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**DEVELOPMENT OF INNOVATIONS IN THE EDUCATIONAL ENVIRONMENT:  
INCLUSIVE EDUCATION AND DIGITAL TECHNOLOGIES**

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**Abstract**

The introduction of digital technologies in the educational process makes it possible to personify the presentation of numerical and graphical information, individually select the pace of learning, make the process of assessing competencies objective and increase the level of methodological support of the educational process. The use of the latest digital technologies in the planning of student-centered inclusive education allows releasing the time reserves of teachers and ensuring the comfort of the implementation of routine processes. The purpose of this work is to analyze the characteristics of student-centered learning relative to the needs of students studying inclusively.

**Key Words**

Inclusive education – Digital technologies – Individual educational route

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## Introduction

New trends in the development of the educational sector, due to the transformation of the socio-economic structure of society and changes in value orientations, actualize, in particular, the transition to a student-centered paradigm of learning<sup>1</sup>. The construction of the national system of individual education is an urgent task of modern education. Taking into account the world experience, realities and traditions of national education allows us to fully meet the individual educational needs of both inclusive students and those broad social groups that require student-centered approaches to meet their educational needs.

The development of information and communication technology (ICT) has initiated changes on a global scale, which in the field of education have led to a new interpretation of educational processes. The teacher-centred learning model, which emphasized the primary role of the teacher in the delivery of knowledge, has been transformed by a competency-based approach to education that focuses on the outcomes of education as such. The most effective method of implementing the competence model is student-centered learning<sup>2</sup> when the centre of the educational process is the person, their abilities and inclinations.

The inclusive format of education, which takes into account the special needs of a particular person, emerged and began to be used by teachers at the end of the last century – as an effective way of socialization of persons with psychophysical characteristics<sup>3</sup>. Implementation of inclusive education requires individual adjustment of the educational process, which is also typical for modern approaches to the implementation of the learning process of each person.

To ensure quality inclusive learning, UNICEF encourages educators to develop student-centred learning programs using appropriate learning technologies, while developing customized curricula to accompany inclusive students during their learning<sup>4</sup>. Designing individual inclusive learning is a challenge at every stage of its implementation and the use of modern digital technologies can simplify, optimize, accelerate and support this process. It is particularly important to develop such a system of information technology support for student-centered education, which would take into account the special educational needs of one of the socially vulnerable segments of society – persons with special needs.

## Literature review

Student-centered learning for inclusive education is investigated in the works of S. V. Alekhina, M. M. Semago, S. J. Peters, V. G. Goncharova, L. A. Didenko, I. Hamburg, S. Bucksch and others. Researchers have developed abstract models of inclusive education and its evaluation<sup>5</sup>, proposed approaches to the formation of an individual educational

<sup>1</sup> S. V. Kulnevich, *Pedagogika lichnosti ot koncepcij do tehnologij* (Rostov-on-Don: Tvorch. centr "Uchitel", 2001).

<sup>2</sup> M. A. Vikulina, *Lichnostno-orientirovannyj podhod v pedagogike: teoreticheskoe obosnovanie i puti realizacii* (Novgorod: NGLU, 2004).

<sup>3</sup> S. V. Alehina, *Inkluzivnoe obrazovanie: istorija i sovremennost* (Moscú: Pervoe sentjabrja, 2013).

<sup>4</sup> UNICEF, *State of the World's Children: Children with Disabilities*. 2013. Available at: <http://www.unicef.org/sowc2013/report.html>

<sup>5</sup> S. V. Alehina y M. M. Semago, *Sozdanie i aprobacija modeli psihologo-pedagogicheskogo soprovozhdenija inkluzivnoj praktiki: methodical manual* (Moscú: MGPPU, 2012).

route<sup>6</sup> and described the specifics of determining the level of psychophysical development of students<sup>7</sup>.

According to researchers<sup>8</sup>, modern digital technologies allow specialists, parents and persons with special needs to provide information technology support and support for certain stages of inclusive education. Publications on such topics are related to the problems of access to certain digital technologies<sup>9</sup>, development and application of such technologies, etc.<sup>10</sup> Researchers<sup>11</sup> argue that digital technologies should use the results of the analysis of educational data to dynamically adapt the individual educational route in real-time. There is an urgent need to formulate the principles and rules for the construction and use of such systems of student-centered learning, which would allow accompanying the education of a person with special needs with the help of digital technology analysis of educational activities. The solution of this problem will be facilitated by the construction of information-logical and structural models of information-technological processes to support student-centered education of persons with special needs<sup>12</sup>. An important prerequisite for the implementation of the ideas of student-centered learning in the design of information technology support systems for inclusive learning, according to researchers, is, in particular, individualized selection of the content of training based on psychophysiological characteristics of the individual<sup>13</sup>. At the same time, the current degree of psychophysiological development and the level of competence of the individual at each iteration of training is fixed in the individual educational trajectory and is to some extent the starting point for the formation of the next iteration of training. The endpoint of such an iteration is the content of the training is a certain set of competencies that the person should receive. An individually selected set of psychological, medical, pedagogical techniques and technologies for obtaining certain competencies is a part of the recommended curriculum, which combines the initial and final points of the iteration of training. Differentiation of training systems for comprehension of separate competences allows choosing the best set of psychological and pedagogical techniques for studying a certain subject<sup>14</sup>.

<sup>6</sup> S. Dzh. Peters, *Inkluzivnoe obrazovanie: strategii ODV dlja vseh detej* (Stavropol': SevKavGTU, 2010).

<sup>7</sup> V. G. Goncharova y L. A. Didenko, "Individualno orientirovannye ob- razovatelnye programmy kak sredstvo povyshenija kachestva professionalno- go obrazovanija lic s ogranichennymi vozmozhnostjami zdorovja", *Specialnoe obrazovanie*, num 3 (2013): 32–41.

<sup>8</sup> A. Ju. Shemanov, "Cifrovye tehnologii v kontekste inkluzii", *Sovremennaja zarubezhnaja psihologija*, Vol: 5 num 3 (2016): 66–74.

<sup>9</sup> I. Hamburg y S. Bucksch, "ICT-based approaches to support learners with disabilities", *Journal of educational policy and entrepreneurial research*, num 2 Vol: 6 (2015): 1-12.

<sup>10</sup> F. K. Ahmad, "Assistive Provisions for the Education of Students with Learning Disabilities in Delhi Schools", *International Journal of Fundamental and Applied Research*, num 2 Vol: 9 (2014): 9-16.

<sup>11</sup> R. A. Madani, "Analysis of Educational Quality, a Goal of Education for All Policy", *Higher Education Studies*, Vol: 9 num 1 (2019): 100-109.

<sup>12</sup> I. Hamburg y S. Bucksch, "Inclusive Education and Digital Social innovation", *Advances in Social Sciences Research Journal*, num 4 Vol: 5 (2017): 162-169.

<sup>13</sup> H. Lidström y H. Hemmingsson, "Benefits of the use of ICT in school activities by students with motor, speech, visual, and hearing impairment: A literature review", *Scandinavian Journal of Occupational Therapy*, Vol: 21 num 4 (2014): 1-16.

<sup>14</sup> O. L. Lehanova, "Povyshenie reabilitacionnogo potenciala studentov s invalidnost'ju sredstvami specializirovannyh adaptacionnyh discipline", *Problemy sovremennogo pedagogicheskogo obrazovanija*, Vol: 52 num 3 (2016): 141–153.

At the same time, an important factor in increasing the level of competence of a person with special needs is the formation of a system of information technology support for individual work with the family of such a student<sup>15</sup>. According to researchers<sup>16</sup>, information technology support of student-centered inclusive education should be implemented in the form of an appropriate recommender system. In their opinion, the recommender system of inclusive education is an intelligent information system that provides the formation of recommendations on the tasks, methods and means of implementation of student-centered training of a person with special needs based on the analysis of the peculiarities of their psychophysical development and the corresponding educational trajectory. Developing recommender systems of inclusive education means to reduce the information burden on teachers, parents, a person with special needs by searching (intelligent selection) the most relevant objects (pedagogical teaching methodology, ICT tools for inclusive learning, forms of control, etc.) from large data sets<sup>17</sup>. The functioning of such system consists in the analysis of features of the inclusive student, their psychophysical development and an individual educational trajectory for the formation of a qualitative individual educational route, which would meet the principles of the student-centered training and would provide effective achievement of the set educational purpose<sup>18</sup>.

The main recommendation methods that are used in modern systems of this class are collaborative filtering, content filtering, hybrid filtering and their improvement: knowledge-based filtering, computational intelligence-based filtering, filtering using social networks (social network-based), context awareness-based filtering, collaborative filtering<sup>19</sup>. Along with the use of recommender systems in such problematic areas as management, business, commerce, tourism, since the 2000s, such systems have been involved in the field of education.

Research hypothesis: to design an individual educational route of inclusive education, it is necessary to use appropriate information and communication tools that make communication and training of persons with special needs more effective.

<sup>15</sup> T. Jeffs; M. Behrmann y B. BannanRitland, "Assistive Technology and literacy learning: reflections of parents and children", *Journal of Special Education Technology*, Vol: 21 num 1 (2006): 38-44.

<sup>16</sup> F. M. Pinto; M. Estefania; N. Cerón y R. Andrade. "iRecomendOne: a design proposal for the development of a pervasive recommender system based on students profile for Ecuador's students' candidature to a scholarship", *New Advances in Information Systems and Technologies*, num 445 (2016): 537-546.

<sup>17</sup> J. Ribeiro y A. Moreira., "ICT Training for Special Education Frontline. Professionals", *International Journal of Emerging Technologies in Learning*, Vol: 5 num 2 (2010): 55-59.

<sup>18</sup> N. M. Nordin; R. Zaharudin; M. H. M. Yasin; R. Din; M. A. Embi y M. A. Lubis, "ICT in education for deaf learners: Teachers' perspective", *Research Journal of Applied Sciences*, Vol: 8 num 2 (2013): 103-111.

<sup>19</sup> J. Liu; X. Wang; X. Liu y F. Yang, Analysis and design of personalized recommender system for university physical education. *International Conference on Networking and Digital Society*, num 2 (2010): 472-475; M. N. Dudin y Y. S. Shishalova, "Development of effective education and training system in the context of the transition to international accreditation", *European Journal of Contemporary Education*, Vol: 8 num 1 (2019): 118-127. Available at: [http://ejournal1.com/journals\\_n/1553683882.pdf](http://ejournal1.com/journals_n/1553683882.pdf) y N. Mikhail, M.N. Dudin, V.V. Bezbakh, E. Evgenia, Frolova, M.V. Galkina. Models of the higher education in Russia and the countries of Europe at the beginning of the 21st century: main directions of development. *European Journal of Contemporary Education*, 7(4) (2018): 653-667. Available at: [http://ejournal1.com/journals\\_n/1553683882.pdf](http://ejournal1.com/journals_n/1553683882.pdf)

## Proposed Methodology

### General description

A set of theoretical and empirical methods was used to achieve the goal of the study:

-theoretical methods: analysis, systematization, generalization of theoretical and empirical research in the field of digital technologies in the planning of student-centered inclusive education;

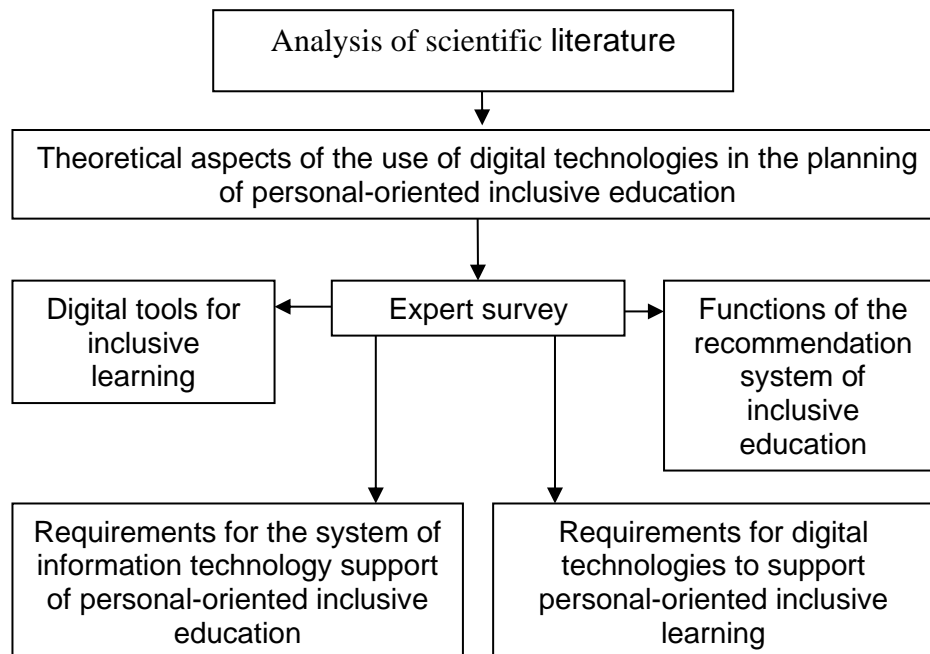
-empirical methods: online expert survey of representatives of Russian universities (32 experts) on the issues of digital media in inclusive education, features of a recommender system in inclusive education, the system requirements, digital technology information support in student-centred inclusive education and the participants in the process of inclusive education, as well as the purposes of the use of information-technological support of such training.

### Algorithm

At the first stage of the study, the analysis of the scientific literature on the use of digital technologies in the planning of student-centered inclusive education was carried out.

At the second stage of the study, we determined digital media in inclusive education, features of a recommender system in inclusive education, the system requirements, digital technology information support in student-centred inclusive education and the participants in the process of inclusive education, as well as the purposes of the use of information-technological support.

### Flow Chart



## Results

According to the experts, the formation of an individual route of inclusive education requires taking into account both the features of the psychophysical development of such a person and the available specialized tools and resources that will support the process of education. Many of this specialized software, technical, information and problem-oriented resources to support student-centered inclusive learning are considered by the experts to be digital means of inclusive learning, which, in their opinion, should combine the universality of the design, accessibility and systematic nature of services provided (Table 1).

Persons with special needs	Digital media
Persons with visual impairments	PC screen magnification tools, clear video and media services, text reading tools, Braille scanning and recognition software, independent text reading, audio devices, Braille recording devices, adapted keyboards, etc.
Persons with hearing disabilities	Frequency simulation devices, infrared sound transmission systems, text phones, speech recognition devices, etc.
Persons with speech disorders	Software for teaching or developing speech, alternative communication systems (using symbols, drawings, sign language), speech synthesizers, etc.
Persons with orthopaedic disabilities	Means of adapted access to the PC adapted equipment for daily use and accessories for recreation, etc.
Persons with learning difficulties	Abbreviation analyzer (software that generates abbreviations for phrases and words frequently used by a person), electronic pen (software that allows one to listen to notes written on special paper), electronic mathematical worksheets (allow one to work with mathematical tasks on a PC screen), free-form databases (provide storage and work with records of any format), etc.

Note: based on the expert survey.

Table 1  
Digital tools for inclusive learning

According to the experts, to formulate the main aspects of technological support for student-centered training of persons with special needs, it is advisable to consider the system of support for such training as a recommender system, analyzing the features of its formation, structural characteristics and functional requirements. The experts believe that recommender systems in training are intended to informationally support the user in choosing a training course, topics and materials, lectures and online discussions, etc. At the same time, recommender systems of information technology support for student-centered inclusive training must meet the basic functional requirements. The basic functions of the recommender system of inclusive education are presented in Table 2.

Nº	Functions of the recommender system	%*
1	Collection and analysis of information about the user and their preferences based on web analysis	90%
2	Accumulation of information about the purpose of training and its features	83%
3	Accumulation of pedagogical knowledge to assess the degree of correspondence between the educational level of the student and the educational goals set for them	83%

Note: based on the expert survey; \* – percentage of expert mentions.

Table 2  
Basic functions of the recommender system of inclusive education

These functional features of recommender systems, according to the experts, allow one to create requirements for the system of information technology support student-centered inclusive education, depending on the stage of training (Table 3).

Stage	Requirements
1	At the beginning of the training system, the training goal is set, determined taking into account the established features of the psychophysical development of the person.
2	Based on predetermined learning objectives, taking into account features of psychophysical development and the specifics of the educational possibilities of the personality, the system, based on the many available tools (educational technology, available methodological and technical support of educational process), in advisory mode, provides the determination of the presentation of educational material and format control.
3	An inclusive student (student) is trained and tested for knowledge in an individually defined form of control, based on which, information is formed about the results and nature of training (an element of the educational trajectory).
4	The system provides a comparison of results for learning and recommendations for decision-making on the further progress of the inclusive learning process. The analysis of the accumulated data on the effectiveness of the proposed form of material submission and the form of knowledge control is used to improve the process of information technology support for inclusive education.

Note: based on the expert survey

Table 3

Requirements for the system of information technology support of student-centered inclusive education

According to the experts, digital technologies to support student-centered learning, which would take into account the individual characteristics of the psychophysical development of students and allow them to meet their educational needs during the formation of individual curricula, should meet the following structural and functional requirements (Table 4).

No	Requirements	%*
1	To create conditions for the selection of educational content following the educational capabilities and needs of the person, as well as the level of acquired competencies	90%
2	To ensure optimal selection of the educational content on relevant topics	84%
3	To provide equal time carrying out educational and correctional work with the person according to features of their psychophysical development	81%
4	To ensure the construction of an individual curriculum taking into account the achieved level of competence acquisition and the level of psychophysical development	81%
5	To promote the synthesis of modern pedagogical, correctional and information technologies	78%
6	To ensure the formation of an individual learning trajectory of the person, supporting the accumulation of learning results and conducting their analysis	78%

Note: based on the expert survey; \* – percentage of expert mentions.

Table 4

Requirements for digital technologies to support student-centered inclusive learning

The requirements for the complex of information technology support of the process of student-centered inclusive education allowed the experts to identify the list of participants in this process and the purpose of using the system of information technology support of such training (Table 5).

<b>Nº</b>	<b>Process participants</b>	<b>Purpose of using the information technology support system</b>	<b>%*</b>
1	a person with special educational needs	to update individual data, monitor their educational trajectory, form transitional curricula and reports on the educational trajectory at the request of university teachers, employers and other participants	100%
2	specialists of the psychological-medical-pedagogical	accumulation of data of psychophysical diagnostics, analysis of accumulated data, monitoring of psychological and medical aspects of personal socialization during inclusive education	94%
3	parents of persons with special needs	to monitor the educational, psychological and correctional development of a person, as a link of interaction with specialists of inclusive education, specialists of the psychological-medical-pedagogical commission, employers	90%
4	university teachers and their assistants	to make basic assessments of individual observation of the process of socialization of a person with special needs, as well as to record the correctional development of the individual	90%
5	teachers of educational institutions	to make additional assessments of individual observation of the process of socialization of a person with special needs	81%
6	employers, specialists of employment centers	to analyze the training trajectory of a person through the generated training reports	78%

Note: based on the expert survey; \* – percentage of expert mentions

Table 5

Participants in the process of inclusive education and their purpose for using the information technology support system for such training

According to the experts, additional advantages of using information technology to support student-centered inclusive learning include the ability to improve the efficiency of the educational process, quickly adapt to changing conditions, optimize information collection channels, automate the control of learning outcomes, analyze educational results, automate and improve the planning of the educational process.

## Discussion

According to the experts, a wide range of modern digital technologies and information resources allows:

- to receive methodical assistance on issues of inclusive education,
- to read the news of inclusive education,
- to use special software designed to facilitate the work of teachers and methodologists during the planning and forming of individual educational goals,
- to support the system of assessment of knowledge of students with special educational needs,
- to develop a "personal communication passport",

- to form "education-health care" plans,
- to use teaching aids for inclusive education,
- to apply training programs for certain disciplines, problem-oriented development,
- to improve knowledge and skills in working with young persons with various special educational needs, etc.

At the same time, one of the effective tools for solving the problem of mass formation of individual training routes for persons with special needs, according to the experts, is the use of specialized software-algorithmic and information technology modules of learning management systems.

According to one of the experts, "the introduction and implementation of the modern educational trend, which is inclusive education, will be facilitated by the availability of a tool that would make it possible to individually plan the educational route of a person taking into account their psychophysical characteristics, talents, opportunities, needs and previously acquired qualifications".

According to the experts, the individual educational student-centered training route for persons with special needs covers an interconnected set of individual curricula (preschool, school, university, additional, transitional, etc.) and an individual educational trajectory that reflects and characterizes the process of accumulation of results of individual curricula.

The experts formulated the main conceptual provisions of the individual educational route for persons with special needs;

- individual educational route is associated with the acquisition of knowledge in a broad sense – the acquisition of academic knowledge in the course of training in mass educational institutions and universities and non-academic knowledge that does not have a direct relationship to them;
- individual educational route involves a gradual increase in the independent work of a person with special needs – from the joint development of the initial plan with the teacher to the gradual reduction of the role of the teacher due to the growth of the individual potential of the student. In the case of inclusive education, the family of a person with special needs, specialists of psychological-medical-pedagogical commissions and correctional medicine also participate in the development of the plan;
- personal development planning is provided during the course of training, which includes self-analysis, keeping personal records, planning and tracking one's progress in achieving one's goals;
- the system of individual assessment of educational progress is formed to create conditions for monitoring the dynamics and level of learning. The accumulated learning results form an individual learning trajectory, the analysis of which is a requirement for the formation of the next iteration of training;
- the formation of an individual educational route for people who study inclusively, allows one to exercise the ability to submit data on the progress of their learning process and its results to interested parties – teachers, employees of the educational institution, employers, specialists of the psychological-medical-pedagogical commission, parents.

During the discussion, the experts paid special attention to the individual transition plan, which, in their opinion, should be used to regulate the transition of a person with special needs from one curriculum to another, for example, in the case of a transition from



school to university. Transition plan, in particular, makes it possible to increase the chances of a person with special needs to obtain a higher education and (or) receive a permanent job, combine the interests, desires, motivation, experience, skills and capabilities with the requirements of the university or the profession, working environment, as well as increase autonomy and confidence in one's capabilities.

The transition of a person with special needs from school to higher education or work should be accompanied not only by their family but also by school teachers, university teachers and employers. Among the key factors that characterize this transition, the experts named:

- the need for effective legal support for such a process;
- establishing effective cooperation between all its participants;
- systematic maintenance and active establishment of new links with organizations and institutions working with persons with special needs;
- getting up-to-date information about the needs and requirements of employers;
- involvement of partners in the process – universities, employers, educational and social institutions;
- development of a plan for the transition from school to future employment, its coordination with the individual curriculum;
- positioning a person with special needs as the center of individual curriculum development and individual transition plan;
- increasing the individual's independence in managing their educational route.

In general, according to the experts, the use of the latest information technologies in student-centered training is a requirement of today. Modern educational trends put the student's personality at the center of the educational process. Individualized training allows a person to more effectively acquire competence through a dynamic combination of knowledge, understanding, skills and abilities.

## Conclusions

The concept of inclusive education is an effective tool for the development of society. The analysis of the features of this concept allowed us to identify important characteristics of the process, taking into account the specifics of teaching persons with special educational needs. To design an individual educational route for inclusive education, it is necessary to use appropriate information and communication tools that make communication and training of persons with special needs more effective.

The results of the study of information technology support for student-centered learning showed the uniqueness of such support for learning for persons with special educational needs. In addition to persons with special educational needs, teachers of inclusive education and their assistants, specialists of correctional medicine, specialists of psychological-medical-pedagogical commissions, families of persons with special educational needs, employers, specialists of employment centers are interested in applying the conceptual foundations of information-technological support of inclusive education.

Understanding the information technology support of student-centered training of persons with special needs as a recommender system allowed us to highlight the features of its formation and describe its structural and functional characteristics.

In general, the results of the study confirmed the hypothesis that the design of an individual educational route of inclusive education requires the use of appropriate information and communication tools that make communication and training of persons with special needs more effective.

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