Published in the Slovak Republic
European Journal of Contemporary Education
E-ISSN 2305-6746
2020, 9(3): 603-620
DOI: 10.13187/ejced.2020.3.603
www.ejournal1.com




# Professional Self-Determination Support for Students in the Digital Educational Space

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**Abstract**

The problem that the study is aimed at is due to the need to change forms and methods of professional self-determination support for students in the digital society in order to prepare them for obtaining the specialization that is in demand and for the formation of the ability “to be able to learn" throughout the life.

The purpose of the study is to theoretically justify and experimentally verify the effectiveness of the use of digital technologies for professional self-determination support for students in the modern educational space.

The research methodology consists of the theoretical analysis of foreign and domestic approaches to career guidance, the comparison of digital resources for navigating professions of the future, the differential diagnostic questionnaire, additional questionnaires, methods of mathematical statistics, and the student self-assessment method. The pedagogical experiment was carried out in two directions: the qualitative assessment of changes in students' professional preferences and the analysis of the results of career guidance activities supported by digital technologies, regarding the development of personal qualities in demand.

The results of the study. The necessity of taking into account the organization of career guidance activities in two directions is justified: informing students about the professions in demand, the needs and priorities of the digital society, as well as the formation of the competence of professional self-determination. The potential of digital technologies for each of the selected areas is described. The authors developed the virtual assistant model to implement the identified

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didactic possibilities. The system of work with the virtual assistant is presented for professional self-determination support for students and for building the personal development path.

In conclusion the summary is given, confirming that the use of the virtual assistant in career guidance in the digital school will increase the effectiveness of preparing students for the conscious choice of the future profession in demand, the formation of cognitive abilities that form the basis of the ability "to be able to learn".

**Keywords:** digital technologies, career guidance, career path, intellectual qualities, professional competence, educational space, virtual assistant, challenges of the future.

## 1. Introduction

### 1.1. Relevance of the problem

Modern society has entered a new era – the era of transformation, which implies the creation of the digital space that adapts to information and social technologies, the requirements of customer-focusedness and competitiveness, and the challenges of the economy of the future. The "Strategy for the development of the information technology industry in the Russian Federation for 2014–2020 and for the long term to 2025" (Strategiya razvitiya..., 2017) defines the directions of development of the digital economy taking into account global trends in globalization and automation. To implement these areas in practice key demanded universal competences for each economic sector were specified in the Atlas of new professions (Nadprofessional'nye navyki). In particular, it is indicated that in the society, under the influence of digital transformation, there will be a reduction in professions where the person is required to perform routine monotonous work (sorter, storekeeper, accountant, seller) (Gurtov, Hoteeva, 2018). The greatest demand among employers will be specialists who can independently master related sectors, perform various functions in teamwork, and forecast decision-making in conditions of uncertainty (Ganseuer et al., 2015). All of these characteristics form the basis of the individual's intellectual competence. The training of "new" specialists who have appropriate qualities requires the digital educational space at all levels from pre-school education to courses of advanced studies for the introduction of innovative teaching ideas.

At present most domestic and foreign researchers point out the discrepancy between the requirements of employers, the demands of the state and business with the real competences of graduates (Varshavskaya, Kotyrlo, 2019). Motivational, psychological, socio-economic, and technical factors are noted as the reasons for this (Zhurkina et al., 2016). However, the leading role of the teacher who support the student's professional self-determination is recognized unchanged (Sidelnikova, 2018).

The teacher in the modern educational space should become a curator who will help develop the individual path of professional development, will orient students in accordance with their chosen priorities (Soboleva et al., 2018). Support for students to choose the future profession in demand in accordance with their abilities and capabilities, and, therefore, support for the formation of intellectual competence, largely depends on the quality of timely information, on cognitive experience.

To increase the effectiveness of professional orientation and designing the career path, modern digital technologies can and should be used. However, their potential in the educational environment is used primarily to inform students about professions, vacancies, and opportunities to continue education (Atlas of the professions of the future; HeadHunter). In some cases, a digital resource is used for diagnostics (Navigatum), testing, questionnaires (Testometrika). At the same time, the functionality of digital technologies also has tools that allow forming competences of professional self-determination, mastering the methods of mental activity, and developing general intellectual skills (Kholodnaya, Gelfman, 2016).

### 1.2. Aims and objectives of the research

The aim of the research is due to the need to change the forms of professional self-determination support for students in the context of new requirements of the digital society and the capabilities of modern software tools to prepare them not only for profession in demand, but also for the development of the ability "to be able to learn" throughout the life.

The objectives of the research:

– to justify the need for changes of forms and methods of career guidance taking into account the priorities of the digital economy;

– to investigate the innovative experience of specialists who are competent in the field of designing the personal career path;

– to formulate ideas that determine the functionality of the digital resource to support the formation of the competence of professional self-determination, mastering methods of mental processes, general intellectual skills;

– to implement functionality on the example of the specific virtual assistant;

– to experimentally verify the effectiveness of the proposed changes in two directions: to assess changes in professional preferences and the formation of the competence of professional self-determination, taking into account the intellectual capabilities of the individual.

## 2. Relevance

### 2.1. Literature review

#### 2.1.1. Analysis of Russian scientific and pedagogical literature

Fundamental scientific works devoted to the study of the peculiarities of career guidance in Russia and the innovative experience of teachers were analyzed to confirm the need for changing the orientation of career guidance in the educational space and the need to include digital resources in the design of the future career path of the individual.

It should be noted that numerous studies are being carried out with the aim of clarifying such concepts as “professional orientation”, “professional self-determination”, “professional preferences”, “professions of the future”, “over-professional competences”, and “personal career path”. Let us single out the works of N.S. Pryazhnikov (Pryazhnikov, 2008), O.A. Kolesnikova, A.M. Doneckij (Kolesnikova, Doneckij, 2016), A.Ya. Zhurkina, E.G. Sergushina, O.V. Sergushina (Zhurkina et al., 2016), I.G. Dezhina, G.A. Klyucharyov (Dezhina, Klyucharyov, 2018), which summarize various approaches to the organization of career guidance activities, justify the need to improve forms of career guidance for the preparation of graduates that meet the requirements of the labor market in the conditions of priorities of the digital economy. These studies are due to the fact that the professionalization of the individual is an essential part of socialization; it ensures the continuity of generations, the development of the institutions of the family, education, and labor market (Klochkov et al., 2017). According to V.A. Gurtov, E.A. Hoteeva, sustainable professionalism and competence is characterized by the high quality human capital, which determines the development of the country as a (Gurtov, Hoteeva, 2018). The authors substantiate that traditional forms of building the career path are becoming ineffective in the context of new requirements of the market and the digital economy. V.A. Gurtov, E.A. Hoteeva distinguish the following characteristic of modern practice of career guidance as one of the reasons for the imbalance between the requirements of employers and the real competences of students: the choice of the specialty by the individual is most often based on emotional attractiveness and success when studying school subjects. The global digital transformation has had a significant impact on the needs of society, business, and the state regarding professions that will be in demand in the future. In reality, schools and universities prepare graduates without taking into account the trends of long-term planning, globalization and competitiveness. Many of the graduates are generally unaware of the new professions of the digital economy. Significance of the noted work V.A. Gurtov, E.A. Hoteeva is that they suggest using information resources (for example, the portal “My Career”) to support professional self-determination of the student’s personality (Gurtov, Hoteeva, 2018). While on the subject of informing students about the professions of the future, we turn to the conclusions of E. Varshavskaya, E. Kotyrlo. According to experts, most of modern graduates do not have a clear understanding of the content of future professional activities, there is no idea about the development of the career path (Varshavskaya, Kotyrlo, 2019).

Another fundamental research in the problem area was carried out by A.V. Korolenko, O.N. Kalachikova (Korolenko, Kalachikova, 2016). The scientists conducted a detailed analysis of the formation of professional preferences among teenage schoolchildren and its impact on the timely mastering of social roles in the digital society. A.V. Korolenko, O.N. Kalachikova noted that "the key problem is the lack of knowledge of the basic requirements for the profession, their own

psychophysiological capabilities, as well as the inability to compare their preferences with real abilities."

Their findings are confirmed by the results of diagnostic surveys, questionnaires, and focus group studies. An important result of the work is that the peculiarities of building students' educational paths (motives, awareness, abilities, self-esteem, preferences) are analyzed. A separate aspect highlights students' understanding of their qualities and skills that will help in mastering their chosen profession, and be competitive in the labor market. The theme of competitiveness as an important condition for preparing students for career planning is continued by G.F. Shafranov-Kucev, L.V. Gulyaeva (Shafranov-Kucev, Gulyaeva, 2019). The most significant for the study is the conclusion of scientists that "the ability to reproduce knowledge when implementing future activities, readiness for constant self-development, and orientation toward the search for new ways to solve problems" should determine the directions of professional self-determination support for the individual. The authors also examine the factors that determine students' choice of future specialization (inclinations, interests, life values, prospects, initiative, sociability). Summarizing the results obtained by G.F. Shafranov-Kucev, L.V. Gulyaeva, it should be emphasized that they actively use the term "competence of professional self-determination", taking into account the intellectual capabilities and educational interests of the personality of the student. This competence can and should be fromed in the modern educational space (Shafranov-Kucev, Gulyaeva, 2019).

More practical problems are solved in the study of I.V. Ivanova, N.G. Ivanov (Ivanova, Ivanov, 2019). The authors proposed a model for interaction of educational organizations at various levels of education and enterprises of the new industry. The described model can be considered as an option to create favorable conditions for the vocational guidance of high school students. The informational, technical, methodological, psychological components of interaction are presented. A significant result of the work is that I.V. Ivanova, N.G. Ivanov (Ivanova, Ivanov, 2019) note the need to support the development of analytical thinking in terms of designing the career path and responsible attitude when choosing the profession.

M.M. Albogachieva, E.V. Ozdoeva identify the peculiarities of support for career guidance at school using the example of specialized training for high school students (Albogachieva, Ozdoeva, 2018). The authors, exploring the pedagogical phenomenon of "specialized training", substantiate that professional self-determination is supported by various forms and methods of preparation. As an important result of the work we highlight the idea that the key to high-quality and effective career guidance is full and timely informing students about new and popular professions. When building the career path, the student's interest in the profession and the ratio of professional preferences and market requirements are transformed.

The methodological approach to the organization of career guidance is presented by A.V. Brehova, M.A. Golubeva (Brehova, Golubeva, 2017). On the example of technology classes the authors describe the system of work with parents, individual consultations with students on the choice of the profession and career planning.

As the analysis showed, only some of the researchers (Gurtov, Hoteeva, 2018) suggest using the potential of information technologies to support students' professional self-determination. At the same time, there is a wide range of scientific works where it is proved that the inclusion of digital services in the cognitive process contributes to the solution of educational and career-oriented tasks (Shulgina et al., 2018), supports the development of mental processes: thinking, memory, attention and imagination (Kholodnaya, Gelfman, 2016).

Moreover, I. Makarova, K. Shubenkova, D. Antov, A. (Makarova et al., 2019), when studying the digitalization of all areas of the activity, global problems in the economy and education, prove that information technology is becoming an integral part of the human life. Scientists justify that "a universal approach to smart education is needed." The education system should ensure high-quality training of engineers who are necessary for business and society. The capabilities supported by computer modeling, simulators, alternate and virtual reality should be used to achieve this goal. The development of this idea was carried out in the work of E.V. Soboleva, A.N. Sokolova, M.L. Votinceva (Soboleva et al., 2018), when the authors designed cognitive activities of students using problem-solving environment with nonlinear representation of information. Students go through a text labyrinth solving training tasks, at the exit of which they receive recommendations regarding the choice of the profession for the future. It is clear that to perform these activities teachers need to be taught . The peculiarities of preparing teachers to use digital technologies in the

didactic process were studied in the work of E.V. Soboleva, M.V. Perevozchikova (Soboleva, Perevozchikova, 2019).

Thus, the analysis allows us to objectively conclude that career guidance should be carried out in two directions: navigation of students in popular professions of the future and the formation of the competence of professional self-determination. The potential of digital technologies to support each of these areas is not enough used.

**2.1.2. Analysis of foreign researches**

As an initial conclusion we note that the concept "career guidance" is not used in foreign studies. The terms "career planning" and "career development" should be considered its analogues.

A wide range of works is devoted to identifying psychological aspects of career management (Lee et al., 2016), other scientists pay more attention to the socio-economic factors of professional self-determination (Noga, 2016). In all modern approaches the role of digital technology for the design of the career path is highlighted, it is especially important for our study. In particular, L. Ilomäki, M. Lakkala study the impact of digital media on improving the quality of the education system regarding the formation of competences which will be in demand in the future (Ilomäki, Lakkala, 2018). The authors note that the capabilities of information technology are still not used effectively (more often to solve one or two educational problems). As a result, graduates do not have sufficient experience in conducting independent research activities, in organizing collaborative work, in planning the individual learning path. L. Ilomäki, M. Lakkala introduce the term "digital competence", which is the backbone for the innovative model of the school community.

Both foreign and domestic researchers describe in detail the factors and conditions that affect professional self-determination and career path design: parental expectations, cultural norms, personal interests and needs, success in studying school subjects (Davies et al., 2014). The study by B. Lee, E. J. Porfeli, A. Hirschi showed that special attention should be paid to the motivational processes underlying career path building (Lee et al., 2016).

Approaches that reflect the importance of early professional self-determination are developed in the scientific community abroad (teWierik et al., 2015). Issues of the impact of university studies on professional adaptation and career are also of interest (Noga, 2016). H. Noga's study was conducted among graduates after their graduation. During the survey, answers regarding questions of the motives for choosing the specialization, the practical application of the gained knowledge, the impact of training on professional status and career growth were received. It is interesting to conclude that many of the respondents noted the positive impact of university studies on both personal life and professional self-determination (Noga, 2016).

N. Galliott, L. J. Graham, note that one of the directions of Australian public policy is to reduce unemployment by improving the quality of career guidance at school (Galliott, Graham, 2017). Scientists analyze the findings of other researchers regarding the impact of the well-being of young people (social status, material wealth of the family) on their career aspirations, professional guidelines. N. Galliott, L. J. Graham, do not agree with these conclusions and prove that the possibility of network communication and obtaining information about professions has a greater influence on the choice of the profession. However, this is not always fair. The authors give examples of various government Internet resources focused on supporting professional self-determination (Galliott, Graham, 2017). And at the same time, they noted that the unemployment rate continues to grow. As a possible reason, the presence of a large number of young people who do not have a clear idea of their preferences is indicated. Such uncertainty may be due to psychological characteristics (low self-esteem, increased anxiety, and perfectionism), educational experience, and the influence of parents. But, of course, one should take into account the influence of timely and relevant informing students on career path building: where to go, what professions exist and what requirements employers have. This position was examined in more detail by N. Galliott when she analyzes and summarizes the practice of including online resources for professional self-determination (Galliot, 2017). The author notes that digital technologies save time resources; they are quite convenient and easy to use. However, the real value of such portals in practice is significantly reduced for the following reasons: students do not know about them; information about professions is contradictory or incomplete.

Continuing on the problem of awareness, we turn to the work of J.P. Sampson, J.P. Makela (Sampson, Makela, 2014). The authors describe the ethical problems of including digital resources

(web portals, social networks, mobile services) in professional self-determination support. These problems are divided into three groups: social justice, resources and services. For example, uneven access to the computer network, unequal material opportunities for acquiring high-tech devices, differences in levels of digital competence. As a result, there is social injustice in supporting career path planning for various social groups.

Some works indicate the importance of developing special software tools to support learning. For example, G.V. Fabic, A. Mitrovic, K. Neshatian offer to support the acquisition of new knowledge, independent research activities by the virtual assistant written in Python (Fabic et al., 2017). The authors argue that inclusion of mobile applications-tutors will increase effectiveness of training.

T. Terzidou, T. Tsiatsos, H. Apostolidis describe a model of interaction in 3D virtual learning environments in order to support online educational activities деятельности (Terzidou et al., 2018). The authors argue that inclusion of intelligent systems increases effectiveness of innovative teaching methods. In the proposed three-dimensional multi-user virtual environment users explore the worlds, communicate with other participants, organize online meetings or even use them as a learning space.

M.R. Ali, E. Hoque (Ali, Hoque, 2017) organize social skills training with the support of the virtual assistant. The authors start from the position that non-verbal signals are an important component of social communication, and develop the virtual assistant as a means of receiving emotional (smile, look, body language) feedback in real time. The application is accessible through a browser.

S. Carlos, D. Peña, F. Gómez-Estern (Carlos et al., 2015) suggest using the virtual assistant to individualize learning and generate exercises. The advantage of the tool is that its use does not require the teacher or students to have special programming skills and databases. The application automatically collects, stores and classifies tasks.

Due to the fact that the professional self-determination support for students is a priority of the modern educational space, there is an objective need to realize the didactic potential of digital resources for building individual career paths.

## 3. Materials and methods

### 3.1. Theoretical and empirical methods

When choosing forms of organizing career guidance in the educational space, we used general scientific methods of analysis and comparison, based on the results of which the necessary conceptual apparatus was drawn up: the competence of professional self-determination, personal career paths, and the virtual assistant.

The decision to develop a software tool for professional self-determination support was preceded by the analysis of existing profession navigators, open information resources. To improve the quality of career guidance in the digital school using the Java language, the virtual assistant that reflects the author's approach to the research problem was implemented.

The research methodology is supplemented by E.A. Klimov's questionnaire, used when identifying the professional orientation of the student personality (Klimov's differential diagnostic questionnaire). To assess the level of awareness of students, an additional questionnaire was developed and conducted. The content of the virtual assistant was based on the results of M.A. Holodnaya's research on the nature of cognitive styles (Holodnaya, 1992).

When studying the practice of including information resources in career guidance activities, praximetric methods were used, which involved assessing the results of students' cognitive activities in the virtual environment.

A special group consists of empirical methods (observation, analysis of the results of working with the digital assistant) and the method of student self-assessment to obtain relevant information about changes in students' professional preferences, development of general intellectual qualities of the person.

The statistical analysis of the reliability of the results of the pedagogical experiment was evaluated on the basis of processing the obtained data according to the Pearson's chi-square test (Ostapenko, 2010).

### 3.2. The research base

Assessment of effectiveness of professional self-determination support for students in the digital educational space was carried out during the pedagogical experiment. The experiment involved 109 high school students of Kirov who in-depth study individual subjects. To fulfill the rules of probabilistic selection, the same mentor conducted career guidance activities throughout the experiment. The experiment was conducted in the specially equipped computer science classes, on the same software. To assess the input conditions, questionnaire materials, atlas of new professions were used. All questions and tasks were developed by the authors in accordance with the requirements of state federal educational standards.

### 3.3. Stages of research

The study was carried out in three stages.

At the first stage the state of topical problems of the organization of career guidance in the modern educational space is investigated. For this, the analysis of the scientific literature, the study and comparison of innovative experience of specialists competent in the field of building the personal career path in order to identify the necessary changes are carried out. At the same stage, Klimov's differential diagnostic questionnaire were used, the questionnaire to identify the level of awareness, and testing (10 tasks, each rated at 2 points). Further, students were divided into groups (experimental – 55 students, control – 54 students), so that it was guaranteed that the same professional preferences and their equal distribution were present in each group. Characterizing the sample, it should be noted that in the experimental group there are 69 % of girls and 31 % of boys.

The second stage is devoted to determining the directions for improving the forms of professional self-determination support for students in the context of new requirements of the digital society and the capabilities of modern software tools. The need for development of the digital tool that provides information about professions of the future and contributes to building the personal career path is found out. Functionality of the digital resource to support the formation of the professional self-determination competence, mastery of methods of the mental activity, and general intellectual skills are determined at this stage.

The third stage of the study covers the experienced teaching and improvement of virtual support. The work is accompanied by constant monitoring of changes in professional preferences, the formation of intellectual qualities of the person. After each new address to the virtual assistant the results are stored in a database for subsequent analysis. Discussion of the results of the study takes place in the form of publications in journals and reports at conferences at various levels.

## 4. Results and discussion

### 4.1. Clarification of the essence of the basic concepts

The authors propose the following approach to the disclosure of the essence of professional self-determination: it is the central aspect of personal development (awareness of needs, interests, motives, opportunities, abilities and limitations). The personal career path is considered to be a professional educational program that supports the implementation of the training standard and provides the possibility for the individual with the help of a tutor/teacher/mentor to build his/her own professional development path. Then the formation of the competence of professional self-determination provides the opportunity to build the professional path, starting with the choice of the future profession, taking responsibility for the choice made and subsequent results. The basis of this competence is the ability to learn, to develop throughout the life.

In this research the virtual digital assistant is understood as a service and/or application for smartphones and personal computers that takes on the functions of determining cognitive, intellectual styles and styles of cognitive attitude to the world. The analysis of digital resources that support navigation in popular professions (HeadHunter; Navigatum; Uchoba) allows us to conclude that most of the resources take into account E.A. Klimov's methods, they contain questions in the sort of "choose option", they are guided by the current labor market. In most cases (for example, Testometrika), the resource determines professional inclinations at a particular point in time without saving and analyzing the results. The navigator suggested by Higher School of Economics occupies a special niche, but it is paid, which limits students in its active use (Atlas of the professions of the future).

The presented virtual assistant is different from others in the field of analysis of the effects of scientific, technical and innovation policy in that for the first time the capabilities of modern digital

technologies have been applied to visualize the cognitive processes in order to support students in choosing the most appropriate for their future needs and individual characteristics the future profession in demand. The model saves previous test results and realigns the professional development path.

To identify the essence of the necessary psychological phenomena, the works of domestic and foreign scientists on the research issues were analyzed: M.A. Holodnaya (Holodnaya, 1992), S. Papert (Papert, 1993), O.A. Khalifaeva (Khalifaeva, 2018) and etc.

As important conclusions, allowing emphasizing the value of the presented virtual assistant, we note:

1. Traditionally defining the formation of skills as the main aim of training, one should think about the quality of acquired knowledge. In the future, knowledge in general will not be claimed, but knowledge that contributes both to the explanation of the phenomena of the surrounding reality and to effective action in various situations. In fact, we are talking about intellectual competence, which involves a special type of organization of knowledge that provides the ability to make effective decisions.

2. In order to support the formation of intellectual competence in practice, the composition and structure of mental experience (intelligence), the relationships and interactions between its components should be determined: cognitive experience, metacognitive experience, intentional experience.

3. The personal cognitive style as an individually-unique way of studying reality is formed on the basis of cognitive, intellectual styles and styles of cognitive attitude to the world.

The information model is based on classifications and criteria formulated by M.A. Holodnaya: field dependence/field independence; narrowness/breadth of the range of equivalence and other (Holodnaya, 1992).

### 4.2. Digital professional self-determination support for students and building the individual career path

To determine the effective conditions for professional self-determination support for students in the modern educational space, new digital technologies should be used more actively. The programming language Java was chosen as a development technology, as it has been taking the first place in the TIOBE international index for a long time. In addition, it is object-oriented, cross-platform, and has a large number of libraries. To implement the virtual assistant interface we used the JavaFX tool, which is a powerful toolkit for creating cross-platform graphical applications on the Java platform. This tool allows developing applications in accordance with the MVC design pattern. What is important for visualization is that the work with JavaFX allows to develop an interface using CSS (i.e., similar to the interface of web pages).

The following models were introduced to achieve the aim of the study: Task (for example, for the test “Included Figures”), Question (for example, for the test “Average Judgment”). An example of the interface and tasks is presented in Fig. 1. The graphical interface is described in the fxml file. The logic of work with each Scene is realized in the corresponding controller. For background sound, the standard JavaFX libraries – javafx.scene.media.AudioClip are used.

Let us reveal the informative content of the virtual assistant in accordance with the personality qualities that form the basis of the ability "to be able to learn".

1. The breadth of mental horizons (as opposed to "encapsulated consciousness"). The formation of this quality is closely related to the worldview aspect. It is important to learn to see the common in heterogeneous. The research of information processes and work with digital resources provide good opportunities for it. As examples we can consider the following: the unity of control processes in systems of various natures; the ability to use the same data structure to describe seemingly different objects; the same patterns according to which logical expressions are built; character sequences are processed. The virtual assistant provides tasks where the same question is given to be solved by mental calculation and for calculation in spreadsheets and for writing in a programming language (block diagram). Here is another example of the formation of this quality of the mind: to develop the ability to see phenomena from an unexpected perspective. In the virtual environment, users are faced with the situation of using negative digits in the alphabet of the number system; representing 4,00 as a real, not as a whole.

2. Flexibility and multivariance of assessment of what is happening (as opposed to “black-and-white” consciousness). This quality is actively developed in the course of project and

collaborative activities, when working in conditions of uncertainty. This is due to the fact that readiness to search for new solutions suitable for different situations, to exchange ideas with other students and the teacher, to perceive “someone else's” decision is formed. Attitude to errors as a natural stage in the process of cognition is important, and, therefore, readiness for their search and correction. For example, there is a solution to a task that works on a specific set of input data. However, for other values it is erroneous. The error can be due to the logic of the initial solution, due to unaccounted conditions. The computer itself acts as a kind of upbringing. It’s useless to argue with it – the system does not work. The virtual assistant also uses tasks for several interpretations of the same concept, for example, information, culture, system, democracy.

3. Readiness to unusual, conflicting information (as opposed to dogmatism). Since the computer processes data according to the laws of formal logic, the results of its operation under certain conditions may contradict our usual ideas. The virtual assistant implements situations when the result of adding a positive number can be a negative number. The experience of overcoming such difficulties teaches us not only to find a reasonable explanation for unusual, at first glance, phenomena, but also to find ways to apply them. The developed digital resource also contains tasks for comparing phrases recorded in natural and formal (i.e., computer-oriented) languages. For example, there is a task written in natural and formal languages. To match the solution and the task. To find a mistake.

For many users it is a significant difficulty to abandon the usual means of expressing thoughts, words and phrases, the meaning of which seems to them indisputable. For example, a list of students born in 1990 AND 1991 is required. The request (filter condition in the information system) is: Year of birth is 1990 OR year of birth is 1991.

Another example: “Double the value of variable A”. In the formal language, the entry is as follows: A: = 2 * A (not 2 * A).

4. The ability to comprehend what is happening simultaneously from the perspective of the past (causes) and in terms of the future (consequences) (as opposed to the tendency to think in terms of "here and now"). When building information models, the ability to foresee all possibilities, anticipate the consequences of decisions made, and predict how the system works in various situations plays a crucial role. The virtual assistant provides tasks for testing the finished model, data selection, modeling of possible user behavior. Didactic and heuristic tasks involving interdisciplinarity are also used.

The example. Assess if the statement is true or false:

a) if oil spills in the ocean, many animals will die. We see a large number of dead pelagians, which means they died due to the oil spill in the ocean;

b) a rainbow appears in the sky after rain. Now you can see a rainbow in the sky, so, it has recently rained.

5. Focus on identifying essential, objectively significant aspects of what is happening (as opposed to the subjective, egocentric cognitive position "I do not need this"). This cognitive conflict can be observed in the students' attitude to fundamental concepts, laws and principles. Especially when the teacher does not pay attention to the motivation to develop and identify the relationship between fundamental and applied knowledge. For example, if the topic is difficult to understand and has no obvious practical usage. Indeed, why know the computer organization and the history of the development of computer technology if this is not required for sending mail and working in office programs. Many laboratory classes come down to practice according to instructions, which describe the sequence of actions without specifying their theoretical meaning in detail. This work is simple and understandable for participants of the didactic process. This shortsightedness is demonstrated not only by students and parents, but also by the teachers themselves. But practical benefits are few. The device interface, control techniques are mastered, but the problem cannot be solved. We need to use fundamental scientific theory, i.e. knowledge should be the starting point in the path of developing the new. The theory independently obtained in the process of solving tasks and overcoming difficulties is remembered for a long time.

In the digital school, educators are tempted to study vivid facts, new tools, and technologies. But it is important to maintain a balance, giving priority to the fundamental, and constantly motivate, explain, prove the correctness of this approach. In the virtual assistant, it is taken into account when developing concepts, a sequence of actions. For example, to match the term and the

concept; to restore the sequence of actions in the algorithm of a segment division in half, to solve a quadratic equation.

Another example. An atelier has an order for sewing a raincoat. One of the steps in solving this task is to create a sketch of the raincoat. Choose the properties of the modeling object that are significant for the specified purpose (creating a sketch of the raincoat): the price of the fabric for the raincoat, the length of the raincoat, the model of the sewing machine, the fabric needed to sew the raincoat, the shape of the sleeves of the raincoat, and if a hood is needed.

6. The tendency to think in probability categories "as if" (as opposed to ignoring impossible events). Students will encounter these events in the future. In the virtual assistant, this skill is formed and tested through the evaluation of unusual facts. For example, the square root of four in the calculation will not be equal to two. Or, "what are the consequences of acid rain: will fish reproduction be better; will chemical properties composition of soil and water change; will harmful bacteria die; will the number of water reservoirs increase"?

Another example: "In 1626, the Indians sold Manhattan Island for $ 20. If this money was placed in a bank and the annual increase was n percent, then what was the capital in 2019?"

7. The ability to mentally see a single phenomenon in the context of its holistic relationships with many other phenomena (as opposed to a single-line view of the world). One and the same concept can be used in various fields and without essential changes have a special semantic connotation in each of them. For example, the concept "file". A file is considered both as a structural unit of information organization when it is stored on an external storage medium, and as a named area of an external storage medium, and as an object of operating system processing.

Another example: choose from the list only those elements that will be presented as independent objects in the information model of the information system for recording orders at the hairdresser's: the hairdresser, the client, the service, `equipment, acquaintance of the client with the list of services, the client's choice of the service, the client's choice of the hairdresser, the client's hair appointment.

Thus, the model has cognitive styles. In particular, the characteristics of information processing styles are taken into account (see Fig. 1): in the form of signs (numbers, scale); in the form of visual images (infographics); in the form of objective actions (clicking, dragging and dropping); in the form of sense-emotional impressions (with predominance of the auditory or emotional component).

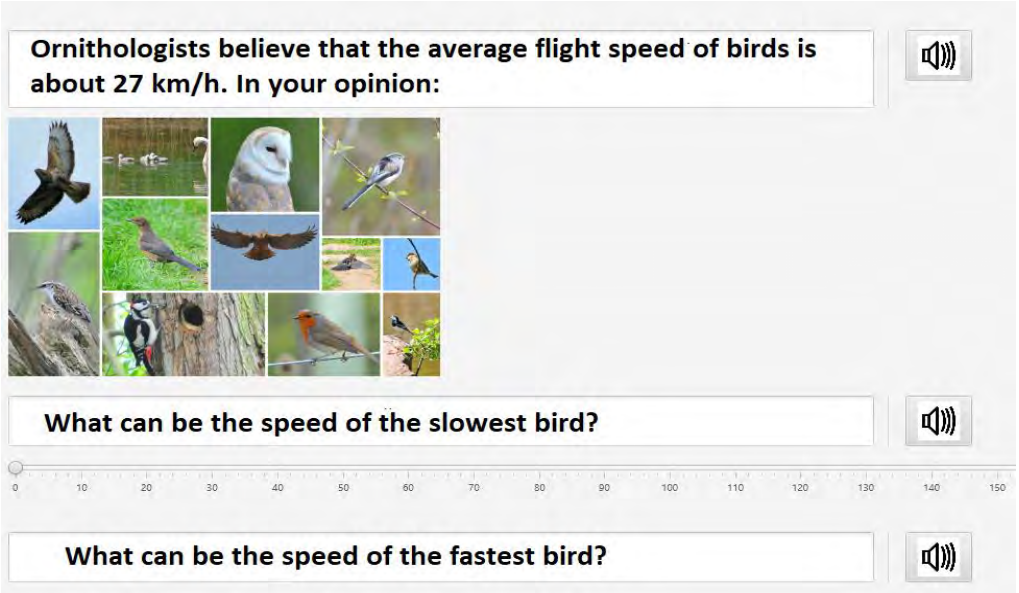


**Fig. 1.** Example of the method

Based on the results of the tasks (intellectual styles, styles of cognitive attitude to the world are assessed), the virtual assistant formulates recommendations for choosing the professions of the

future. For example, that the future profession should involve creative activities, the search for new solutions, or vice versa, involves reproducing and a strictly defined algorithm.

Let us describe the work of the virtual assistant using the example of choosing the profession of the future for a particular student. The following are the results of the pedagogical experiment for the young man who used the service for career guidance. The initial interests of the young man were in medicine, biology. Out of other psychophysical features, we note a tendency to artistry, sociability, mobility. The young man did not experience problems of social adaptation; his parents supported his every initiative.

The results of the method "Focusing – scanning control": regarding the features of concentration and distribution of attention in perceiving what is happening, your cognitive style is the style of scanning control. The characteristic of your style: you readily focus on the important, essential element of the perceived situation, and you can mentally cover all other aspects of the situation. You quickly distribute attention to many aspects of the problem and emphasize the objective details. You are able to control your affective states in the acts of cognition and decision making. When sorting emotionally significant and neutral material, you can record a greater number of objective details in the problem and take into account your emotional impressions to a lesser extent. You can perceive a large amount of information at once, but it is difficult for you to concentrate on one thing in the presence of several objects. If a detailed study is required, then you need to be presented the material partially.

According to the results of the method "Impulsivity – Reflectivity", your cognitive style is reflective. Characteristic of your style. You are inclined to put forward various hypotheses not out loud and test them, and only then give an answer. You need to be given more time to make a decision, not to be required an instant response. But you make mistakes less often than people with the impulsive style. To make decisions, before answering, you collect more information about the incentive, you use more productive methods for solving problems, and more successfully apply activity strategies acquired in the learning process under new conditions. People with your cognitive style tend to be less sensitive to rewards (rewards for the correct answers). When studying the exact sciences, people with the reflexive style do better in tasks under low control conditions compared to impulsive ones, who are more effective under high control. Reflective people are more field-independent than impulsive. They have higher stability of attention (and its concentration), they use feedback more efficiently, have better visual and aural short-term memory. You are characterized by reliance on the number of elements (features), i.e. analyticity at the level of perception, and greater verbal intelligence.

According to the results of the method "Field dependence/field independence", you have a field dependent cognitive style. Characteristic of your style: field-dependent people rely on the help and support of others. It is much easier for them to answer questions when they hear approving assessments of their answers. They prefer collective forms of activities; in the presence of other people they improve their performance. Such people are much more interpersonal-oriented, they can receive much more information in the process of communicating with others, they engage in conflicts less, tend to change their views in accordance with the position of authorities. On the other hand, the ability of field-dependent people to resort to the opinions of others can be perceived as a necessity, the need to search for information in order to use the latter when structuring an uncertain situation, because they can do it themselves weaker. Another object is both a source of information, and a method, and an instrument for its processing. Such people need the presence of all their socially useful qualities.

Representatives of the field-dependent style trust visual impressions more when assessing what is happening and hardly overcome the visible field if it is necessary to detail and structure the situation. Field-dependent people use a globally holistic approach to solve the problem, which involves a lot of work of the right brain.

The list of professions recommended by the virtual assistant (in the order of their ranking according to the analysis criteria): Telemedicine doctor, Genetic consultant, Medical robot designer, Molecular biologist, Developer of medical gadgets.

Thus, a holistic software implementation of the virtual assistant for visualizing and schematizing a difficult choice of the profession is described. We emphasize that the initial purpose of the digital resource is to diagnose the student and determine the input conditions for the learning model. However, during the research, additional significant results were obtained.

The experimental work in the framework of the testing program allowed implementing an educational project that allows its participants to get acquainted with the professions of the future while playing. The virtual assistant can also be considered as a tool, a means of managing the personal path of personality development in the future.

### 4.3. Experimental evaluation

#### 4.3.1. The ascertaining stage of the experiment

At the first stage of the experiment, a survey was conducted among students according to E.A. Klimov's methods to identify the professional orientation of the student's personality (Klimov's differential diagnostic questionnaire). The diagnostic results allowed us to conclude that the largest number of respondents is inclined to the interactions "man-man" (31 %) and "man-technical equipment" (25 %). For other types "man-nature", "man-art", "man-semiotic system" we got 14 %, 12 %, 18 % respectively.

To verify the validity of the experiment results, students were asked on a scale of «one» (do not match) up to «four» (completely match) evaluate their agreement/disagreement with the results obtained. The results of testing before and after the experiment are shown in Table 1. Processing of results is performed in section 4.3.2. (Forming stage of the experiment).

**Table 1.** The results of the test

| Level | Groups | | | |
|---|---|---|---|---|
| | The experimental group (55 pupils) | | The control group (54 pupils) | |
| | Before the experiment | After the experiment | Before the experiment | After the experiment |
| 4 | 9 | 10 | 10 | 9 |
| 3 | 26 | 28 | 20 | 21 |
| 2 | 14 | 11 | 22 | 21 |
| 1 | 6 | 6 | 2 | 3 |

To assess the level of awareness of students, an additional questionnaire was developed and conducted. For example, do you imagine the nature and content of the future profession? The possible answers were the following: «yes, entirely»; «I have an idea that this profession exists»; «I did not think about choosing a profession». The corresponding results are shown on the diagram (see Figure 2). Processing of results is performed in section 4.3.2. (Forming stage of the experiment).

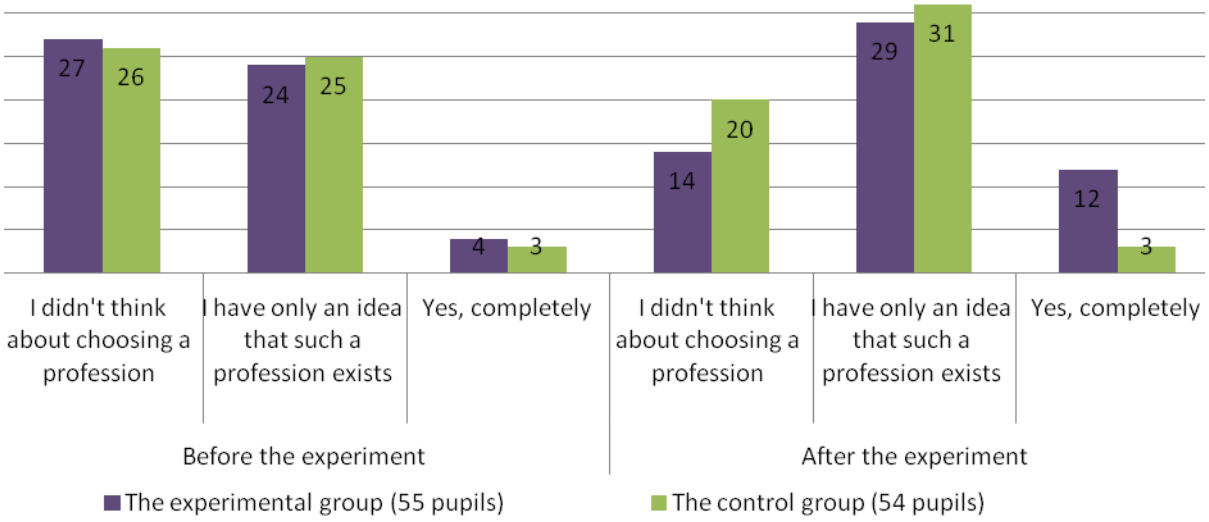


**Fig. 2.** Test results

A list of skills, which were subsequently assessed, was made up and tasks corresponding to this set were developed. Further, the entrance testing was conducted among the participants. Based

on the fact that the assistant is focused on supporting the professional self-determination formation for students and on the development of personality traits that form the basis of the ability to "be able to learn," there were two types of questions in the test. Thus, there were 10 tasks: 5 questions of each type. Two points were given for each question. If the student received more than 17 points, then the skill level was defined as "high"; the range from 9 to 16 (inclusive) corresponded to "average" level, results below 16 corresponded to "low" level. An example of the first type question: indicate competences that are in demand among employers (creativity, critical thinking, ability to quickly count, initiative, flexibility and stress resistance, large amount of knowledge).

An example of the second type question: the steps of constructing an information model are listed and it is necessary to put numbers on the left of the step in order: formalization, model analysis, analysis of the modeling object and highlighting its properties, choosing the form for representing the model, setting the goal of modeling, determining the practical problem, for which the model will be built.

#### 4.3.2. Forming stage of the experiment

Interaction with the virtual assistant was included in career guidance activities with students of the experimental group. For participants in the control group, professional self-determination support was traditional: they had meetings with employers, career-oriented class hours, newsletters about the admission requirements to various educational institutions.

In order to assess the effectiveness of the proposed approach at the end of work with the virtual assistant the students were asked to complete the final task. Questions for self-esteem were proposed to determine changes, the identification of professional preferences. In the process of the final event a series of tasks was also formulated, which involved assessing changes in the formation of the professional self-determination competence and personal traits, which form the basis of the ability to "be able to learn". In testing, when formulating questions, the mentor took into account the difficulties that participants faced when interacting with the virtual assistant. For example, to match employer requirements with universal skills.

Requirements of employers: to be ready to constantly learn something new; to be on a first-name basis with machines and technologies; to be able to do what machines cannot; to think rationally, holistically and systemically; the ability to act in situations of uncertainty; to cope with the increasing complexity of the world; to freely navigate in large flows of information.

Universal skills: emotional intelligence; design thinking, project thinking, system thinking; self-learning, knowledge of languages, cross-functionality; stress resistance, maintaining own psychological and physical health; creativity, enterprise, ability to collaborate with other people; ability to sum up, to choose necessary, analytical skills; technological literacy, programming skills. The results of testing before and after the experiment are shown in Table 2.

**Table 2.** The results of the test

| Level | Groups | | | |
|---|---|---|---|---|
| | The experimental group (55 pupils) | | The control group (54 pupils) | |
| | Before the experiment | After the experiment | Before the experiment | After the experiment |
| High | 3 | 11 | 5 | 6 |
| Average | 8 | 27 | 9 | 16 |
| Low | 44 | 17 | 40 | 32 |

Carrying out the quantitative analysis of the above results, we can conclude that after the experiment was completed 20 % of the students in the experimental group had a high level of skills and abilities, while initially this percentage was 5 %. For 49 % of the respondents in the experimental group, the fixed level is average, while initially this percentage was 15 %. This suggests a qualitative improvement in learning of respondents in the experimental group. At the same time, the level of skills in the control group also increased, but not so significantly: after testing only 11 % of the participants in the control group showed high results (compared with 9 %

before the experiment), 30 % of the respondents remained at the average level (17 % before the experiment) and low (59 %) level.

### 4.3.3. Control stage of the experiment

The statistical analysis of the reliability of the results of the pedagogical experiment was evaluated on the basis of processing the obtained data according to the Pearson's chi-square test. We calculate the value of the statistic of the criterion before ($\chi 2_{obs.1}$) and after ($\chi 2_{obs.2}$) the experiment using the online resource http://medstatistic.ru/calculators/calchit.html. Then we choose the significance value $\alpha$ = 0,05.

To implement the criterion (for Klimov's different diagnostic questionnaire), the following hypotheses were adopted: H0: the level of coincidence of professional aptitudes and interests of students in the experimental group is statistically equal to the level of the control group; H1: the level of matches in the experimental group is higher than in the control group. According to partition tables $\chi^2$ for $\nu$ = 3 and $\alpha$ = 0,05 , the critical value of the statistic is 7.82. Thus, we obtain: $\chi 2_{obs.1} < \chi 2_{crit}$ (4,64 < 7,82), a $\chi 2_{obs.2} > \chi 2_{crit}$ (8,58 > 7,82). According to the decision-making rule, this means that the hypothesis $H_0$ is valid before the experiment, and hypothesis $H_1$ is true after the experiment.

To implement the criterion (for level of awareness about professions), the following hypotheses were adopted: H0: the level of knowledge about professions in the experimental group is statistically equal to the level in the control group; hypothesis H1: the level of knowledge about professions in the experimental group is higher than the level of the control group. In this case c = 3. According to partition tables $\chi^2$, the critical value of the statistic is 5.99. Thus, we obtain: $\chi 2_{obs.1} < \chi 2_{crit}$ (0,21 < 5,99), a $\chi 2_{obs.2} > \chi 2_{crit}$ (6,6 > 5,99). According to the decision-making rule, this means that the hypothesis $H_0$ is valid before the experiment, and hypothesis $H_1$ is true after the experiment.

To implement the criterion (formation of the professional self-determination competence and the general intellectual qualities) the following hypotheses were adopted: H0: the level of formation of skills, abilities and personal qualities of the experimental group is statistically equal to the level of formation of the control group; hypothesis H1: the level of formation of skills, abilities and personal qualities of the experimental group is higher than the level of the control group. Thus, we obtain: $\chi 2_{obs.1} < \chi 2_{crit}$ (0,8 < 5,99), a $\chi 2_{obs.2} > \chi 2_{crit}$ (8,9 > 5,99). According to the decision-making rule, this means that the hypothesis $H_0$ is valid before the experiment, and hypothesis $H_1$ is true after the experiment.

Thus, the experimental assessment confirms the qualitative difference in relation to the formation of the professional self-determination competence and the general intellectual qualities of the person.

The sample was not probabilistic, since the experimental and control groups were formed in such a way that it was guaranteed that each group had the same professional preferences and their distribution. Throughout the experiment, work with the virtual assistant was carried out by the same mentor, on the same software equipment in special computer science classes. Since the initial stage of the experiment took into account the results of a survey of students, previous educational achievements, and the opinions of a team of teachers.

Participants of the experimental group significantly increased the level of skills that form the basis of the useful skill "to be able to learn". Of particular importance for building the personal development path is the fact that the virtual assistant stores the results of previous tests in the database and makes up a set of recommended professions. In addition, the choice is always the student's. The digital resource offers the most suitable options that take into account the qualities of the mind and professional preferences.

The analysis of the cognitive activity of students also allowed us to confirm that the use of the virtual assistant provides additional opportunities for directing the learning process according the needs of education of the future due to interactivity and enhanced feedback, and activation of information interaction.

On the other hand, in the course of the experiment, we had to solve didactic and technical problems: explaining the principles of the virtual assistant to parents, debugging and testing the program for correct diagnostics, low level of language training, high time and labor costs both for students and teachers.

In general, the pedagogical experiment allows us to conclude that the inclusion of the virtual assistant in career guidance activities allows to determine students' professional preferences more accurately, identify competitive personality traits, support professional self-determination and career path planning.

## 5. Conclusion

The results of the study prove that the new challenges and requirements of society, the state, and business on the educational system necessitate the formation of students' competence in professional self-determination, taking into account intellectual capabilities. The main role in career guidance is the role of the teacher. But functionality of digital resources allows to use them not only to inform about the popular professions, but also to build the career path. The practical implementation of the corresponding opportunities in the modern educational space has singular examples, most often it is unsystematic.

The development of the presented virtual assistant to support professional self-determination and career path was preceded by the analytical work: the essence of the phenomena "professional path", "professional self-determination", "intellectual competence", and "styles of cognitive attitude to the world" were studied. A justified choice of methods of psychological and pedagogical tools, in accordance with the capabilities of digital technologies, personality characteristics, taking into account the requirements imposed on specialists of the future, allowed the development of the information model to support the formation of the necessary competence of the student's personality. Pedagogical support is presented by the description of the system of work in the virtual software environment.

The effectiveness of the proposed approach is confirmed by the pedagogical experiment, during which the assessment of changes in the students' professional preferences and in the results of career guidance activities supported by digital technologies was made. Positive changes were recorded in the development of such demanded personality traits as the breadth of mental horizons, flexibility and multivariance of assessment of what is happening (as opposed to "black and white" consciousness), readiness to unusual, conflicting information, the ability to comprehend what is happening simultaneously from the perspective of the past (causes) and in terms of the future (consequences), etc. Thus, the use of the virtual assistant in career guidance activities of the digital school can increase the effectiveness of training students, the conscious choice of profession that will be in demand in the future, development of mental qualities that form the basis of the skill "to be able to learn."

A promising direction for improving the proposed virtual assistant is seen in supplementing it with capabilities that support the choice of an educational institution or a potential employer.

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