Development of students' information skills during project-based learning

O L Osadchuk¹, E V Lopanova²,⁴ and N V Savina³

¹ The Siberian State Automobile and Highway University, 5 Mira Ave., Omsk, 644080, Russia
² Private Educational Organization Institution of Higher Education “Omsk Humanitarian Academy”, 2A 4th Chelyuskintsev St., Omsk, 644105, Russia
³ Omsk State Pedagogical University, 14 Tukhachevskiy Emb., Omsk, 644099, Russia
⁴ E-mail: evlopanova@gmail.com

Abstract. The aim of the study was to experimentally test the effectiveness of pedagogical conditions for the development of information skills in students in project-based learning. The research methodology was presented by the competence-based approach, from the position of which information skills were considered as an important component of students’ information competence, the project activity of students was a way of forming information skills. The leading research methods were pedagogical experiment and expert assessment. It has been experimentally proven that the process of developing students’ information skills in project-based learning can be effective if: the subject of projects will be formed based on the content of academic disciplines, taking into account the direction of professional training; the type of project will characterize the dominant goal of the students' activity; the structure of the project will be determined by its type; students’ project activities will be carried out in the form of group independent work. The following methodologies were used: the methodology for assessing the projects completed by students, as well as the methodology for assessing the development of information skills among students. For the first time, the comparative analysis results of the various groups of information skills development among students - future teachers of different areas of professional training are presented. The results of the research can be used in the design of training sessions both in the social and humanitarian, and in the natural sciences and engineering disciplines at the university.

1. Introduction

In the context of the need to prepare students for life and activities in the information society, that is, according to the definition of H K Nath in “such a post-industrial society in which information plays a key role”, there is a need to form their information competence [1].

S I Osipova and A D Arnautov consider information competence to be key for modern specialists, since it ensures the productivity of their activities in various areas (professional, social) [2]. According to E A Kosorukova, information competence ensures the readiness of future specialists for professional activity and further self-realization in it [3].

New Russian standards of higher education presuppose the formation of students' universal competence related to working with information. Therefore, researchers are actively looking for
effective ways to develop students' information skills. Project-based learning can be a promising way to develop such skills.

This point of view is expressed by E Gabdrakhmanova, T Rusakova and T Morozova, who propose to teach students to design objects corresponding to the products of their future activities in the specialty [4].

At the same time, a problem is revealed that consists in the uncertainty of the pedagogical conditions for the development of information skills in students through project-based learning. In accordance with this, we have carried out the work, the results of which are presented in this article.

2. Literature review

The theoretical foundations for the implementation of the competence-based approach in education in Russian pedagogical science were developed by I A Zimnyaya [5]. In accordance with modern concepts, competence is a complex of knowledge, abilities, skills, experience required in any field.

A number of domestic researchers actualize the task of developing students’ information competence during the period of preparation at the university. Thus, E I Kazakova and I Y Tarkhanova indicate that specialists with a high level of information competence formation are in demand in the intellectual labour market [6]. Therefore, in their opinion, the development of students' skills to receive, process and use information using computers and other means is in the first place in the educational process of higher education.

A similar position is demonstrated by foreign researchers. For example, G-P Marciales-Vivas and H Castaneda-Pena emphasize that the development of information skills is now prominent in higher education, given the relevance of these skills to the information society [7].

At the same time, a generally accepted definition of the information competence concept is still absent in pedagogical science. There are two approaches that interpret information competence as an integrative result of professional training. However, these approaches differ in understanding how this result is generated. The first approach focuses on the use of information technologies and computer tools in the learning process, the second approach - on the process of working with information in any, not only digital, format.

The first approach is presented in the works of E N Strukov [8], O N Ionova [9], E K Henner [10] and others. Proponents of this approach actually equate information competence with computer competence.

The adherents of the second approach are V F Burmakina, M Zelman and I N Falina [11], Yu A Pavlova [12], D S Ermakov [13], E V Petrova [14], S V Trishina [15] and others. We share their views and understand the information competence of a specialist as the ability to implement information activities related to the processes of searching, receiving, transforming, accumulating and transmitting information in any format to solve personal, social or global problems.

In pedagogy, there are different opinions about the structure of information competence. For example, O N Griban describes the structure of students’ information competence as a set of competencies (terminological, information processing, use of computer technologies) [16].

N A Voynova and A V Voynov define the following components of information competence: knowledge of the features of information flows in the profession, possession of the skills to use technical devices, the ability to use computer technology, the ability to work with various information [17].

Taking into account the positions of these researchers, in accordance with the competence-based approach, we single out in the structure of information competence theoretical knowledge, practical skills, skills and experience of their use in the implementation of information activities.

We also share the point of view of V F Burmakina, M Zelman and I N Falina [11] and consider it possible to identify 14 information skills required for a specialist to solve 7 basic information tasks (definition, management, access, integration, assessment, creation, transfer). These skills are listed in table 2.

Questions related to the search for effective pedagogical methods of forming information competence in future specialists are highlighted in the works of domestic and foreign researchers. The
publications of E Spivakovska, N Osipova, M Vinnik and Y Tarasich [18], S Karas, O Ostrikova, M B Arzhaniak and I O Korneva [19] are devoted to the analysis of the effectiveness of the information and communication technologies use for the information competence formation in students at different universities.

There is a wealth of experience in applying the project method for various educational purposes in higher education. Design is defined by V S Zaitsev as a modern innovative teaching technology [20]. The special significance of design, according to A A Shkunova and K A Pleshanova, lies in its ability to improve the quality of the general and professional competencies formation [21]. Asbjornsen D J believes that project-based learning enables students to become innovators [22]. According to N P Nesgovorova, project activities have a pronounced social character, which is associated with obtaining a socially significant result, using complex types of communication with other people during the project [23]. N Dukakis and V Efthymios emphasize the benefits of project-based learning in the personal and social development of professionals [24]. O L Osadchuk (2014) presents experimental data on the effectiveness of the development of student independence through group research projects [25].

However, the pedagogical conditions for the development of students' information skills in project-based learning were not the subject of a special scientific search, which emphasizes the scientific novelty and practical significance of our empirical research.

3. Methodology
The methodological basis of the study was a competence-based approach, from the position of which: information skills are an important component of students' information competence; project activity of students acts as a way of forming information skills.

The object of the research was the process of developing students' information skills in project-based learning. The subject of the research was the pedagogical conditions for the development of informational skills among students in project learning.

The aim of the study was to experimentally test the effectiveness of pedagogical conditions for the development of information skills in students in project learning.

The hypothesis of the research contained the assumption that the process of developing students' information skills in project-based learning can be effective if: 1) the topics of projects will be formed based on the content of social and humanitarian disciplines, taking into account the direction of professional training; 2) the type of project will characterize the dominant goal of the students' activity; 3) the structure of the project will be determined by its type; 4) students' project activities will be carried out in the form of group independent work.

The research methods were pedagogical experiment and expert assessment. The pedagogical experiment was carried out in two universities in Omsk. The experiment involved 3 groups of students: Group I (future nursery teachers) and Group II (future teachers) from Omsk State Pedagogical University, Group III (future teachers of vocational training) from Siberian State Automobile and Highway University.

The assessment of the projects completed by the students was carried out according to the methodology of O L Osadchuk [25]. The assessment map of projects completed by students is presented in table 1.

| Table 1. Assessment chart for student projects. |
|-----------------|-----------------|-----------------|-----------------|
| Criteria        | Indicators      | Points          |
|-----------------|-----------------|-----------------|-----------------|
| Project quality | The topic disclosed and author's position are deeply | 3               | 2               | 1               |
| 1.1. Disclosure of the topic and author's position | The topic is fully disclosed, the author's position is not shown | Topic and author's position are not disclosed |
| 1.2. Scientific reasoning | Convincing reasoning is presented | Supporting reasoning is presented | Reasoning is not presented |

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To assess the development levels of students’ information skills, the methodology of Burmakina V F, Zelman M and Falina I N “Big Seven” was used [11]. The map for assessing the development of information skills levels among students is presented in table 2.

**Table 2. Chart for assessing the levels of development of information skills among students.**

| Tasks | Skills | Points |
|-------|--------|--------|
| 1. Definition | 1.1. Determine the information problem | The problem is clearly defined | The problem is not clearly defined | The problem is not defined |
| | 1.2. Identify information | All information is identified | Most of the information is identified | Information is not identified |
| 2. Control | 2.1. Identify sources | All necessary sources are identified | Insufficient number of sources is identified | Necessary sources are not identified |
| | 2.2. Select sources | Best sources are selected | Not optimal choice of sources | No sources selection is made |
| 3. Access | 3.1. Find sources | Matching sources are found | Sources weakly related to the problem are found | Random sources are found |
| | 3.2. Find the information needed | All the information needed is found | Some of the information needed is found | The information needed is not found |
| 4. Integration | 4.1. Arrange information | Information is arranged efficiently | Information is poorly arranged | Information is not arranged |
| | 4.2. Present information | Information is presented | Information is presented with minor gaps | Information is not presented |
| 5. Assessment | 5.1. Assess product quality | Product quality assessment criteria are clear | Fuzzy criteria for assessing product quality are selected | Product quality assessment criteria are not selected |
| | 5.2. Assess work efficiency | Efficiency of work is assessed objectively | Assessment of work efficiency was carried out formally | Performance assessment is not carried out |
| 6. Creation | 6.1. Solve the problem | The problem was solved completely based on the information received | The problem is partially solved | Проблема не решена |
| | 6.2. Make a conclusion about solving the problem | Conclusions are made based on the information received | The conclusions are partially based on the information received | Conclusions are not substantiated |
| 7. Transfer | 7.1. Extract information | Means, language of communication are adapted to the audience | Either the means or the language of communication is not adapted to the audience | The means and language of communication are not adapted to the audience |
| | 7.2. Transfer information | Own position is supported by correct links to authors | Statement of own position with citing text without respecting copyright | Transfer of information on your own behalf, without references to sources |
4. Results
The results of evaluating projects completed by students using the Osadchuk O L method [25] are presented in table 3.

Table 3. Grade chart for projects completed by students.

| Criteria                      | Indicators                                      | Excellent | Marks (%) | Satisfactorily |
|-------------------------------|-------------------------------------------------|-----------|-----------|----------------|
|                               |                                                 | I^a       | II^b      | III^c          | I^a | II^b | III^c |
| 1. Project                     | 1.1. Disclosure of the topic and author's position | 61        | 64        | 66             | 35  | 33   | 32   |
| quality                       | 1.2. Scientific reasoning                      | 33        | 35        | 38             | 59  | 58   | 52   |
|                               | 2.1. Design culture                             | 52        | 50        | 55             | 42  | 46   | 40   |
| defense quality               | 2.2. Culture of presentation                    | 39        | 42        | 44             | 53  | 51   | 50   |
| Average                       |                                                 | 46        | 47        | 50             | 47  | 46   | 44   |

* a Future nursery teachers.
* b Future teachers.
* c Future teachers of vocational training.

It was found that the experts-teachers gave the highest marks to students for the disclosure of the topic and the author's position, the lowest marks - for the scientific argumentation of projects. We explain this result as a subjective difficulty for students to search for supporting arguments, which is associated with the need to make efforts, to overcome their own passivity.

It was also found that the projects of future teachers of vocational training were rated the highest, the projects of future nursery teachers were the least highly rated.

The results of assessing the levels of development of information skills among students using the methodology of V F Burmakina, M Zelman and I N Falina [11] are presented in table 4.

Table 4. Levels of information skills development among students.

| Types of skills | Levels before / after the pedagogical experiment (%) |
|-----------------|------------------------------------------------------|
|                 | I^a | II^b | III^c | I^a | II^b | III^c | I^a | II^b | III^c |
| 1.1.            | 33  | 42  | 35/42 | 63  | 57  | 62/57 | 62  | 56  | 4/3   |
| 1.2.            | 24  | 30  | 25/32 | 26  | 30  | 79/67 | 79  | 65  | 79/67 |
| 2.1.            | 9   | 25  | 11/28 | 10  | 30  | 78/71 | 77  | 70  | 76/67 |
| 2.2.            | 7   | 20  | 9/24  | 8   | 22  | 73/68 | 73  | 66  | 73/67 |
| 3.1.            | 60  | 73  | 62/77 | 64  | 75  | 36/24 | 36  | 22  | 33/26 |
| 3.2.            | 62  | 65  | 64/68 | 65  | 70  | 35/33 | 34  | 31  | 36/29 |
| 4.1.            | 14  | 35  | 12/38 | 12  | 37  | 80/61 | 82  | 59  | 79/61 |
| 4.2.            | 13  | 36  | 11/40 | 10  | 38  | 81/61 | 81  | 58  | 80/60 |
| 5.1.            | 14  | 45  | 16/48 | 15  | 50  | 79/49 | 77  | 47  | 79/46 |
| 5.2.            | 32  | 40  | 35/46 | 33  | 44  | 62/54 | 57  | 51  | 62/52 |
| 6.1.            | 74  | 79  | 78/82 | 77  | 82  | 23/20 | 20  | 17  | 21/17 |
| 6.2.            | 65  | 72  | 64/77 | 62  | 75  | 31/25 | 32  | 20  | 33/23 |
| 7.1.            | 46  | 55  | 45/58 | 48  | 56  | 42/41 | 45  | 38  | 42/43 |
| 7.2.            | 39  | 44  | 44/45 | 42/46 | 53/53 | 50/53 | 51/52 | 8/3   | 6/2   |

* a Future nursery teachers.
The data were received that during the period of experimental work, the most developed skills of students were related to solving problems of access and creation; moderately developed - skills related to solving problems of definition, integration, assessment and transfer; poorly developed - skills associated with solving control problems. We explain the low level of skills associated with solving the control problem by its objective complexity for students, associated with the need to identify all sources of information possible for solving the problem and choose the best of them.

We found the positive dynamics of the information skills development levels among students of all experimental groups during the period of the pedagogical experiment. However, the greatest dynamics was recorded among students of group III (future teachers of vocational training). This result of assessing the information skills development levels among students is consistent with the above results of assessing the projects completed by students.

We explain this result by the specifics of the content of education received by future teachers of vocational training. This content has a dual focus (pedagogical and technical). This determines a large proportion of independent educational work of future vocational training teachers with various sources of information in comparison with the other two groups (future nursery teachers and future teachers).

The data obtained confirm the position of Murtuzaliyeva LS that the activity of teachers of vocational training is essentially informational activity [26].

5. Discussion

We connected the results obtained in the study with the content of the pedagogical experiment: it was the implementation of projects by students in social and humanitarian disciplines.

Student projects were thematic (carried out on the instructions of a teacher for a specific academic discipline) and at the same time were interdisciplinary in nature since they demanded the integration of certain knowledge and skills from various scientific fields.

When choosing project topics, the areas of professional training were taken into account. For example, a project on the theme “Colour perception” was presented with three options. Students of group I (future nursery teachers) were asked to complete a project on the theme “Colour perception by pre-schoolers”, Group II (future teachers) - a project on “Colour perception by schoolchildren”, Group III (future teachers of vocational training) - a project on “Colour perception by students”.

During the period of the pedagogical experiment, students carried out projects of various types. The type of project was characterized by the dominant goal of the students' activity. For example, the “Colour Perception” project, although it included research elements, was predominantly a practice-oriented project. It involved obtaining a specific product for use in practice (preparing a multimedia presentation of zoning the premises of an educational organization using colour). Although the project on the topic “Motivation of students” assumed the receipt of a certain product (presentation of the results of work in the form of a scientific report at a conference or scientific publication), it was, for the most part, a research project. It was aimed at gaining experience in planning, organizing, analysing the results of research activities.

The structure of the project was determined by its type. For example, a practice-oriented project included the following sections: social need; idea; terms of project implementation and expected results; staffing and material and technical support; costings; organization of external expertise. The structure of the research project was similar to the structure of scientific work. Such a project included the following sections: justification of the relevance of the selected topic; setting the goal and objectives of the study; putting forward a hypothesis with its subsequent verification using the selected methods; processing and analysis of the results obtained; formulation of conclusions and designation of further research prospects.

The project activities of students were carried out in the form of group independent work. Teachers provided advice to students and encouraged them to use various sources of information in the
implementation of projects: scientific literature, print press, television, Internet publications. All projects carried out by students involved working with information and its subsequent presentation to any social group (society, the teaching community, fellow students, etc.).

Thus, the experimental work carried out confirmed the effectiveness of the selected pedagogical conditions influence for the development of information skills in students in project learning.

6. Conclusion
In the context of the need to prepare students for life and activities in the information society, there is a need for the formation of their information competence.

We understand by the information competence of a specialist the ability to implement information activities related to the processes of searching, receiving, transforming, accumulating and transmitting information in any format to solve personal, social or global problems.

In accordance with the competence-based approach, we distinguish theoretical knowledge, practical skills, abilities and experience of their use in the implementation of information activities in the structure of information competence. We also consider it possible to identify 14 information skills required for a specialist to solve 7 basic information tasks (definition, control, access, integration, assessment, creation, transfer).

Comprehension of the materials presented in the scientific literature made it possible to single out the pedagogical conditions for the development of information skills in students in project-based learning, which were then tested in experimental work. We have received data that the process of developing students' information skills in project-based learning can be effective if: the topics of projects will be formed based on the content of academic disciplines, taking into account the direction of professional training; the type of project will characterize the dominant goal of the students' activity; the structure of the project will be determined by its type; students' project activities will be carried out in the form of group independent work.

Comparative analysis of the information skills various groups development among students of different areas of vocational training showed that the greatest dynamics of these skills was recorded among students of group III (future teachers of vocational training). We connected this result with the specifics of the educational content received by the students of this group.

The results of this study can be used in the design of training sessions in social and humanitarian, as well as natural science and engineering disciplines at the university.

References
[1] Nath H K 2017 The Information Society Space and Culture, India 4(3) 19-28
[2] Osipova S I and Arnautov A D 2017 Information competence of the future bachelor as an object of pedagogical analysis European social science journal 6 345-51
[3] Kosorukova E A 2014 Information competence as a basis for self-realization of future specialists Social and professional mobility in the XXI century ed G M Romantsev and V A Kopnov (Yekaterinburg: Russian state vocational pedagogical University Press) pp 74-7
[4] Gabdrakhmanova E, Rusakova T and Morozova T 2016 Training Design Studies Graduates to Deal with Professional Matters: Case-Study of A Competency-Based Approach Proceedings of INTED2016: 10th International conference on technology, education and development (Valencia: IATED Press) pp 8353-60
[5] Zimniya I A 2004 Key competencies as a result-target basis of the competence approach in education (Moscow: Research center for problems of quality of professional training) p 38
[6] Kazakova E I and Tarkhanova I Y 2018 Assessment of universal competencies of students in the development of educational programs Yaroslavl pedagogical Bulletin 5 127-35
[7] Marciales-Vivas G-P and Castaneda-Pena H 2015 Development of information skills in college: Approaches, models and intervention strategies Investigación bibliotecológica: índice acumulativo 29(65) 39-72
[8] Strukov E N 2008 Information competence as a condition for improving the quality of higher
education *Educational Technology & Society* 11(2) 355-60

[9] Ionova O N 2007 Theoretical aspects of formation of information competence of adults *Open and distance education* 1(25) 1

[10] Henner E K 2008 Formation of ICT competence of students and teachers in the system of continuing education (Moscow: Binom) p 188

[11] Burmakina V F, Zelman M and Falina I N 2007 *Big Seven (B7) Information and communication technology competence: Methodological guide for preparing teachers for testing* (Moscow: International Bank for reconstruction and development. National Foundation training. Center for the development of education ANH under the government Russian Federation) p 56

[12] Pavlova Yu A 2008 Pedagogical bases of formation of students' information activity skills and abilities at the University *Bulletin of Bashkir University* 13(2) 423-5

[13] Ermakov D S 2011 Information competence: getting knowledge from information *Open education* 1 4-8

[14] Petrova E V 2012 Information competence in education as a key to successful adaptation of a person in the information society *Information society* 2 37-43

[15] Trishina S V 2005 Information competence as a pedagogical category *Ides: an Internet journal* 9 1

[16] Griban O N 2015 Formation of information competence of pedagogical University students (Yekaterinburg: Ural state pedagogical University Press) p 162

[17] Voynova N A and Voynov A V 2004 Features of formation of information competence of University students *Innovations in education* 4 111-8

[18] Spivakova E, Osipova N, Vinnik M and Tarasich Y 2014 Information Competence of University Students in Ukraine: Development Status and Prospects. *ICTERI 2014: 10th international conference on ICT in education, research and industrial applications* (Kherson: Kherson state University Press) pp 194-216

[19] Karas S, Ostrikova O, Arzhanik M B and Korneva I O 2014 The development of information competences for medical students *Бюллетень сибирской медицины* 13(14) 47-52

[20] Zaitsev V S 2017 Project method as a modern teaching technology: historical and pedagogical analysis *Bulletin of the South Ural state humanitarian and pedagogical University* 6 52-62

[21] Shkunova A A and Pleshanova K A 2017 The organization of project activities of University students: the results of the scientific research and development prospects *Vestnik of Minin University* 4 4

[22] Asbjornsen D J 2015 The Development of Innovation Skills through Project Based Learning *International Dialogues on Education: Past and Present* 9 1

[23] Nesgovorova N P 2013 *Project technology in the professional activity of a teacher* (Kurgan: Kurgan state University) p 316

[24] Dukakis N and Efthymios V 2013 Adult vocational training and the project technique *Industrial and Commercial Training* 45(2) 99-109

[25] Osadchuk O L 2014 Group research projects in psychology as a means of developing cognitive independence in medical students *Omsk scientific Bulletin* 2(126) 133-6

[26] Murtuzaliyeva L S 2007 Development of information activity of the future teacher of professional training on the basis of information and educational environment *Siberian pedagogical journal* 11 117-23