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Efficiency of the project method in the development of professional competencies in future teachers

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ABSTRACT

The objective is to study the effectiveness of the project method in the formation of professional competencies of future employees in the field of education. Methods: surveys and questionnaires, methods of remote collection and processing of information (GOOGLE Forms) the main methods used in the study were the method of questionnaires, the method of synthesis and analysis, the method of expert evaluations. The chi-square criterion, the feature combination criterion, and Pearson's correlation coefficient were used to calculate the results of the study. Results: The results of the study showed high indicators of the level of formation of students' subjectivity when using the project method in both the main and control groups. The introduction of the project method has an unconditional favourable effect in the process of forming the professional competencies of future teachers. Together with traditional teaching methods, the project method is an effective tool for training future teachers. It is stated that the reliability of the obtained results is proved by the chi-square criterion. Its level is 0.01, on the basis of which it can be concluded that the proposed model is appropriate. Conclusion: Thus, after the analysis of the obtained results, the expediency of applying the project method in the training of future teachers was established.

KEYWORDS: project method; professional competencies; development of competencies; pedagogical education; modern education.

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Eficiencia del método de proyecto en el desarrollo de competencias profesionales en futuros profesores

ABSTRACT

El objetivo es estudiar la efectividad del método de proyectos en la formación de competencias profesionales de los futuros empleados en el campo de la educación. Métodos: encuestas y cuestionarios, métodos de recolección remota y procesamiento de información (GOOGLE Forms), los principales métodos utilizados en el estudio fueron el método de cuestionarios, el método de síntesis y análisis, el método de evaluaciones de expertos. El criterio de chi-cuadrado, el criterio de combinación de características y el coeficiente de correlación de Pearson se utilizaron para calcular los resultados del estudio. Resultados: Los resultados del estudio arrojaron altos indicadores del nivel de formación de la subjetividad de los estudiantes al utilizar el método de proyectos tanto en el grupo principal como en el de control. La introducción del método de proyectos tiene un efecto favorable incondicional en el proceso de formación de las competencias profesionales de los futuros profesores. Junto con los métodos de enseñanza tradicionales, el método de proyectos es una herramienta eficaz para la formación de futuros profesores. Afirmamos que la fiabilidad de los resultados obtenidos se prueba mediante el criterio de chi-cuadrado. Su nivel es 0.01, en base a lo cual podemos concluir que el modelo propuesto es apropiado. Conclusión: Así, luego del análisis de los resultados obtenidos, se estableció la conveniencia de aplicar el método de proyectos en la formación de futuros docentes.

PALABRAS CLAVE: método de proyecto; competencias profesionales; desarrollo de competencias; educación pedagógica; educación moderna.

Introduction

The relevance of the study is due to the transition of the country's economy to an innovative path of development. Strategic tasks of modernization of the system of vocational education and development of human resources include the priority task of formation of competences of innovative activity in university graduates. This ability and readiness for continuing education should be the key to the formation of professional competencies. Systematic self-improvement, professional mobility, the ability to think critically, creativity, entrepreneurship, the ability to work independently, willingness to work in a team and a highly competitive environment should be the competencies that distinguish a true professional. The success of the introduction of innovations in education largely depends on the readiness of teachers (Ismailova et al., 2020c). New conditions, updated content of

education, innovative forms and methods of teaching, growing demands on the quality of knowledge, complicated forms of organisation of classes — all this inevitably requires and entails increasing professional competence and forming the readiness of future teachers for their professional activities (Ismailova et al., 2020a).

Competentia (Latin) is a range of issues which a person knows well, has expertise and experience. A person competent in a certain field has special knowledge and abilities that allow him/her to reasonably judge this area and act effectively in it. The professional competencies are developed through the content of education, which includes not only the list of subjects, but also professional skills and abilities that are developed in the course of mastering the subject, as well as through active student position in various spheres of life (Ismailova et al., 2020a).

It is impossible to achieve a new quality of education (new educational outcomes that meet the needs of society) by increasing the amount of knowledge and even by changing the content of knowledge in certain subjects. Another way is to change the nature of the connections and relationships between the subjects and to change the nature of the connections and relationships between the participants in the learning process itself. The development of competencies is inextricably linked to the experience of successful activities. Therefore, it is advisable to organise learning and research work of students, the use of business, role-playing, simulation games in the creative independent work of students (Lee et al., 2021).

There following abilities are of great importance for future teachers: the ability to search, analyse, interpret scientific information and adapt it to their teaching activities, use professional databases; apply the achievements of domestic and foreign science and educational practice in their teaching activities; organise research and project activities of students; knowledge of legal, psychological, pedagogical, project, methodical, organisational and managerial means of conducting research; mastery of scientific and professional oral and written communication techniques (Khimmataliev et al., 2021a). The organisation of research, creative and independent activities of students in specialized subjects, elective subjects can facilitate the acquisition of these skills and abilities (Ellingsen, et al., 2021).

Research activity ranks one of the first both in-class and out of it, it is attributed to learning technology. It promotes the development of critical thinking, creative and communicative abilities of the individual, the ability to set goals and determine ways to

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implement them. Students are engaged in research activities in the course of the project implementation within a particular subject (Bazeliuk et al., 2018).

The project method is the main modern method of teaching. The project method and its elements are an effective interactive teaching method. Interactive teaching methods are understood as all types of activities that require a creative approach to the material and provide conditions for the fulfilment of each student's potential. Interactive ("inter" is mutual, "act" is to act) means to interact, to carry on a conversation, dialogue with anyone. In contrast to active methods, interactive ones are focused on the wider interaction of students not only with the teacher, but also with each other and on the dominance of student activity in the learning process (Záhorec et al., 2020).

The project method involves solving a particular problem, and leads to a specific practical or theoretically significant result, the product. The project method involves the use of a combination of different teaching methods and tools, as well as combining knowledge and skills from different fields of science, creativity, engineering and technology. A completely natural integration is achieved. But the project method is also aimed at acquiring new knowledge in the course of research (Flores-Lueg & Roig-Vila, 2019).

The project method is always focused on the independent activities of students: individual, pair, group, which they perform over a period of time. Students single out a significant research problem or assignment that requires complex knowledge, research; advancing and testing the hypothesis for its solution/completion. Students enter the discussion; collect, arrange and analyse the obtained results, discuss research methods, draw conclusions, put forward new research problems, choose the form of presentation of results (Varela-Ordorica & Valenzuela-González, 2020).

Project activity becomes more important in the course of professional development of future teachers due to the mastery of active ways of action, their acquisition of not only personal qualities such as independence, focus, but also planning skills: goal setting, reflection, control and evaluation of their own activities. For a project to be successful, the group must have a positive relationship between students (Pérez-Ordás et al., 2021). These are just those personal qualities which make the successful implementation of the project possible and which need to be developed: mutual understanding, mutual respect, mutual assistance, cooperation, responsibility.

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When considering the main components of the concept of "project activity" in psychological and pedagogical science, Postholm (2016) concludes that participation in projects develops research and creative competencies of the individual — the ability to self-determination and goal setting, orientation in the information space. Admiraal and Hoeksma (2011) draw attention to the fact that student involvement in project activities allows establishing an active and independent position that will promote further self-development.

Other personal qualities that are developed when using the project method include: the ability to work in a team, respect for the honour and dignity of the individual, a tolerant attitude to social, ethnic, religious and cultural differences; goal setting skills; the ability to take responsibility for the result of the completed assignment. So, personal qualities are the essence of the general cultural competencies of the future teacher (Bavčević et al., 2018). As a result of working on the project, the student shall master such skills as formulating a scientific problem; adequate selection of tools and methods for competing the assignments; use of different methods to collect information; mastery of techniques for processing results and their interpretation; drawing substantiated conclusions based on research results and their presentation (Cebrián et al., 2020).

The initial level of training should rather maintain a disciplinary structure, while knowledge and skills will also be assessed according to the descriptors of competencies at the level of subjects. Today's popular tests, cases and assignments are more suitable for this level as assessment tools. But the principles of gradual formation of competencies and independence of assessment should be traced here as well. Therefore, teachers of the second level of education should assess knowledge and skills, and also participate in the development of assessment materials. After all, in fact, they are "orderers" of the knowledge and skills that will be needed for training at the next level, including for the development of educational and proto-professional projects. Otherwise, the level of students' skills necessary for project development will be insufficient, those skills shall be formed during the study of previous subjects (Table 1).

The aim of the article is to study the theoretical and practical aspects of the effectiveness of the project method in the development of professional competencies in future teachers. The aim involved the following research objectives:

1. Research of educational practices of application of the project method.

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2. Research of efficiency of the project method in the development of professional qualities in future teachers.

Table 1. The main elements of the system of training and assessment of competencies

Levels by type of training	Subject of assessment	Assessment tools	Forms of assessment	Persons to be assessed
Disciplinary	Knowledge, skills, abilities in accordance with the descriptors of competencies	Tests, practical assignments	Traditional	Second-level teachers
Modular and project	Indicators of achievement of competencies	Educational projects + interdisciplinary exam	Score and rating	Third-level teachers
Professional and project	Professional competencies	Professional projects	Need further research; formalised results are not reflected in the graduate's documents now	Employers

Source: Ellingsen et al. (2021).

1. Literature review

Mastering the technology of project activities also affects the motivation of future teachers: to solve a specific problem they have to gain knowledge; besides, project activities allow revealing their creative potential. Project work allows students to combine theoretical knowledge with practice, and creativity — with research. Creative self-fulfilment, which is facilitated by the assignment, finds personal meaning for students. Çetin (2021) understands project activity as a form of learning, notes its main indicators, such as the psychological new formations that are developed at a certain age, accounting for leading activities of a certain age, spontaneity or purposefulness of content and methods of leading activities, their relationship with other activities, a system of methods to determine the levels of relevant new formations, the nature of the relationship of these levels with the ways of organising leading activities and other related activities.

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Examining the project characteristics, Pöntinen and Räty-Záborszky (2020) note its distinctive feature from "pseudo-project", specifying that the need to choose a project as a form of activity arises when its participants are aware of the need for something, and those who have this need do not know what exactly they need to do and how, therefore, the scholars understand the project as a special way of setting and solving problems (Ismailova et al., 2020d). According to psychologists, the main mental new formations of adolescence are cognitive changes, the desire to organise educational and professional activities, the process of building self-awareness and building relationships with others (Hüttel & Gnaur, 2017).

The studies of Bernate and Vargas (2020) deal with the emergence of an individual style of mental activity, and the possibility of intellectual advancement of the individual is provided through the development of learning skills in organising work with educational and scientific literature, formal and logical operations. Shuhailo and Derkach (2021) consider the project training for engineering students majoring in Textile Technology and Design. In the works of Fomina et al. (2020), interactive learning is considered as a means of developing professional competencies in the context of digitalisation of education. Requies et al. (2018) consider the evolution of project-based learning in small groups in Environmental Engineering courses. The article by Sadrina et al. (2018) examines project-based learning assessment in Malaysia.

Silva et al. (2018) consider joint learning involving projects focused on sustainable development. In their article, Khimmataliev et al. (2021b) consider the case-study method in training of students. Ismailova et al. (2020d) focus in their work on the development of students' learning activities in the context of educational mobilisation. Ismailova et al. (2020b) consider an integrative approach to designing the content of vocational secondary education.

2. Methods

Research papers which revealed the pedagogical potential of project activities were the theoretical and methodological background of the study. The works of Ellingsen et al. (2021) deal with the forms of project activity. Methods used in the study: generalisation, analysis and synthesis of information, comparison, survey, Delphi technique. Having

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analysed the research of foreign and Ukrainian authors, we revealed the essence, purpose of project activity, the forms of project activity which can be applied in pedagogical higher educational institutions (HEIs) and develop personal and professional qualities of future teachers. The methodological background of the study are the ideas of developmental learning, on the basis of which the project activities of future teachers are considered as a form of learning; activity approach aimed at developing the abilities, personality traits necessary for the implementation of project activities.

The summative stage involved the theoretical analysis of students' features acquired after work on educational projects on the major. Based on the information presented in 42 features and the assessments given to future teachers, the peculiarities have been identified that are of great importance in the study (Ellingsen et al., 2021).

2.1. Objectives

To experimentally test the effectiveness of the project method of developing the professional competencies in future teachers.

2.2. Sample

Active and purposeful intervention in the educational process through the implementation of the developed model, creating special controlled conditions for its implementation, recording changes in the properties or qualities of the considered objects determines the applied method of empirical research, such as pedagogical experiment. The experiment is carried out within the real pedagogical process, so it belongs to the natural type of experiments. It should be noted that the experimental work involved 378 students, which corresponds to the term "research work". The participants of the experiment were selected from among the students of pedagogical faculties from 2 to 5 years of study of Borys Grinchenko Kyiv University, which allowed to obtain objective and reliable results of the study. The study was conducted through a survey (Sugiyono, 2018) using Google Forms.

2.3. Methods

1. The chi-squared test was calculated by the formula:

$$x^2 = (f_1 - f_2)^2/(f_1 + f_2) \quad (1)$$

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where f_1 і f_2 — the frequencies of the compared samples.

2. The contingency test if related with chi-squared test the following way:

$$C = \sqrt{\frac{x^2}{x^2+n}} \quad (2)$$

3. Pearson's correlation coefficient is found using the formula:

$$r_{xy} = \frac{\sum (x_i - \ddot{x})*(y_i - \dot{y})}{\sqrt{\sum (x_i - \ddot{x})^2 * \sum (y_i - \dot{y})^2}} \quad (3)$$

where x_i — the value of variable X; y_i — the value of variable Y; $\ddot{x}$ — mean for the variable X; $\dot{y}$ — mean for the variable Y.

2.4. Instruments

Google Forms were used for the survey. Data entry and processing was performed using SPSS Statistics 16.0. All data are given in absolute (number of choice of answers) and relative (% of the number of respondents) values.

3. Results

Most of the future teachers (71%) during the implementation of educational projects were not able to quickly solve problems using equipment and software that was not studied in the HEI, more than half of students (57%) had difficulties communicating with each other, could not work well in a team. On average, the quality of students' professional knowledge and skills was rated at 3.7 on a five-point scale.

During the conversation with the teachers who supervised educational projects and with senior students, it was established that the new environment caused by change of the team, duties, means and technologies of activity in the course of independent work, caused a lot of difficulties for students. According to the students, they felt "ashamed", "afraid of making a mistake or not being competent enough", "could not formulate their problems", "did not know where to get the necessary information", "could not deal with unfamiliar software", etc.

The summative stage involved a survey of second-year students. The questionnaire includes to identify the reasons for the choice of future teachers of the educational institution

and major, questions related to students' understanding of the phrase "project method" and the qualities that a successful specialist needs, as well as questions aimed at understanding the features of professional activities of teachers. The results of the questionnaires and additional clarifying interviews show that the majority of respondents who became students of the HEI did not focus on their own desires and abilities, but made a choice under the influence of parents and friends. The percentage of students who have formed a stable interest in the chosen profession by their age was only 9-15%.

A group of independent and competent experts, consisting of teachers, supervisors that participated in the experiment, were involved to objectively evaluate the results of the study. At the summative stage of the research, the levels of the subjectivity of future teachers and their professional competencies were determined. Figure 1 presents the identified levels of subjectivity.

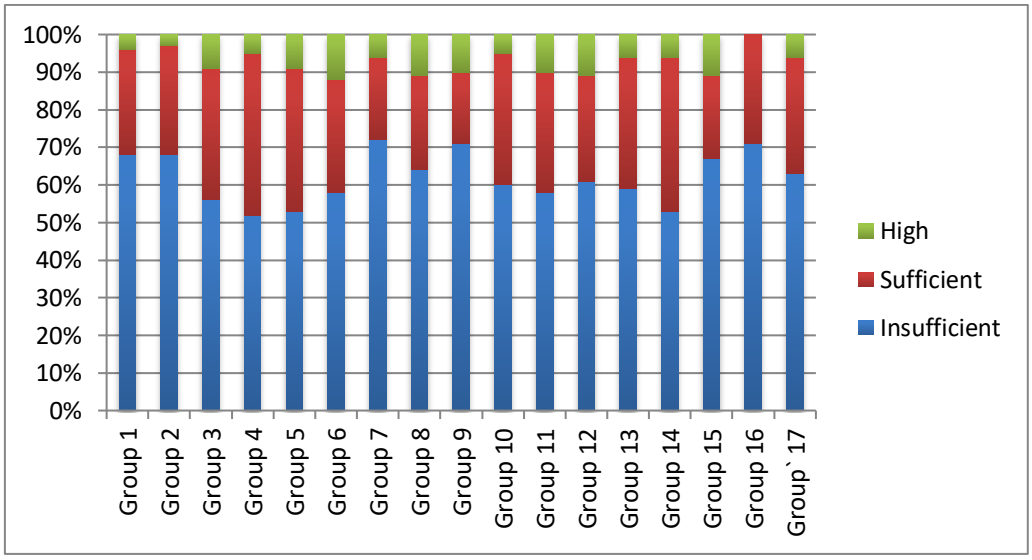

Figure 1. The results for the subjectivity level of future teachers (zero slice), %

The comparison of the data of control and experimental groups gave the following results, corresponding to the level of statistical significance equal to 0.10 (Figure 2).

The obtained results indicate the absence of significant differences in the subjectivity levels of students in the control and experimental groups at zero slice. The data obtained at the zero slice show that most students have a low subjectivity level of personality. In addition to the level of subjectivity of students, it is important for the study to establish the initial level of elements of professional competencies in students of the studied groups. Here we are consciously talking about the elements, as in the second year future teachers do not yet have

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a sufficient level of professional knowledge and skills, as well as a positive experience of their manifestation, which describes professional competence (Figure 3).

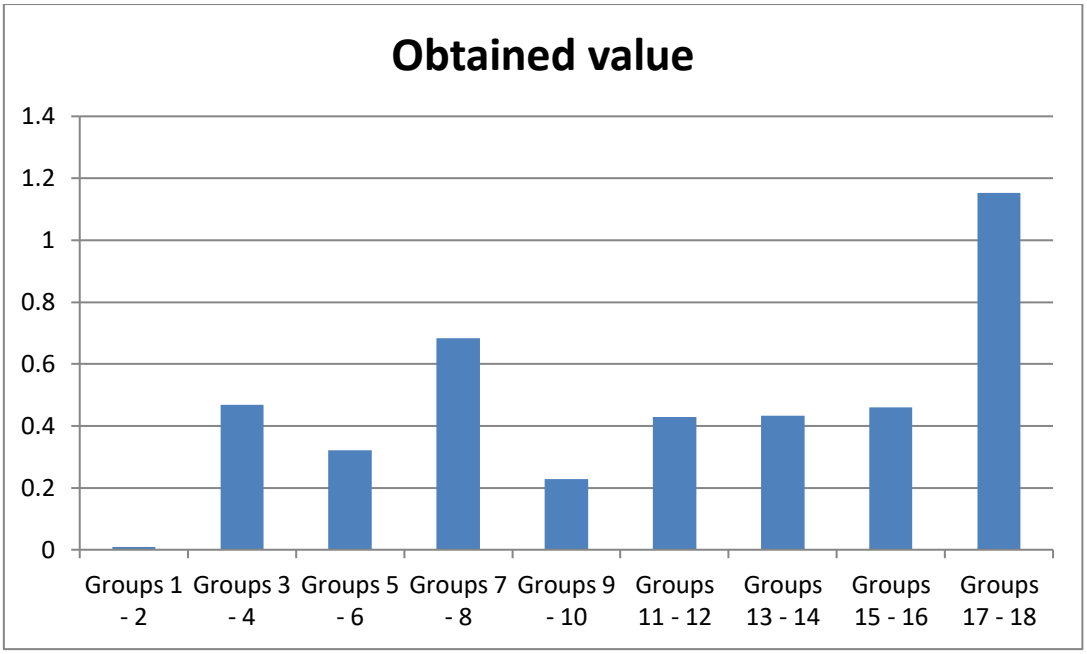

Figure 2. Empirical values of χ^2 of the control and experimental groups

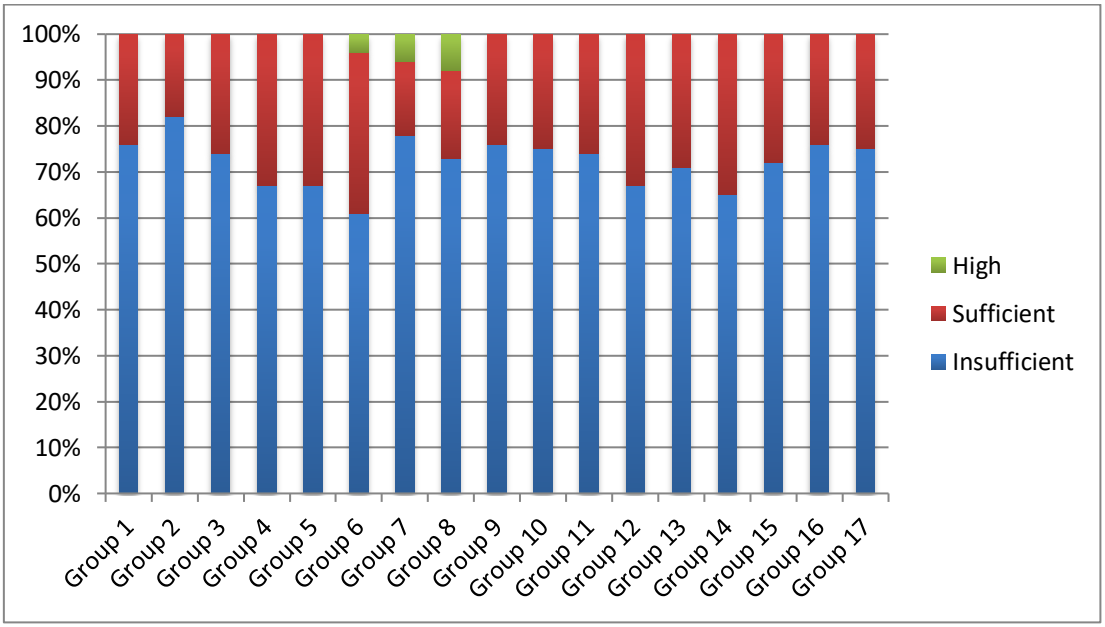

Figure 3. The results for the level of professional mobility in future teachers

When comparing the data of control and experimental groups, we obtained the following results corresponding to the level of statistical significance equal to 0.10 (Figure 4).

The obtained empirical values of χ2 indicate the absence of significant differences in the levels of professional competencies in students of control and experimental groups.

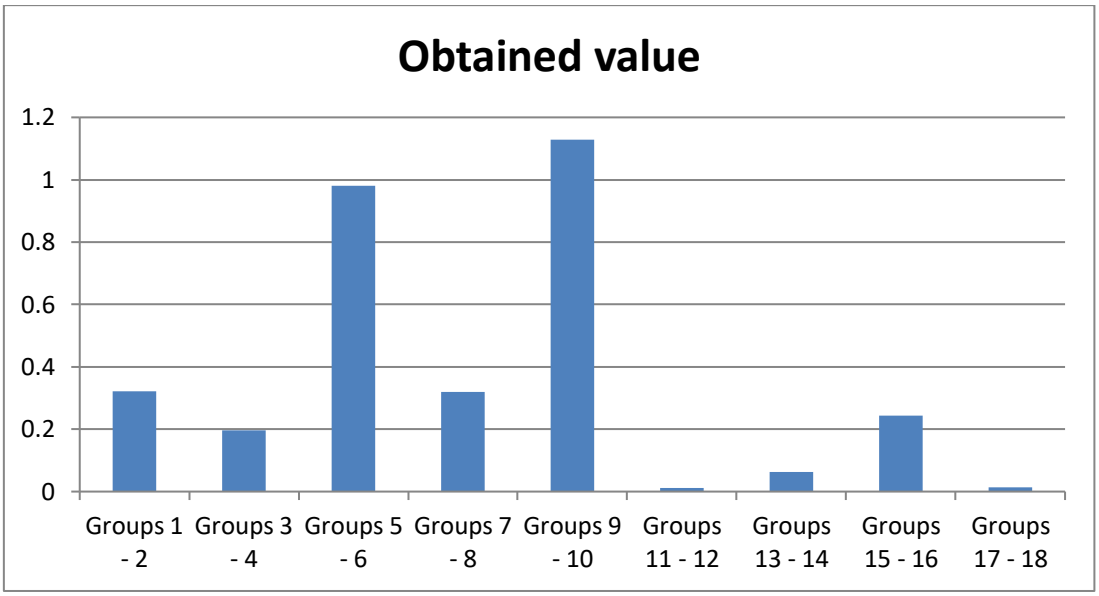

Figure 4. Empirical values of χ^2 of control and experimental groups

Pearson's correlation coefficient was used to measure the strength and direction of the relationship between the levels of subjectivity and professional competence. At the summative stage, the values of correlation coefficients r were obtained, which indicate positive relationships between the students' subjectivity and their professional competencies (Figure 5). The values obtained demonstrate a positive relationship between the subjectivity levels of students and their professional competencies in all studied groups.

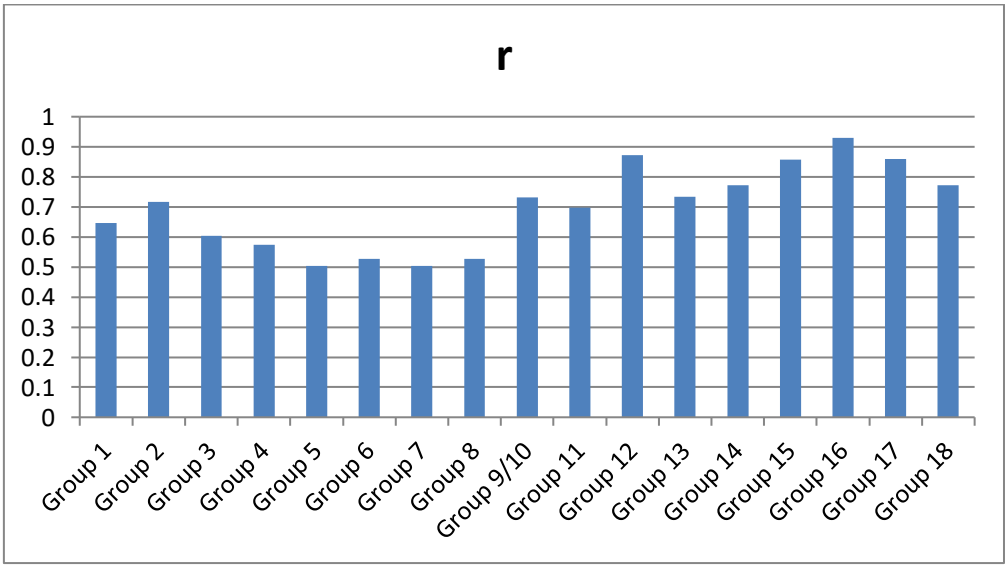

Figure 5. Empirical values of Pearson's correlation coefficient (r)

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The results of the diagnostic slice show a mostly low level of professional competencies in students of control and experimental groups. The need to study the identified problem is confirmed by the need to practice. Thus, according to the results of surveys conducted as part of the summative stage of the experiment, the importance of professional competence for future teachers is perceived by the majority of respondents (about 94%). Unanimity was also expressed on the following:

1) the need to show professional competencies in future teachers appears already in the period of practice in the specialty, organized on the basis of educational institutions;

2) the educational process of HEIs allows, without making significant changes in it, accumulating subjective experience of educational activities of future teachers as a factor in the development of their professional competencies (98% of respondents);

3) insufficient attention is paid to the development of professional competencies in the process of training future teachers (82% of respondents);

4) teachers involved in the training of future teachers would contribute to the development of professional competencies in students through the introduction of the project method, if they had developed and scientifically sound technologies (98% of respondents).

So, the summative stage of the study provided data on the low level of professional competencies and subjectivity in future teachers, and identified the reasons why these levels were insufficient:

1) insufficient focus on the future profession, lack of clear ideas about the features of future professional activity;

2) lack of clear ideas about the place of competencies in future professional activities;

3) insufficient level of self-organization and self-education skills;

4) lack of communicative experience due to interaction with various subjects of the educational process;

5) lack of experience in learning information on the subjects not provided for in the curricula;

6) the lack of systemic and purposeful work on the development of professional competencies of future teachers in-class, in extracurricular activities, in independent activities of students.

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The obtained results give grounds for the conclusion about the reasonability of making changes in the pedagogical process in order to develop professional competencies in future teachers.

The following scheme (Table 2) was chosen to test the effectiveness of certain pedagogical conditions for the effective implementation of the project method, taking into account the available capabilities of the pedagogical process.

Table 2. The scheme of checking the effectiveness of the proposed pedagogical conditions and their complex

Group	1	2	3	4	5	6	7	8	9
Conditions	1+2	1+3	1+2+3	1	1	2	3	1+2+3	2+3

According to the selected goals, the main objectives of the stage are:

1) determination of the direction of training of experts on general didactic and private methodical principles taking into account the purposes of a stage;

2) arrangement of the training conditions promoting effective subjective experience of educational and project activity of students;

3) training of specialists, which ensures the development of students' value attitude to active, independent educational and project activities as a prerequisite of success in future professional activities, organisation of students' mastery of educational and professional activities, development of skills of independent educational and project activities of future teachers;

4) Determining the levels of subjectivity and professional competencies of future teachers at the end of the adaptation and motivational stage (at the end of the first year of study);

5) Analysis of the results obtained in order to organise and implement corrective measures.

The adaptation and motivational stage is characterised to a greater extent by the subject—object relationship between teacher and student.

Therefore, in the first years of study teachers play the role of mentors, teaching general subjects and carrying out activities aimed at developing the experience of educational and project activities and elements of subjective experience.

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This leads to the use of the following methods in this period: persuasive conversations, persuasive demonstrations, excursions, observations, exercises (practical assignments), discussions and educational aids: visual (including videos), public resources. During the first stage of the development of professional competencies the teachers should provide comprehensive assistance to students in effective adaptation to the educational process, provide assistance in creating the prerequisites for the ability to organise students' independent effective educational and professional activities.

The result of the adaptation and motivational stage is:

1) students' understanding of the content of future professional activity, awareness of the importance of active, independent educational and project activities;

2) mastering of methods of educational and professional activity by students;

3) experience of independent educational and project activity of students;

4) identification of the level of subjectivity and professional competencies of future teachers at the end of the adaptation and motivational stage;

5) corrective measures taken.

The traditional education system is focused on mastering the mandatory minimum content presented in state educational standards. Within this content, students majoring in pedagogy master classical methodologies, approaches to curriculum development, classical teaching methods, technologies of organisation of interaction between participants of the educational process, etc.

4. Discussions

Thus, for the areas of professional training of teachers, whose activities involve participation in project activities or project management, a system is proposed in which the project method acts as the main means of learning, and its results — as an assessment tool. These results are confirmed by international studies by Postholm (2016). Having identified a product that is not only used for final certification in the HEI as a final result, but can also be presented to the employer to demonstrate professional training, we determined the structure, forms of training and basic assessment tools. This is also confirmed by the materials of the study by Bavčević et al. (2018). Decomposition of competencies can help determine the structure and content of the educational process, but considering this method as a basis for assessing the level of competencies, using it to justify the full preservation of

disciplinary or project approach in education will mean only endless movement in a circle. Cebrián et al. (2020) and Pöntinen and Räty-Záborszky (2020) expressed the same opinion in their articles.

The pedagogical principle "from simple to complex", the movement from knowledge and skills to competencies should be reflected in the organisational structure of training, which is proposed to include three levels: higher level — project training with the development and implementation of professional projects evaluated by employers, intermediate level — development of training and proto-professional projects, with their evaluation by top-level teachers and at Ukrainian student rating competitions, initial level — traditional disciplinary training, with the evaluation and formation of "orders" for the evaluated product by middle-level teachers. This idea of implementing the project method is confirmed in the works of Lee et al. (2021), Shuhailo and Derkach (2021).

The main problems of developing professional competence in future teachers were identified as a result of completing questionnaires, surveys of students and teachers, interviews with leaders of educational projects. In addition, the analysis of personal data and the results of surveys showed that teachers and future teachers themselves note the importance of the project method in acquiring professional competencies of future teachers, but purposeful work for the development of the studied phenomenon is not conducted in educational institutions. This is noted by Hüttel and Gnaur (2017) and Sadrina et al. (2018) in their studies.

The study took into account the gradual development of professional competencies in future teachers. At each subsequent stage of training, the methods and means of teaching changed in accordance with the change in the subjective experience of educational and professional activities of students. This is also reflected in the works of Bernate and Vargas (2020) and Ismailova et al. (2020d).

Conclusions

The research is topical because the educational process, which is based not on the logic of the subject, but on the logic of activities that have a personal meaning for the student, increases his/her motivation in learning; promotes the development of the necessary types of activities; deep, conscious development of basic knowledge due to their universal use in

different situations; development of creative potential, communicative skills. The organisation of research activities of students in the implementation of projects on specialised subjects — elective subjects — contributes to the effective development of a number of professional competencies in future teachers.

The development of professional competencies of future teachers was determined at 3 levels (insufficient, sufficient, high); the criteria for assessing the levels of the student's subjectivity (his/her activity, independence, responsibility, communication, creativity, self-organisation and self-assessment skills in educational and professional activities) and his/her professional mobility (motivational and value, cognitive activity, reflexive evaluation criteria), as well as evaluation scales were developed. The level of subjectivity and professional competencies of future teachers was assessed through surveys, observations, analysis of student's products of activity, Delphi technique and mathematical statistics.

At the generalising stage of experimental work, the reliability of the obtained results is proved by the chi-square test (χ^2) at the level of statistical significance of 0.01. It allowed drawing a conclusion about the reasonability of applying the proposed project model to develop professional competencies in future teachers when acquiring subjective experience of educational and professional activity with all three pedagogical conditions of its effective functioning.

The research will be a valuable source in the preparation of programmes for the implementation of project methods in the training of future teachers. Despite the wide interest in the introduction of innovative methods of education in the development of professional competencies, the application of the project method remains poorly covered in the domestic scientific literature. Further prospects for research include finding optimal mechanisms for implementing the project method in the educational process.

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