of cooperation with subjects of the educational process;
– Implementation and development of an individual development program for each individual;

– Establishing an effective partnership with parents or guardians (Kuchai et al., 2017).

Let's consider the main reasons for working with children with special educational problems:

– Insufficient medical, pedagogical, and psychological knowledge of teachers about children with deviant behavior, sensory defects, children with intellectual disorders, and diseases of the musculoskeletal system;
– Lack of practice in the organization of joint education of children without developmental disorders and children with special educational problems in the educational process;
– Lack of awareness of work techniques and methods of dealing with children with special educational problems;
– Psychological readiness for working with children with special educational problems is not formed;
– Insufficient level of inclusive personality culture in society.

Therefore, one of the leading tasks of working in the inclusive educational environment of the school and the process of training teachers-tutors capable of solving all the diversity of educational tasks is the formation of the personality of the future professional, who can ensure adaptation, socialization, filling in the content of educational software, psychological support of persons with special educational problems in the educational environment.

Improving the professional training of such a competitive specialist requires a review of the structure and content of his training, new ways of organizing the educational process in higher education, and bringing professional education in line with the modern innovative professional level (Balalaieva et al., 2023).

An inclusive educational modern environment requires the introduction of innovative components in the informatization of the education process. During the professional training of a future specialist to work in an inclusive educational modern environment, there is a need in institutions of higher education to include innovative technologies aimed at the development of intellectual, educational, creative abilities and abilities of all school students and students with special educational problems, in particular (Bakhmat, 2020).

The content of an inclusive educational environment and its significance for modern education.

Valuable members of society in general and the school community in particular are children with various needs, including special educational problems. Since an inclusive educational environment is understood as a set of methods, conditions, and means of their implementation, which are aimed at the joint education, training, and development of education seekers, taking into account the needs and opportunities of future specialists to work in an inclusive educational modern environment should contribute to the creation of a positive environment in the educational institution, which provides equal opportunities for all participants in the educational process by the needs, shows support for students with various types of special educational needs. In this case, an inclusive class will become an effective tool for the socialization and education of all students in the class (Knysh et al., 2023).

Special training of teachers is needed to solve complex tasks of implementing an inclusive approach in education. An important problem in this regard is the creation of a system of training competitive, highly qualified personnel capable of creating developmental conditions for children with special educational needs that will be psychologically comfortable for them. Urgent problems of the implementation of inclusion in educational institutions, the need to form a multidisciplinary team of specialists, and the formation of inclusive competence to successfully work with children with special educational needs need to be solved as a priority.

The formation of value orientations in future organizers of the inclusive space and assimilation by future specialists of modern ideas about the essence of the inclusive approach is one of the important aspects of the formation of inclusive competence.

In this process, it is necessary to take into account the following positions in the preparation of higher education applicants for the specified field of activity:

1) Inclusive education is a pedagogy of an individual approach to the child, which ensures the elimination of special classes and schools for those who do not meet the conventional standard of "normality" –

any form of school segregation. With this approach, inclusive education is developed based on the principles of individualization, humanization, equality, and accessibility and is considered as "accessible for all", and "barrier-free".

2) Children with special educational needs are atypical individuals who are included in the inclusive educational process as active participants. According to the special needs of the individual (physical, social, emotional), the child is allowed to develop his potential with the help of additional resources that require special attention and services. Emphasis is placed not on human deviations and differences but on the need to provide additional support in self-realization, training, and development (Budnyk et al., 2022).

Note that one category of persons with special educational needs is gifted children, who are divided into two groups:

- Happy and successful;
- Unsuccessful, unrealized, problematic, with a high level of frustration and anxiety.

Both groups require special attention and require the creation of additional conditions to realize their potential. Specialists in the field of inclusive pedagogy should constantly be in the focus of attention of gifted individuals, as an important category of children who differ from the conventional norm, are characterized by development, and their educational needs go beyond the generally accepted standards (Demchenko, 2018).

Essential properties of the concept of "interactive whiteboard" and the need to use interactive whiteboards in an inclusive educational environment.

Smart Notebook software for interactive whiteboards. Information and communication technologies, in particular, the use of interactive whiteboards in an inclusive educational environment, which play an important role in ensuring the transition to an inclusive educational system for all participants in the educational process, are one of the important means of supporting student youth today, which can ensure the implementation and implementation of inclusive education.

Let's highlight the essential properties of the concept of "interactive whiteboard":

- The functionality of an ordinary board with the possibility of touch control;
- Software and technical specialized multimedia devices;
- Manipulation of information objects of digital resources;
- Serves as a basis for cooperation, self-study, and group interaction;
- Increases the effectiveness of the educational process by activating the visual, auditory, kinesthetic, tactile senses, emotional, and logical spheres.

The disclosure of the characteristics of the concept is connected with the coverage of the method of using one or two mostly well-known interactive tools, in particular: SmartBoard, ActivBoard, MozaBook, IntechBoard, Smart Notebook, etc.

Recently, interactive online whiteboards, which aim to organize joint work in distance learning conditions, have gained popularity: Mirro, Twidla, Padlet, NoteBookCast, JamBoard, etc. To create lessons in an inclusive environment, they contain fewer tools designed for interactive multimedia complexes than their offline counterparts.

Smart Notebook software for interactive whiteboards and its use in an inclusive educational environment enables the teacher to:

- Use special adjustments to page content and markers for change;
- Create thematic pages with inscriptions, handwritten texts, and various images;
- Display on the screen – interactive games (ash-objects) and calls to other resources.
- Add a magnifying glass to the screen, hiding a certain part of the content or page;
- Getting involved in the activities of other students in the class helps students with special educational needs;

- Provides innovative work for presentations and stories;
- Work at the blackboard, using it innovatively.

This work of using interactive boards in an inclusive educational environment will help the teacher to reveal the potential of children with special educational needs, to diversify classes, to increase the quality of an inclusive educational environment, and not only increase interest in learning (Tokar, 2022).

Ideal for remedial classes, interactive learning, presentations, interactive LCD screen, easily moved on a floor stand with wheels, equipped with a compact computer with the Android operating system, which is powerful, WiFi, and sound. Takes into account the physiological age characteristics of the child and promotes its dynamic development (Shetelya et al., 2023).

The interactive LCD screen helps to concentrate and attract attention due to game techniques on exercises, helps in solving educational and cognitive tasks, includes didactic exercises and games aimed at developing coordination of movements, basic cognitive processes, praxis, and gross motor skills, makes it possible to work in a small group or individually with a child.

Briolight interactive panel, its modular design allows you to connect additional equipment:

- Fine and gross motor controllers;
- Balancing boards;
- Laptops;
- Microphones.

Allows users to install applications from various resources, in particular, Google Play.

Online resources (interactive tools) and interactive whiteboard programs to create new products on relevant platforms and use existing ones in an inclusive educational environment.

Online resources (interactive tools) significantly expand the capabilities of the interactive board and are important for the teacher. You can create new products on the appropriate platforms and use existing ones. These are:

- ***Interactive online measurement and calculation*** (TangMath, Photomath, MozaWeb, Math learning center, Geogebra, etc.);
- ***Quizzes and surveys*** (Plickers, Kahoot, Quizziz, MentiMeter, Genial.ly, TestPad, etc.);
- Online exercises and games (learningApps, GamesMatch, StadySmle, learning.ua, MozaWeb, Gamil.lab, Genial.ly);
- ***Memory cards and interactive infographics*** (mirro, Genial.ly, Canvas, Goggle.it, Mapul.com, Spiderscribe, etc.);
- ***Interactive worksheets and posters*** (Wizer.my, Genial.ly, LiveWorcSheets, Classkick, etc.);
- ***Interactive presentations and videos*** (Canvas, Genial.ly, PlayPosit, H5P, Wizer.my, EDPAZZLE, Vialogues, NEARPOD);
- ***Interactive textbooks*** (Book Creator, MozaWeb, Canvas, Writereader, Ourboox, Storyjumper, etc.);
- ***Interactive lessons*** (MozaWeb, Matific, EduGames, electronic teacher's assistant – Elpom.com.ua, Smart Exchange, etc.);
- ***Resources with 3D interactive models*** (MozaWeb, Solarsystemscope.com, Corinth3d, Earth.google.com, Roqed.com, Sketchfab.com, 3D Space Museum, etc.).

State-of-the-art interactive whiteboard provision in an inclusive educational environment, which is ad hoc and programmatic, includes a gallery of 3D models, built-in interactive resources, collections of interactive games, quiz templates, a cloud platform for learning and interaction, and integrated interactive online resources. Today, there are significant differences in the special software (basic) support of different manufacturers for interactive whiteboards.

Let's consider modern programs for interactive boards that can be used in an inclusive educational environment. For SmartBoard interactive displays, there is an inherent learning module of the Smart software, which includes:

Smart Lnk – creates conditions for written comments on top of various online resources and file formats with saving notes in the file;
Smart Note Book – makes it possible to add interactivity to the video, with the technology of instant response; class designer with templates of quizzes, games, and resources from various subjects;
Suite – network software that creates conditions for working with multimedia and interactive texts on a cloud platform, creating interactive lessons and interactive tasks; conducting surveys of pupils and students with the use of personal devices, organizing the joint work of those seeking educational space (SMART Technologies ULC, 2019).

IntBoard ID software includes the IntBoard Space network resource in addition to the class designer. The paid service Corinth3d, which contains 3D models from various disciplines, can be installed. To create interactive classes, it integrates 90 different online services, which are grouped by main educational subjects, as well as groups of interactive applications (INTBOARD, 2024).

Mozaik has developed the MozaBook software for computers and interactive whiteboards, which includes the following components: a panel of digital textbooks, a panel of notebook design, and presentations, with the possibility of virtual reality – 3D gallery, photo gallery, media gallery, audio gallery, toolbar: virtual experiments, interactive quizzes and tasks with ready-made creation templates, a time machine with texts – historical, scientific, creative, interactive, etc., drawing tools, practical tools.

The program contains ClassHome and ClassWork modules, which allow you to create virtual classes both for independent work at home (by sending tasks by e-mail) and for group or individual work in class (using a Wi-Fi channel through tablets with installed software).

The Mozaweb online platform has a virtual learning function, which includes all MozaBook developments by topic and allows you to assign them to perform assignments in the classes created on the platform.

The MozaLog network system is one of the programs of the Mozaik company, its components are electronic journals and diaries with the possibility of communication with colleagues and parents, viewing the attendance of students in the educational space, viewing and creating a schedule of classes (Mozaik Education, 2020).

Included with Intech interactive whiteboards and panels is the Intech Touch Board software, which is basic and does not require a driver for the Windows educational system. In it, on top of other tabs and windows, the functions of commenting and management of the educational system are integrated; creating slides with interactive objects, a lesson designer, additional resources and tools); built-in testing system; cloud support for the most common cloud storages (file import and saving from Google Drive, Dropbox, One Drive, etc.); creating a distance lesson in an inclusive educational environment (requires additional software Intech RC Server, through the server provides access to the lesson, which allows you to observe the actions on the interactive board in real time; organization of group work and independent (students of education using a smartphone by providing a QR link , can view classes in image format, make comments, remotely control the board, upload files to the board screen, synchronize devices – requires the installation of the IntechSharing application); a built-in collection of 3D objects and media resources, divided by topics and by main subjects (INTECH, 2021).

ActivInspire – software (a product of Promethean company) is used for the Active Board interactive board. Creating a workspace, flipcharts is one of the main purposes of the program, which consists of an unlimited number of pages intended for group, pair, and individual activity in an inclusive educational environment. Flipcharts are created based on a blank page by exporting PowerPoint, FDF, and SmartBoard files based on the desktop and programs and applications opened from it. The program offers resources from various subjects, a large number of objects, active tools, buttons, changing properties of objects, and formalized actions of objects for the creative development of interactive tasks and the work of the teacher. Ready-made templates of interactive games include a program (matching, categorization, memory, crossword, etc.), a question designer (formats: create a sequence, multiple choice, text, yes-no, numbers, equations), which is an integration of modules of the corresponding ClassFlow platform, developed for implementation and organization of distance learning.

You can upload a ready-made flipchart to the network service and view it online with students using mobile devices (Polymedia, 2021).

The educational potential of the interactive whiteboard in an inclusive educational environment for students and teachers.

Let's consider the possibilities of an interactive whiteboard for education seekers:

- Provision of group work on the material (with the help of different modes, it is carried out in different programs – division of the board into several parts, pair work mode – remote control modes, discrimination by the system from 10 different touches, modes of exchange of students within the class with individual digital devices, with the possibility creating virtual classes for using online platforms and assigning tasks for solving, etc.);
- Through extended interaction with educational material – increasing the motivation of students to learn in an inclusive educational environment (tactile, game, dynamic, using interactive multimedia, augmented and virtual reality, etc.);
- Guaranteeing developmental research training (use of augmented and virtual reality, 3D simulation, real processes and experiments, natural phenomena;
- Virtual developmental game interactive tasks, drawing and measuring tools, etc., which contribute to the formation of the subject and key competencies of the acquirers of the educational space;
- Creation of a safe microclimate (in the blackboard field, the jump-like mobility of the eyes prevents fatigue; gamification, bright objects, and tasks of an interactive nature contribute to the removal of uncertainty, anxiety, and an increase in the psycho-emotional background; the maximum resolution of modern panels is observed – 4K, which allows you to perceive virtual objects without eye strain objects, from any location of the classroom is responsible for the high definition of the image).
- Ensuring conscious assimilation by using simultaneous auditory, visual, and tactile analyzers, which is similar to the natural perception of information.

Let's consider the possibilities of an interactive whiteboard for a teacher:

- Based on the use of program modules – providing feedback (quizzes, survey wizard, instant response functions, additional online applications for surveys, and knowledge monitoring with the ability to display results on the screen);
- Saving time in class (in the environment of the designer program, the tasks developed by the teacher are used for implementation and do not require additional writing on the board; they are saved together with comments, explanations, and video recording of manipulations on the board and can be returned to, viewed, printed at any time, use later);
- Development of creativity (using the designer's tools, creating your own interactive tasks, additional online resources built into the program, templates of built-in games).

Interactive whiteboard software is interchangeable. The teacher can experiment with applications and programs from different developers (Streletska & Halepa, 2022).

Advantages of the interactive whiteboard in training specialists to work in an inclusive educational environment.

Teachers, using an interactive board focusing on certain age groups of student youth can make classes more interesting and productive. Even those students who reluctantly come to an educational institution while viewing educational files and video materials are quickly involved in the educational process because they constantly use electronic devices actively in their everyday lives and navigate new technologies. Thanks to this, they can see and analyze video plots, connect parts of objects, interact with the screen by moving pictures and letters, and draw. Working through the studied material in this way, they absorb information several times faster and become not passive listeners but active participants in the educational process in an inclusive educational environment (Kozmenko et al., 2022).

Software for interactive whiteboards allows you to save classes in an interactive format in an inclusive educational environment, supplement them with notes, clearly structure the material, improve it, inspire the teacher to creatively, constantly improve pedagogical development, revitalize the process of education in an inclusive educational environment in all classes, as a result, which increases the activity of students, and the lesson moves to another qualitative level.

Interactive whiteboards inspire children to acquire new knowledge and help the teacher to interest and activate children, High resolution on the screen of images that are in color attracts children. Therefore, future specialists should use visual materials in the form of pictures, objects, and video clips to work in an inclusive educational environment, take into account the possibility of highlighting the text in any color with frames and shapes, which ensures the general attention of students (Sulym et al., 2023).

To increase the overall productivity of the educational space of the inclusive environment, future specialists will use the principle of the interactive whiteboard to use color markings and comments, possible corrections, and connect a microscope, digital camera, Web camera, and video camera to the board.

The advantages of using an interactive whiteboard in an inclusive educational environment make it possible to enliven the general atmosphere of the educational process, adjust to the needs of each student, help with extracurricular activities, and raise the productivity and mood of students. Due to the increase in the number of illustrative materials, the interactive whiteboard becomes an indispensable supplement to the teacher's words, allowing the future teacher to improve the perception of the material and the students to perceive information faster, discuss the topic with interest, and participate in group discussions (Kyrychenko & Harakh, 2019).

The interactive whiteboard enables the future specialist to use and productively combine:

– Presentation software (MS Office PowerPoint);
– Special software;
– Digital media;
– Graphic or text editors (MS Office Word, Adobe Photoshop, etc.);
– Graphical information (drawings, photographs, diagrams, etc.);
– Internet network;
– Video and audio materials (Kostikova, 2018).

Principles of interaction between teachers and children with special educational needs.

We consider it necessary to adhere to the principles during the constant interaction of teachers and children with special educational needs:

– ***Humanism*** – recognition of a child with special needs as the goal of socially oriented pedagogical action, the highest value of society; creation of an educational trajectory for the formation of certain value orientations, for the assimilation of certain skills and knowledge;
– ***Pedagogical support*** – development of a system of pedagogical and educational activities and development oriented towards minimizing the child's difficulties in the corrective and developmental process, support for the individual's success;
– ***Anthropocentrism*** – provision of safe, conflict-free, comfortable conditions for the education of a person with special needs, the actualization of vitamin experience, the realization of his natural potential;
– ***Subjectivity*** – implementation of the subject's position in the process of communication, understanding of personality problems, demonstration of respect for the child, awakening of faith in the success of one's own activities, the ability to self-stimulate to correct mistakes;
– ***Activity approach*** – organization of communication for prevention, correction, and development of violations based on partnership and equal interaction; humane educational activity;
– ***Individual approach*** – the creation of a comfortable compensatory environment, a developmental, educational environment taking into account the individual characteristics of children (Plakhotnik et al., 2023)

Experiment

During our research, we tested the effectiveness of forming the professional readiness of future specialists to use an interactive whiteboard for work in an inclusive educational environment, which was confirmed by the positive dynamics of quantitative changes and qualitative changes in indicators of the levels of professional readiness of future specialists to use an interactive whiteboard to work in the inclusive educational environment in the experimental group compared to the control group.

The purpose of the experiment was that the process of training future specialists to use an interactive whiteboard for work in an inclusive educational environment would be effective, provided it is considered an innovative pedagogical system, which is characterized by the following structural components:

- Environmental (inclusive educational environment);
- Technological (methods, forms, means, and technologies of education);
- Content (the content of educational activities in an inclusive educational environment);
- Target (tasks and goals);
- Subject-subject (subject-subject relations and interaction of a teacher, pedagogue, student, pupil).

To study the formation of future specialists for the use of interactive whiteboards for work in an inclusive educational environment, a survey of pedagogical workers was conducted – 166 teachers, of which 99 respondents are future specialists for work in an inclusive educational environment, 35 respondents are teachers of an inclusive class; 24 respondents are teacher assistants; 2 respondents are student assistants; 6 respondents are defectologists.

After summarizing the obtained data, the following trends were identified at the control stage of the experiment:

- With a high level of readiness to use an interactive whiteboard to work in an inclusive educational environment, the number of respondents increased in all EG and CG groups, and CG – by 7.5%; in EG – by 20.1%;
- With an average level of readiness to use an interactive whiteboard to work in an inclusive educational environment, the number of respondents increased in CG – by 21.2%; in EG by 21%;
- The number of respondents with a low level of readiness to use an interactive whiteboard for work in an inclusive educational environment decreased in all groups and CG – by 29.5%, in EG by 42.4%.

We see the existing advantages in the experimental group over the control group after the experiment. This indicates the effectiveness of the implemented pedagogical system on the respondents' professional readiness to use the interactive whiteboard for work in an inclusive educational environment.

The final diagnosis indicates an increase in the percentage of respondents in EG with high and medium levels of readiness to use an interactive whiteboard to work in an inclusive educational environment (by 23% and 18%, respectively), the number of respondents with a low level decreased by 40%. Higher indicators of respondents' willingness to use an interactive whiteboard for work in an inclusive educational environment of the experimental group are due to the inclusion of learning technologies, principles, and in-depth content of using an interactive whiteboard for work in an inclusive educational environment, as well as the use of online resources, programs for interactive whiteboards for creation of new products on appropriate platforms and use of existing ones in an inclusive educational environment in the process of professional training of specialists.

We also observe slight positive changes in the control group, which is not related to the systematic use of measures aimed at forming the professional readiness of respondents to use an interactive whiteboard for work in an inclusive educational environment.

The statistical significance of the differences in the number of respondents in the professional readiness of respondents to use an interactive whiteboard for work in an inclusive educational environment at a high level of formation was checked in the EG based on the results of the control stage of the experimental work using Fisher's multifunctional test (φ^*). Differences at the level of $\rho \leq 0.01$ are statistically significant. The obtained empirical value is in the zone of significance ($\varphi^*_{emp} \approx 3.83$). The results obtained in the process of experimental work testify to the effectiveness of the pedagogical system of the respondents' professional readiness to use the interactive whiteboard for work in an inclusive educational environment, which is the basis for implementing the research results into the educational process of higher education institutions that prepare future specialists to work in an inclusive educational environment.

Practical recommendations regarding the implemented pedagogical system of professional readiness of specialists to use an interactive whiteboard for work in an inclusive educational environment.

Based on the results of the study, practical recommendations were developed regarding the implemented pedagogical system of professional readiness of specialists to use an interactive whiteboard for work in an inclusive educational environment:

- The formation of professional competence of specialists to work in an inclusive educational environment should take place through the use of innovative technologies;
- Regardless of specialty, creating conditions for future teachers to acquire inclusive competence;
- To introduce special disciplines into the educational process of pedagogical faculties to improve the quality of professional training of specialists to work in an inclusive educational environment;
- Training of special specialists to use the interactive whiteboard to work in an inclusive educational environment with the aim of quality organization of work with children with special educational needs;
- Development of a program of professional development of teachers by the specifics of the educational process in an inclusive educational environment and social and psychological support of students with special educational problems.
- Systematic professional improvement of teachers and their self-education as subjects of an inclusive educational environment.

The reliability and validity of the obtained results and the objectivity of their evaluation were ensured by the methodological validity of the initial positions and the qualitative mechanism of the assessment of the quality under study, the use of a complex of complementary research methods, and the involvement of a group of respondents from a higher educational institution in the analysis of its results.

To assess the homogeneity of experimental and control data, statistical processing was performed using MS Excel and SPSS (Statistical Package for Social Science).

Research is largely dependent on the accuracy and reliability of the data. In research work, the quality of data collection and analysis not only adds weight to the research but also contributes to the formation of sound conclusions, which is the key to academic success.

The following digital data collection tools were useful in the study:

- Google Forms – a simple tool for creating surveys that allows you to collect data from respondents, create different types of questions, and collect answers in spreadsheets.
- SurveyMonkey – a modern survey tool that offers a wide range of customization options and analytical tools for analyzing the collected data.
- JSTOR, Google Scholar, and other academic search engines provide access to scholarly articles, books, and other academic resources that may be useful for literature review and theoretical data collection.
- Zotero or Mendeley – bibliography management programs that help organize research materials, store references, and format bibliographies and citations according to different citation styles.
- Microsoft Excel or Google Sheets – spreadsheets are useful for organizing and analyzing collected data when working with quantitative data.
- SPSS, R, or Python for more advanced data analysis, statistical analysis, and processing of volumes of data.

Conclusions

The conditions for the successful implementation of inclusive education in the educational environment are considered, the issue of influence on the development of education seekers is clarified, and the main reasons that cause difficulties in working with children with special educational problems are highlighted. The content of an inclusive educational environment and its significance for modern education are revealed.

The essential properties of the concept of "interactive whiteboard" are shown, and the necessity of using interactive whiteboards in an inclusive educational environment is proven.

The Smart Notebook software for interactive whiteboards and the possibility of using it in an inclusive educational environment by a teacher are analyzed.

The most effective online resources (interactive tools) and programs for interactive whiteboards for creating new products on relevant platforms are highlighted, and ways of using existing ones in an inclusive educational environment are shown. Modern programs for interactive whiteboards that can be used in an inclusive educational environment are considered.

The educational potential of the interactive whiteboard in an inclusive educational environment for students and teachers is revealed.

The advantages of the interactive whiteboard in training specialists to work in an inclusive educational environment are shown.

The principles of interaction between teachers and children with special educational needs are described.

During the study, the effectiveness of the formation of the professional readiness of future specialists to use an interactive whiteboard for work in an inclusive educational environment was verified by research and experiment, which was confirmed by the positive dynamics of quantitative changes and qualitative changes in indicators of the levels of professional readiness of future specialists to use an interactive whiteboard to work in an inclusive educational environment in the experimental group compared to the control group.

We see the existing advantages in the experimental group over the control group after the experiment. This indicates the effectiveness of the implemented pedagogical system on the respondents' professional readiness to use the interactive whiteboard for work in an inclusive educational environment.

Practical recommendations have been developed regarding the implemented pedagogical system of professional readiness of specialists to use an interactive whiteboard for work in an inclusive educational environment.

Consideration of software for interactive whiteboards, which allows you to save lessons in an interactive format in an inclusive educational environment, requires further research.

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