

Building the Content of Teacher Training in the Context of Education for Sustainable Development

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Abstract: The article presents and justifies a technology for building the content of teacher training through sustainable development. Considerable attention is paid to environmental issues of society, which urge to change the philosophy of life and the mindset of people. The designed technology for building training content is primarily relevant owing to the need to implement the main concepts of sustainable development and introduce some novel approaches to teacher training. It can be implemented at three levels: degree programmes, curricula, syllabi. The level of building training content consists of such stages: defining expected learning outcomes for courses; outlining the information field of courses; compiling the basic educational material; determining didactic units of the main educational material; designing the structural and semantic model of the basic educational material; dividing the basic educational material into subjects. The article also presents the results obtained from the experiment conducted from 2015 to 2018. The research sample comprised 457 respondents (231 respondents in the control group (CG) and 226 respondents in the experimental group (EG)). The analysis of the obtained results shows that during the formative experiment the number of respondents with advanced (creative) level has increased by 5.82% in the EG compared with the CG; the number of respondents with intermediate (sufficient) level – by 5.18. The number of respondents with basic (reproductive) level has decreased by 11%. The differences between the CG and the EG are statistically significant ($\chi^2 = 8,276$), do not exceed the established limits and are at the level of $0.05 \leq p \leq 0.01$ ($5.991 \leq 8.276 \leq 9.21$).

Keywords: *content; teacher training; teacher; environment; sustainable development.*

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Introduction

Nowadays, one of the most thorny issues is the global environmental crisis, which is mainly caused by anti-environmental activities of the global population. On the one hand, society comprehends the need to change an attitude towards nature and strives to embrace a more environment-friendly way of living. On the other hand, progress in science and technology does not create proper ways to overcome the global environmental crisis. It calls for reconsidering approaches to nature and creating a new philosophy of life, moral and ethical standards, which must be laid down in society and determine educational policy. The implementation of this educational policy will contribute to shaping a new world perception of young people and a system of their value orientations aimed at protecting and preserving nature. An important role in this process belongs to the teacher. It must be noted that professional activities of general education teachers in terms of sustainable development has its own characteristics, namely productive collaboration with participants in the educational process and their interaction with each other. Taking into account theoretical principles of sustainable development and its aim to enhance human life, the teacher must motivate students and their parents to realize their educational goals, organize the educational process properly and provide appropriate conditions and resources for student development, help and support students in the process of implementing educational goals, consider their individual needs and capabilities and help them reveal their potential during the educational process, measure educational attainment. All this is necessary from the standpoint of sustainable development, which is not limited, however, to only environmental development of society and indeed reflects a rather simple but important idea of the need to achieve harmony between people, on the one hand, and between society and nature, on the other hand.

It must be noted that education is the most important base for sustainable development of the global population. This is confirmed by a declaration by the Environment Ministers of the region of the United Nations Economic Commission for Europe (UNECE) adopted at the Fifth Ministerial Conference “Environment for Europe” in Kyiv in 2003. The document states that education should aim to nurture the environment and promote sustainable development and peace (United Nations & Economic Commission for Europe, 2003). Therefore, all the countries were invited to cultivate sustainable development at all educational levels.

This was followed by the adoption of the Draft UNECE Strategy for Education for Sustainable Development at the first Regional Meeting in Geneva in 2004. Subsequently, on March 23, 2005, the UNECE Strategy for Education for Sustainable Development was adopted at the high-level meeting. It indicates that environmental aspects should be incorporated into other educational fields through an integrative approach towards education for sustainable development (United Nations & Economic Commission for Europe, 2005). This, in turn, requires a new generation of teachers, who should be able to promote sustainable development within the educational process. Therefore, it is necessary to introduce new approaches to teacher training, new models and methods of the educational process and, last but not least, update the content of teacher training.

The General Context of the Study

The Rio Declaration on Environment and Development (1992) aimed to promote new partnership through creating new levels of cooperation among countries, crucial fields, reinforce international agreements respecting interests of citizens and protecting the global environmental system, as well as recognize the interdependent nature of the earth (United Nation, 1992). It consists of 27 interrelated principles. Some of them are presented below:

1. It is crucial to help people to lead a healthy and harmonious life.
2. It is important to develop generations in the context of meeting environmental needs.
3. It is vital to eliminate poverty and enhance living standards worldwide.
4. It is necessary to ensure the protection of the environment.
5. It is essential to meet the environmental interests and needs of all countries.
6. It is obligatory to promote environment-friendly production and consumption to achieve sustainable development (United Nation, 1992).

In 2012, UNESCO defines sustainability as a way of thinking about the balanced environmental, economic and social development in the pursuit of sustainable development. The above-mentioned principles are regarded by the Organization as those which should guide all countries to outline goals of sustainable development and help them discover ways to accomplish these goals (UNESCO, 2012).

J. Porritt (2014) stated that the role of education consists in educating young people for “a world that has already ceased to exist”

(pp. 5–6). Yet, he indicated that the system of formal education is unable to deal with these challenges. An economy that many now believe is already collapsing under the weight of the social and environmental costs it now imposes on people and planet alike. According to J. Huckle & S. Sterling (2014), over the past decades years, ESD has been rather promoted all over the world. Indeed, it is reflected internationally, in government strategies in many countries, advocated and supported by UNESCO, incorporated into formal and non-formal education, educational policies and practices.

A sourcebook on ESD developed by UNESCO (2012) contains relevant information for primary and secondary teachers, mid-level decision-makers and teacher educators such as how to integrate ESD in primary and secondary schooling and thus ensure sustainable development of society. They indicate that curricula should be reoriented towards sustainability and therefore identify the prospects of sustainable development.

Traditionally, the content of teacher training contained a system of knowledge of the past and the present, as well as the experience of previous generations. It is essential to adjust the content of teacher training to the latest advances in the field to consider the needs of modern generations. This will enable them to develop their ability to plan a scheme for developing society and ecosystems, anticipate the consequences of their actions for the future and make responsible decisions, think critically and be willing to act and live under rapidly changing environmental and socioeconomic conditions.

J. Huckle (2012) indicates that modern teachers, who are ready to promote ESD should be able to critically analyze the structures and processes, which shape the development and underdevelopment of societies within they teach and, most importantly, benefit from the use of ICTs in the educational process to change the mindset of modern students in favour of cultivating ecological culture.

Filho & Pace (2016) believe that it is a rather important aspect of higher education to prepare future specialists for further employment. However, programmes for ESD should embrace a wider target and prepare future specialists to deal with an unpredictable future. To do this, they suggest developing the skills mentioned by D. Iliško, A. Skrinda & I. Mišule in their research (2016): problem-solving, critical thinking, collaboration skills, creative skills, communication skills, innovation skills, self-direction, etc. K. Shephard (2015) argues that curricula on sustainability have not yet become top-priorities of educational strategies in terms of higher education today. Traditional ESD is still striving to become a thorny issue of higher education and be incorporated into its general agenda.

According to Barth et al. (2015) universities as research centres and teaching institutions help with discovering and disseminating relevant knowledge and encouraging future decision-makers to strive for a sustainable future. The scholars assure that sustainable development can help universities to grasp the complexity and uncertainty of diverging norms and values and thus cope with them. Besides, it can launch systemic changes and transform the thinking and learning of future teachers.

A. Leicht, J. Heiss & W. J. Byun (2018) state that education must highlight such issues as poverty, climate change, environment-friendly production and incorporate these issues in the contexts of curricula to prepare future teachers to understand the changing world and be ready to cope with the existing environmental and developmental challenges. Consequently, learning outcomes should include the following competencies: decision-making, systemic thinking and taking responsibility for modern and future generations.

Therefore, the content of teacher training should be based on the following:

- fostering future teachers' confidence in their skills and capabilities and responsibility for the results of the educational process;
- preparing students to make responsible decisions about their lifestyles and implement them;
- creating comfortable psychological conditions for learning by providing free access to the content of teacher training and relevant teaching methods;
- creating relevant psychological and pedagogical conditions for encouraging future teachers to interact with participants in the educational process, the environment and teaching them to appreciate the results of such interaction.

Methods

The following research methods were used:

- *theoretical methods*: a logical analysis of scientific researches; induction, deduction, synthesis and generalization – to justify theoretical and methodological framework of research; modelling – to build the content of teacher training; generalization – to formulate conclusions and recommendations for building the content of teacher training in the context of ESD;

- *empirical methods*: archival research (study and analysis of syllabi, curricula and degree programmes for future teachers and their professional

performance); survey and diagnostic methods (questionnaires, tests, interviews) – to identify the level of future teachers' preparation; experimental methods (searching, ascertaining, formative and summarizing stages of pedagogical experiment) – to identify the level of future teachers' preparation at different stages of research;

- *methods of quantitative and qualitative analysis* and *mathematical statistics*: graphical methods – to visualize research findings; frequency analysis – to calculate the distribution of future teachers by levels of preparation for professional life; a statistical test applied to sets of categorial data (Pearson's chi-squared test (χ^2)) – to evaluate the reliability of the differences between the CG and the EG.

Experimental data were statistically compiled with the help of the Statistical Package for the Social Sciences (SPSS) and Microsoft Excel.

Participants and Procedure

This section deals with the requirements and results of building the content of teacher training in the context of ESD at three levels: degree programmes, curricula, syllabi.

Within this research, a degree programme is regarded as a system of educational components at the appropriate level of higher education, which identifies the requirements for education level of those individuals who can be admitted to this degree programme, the list of academic courses to be studied, total number of ECTS credits required for this degree programme, as well as expected learning outcomes (competencies).

When building the content of *a degree programme*, the following requirements must be taken into account: compliance with professional standards / higher education standards, the requirements of the labour market and the needs of society, in particular in the context of sustainable development; incorporation of relevant components of professional competency; correspondence of learning outcomes with these components; correspondence between learning outcomes and academic courses; the timing of their studying; no repetition of the content. In the context of ESD, the implementation of the degree programme should be aimed at developing the following abilities: the ability to preserve and multiply natural resources and the ability to cultivate an ecological culture in students.

On the one hand, the degree programme serves as the basis for building *a curriculum*, which is traditionally understood as a document containing the list of academic courses and defining the timing of their studying and the number of hours allocated to it. On the other hand, the

curriculum is a document, which reflects the specific content of the degree programme and regulates the process of teacher training. Thus, the current research considers the curriculum to be a normative and regulatory document, which characterizes the specifics of training content and the features of the educational process organization.

Therefore, the process of building teacher training curricula should involve the following elements: 1) the general characteristics of the curricula, namely goals and strategic guidelines for building the content of teacher training; 2) scientific ideas (principles) incorporated into the structure and content of the curricula; 3) the description of syllabi incorporated in the structure of the curricula; 4) the features of compulsory and optional components; 5) expected learning outcomes.

The process of building the content of a *syllabus* corresponds to the third level and adheres to a particular algorithm (see Fig. 1).

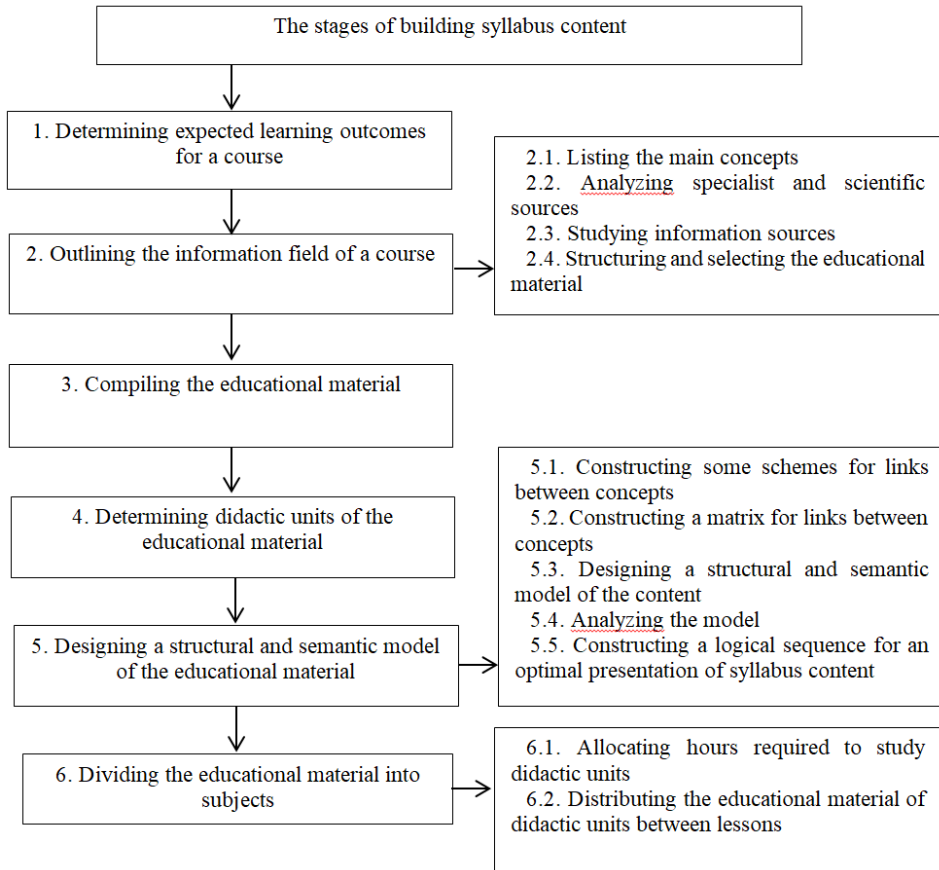


Fig. 1. The algorithm of building syllabus content

Thus, the implementation of the proposed algorithm for building syllabus content begins with *defining expected learning outcomes*, namely goal-setting. Only when they are clearly defined, one can plan the sequence of educational activities aimed at their achieving. The process of goal-setting is rooted on activity-based and developmental approaches, that is the goals of any course are determined through a set of observed actions aimed at developing the personality of a future specialist and his/her professional competency in the context of ESD. It makes it possible to build learning through actions and evaluate and monitor the process of achieving the goals. When defining expected learning outcomes of any course, the following requirements should be taken into account: testability and integrity, expediency and relevance (see Table 1).

Table 1 - Expected learning outcomes on the example of the course “Professional Interaction in Professional Activities”

Didactic goal	Required level of actions formation	Didactic tasks	
		Educational tasks	Developmental tasks
Ability to characterize pedagogical interaction in pedagogical activities	Independently	Have knowledge about: – the essence of pedagogical interaction and its types; – mechanisms of pedagogical interactions and ways of its implementation; – principles of pedagogical interaction;	Develop one’s skills in analysis and comparison of objects, as well as generalization and expression of one’s opinions.
Ability to choose strategies, ways and types of interaction, as well as methods of pedagogical influence, optimal for certain conditions	Independently	Have knowledge about: - forms of pedagogical interaction and their description; –strategies of pedagogical interaction; – pedagogical influence and ways of its implementation;	Develop one’s skills of generalization, systematization and determination of optimal ways of interaction under certain conditions
Ability to establish pedagogical interaction with the participants in the educational process	Independently	Have knowledge about: – the essence of pedagogical ethics and tact, their importance in the establishment of	Develop one’s skills of analysis, generalization and assertion of one’s opinions.

		<p>pedagogical interaction; – barriers which may occur in the course of pedagogical interaction and ways of overcoming them; – the characteristics of pedagogical interaction with pupils' families; – types of conflicts in the educational process, their stages and ways of their intervention</p>	
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At the second stage, one should *outline the information field* of a course. To this end, it is necessary to list the main concepts, analyze specialist and scientific sources, study information sources, structure and select the educational material following the list of the main concepts. It is important to take into consideration only relevant sources and effectively process them to compile the necessary educational material and thus implement the goals of a course. It is also crucial to analyze the links of the educational material within a course related to other academic courses and subjects to implement interdisciplinary connections. When well established, they contribute to implementing an interdisciplinary approach in the educational process. This makes it possible to compile *the main educational material* and avoid duplicating its content.

The method of analyzing the educational material structure includes dividing them into components, identifying and optimizing informative logical connections between them and, subsequently, planning the timing of their studying. Therefore, the next stage of building syllabus content involves *determining didactic units of the educational material*.

Within this research, a didactic unit (DU) is viewed as a logically independent array of educational information, which preserves characteristics of the educational material. For convenience, each didactic unit is assigned a number. Their names reflect their essence and, therefore, both the number and name of didactic units are written as follows: DU 1 – the concept of pedagogical interaction in the context of ESD. At this stage, the content of each didactic unit and its characteristics (the levels of abstraction and knowledge formation, as well as the degree of novelty) are determined.

The next stage of building syllabus content involves *designing a structural and semantic model* of the educational material to determine the sequence of presentation of didactic units. This makes it possible to identify the internal connections between didactic units of the educational material. The structural and semantic model is designed with the help of graphical methods. The first stage of designing the model involves constructing a scheme of interconnections between the concepts, namely the initial graph for didactic units (see Fig. 2).

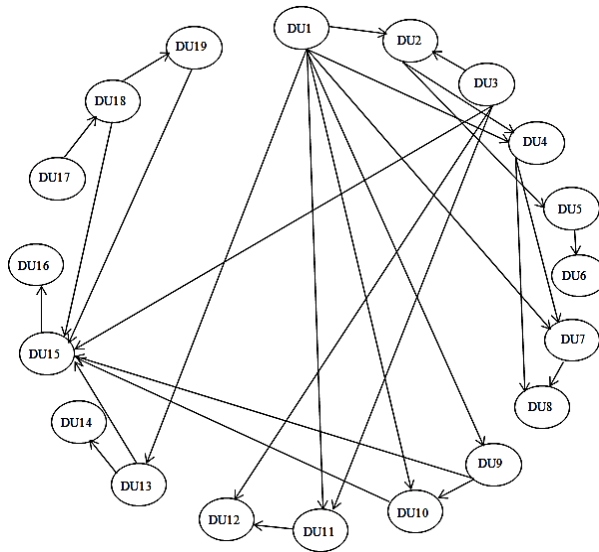


Fig. 2. The pattern of the initial graph for didactic units within a course

At the second stage, one should construct a matrix of links between didactic units (see Table 2). The matrix's dimension corresponds to the number of didactic units.

Table 2 - The matrix of links between didactic units (DU) within a course

No of DU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	W_b	
1	0	1	0	1	0	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	7
2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	4
4	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Having determined the main distributed layers of didactic units within the content of the educational material, the structural and semantic model of the educational material is designed (see Fig. 3). Its analysis makes it possible to construct an optimal sequence for presenting syllabus content (see Fig. 4). It must be noted that the constructed sequence for presenting didactic units may differ from the one adopted before.

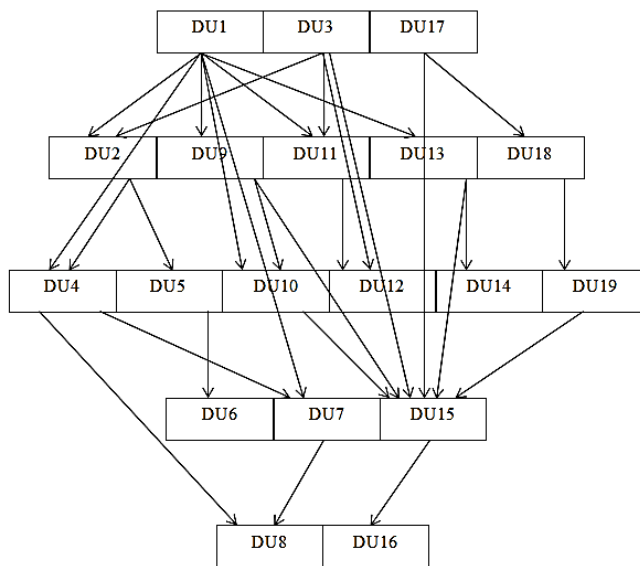


Fig. 3. The pattern of a structural and notional model of course content

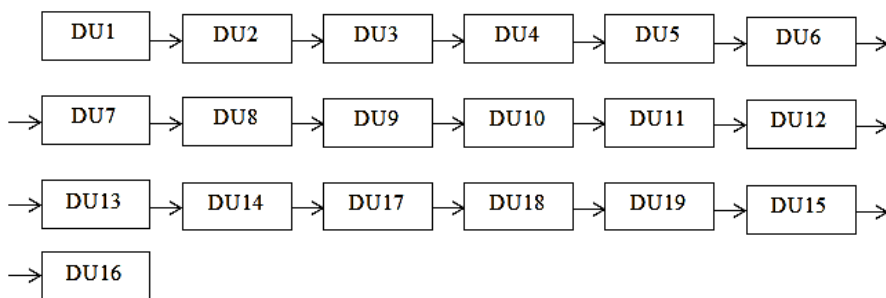


Fig. 4. The pattern of the most optimal sequence for presenting syllabus content

The final stage of building syllabus content involves *preparing a preliminary subject plan* for studying a course. To do this, it is necessary to

calculate the time required for mastering didactic units and to distribute their content between lectures and practical classes.

The time required for mastering each didactic unit is calculated according to the formula below:

$$T_{DU}^i = T_{min} (K_n K_a K_{kowl}) \quad (2),$$

where T_{min} – the minimum time required for mastering a didactic unit;

K_n – the coefficient of novelty, which is equal to 0.25 for familiar didactic units; 0.5 – for partially familiar didactic units; 1 – for unfamiliar didactic units;

K_a – the coefficient of abstraction, which accepts a certain value following the level of abstraction. Thus, it is equal to 1 for the phenomenological level, 2 – for the analytical and synthetical level; 3 – for the prognostic level, 4 – for the axiomatic level;

K_{kowl} – the coefficient of knowledge formation level, which accepts a certain value following the level of knowledge formation. Thus, it is equal to 1 for the basic level, 2 – for the conceptual and analytical level, 3 – for the productive level.

The total time required for mastering all didactic units is determined by calculating the amount of time of all didactic units. The time required for studying educational material is thus approximate. Such calculation, however, makes it possible to distribute didactic units between individual lessons, taking into account the level of knowledge, novelty and abstraction, as well as to present the educational material in a logical sequence and to determine the goals and teaching methods of the lesson.

The process of building the content of teacher training in the context of ESD is based on the fact that it should take into account specific conditions of professional activities and the potential of future teachers. Also, it is necessary to take into account the requirements for teacher training in the context of ESD, as well as the characteristics of the course they will teach.

The conducted experiment aimed to determine the criteria for evaluating the levels of future teachers' preparation; to conduct the formative experiment with future teachers to identify their level of preparation for professional activity; to build and theoretically justify the content of teacher training in the context of ESD; to develop and verify syllabi content of teacher training in the context of ESD; re-evaluate and generalize the obtained findings.

The experiment was conducted from 2015 to 2018 included four stages: searching, ascertaining, formative and summarizing stages of the pedagogical experiment.

At the searching stage, the problem of building the content of teacher training was studied in the context of pedagogical theory and practice. In particular, philosophical, psychological and pedagogical, cultural and methodological sources were analyzed; normative, educational and methodical documents and theses were justified. Methodological, psychological, pedagogical and methodical sources made it possible to identify the main approaches and requirements for building the content of teacher training in the context of ESD.

The ascertaining experiment was conducted in higher education institutions. Experimental work was performed following the designed and justified research methodology. The programme of the experiment included evaluating the effectiveness of the existing ways to build the content of teacher training in the context of ESD by determining the level of future teachers' preparation for professional activity; mathematical processing of the results obtained during experimental work.

In the course of the research, the following levels of future teachers' preparation were identified: the basic (reproductive) level – it indicates that future teachers have mastered the basic principles of professional activity and can establish the interaction with participants in the educational process and nature in general; the intermediate (sufficient) level – it characterizes future teachers' readiness to solve educational problems independently during the interaction with the participants in the educational process and nature; the advanced (creative) level – it indicates that future teachers can creatively solve educational tasks in standard and non-standard situations based on the collaboration.

When organizing the pedagogical experiment, the required number of experimental objects and subjects was determined, as well as the duration of the experiment, which was prolonged in time and of the monitoring nature. It made it possible to modify the course of the experiment and its conditions. During the experiment, the same conditions were provided for all its participants. Special attention was paid to the selection of criteria and indicators for identifying the level of future teachers' preparation for professional activity. The main requirements for conducting experimental work include ensuring the validity and reliability of experimental data.

The research sample comprised 457 respondents (231 respondents in the control group (CG) and 226 respondents in the experimental group (EG)).

The formative experiment aimed to verify the process of building the content of teacher training in the context of ESD, to determine the level of formation of future teachers' professional knowledge and skills and to verify the homogeneity of two empirical samples (in the CG and the EG) with the help of Pearson's chi-squared test (χ^2).

At the summarizing stage, conclusions were formulated and methodical recommendations for building the content of teacher training in the context of ESD based on the obtained research findings.

Results and Discussion

Thus, the results obtained from ascertaining and formative stages of the experiment were compared to prove that during the formative experiment the level of future teachers' preparation in the CG and the EG has increased statistically significant. we compared (see Table 3). Subsequently, the dynamics of levels of professional-pedagogical knowledge formation based on the established levels of preparation was determined.

Table 3 - Comparative Results on Diagnostics of Future Teachers' Preparation Levels at Ascertaining and Formative Stages of Experiment

Experiment stages	Groups	Levels of knowledge formation						χ^2
		Primary (reproductive)		Basic (sufficient)		High (creative)		
		%	EG-CG	%	EG-CG	%	EG-CG	
Ascertaining stage	CG	36.28	+1.33	39.48	+0.17	24.24	+0.5	0.164
	EG	37.61		39.65		22.74		
Formative stage	CG	26.84	-11	41.99	+5.18	31.17	+5.82	8.276
	EG	15.84		47.17		36.99		

Based on the data presented in Table 3, the diagrams for the CG (Fig. 5) and the EG (Fig. 6) constructed to illustrate the dynamics of changes in the levels of future teachers' preparation.

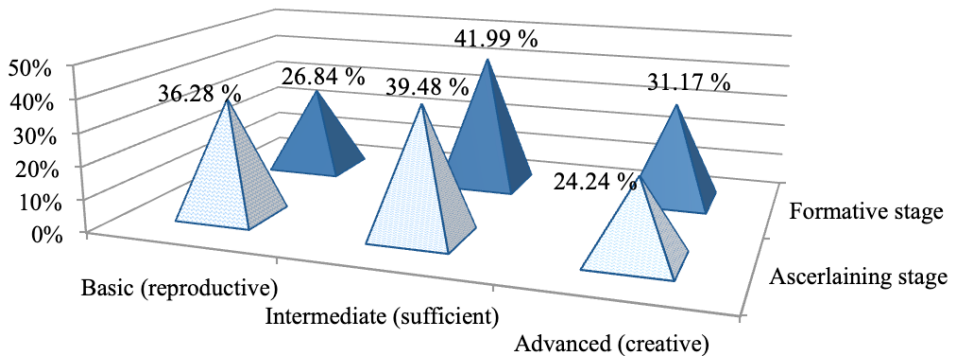


Fig. 5. Formation levels dynamics of future teachers' professional pedagogical knowledge and skills in the CG

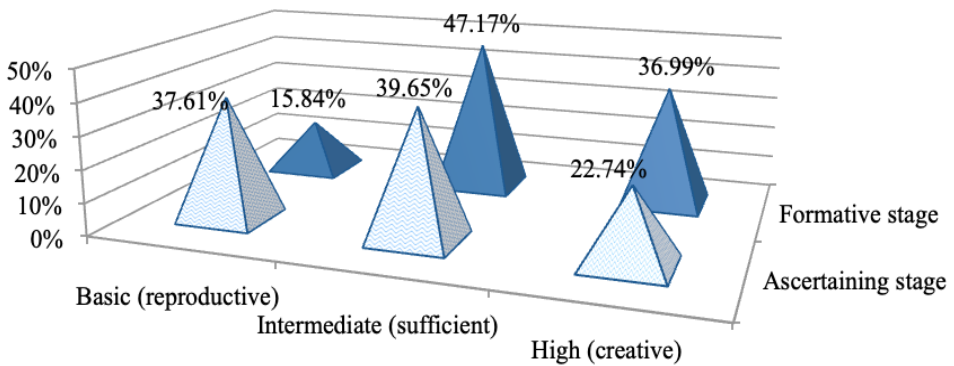


Fig. 6. Formation levels dynamics of future teachers' professional pedagogical knowledge and skills in the EG

The analysis of the diagrams shows that the increase in indicators of high (creative) and basic (sufficient) levels and the decrease in indicators of primary (reproductive) level are more pronounced in the respondents from the EG. During the formative experiment, the number of respondents with advanced (creative) level has increased by 5.82% in the EG compared with the CG; the number of respondents with intermediate (sufficient) level – by 5.18. The number of respondents with basic (reproductive) level has decreased by 11%. The differences between the CG and the EG are statistically significant ($\chi^2 = 8,276$) and do not exceed the established limits and are at the level of $0.05 \leq p \leq 0.01$ ($5.991 \leq 8.276 \leq 9.21$). Therefore, the results of the formative

experiment prove a significant increase in the levels of formation of future teachers' professional pedagogical knowledge and skills.

Conclusions

Therefore, when clearly justified and built properly, the content contributes to the effectiveness of teacher training and is implemented at three levels, namely degree programmes, curricula and syllabi. The main stages of building training content include identifying learning outcomes for courses; outlining the information field of courses; compiling the basic educational material; determining didactic units of the basic educational material; designing the structural and semantic model of the basic educational material; dividing the basic educational material into subjects. The way of building the content of teacher training in the context of ESD can enhance the level of future teachers' preparation for professional activity based on the principles of sustainable development, improve their collaboration with participants in the educational process and their interaction with each other. Teacher training in the context of building training content based on the principles of sustainable development will help to achieve harmony between people, on the one hand, and between society and nature, on the other hand, and create a generation of teachers with a new philosophy of life rooted in the idea of preserving and enriching nature and fostering interaction between nature and people.

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