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IMPLEMENTATION OF PROJECT-BASED ACTIVITIES IN THE MUNICIPAL SCHOOL STUDENTS' GUIDANCE SYSTEM

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Abstract

The relevance of project-based activities research and its perspectives development with the aim of students' professional orientation is caused by caused by the following problems in implementing Federal state educational standards for schools: students ' readiness to choose training profiles and ways to continue their education formation under conditions of municipal educational environment integration ensuring students ' education quality by their project-based activities personalizing; improving the municipal schoolchildren guidance system management quality using information technologies and mathematical models. The work is directed towards a comprehensive solution of choosing the type of project-based activity problem depending on students' personal characteristics. This research contributes to methodology and methods of making pedagogical decisions about the choice of the type of school students project-based activity. To solve the research problem, psychological methods (testing, surveys) were used as well as pedagogical approaches, methods of statistical data processing, Saati method of hierarchies analyzing, and information technology tools. The results of the study are the basis for developing information and analytical systems for the organization of secondary schools' students project-based activities as well as for training teachers of the region Kemerovskaya oblast - Kuzbass for the optimal implementation of this type of activity.

Keywords: Municipal guidance system, project-based activity, Hierarchical model, Analysis hierarchy process, Saaty Method

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1. Introduction

In the region of Kemerovskaya oblast - Kuzbass, the existing school students' guidance system is currently being modernized, including regional and municipal planning, organizational and scientific-methodological structures, mechanisms for coordinating activities, a system of school students' professional probations and its informational support. This system includes various forms of network education and partnerships of educational, public organizations and other institutions in order to implement students project- based activities that contribute to their professional identity. Theoretical aspects of interaction in the sphere of career guidance system are considered in the works of Makarenko, Pryazhnikov and others (Makarenko & Panina, 2017; Pryazhnikov et al., 2018a). The analysis of the system shows that the key directions of its modernization are integration and coordination of activities at the municipal and regional levels, and, consequently, the issues of quality management are updated (Blinov et al., 2020) as well as information technologies and mathematical methods and models application issues for this purpose. At the municipal level, school students project-based activity environment is integrated and coordinated as a component in the career guidance system.

2. Problem Statement

To justify the conditions under which the effectiveness of the municipal system of vocational guidance for school students is ensured.

3. Research Questions

Research questions:

3.1. Identify the main trends in municipal guidance systems modernization.

3.2. Substantiate the organizational and pedagogical support as a component of the guidance system for school students.

3.3. Define the project-based activity as a component in the municipal guidance system for school students.

3.4. Justify a personification indicator for school students project-based activities.

3.5. Prove that the use of mathematical methods and models ensures the validity and optimality of managerial and pedagogical decisions on the choice of project-based activities of school students for their personal and professional identification.

4. Purpose of the Study

The purpose of the work is to develop informational and analytical support for making managerial and pedagogical decisions about school students project-based activities for their personal, social and professional identification (Pryazhnikov et al., 2018b; Zemlyanuhina et al., 2019).

The main requirement for the developed support is the possibility of its use in practical activities at schools, organizations of additional education, educational management bodies in order to personalize school students project-based activities depending on their personal and individual characteristics.

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5. Research Methods

As a generalized indicator for the personification of school students project-based activities was determined readiness for this activity, its structure was justified. In Zhukova (2012) work, the frequency of defining the readiness components by various authors and its structures were analyzed. As a result, in this work the following most common readiness structure components, presented in psychological and pedagogical researches, were identified: motivational, emotional and volitional components. The analysis of scientific literature on the problem of readiness for project-based learning allowed us to identify also a cognitive component in the structure of readiness.

To make an informed decision under conditions of several factors influence, it is necessary to choose the optimal one among a number of alternatives. One of the mathematical methods for processing alternatives is the Saaty method - the "hierarchy analysis Method" (Saaty, 1980). This method is used for solving multi-criteria problems with hierarchical structures that include both quantitative and qualitative factors.

To find the criteria necessary for building a hierarchical model, at the first stage of the research, an empirical study of school students of 8-11 grades (total: 500) and teachers (total: 50) was conducted. The data was processed using mathematical statistics. The purpose of this stage was to determine the level of school students' readiness for project-based activities. A set of methods was used to determine the personality characteristics as motivation to success (the method of motivation to success), willpower ("self-assessment of willpower"), responsibility (multidimensional functional diagnostics of "responsibility") (Kagakina et al., 2018). At the next stage of the study, an expert assessment based on the data obtained to determine the significance of the identified characteristics was conducted.

The next stage allowed to determine the type of school students' project-based activity in order to achieve planned educational results. The interdependence of school students' educational results and their professional identification was considered in the works of Rodichev (2016) Pryazhnikov et al. (2018a,b). The following types of project-based activities were considered as pedagogical alternatives:

- P1 - individual project-based activity within a single academic subject;
- P2 - group project-based activity within a single academic subject;
- P3 - individual interdisciplinary project-based activity;
- P4 - group interdisciplinary project-based activity.

It should be taken into account that school students have different abilities, peculiarities of information perception, etc. To compare the types of the project-based activities, the following characteristics were selected:

- academic performance (AP);
- motivation for success (M);
- willpower (W);
- responsibility (R);
- teachers' readiness (TR).

Algorithm for determining the type of project activity:

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- construction of a matrix of pairwise comparisons of criteria for the goal (based on data obtained at the first stage of the study);
- calculating the priority vector, maximum eigenvalue, consistency index, consistency ratio;
- construction of a matrix of pairwise comparisons of alternatives for each characteristic;
- for each characteristic, the priority vector, maximum eigenvalue, consistency index, and consistency ratio were calculated;
- calculation of overall ratings for each alternative;
- calculation the total consistency index (TCI), the total consistency ratio (TCR). The value of the TCR parameter can be used to judge the reliability of the result

Based on the obtained estimates, the type of project-based activity for each student can be recommended for the selected alternatives, depending on their personal characteristics. Thus, it becomes possible to build an individual education route that contributes students' professional self-determination (Rusakova et al., 2019).

6. Findings

On the basis both the analysis and selected criteria a three-level hierarchical model was built (Figure 01).

The figure shows that the model' elements are independent at each level. At the same time, elements of each group are influenced by elements of another level and themselves influence them.

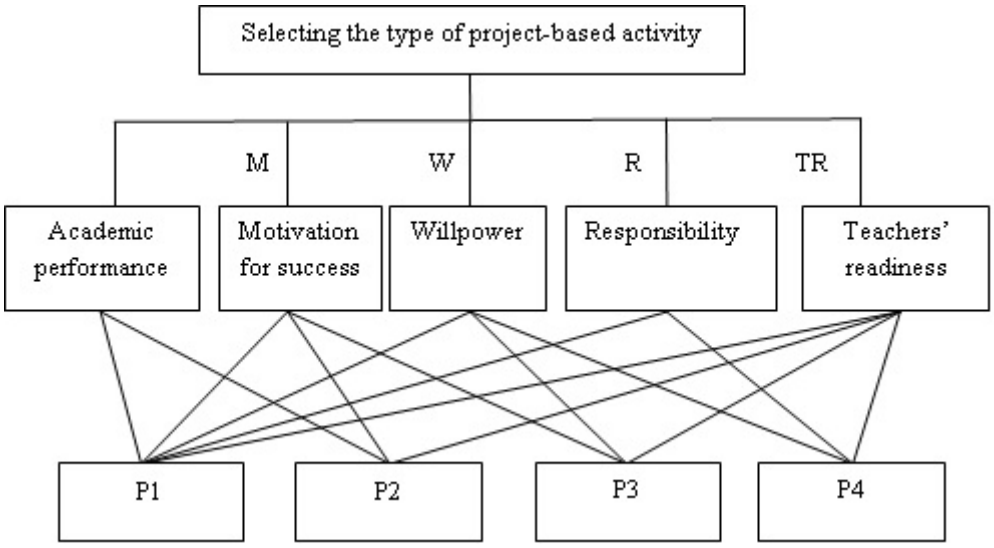

Figure 1. Hierarchical model for selecting the type of project-based activity

6.1. The type of project-based activity choosing

The task of this stage of the study was the analysis based on the constructed model without feedback. Further, the influence of the selected characteristics and comparison of the results were studied. Taking into

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account the mutual influence of the elements at different levels allows to give a more accurate assessment of the results.

The selected types of project-based activities were analyzed for their effectiveness depending on the presented characteristics. The characteristics are individual character for different students.

Numerical calculations were made to demonstrate the dependence of the characteristics for the choosing among pedagogical alternatives for the purpose of project activities' organizing.

The matrix of pairwise comparisons of characteristics with each other is presented in table 1. the Matrix of pairwise comparisons of characteristics is filled in according to the rule (Saaty, 1980):

- if the first and second characteristics are equally important - put in the table 1;
- if the first is slightly more important than the second - put 3;
- if the first is much more important - put 5;
- if the first is clearly more important - put 7;
- if the first absolutely surpasses the second - put 9.

In compromise cases, the values 2,4,6,8 are selected.

Comparison of characteristics is carried out by experts.

As can be seen from the table, such characteristics as motivation for success, willpower are, according to experts, more significant than, for example, student's eeducational performance.

Algorithm for calculating the priority vector: divide the elements of each column by the sum of the elements of this column (normalize the column elements), find the sum of the column elements of the resulting matrix, and divide the resulting values by the number of elements.

Table 1. Comparison of characteristics regarding the choice type of project-based activity

	AP	M	W	R	TRУ
AP	1	0.2	0.2	0.333	0.125
M	5	1	3	1	0.125
W	5	3	1	0.125	0.125
R	3	1	8	1	0.125
TR	8	8	8	8	1

As a result, the following vector of priority characteristics was obtained (0,037; 0,13; 0,12: 0,16; 0,56).

Consistency of the result is determined by the maximum eigenvalue λ_{max}, which is calculated according to the rule: we multiply the original matrix on the right by the priority vector, divide the elements of the resulting vector by the corresponding elements of the priority vector, and find the average value of the obtained elements. If the matrix is consistent, the eigenvalue is equal to the number of elements in the matrix n.

The deviation from matrix consistency can be estimated using the consistency index (CI) and the consistency ratio (CR). CR value less than or equal to 0.10 is considered acceptable.

Calculations have shown that for the initial matrix of pairwise comparisons, the corresponding values are equal to: λ_{max}=6,1; CI=0,43; CR=0,41.

These values are quite far from the values in the case of consistency.

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The next stage of the analysis was to compare pedagogical alternatives for each characteristic. The corresponding tables of pairwise comparisons were compiled for the five selected characteristics (AP, M, W, R, TR). The tables were compiled in the same way as table 1 based on expert assessments.

The following values were obtained as a result of calculations:

- AP (academic performance): the priority vector (0,069; 0,21; 0,41; 0,31), λmax= 4,3; CI =0,038; OC=0,043.
- M (motivation to succeed): the priority vector (0,052; 0,093; 0,27; 0,59), λmax= 4,2; CI =0,071; CR=0,079.
- W (willpower): the priority vector (0,52; 0,093; 0,27; 0,59), λmax= 4,2; CI =0,071; CR =0,079.
- R (responsibility): the priority vector (0,096; 0,17; 0,27; 0,46), λmax=4,3; CI =0;1; CR=0,012.
- TR (teachers' readiness): вектор приоритетов (0,25; 0,25; 0,25; 0,25); λmax=4; CI =0,00; CR=0,01.
- The results show that the consistency ratio for each of the five matrices of pairwise comparisons, taking into account the selected characteristics, has a value less than 0.10. This indicates the reliability of the result.
- Based on the data obtained, you can get a General ranking of each type of project-based activity. To do this, we will make a matrix of vectors of priority characteristics (table 02).

Table 2. Comparison of characteristics for different types of project-based activity

	AP	M	W	R	TR
P1	0,069	0,052	0,052	0,096	0,25
P2	0,21	0,093	0,093	0,17	0,25
P3	0,21	0,27	0,27	0,27	0,25
P4	0,31	0,59	0,59	0,46	0,25

To get a General assessment of each pedagogical alternative, we multiply the resulting matrix by the priority vector of the original matrix of characteristics (0,037; 0,13; 0,12: 0,16; 0,56). As a result, we get the priority vector for project activities (0,17; 0,197; 0,264; 0,368). Calculating the total consistency index (TCI) and the total consistency score (TCR), we get TCI =0.035; TCR =0.032. Since the consistency ratio is less than 0.10, the result obtained is valid.

Thus, the most preferable for the above expert values of project-based activity is the group interdisciplinary project-based activity (P4).

6.2. The influence of expert assessments on pedagogical alternatives choosing

As shown above, when characteristics such as motivation for success and students' willpower are considered by experts to be more important than educational performance, such types of project activities as P4 (group interdisciplinary project-based activity) and P3 (individual interdisciplinary project-based activity) are preferred. In the course of the study, calculations were made for various expert assessments. So, if experts consider academic performance to be a more important characteristic, while the other tables of pairwise comparisons remain unchanged, then the priority vector for project activities becomes equal (0,169; 0,219; 0,299; 0,313), TCI=0.024; TCR =0.021. Thus, the rating of the second (P2) and third types

(P3) of project activity increases and decreases for the fourth. When changing the expert ratings for the AP (academic performance) characteristic, the priority vector for the types of project activities becomes equal (0,326; 0,179; 0,232; 0.26); TCI =0.048; TCR=0.043. That is, in this case, the best educational results are provided by individual project-based activity within a single academic subject (P1).

7. Conclusion

Numerical modeling of the process of choosing the type of project activity with help of AHP method (Saaty, 1980) showed that the choice of a pedagogical alternative to achieve optimal educational results requires a systematic study of the characteristics of students. The research results were implemented in the guidance system for school students in Mezhdurechensk City County of the region Kemerovskaya oblast - Kuzbass. The realized research has shown the key meaning of school students' project-based activity for their professional identification, that confirmed the necessity to improve its quality through the use of a complex of psychological, pedagogical and mathematical methods, modeling and information technologies.

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