

Information Technology of Adolescents' Professional Self-Identification

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Abstract

The main task of the study is to increase the effectiveness of career guidance activities in colleges. It is proposed to solve this problem by gamification of the professional self-identification of adolescents. The conclusion on the timeliness and appropriateness of the computer gaming technology introduction in the career guidance activities of colleges is based on the analysis of information and communication systems developed for self-identification of people of all ages. The focus of the study was based on freely available tests and information systems for diagnosing an individual's psychological qualities and special abilities. A structural model of an intelligent information and communication system has been developed to support the adolescent's decision to choose a specialty, the implementation of which will allow to automate the process of professional self-identification. It is shown that all decision support systems for choosing a future specialty, designed for career guidance work of different colleges, will differ only in the knowledge base. The principle of forming the knowledge base of the system is described. Examples of computer game tasks that simulate different situations when performing professional activities in different conditions are given. A set of clear criteria is substantiated, which will provide an adequate estimation of the adolescent's professional abilities by the fuzzy artificial neural network Takagi-Sugeno-Kanga.

Keywords

career guidance diagnostic; gamification; interest; personal qualities; self-identification; special abilities

1. Introduction

Adolescents' belonging to a certain social group, community, category and awareness is the most important component of personality development and definition of life strategies [1, 2]. At the same time, the choice of profession is one of the most important person's strategic decisions, which determines the decisive factors in choosing ways to solve certain life problems [3, 4]. However, choosing a future profession being an adolescent is a difficult and fuzzy task.

To solve this problem adolescents, need:

- Orientation in the world of professions;
- Understanding the suitability of their abilities for certain professions.

An important precondition for successful professional identification is the formation in the individual of certain physiological, mental and psychological qualities that meet the requirements and

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contribute to the successful mastery of a profession. However, adolescents usually lack an understanding of the suitability of their abilities for different professions, which is necessary for further self-determination, because at this age they do not yet have sufficiently formed psychological inclinations. This characteristic of adolescence significantly complicates the process of professional self-identification.

2. Information technology in education and adolescents' professional identification

At present, such a promising subject area as "Information Technology in Education" has been formed and is rapidly developing in society.

This area includes such issues:

- Open education;
- Remote education;
- Informational educational environments;
- Intellectual educational systems.

The active introduction of computer and Internet technologies in the educational process contributes to the rapid development of such a phenomenon as virtual testing.

This area is developing on the border of pedagogy and psychology and involves the usage of intelligent and info-communication systems and technologies to:

- Control of the knowledge level, skills and abilities;
- Estimation of special abilities of people of all ages.

In Ukraine's education system, the priority is the introduction of information and communication technologies that improve the educational process, accessibility and effectiveness of education and the preparation of the younger generation for life in modern society. That is why this article examines information systems and technologies for diagnosing psychological qualities and special abilities of the individual, which are designed to support the decision to choose a specialty [5].

2.1. Psychological qualities and special abilities testing

There are a large number of tests in the Internet environment aimed at estimating the compliance of physiological, mental and psychological qualities of the individual to the qualification requirements of specific professions. However, these tests are mostly designed for school graduates who are purposefully looking for work and are sufficiently aware of their interests, aspirations and professional plans [3]. In adolescence, these personal qualities are usually not sufficiently formed, so the test results are likely to be unreliable.

It should also be noted that tests of psychological qualities and special abilities of the individual are implemented in free access and:

- On the one hand, allow to define professional qualities and to receive recommendations on expediency of a choice of a profession;
- On the other hand, do not take into account employment prospects and the needs of society in the future.

To estimate the adolescents' psychological qualities, career guidance techniques are developed based on testing special abilities of the individual.

But there are also nuances associated with the requirements for the tests themselves, namely:

- Modernity;
- Adaptability to a specific region;
- Ability to take into account future demand for existing professions;
- Ability to take into account the perspectives of new professions.

The leader in the market of professional guidance for young people in Europe is the complex "Magello" [6], which does not require software installation and covers a wide range of specialties. The methodology that is the basis of "Magello" takes into account the requirements of modernity and

focuses on the future. But the "Magello" complex is adapted to the requirements of European universities.

SAT Reasoning Test is a standardized test for admission to colleges in the United States [7]. The purpose of testing is to estimate a student's readiness for college. SAT Reasoning Test consists of three sections: text analysis, mathematics and writing.

In Ukraine, UkrSAT ability tests are used to identify specific abilities of an individual to master a certain specialty. This test is based on the American and Swedish SAT and adapted for usage in Ukraine. As a way of selection for higher education institutions, UkrSAT complements the subject competencies of entrants in the direction of the development of subject tests. But UkrSAT is focused on entrants to higher education institutions, and this is another target audience.

In [7, 8] the test of general educational competence is considered. The concept of creating these tests is based on the system of key competencies of higher education institutions in Ukraine.

At the same time:

- Acquisition of key competencies is defined as the main goal of general secondary education and a prerequisite for self-development and self-realization of the individual to learn successfully;
- The methodology on which the test of general educational competence was developed does not take into account the interest in the profession, does not reflect the relevance of the specialty and employment prospects.

In [9, 10] the information system of identification of abilities of entrants "Applicant" is investigated. This system allows you to predict the success of professional activities of individuals in various fields based on a map of recommended professions. However, the results of diagnostics according to the method that is the basis of the system, only roughly outline the scope of professional activity, which does not solve the problem of uncertainty at the level of specialty choice.

Thus, studies of testing psychological qualities, professional and special abilities systems, have shown that providing reasonable support to the decision of the adolescent to choose a future specialty requires analysis of test results. However, test results based on different theoretical approaches are usually heterogeneous and not always consistent. Adolescents' attempts to summarize such results on their own cannot only further complicate the choice of specialty, but also lead to an increase in internal contradictions caused by the need to make decisions in conditions of uncertainty.

As follows: if an adolescent cannot decide on his / her choice of future profession, it is advisable to rely on experts to support the decision.

Experts make recommendations for choosing a specialty based on [11, 12]:

- Adolescent models by profession;
- Forecasting future indicators of the quality of education by the specialty.

The adolescent model by profession includes the main characteristics of students which may include:

- Psychological characteristics;
- Interest in the activity;
- Level of initial knowledge;
- Outcomes from education in individual disciplines;
- Self-estimation of educational outcomes in certain disciplines and other characteristics.

Based on the model of an adolescent, experts form a model of a specialist in a particular field and provide recommendations on the appropriateness of choosing a particular specialty. But the provision of expert support significantly complicates the organization of decision support in conditions of limited offline communication, as it requires individual communication. At the same time, the estimation of interest in activities that have never been performed is a particularly difficult task.

The solution to the set of problems described above is seen in the introduction of computer game technology in the process of professional self-identification of adolescents.

2.2. Education and professional self-identification gamification

The game is one of the ways of self-actualization and search for a model of self-affirmation, which is defined in the conditional construction of reality. In the course of the game the peculiarities of the adolescent's thinking and imagination, his emotionality, activity and need for communication are

clearly manifested. Analysis of the phenomenon of the game showed that in the game it is possible to reproduce a certain experience through the simulation of relevant situations and, so, to realize the interest in different activities.

In recent years, the active search for new methods of organizing educational activities, which are aimed at ensuring effective learning and harmonious development of personality, has led to growing interest in the game in the field of education. The game is considered a special kind of human activity.

Game technology is built as a holistic education, covering part of the learning process and united by a common content. It consistently includes games and tasks that form the ability to identify the main, characteristic features of objects, compare, contrast them.

Under the concept of "gamerization" in this work we understand the use of typical elements of the game process (definition of the game rules, competition and results evaluation) in different fields of activity to encourage interaction.

Demand for cognitive enhancement and the development of computer technology has prompted the gaming industry to develop educational programs aimed at developing and improving skills. The main purpose of educational games is to form in future professionals the ability to combine theoretical knowledge with practical activities, as the game is a certain type of activity in situations aimed at reproduction and assimilation of social experience [13, 14]. At the same time, the use of the game at each stage of personality development has its tasks and consequences [12, 15].

Studies [13, 16] have identified a motivational effect and cognitive potential of computer games, which anticipate their orientation on stimulating cognitive and developmental functions. Computer games have an impact on learning ability and social adaptation of the individual.

An analysis of recent research and publications has shown that modern computer technology allows not only to evaluate the results of educational games, but also to:

- Record the characteristics of the personality that are appeared during the game;
- Reflect the degree of interest in the profession;
- Reflect the ability to study in the relevant field.

Therewith, the potential of gaming is not sufficiently used in the process of estimating the personal qualities and special abilities of adolescents. However, the diagnosis of these characteristics on the basis of professional computer game tasks not only gives adolescents the opportunity to actively test themselves in various fields of work, but also helps to determine their preferences. That is why the task of professional self-identification of adolescents with the use of computer game technologies is relevant and timely.

3. The purpose and objectives of the work

The purpose of the work is to form information technology of professional self-identification of adolescents based on the results of computerized game tasks of professional orientation.

For the successful implementation of computer game technologies in the process of professional self-identification of adolescents, first of all it is necessary to:

- Ensure the correctness of the tasks selection and the reliability of the results evaluation after their completion;
- Develop an infocommunication system that is able to automatically capture not only the psychological qualities and special abilities of the individual, but also to reflect the degree of interest in the profession.

4. Professional self-identification computer game technologies

Earlier, in work [17] the model of intelligent infocommunication system for identification of entrant's abilities (IISIEA) of higher education institutions and the scheme of user interaction with the system were described. In this study, the IISIEA model is proposed to be adapted to the structure and requirements of institutions that provide educational services to junior professionals.

The model of the intelligent infocommunication decision support system of the adolescent to choose a specialty is shown in Fig.1.

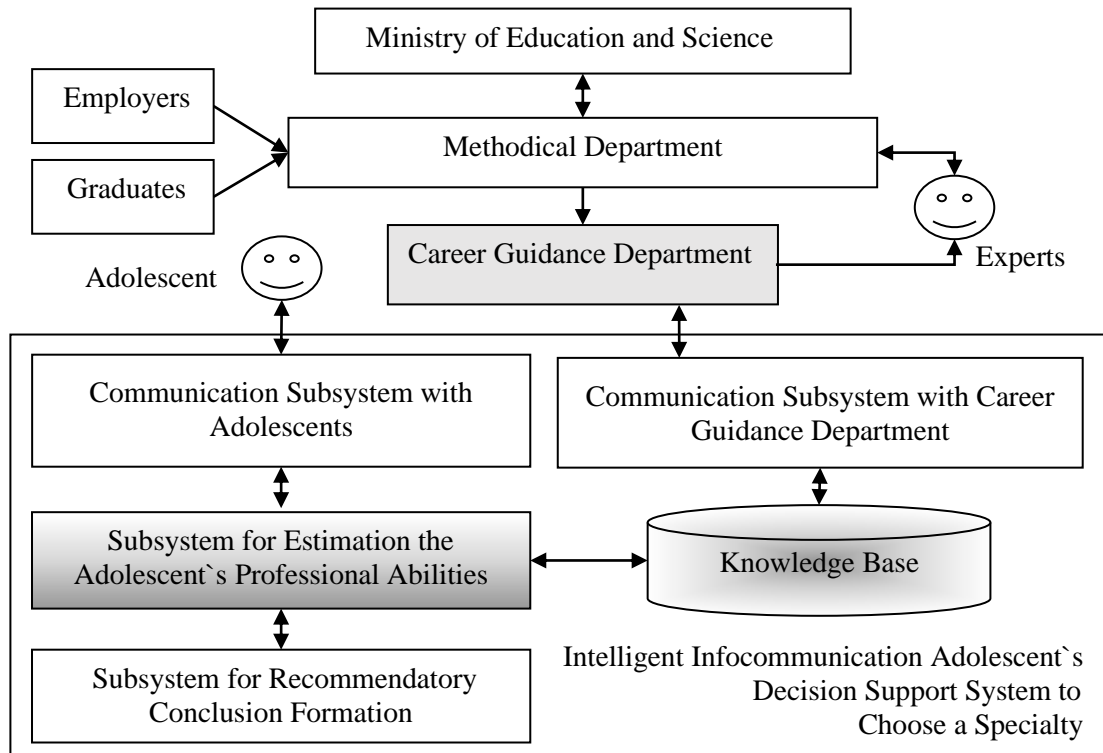


Figure 1: The scheme of adolescent's professional self-identification

At this stage of research, the organization and testing of special abilities, which are required to varying degrees to acquire knowledge, skills and abilities that best meet the requirements of the specialists' profile in various specialties, it is proposed to put on career guidance departments of colleges.

Intellectual support of the adolescent's decision to choose a specialty is provided by a system based on educational and professional programs - a single set of educational components, planned and organized by the educational institution to achieve successful educational outcomes.

Decision support is provided according to the scheme shown in Fig.2.

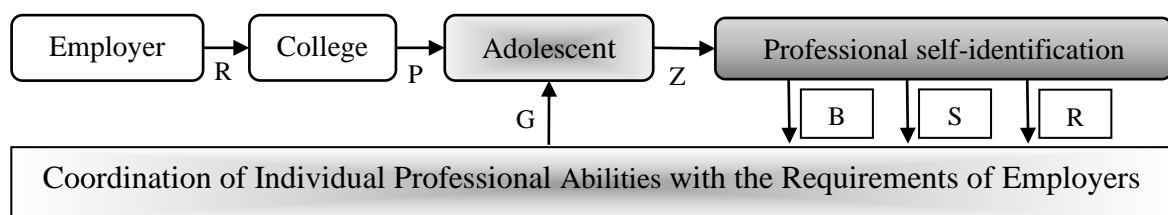


Figure 2: The scheme of implementation of adolescent's intellectual decision support on a choice of a specialty

In Fig.2 the following markings are accepted:

- R – set of popular professions;
- P – list of specialties offered by the college;
- Z – a set of professional preferences and personal qualities of an adolescent, such as: interest, special abilities, character and temperament;
- B – a set of adolescent's interests ($B \subset Z$);
- S – a set that reflects the knowledge, skills, and special abilities of the adolescent ($S \subset Z$);
- $G = \psi(B, S, R)$ – the recommendation conclusion formed by the system;

- $\psi(B, S, R) = B \cap S \cap R$ – the function of matching the interests, abilities, knowledge and skills of the adolescent with the employers' requirements.

To implement the professional self-identification of a college entrant from the knowledge base of the decision support system in the subsystem for estimating the professional abilities of adolescents, professional orientation tasks of different complexity levels are loaded.

It is suggested to leave the choice of a game task from a set of alternatives to the adolescent. At the same time, fixing the time an adolescent spends choosing a task provides an opportunity to form a criterion for estimating the degree of interest in the profession.

It is proposed to determine a clear estimation of the expression of interest in the specialty degree according to (1):

$$v = \frac{t_{\text{choice}}}{N \cdot 60}, \quad (1)$$

Where t_{choice} – time in seconds that an adolescent spends choosing a computer game task; 60 – time in seconds, that is given to select a task; N is the ordinal number of the selected task ($N = 1, 2, 3$).

It is proposed to use these values as a binding heuristic and adaptation before adjusting the parameters of the fuzzy artificial neural network Takagi-Sugeno-Kanga, which is proposed to be used in IISIEA for automatic evaluation of game results [11].

Special abilities of adolescent are offered to be estimated with the help of such accurate parameters which directly depend on performance time of various level game tasks τ_i ($i=2, 3, 4$) – time spent by the user to complete the task of the k-th game level.

At the same time:

- The first level is considered passed if the task is completed in the appropriate time;
- The second level is considered passed if the task is completed with two minor errors or one significant error;
- The third level is considered passed with two, and the fourth – with one minor error.

Because the error results in a return to the beginning of the task, this increases the time that the adolescent spends on the task and allows you to automatically take errors into account when estimating professional abilities.

The clear evaluation value of adolescent's professional abilities, formed in the Subsystem for Estimation the Professional Abilities of Adolescent based on the results of the professional orientation game task, reflecting special abilities to meet the requirements of the j-th specialization, is calculated according to (2):

$$\theta = v + \zeta + \sum_{i=2}^4 \frac{C_i}{\tau_i}, \quad (2)$$

Where ζ – estimation of the first level of the task; τ_i – the time of passing the i-th ($i = 2, 3, 4$) level of the computer game task; C_i – a constant determined by the time of execution of the i-th level of the task by a qualified specialist.

This set of criteria provides an adequate estimation of the adolescent's characteristics, as it reflects all the characteristics of the individual in the space of requirements for the specialist's profile in various specialties, provided the adequacy of professional tasks selection.

Selection of computer game tasks to predict future education outcomes is performed by experts based on:





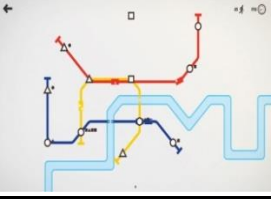


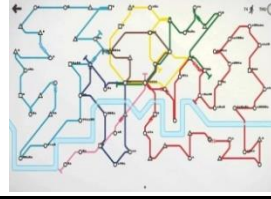

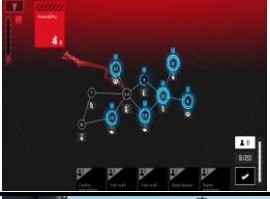
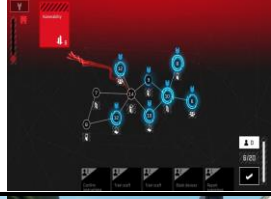
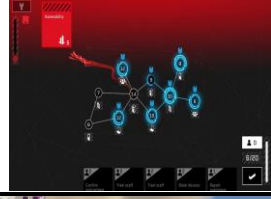




- Qualification requirements of the employer, which determine the ability of the specialist to perform the relevant professional duties;
- A set of competencies in the relevant educational and professional program of the educational institution, reflecting the ability to apply knowledge in practical situations.

Examples of computer game tasks that simulate different practical situations in different areas are given in Table 1.

In the game "Surgeon simulator" the adolescent is offered tasks of different levels, during which he can feel like a surgeon. The game reflects the interest in mastering the specialization of a surgeon.

Table 1

Fragments of the support system database for choosing a future profession

Game	Level 1	Level 2	Level 3	Level 4
Surgeon simulator				
Subway constructor				
Zero Threat				
Microsoft flight simulator				

Successful completion of tasks requires some knowledge of anatomy, chemistry and biology, as well as the presence of such traits as the ability to [17]:

- Choose justified decisions in standard clinical situations, based on acquired competencies;
- Maintain attention and endurance when working out standard clinical situations;
- Focus on one object for a long time;
- Control emotions;
- The use of information space and modern digital technologies in professional activities.

In addition, many of the necessary criteria for estimating the ability to master the medical profession should include an estimation of the emotional state, which reflects the attitude to life and health of patients.

The game "Subway constructor" offers adolescents game tasks related to the design and construction of the subway in different conditions. Tasks of different levels differ in the number of individual networks, their size and increase in the number of common peaks, as well as time constraints and additional geological conditions.

Successful completion of the tasks of "Subway constructor" implies the absence of claustrophobia, a sufficient level of dimensional imagination and the availability of certain knowledge in such disciplines as geography, geology, geometry and physics.

This game also reflects an interest in mastering specializations such as logisticians and technicians to examine the status of systems and networks for various purposes.

All professions related to networks and systems provide the ability to:

- Make the best decision from a variety of alternatives;
- Solve the problems of decomposition and composition of spatially developed networks;
- The use of information space and modern digital technologies in professional activities.

As follows, all decision support systems on the choice of future specialty, intended for career guidance work of different colleges, will differ only in the knowledge base, which consists of a database and a rule base.

In the "Zero Threat" turn-based learning game, the playing field is seen as a set of interconnected nodes that are moving parts of an organization's real network that includes cell phones, laptops, servers, cloud storage, and employees themselves. The strength and frequency of threats and attacks on browsers are gradually increasing and spreading through the network. This leads to data theft, destruction or alteration. Thus, different types of cyber-attack situations are simulated for corporate "employees". The purpose of the game tasks is to choose precautionary measures or countermeasures that will protect network data.

Successful completion of "Zero Threat" tasks requires a sufficient level of knowledge of a foreign language, a certain level of knowledge of programming languages, the ability to use the information space, which reflects the ability to perform professional duties in specialties [18, 19]:

- Secure Network Administration Specialist;
- Specialist in counteracting hacker attacks;
- Specialist in information protection in information and communication systems;
- Information security risk analysis specialist
- 2529 Security specialist (International Standard Classification of Occupations 2008 (ISCO-08)).

All professions in the specialty "Cybersecurity" provide the ability to quickly:

- Respond to information security incidents;
- Estimate information security risks;
- Make the best decision from a variety of alternatives.

The "Microsoft flight simulator" offers adolescent tasks that are directly related to piloting an airplane. The complexity of the tasks is set by the weather conditions and situations that arise when piloting in the air, takeoff and landing, and allow the adolescent to understand the consequences of wrong decisions and inappropriate actions.

The task of "Microsoft flight simulator" not only requires some knowledge of: physics, geometry and reflects interest in mastering the specialization "Flight Operations", but also allows the system to estimate such physiological, mental and psychological qualities as the ability to [20, 21]:

- Rapid practical application of the modern aircraft operations rules;
- Quick understanding of the reasons for changes in the aircraft flight characteristics.

In addition, the successful completion of tasks involves the ability to use the latest information technology in the aircraft operations, taking into account the peculiarities of practical situations and the presence of such character traits and natural abilities as the ability to:

- Quickly navigate in different coordinate systems;
- Keep a large number of dynamic objects in sight for a long time;
- Respond quickly to unexpected changes in external conditions and intuitively make the right decisions in conditions of uncertainty and risks of various kinds.

The database contains game tasks that simulate practical situations that are typical for the professional activities of specialists who have received special education according to the college profile. The attributes of the database are the codes of the specialties of the institution, and the entities are set by the names of games that reflect the ability of the individual to study in these specialties.

The rule base consists of a rules system according to which:

- Different specialties of the institution that provide educational services are matched to a certain set of professional game tasks and evaluation criteria are determined;
- Based on the results of professionally oriented tasks of different levels, a recommendatory conclusion is formed.

The process of forming a recommendatory conclusion based on the performance of professional game tasks is described in detail in [11, 22].

5. Results analysis

Currently, the Department of Information Technology of Design and Applied Mathematics in Kyiv National University of Construction and Architecture, with the participation of teachers from the Université Cadi Ayyad are working on:

- Development of an adolescent model by profession;
- Formation of standards for estimating the degree of compliance of adolescents' personal qualities with the qualification requirements for the profile of the specialist.

The research involves students of different specialties who have different levels of success and to varying degrees are satisfied with their choice of specialty to study.

According to a survey of students who were involved in the study of the individual's special abilities based on computer game tasks of professional orientation, it was found that the professional self-identification of adolescents using computer game technology:

- Will reduce the number of students who are dissatisfied with the choice of specialty;
- Will significantly affect the quality of education, will contribute to high success and full realization of personal potential, due to the presence of interest in the future profession.

However, the implementation of the proposed model requires an automatic estimation of the adolescent's professional abilities in accordance with (2). This, in turn, implies the presence of a trained fuzzy artificial neural network Takagi-Sugeno-Kanga, which is proposed to use in the intelligent infocommunication system to support the decision of the adolescent to choose a specialty to automatically estimate the game results.

Accumulation of a sufficient number of test results by performing game tasks of professional orientation by persons who have variously realized their special abilities in professional activities provide an opportunity to form a sample for learning artificial neural networks and so ensure the adequacy of models underlying the ontology of intelligent infocommunication decision support system for the adolescents to choose a specialty. Therefore, further research will focus on the implementation of this artificial neural network.

6. Conclusion

1. Studies of the implementing information technology process in the field of education and adolescents' professional identification have shown that currently intellectual support at the educational level is actively used and developed. At the same time, intelligent infocommunication technologies and systems are not sufficiently used in the process of estimating the special abilities of adolescents.

2. Analysis of modern methods and tools for diagnosing psychological qualities and special abilities of the individual showed that the development and implementation of specialized intelligent decision support systems in career guidance colleges to choose a future specialty is a timely and socially justified task.

3. The proposed clear criteria for estimating the level of interest and professional abilities of an adolescent based on the computer game task results are unified, which makes it possible to use them to solve similar problems of socio-economic nature.

7. Acknowledgments

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