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Evaluating the Effectiveness of Sustainable Development Goals Integration into the Future Geography Teachers' Education

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ABSTRACT: This study evaluated the effectiveness of implementing training materials and SDG activities for future geography teachers. The experimental discipline "Climate Change and its Consequences" was developed and implemented. The sample of participants in this study consisted of 121 3rd and 4th-year students with experience in teaching practice. The renting method checks the methodology's effectiveness according to the "Knowledge in the Field of Sustainable Development Goals" questionnaire before and after introducing the discipline. During one semester, the participants completed the course, and they were also provided with SDG-oriented webinars on the topic "Geographical Analysis of the Sustainable Development Goals" and events (Brain-ring and Olympiad). When studying the literacy rate according to the SDGs, 121 respondents showed an average increase in results by an average of 13.6% with a p-value of 0.049 ($p<0.05$). The results obtained indicate the effectiveness of this practice. This represents essential information for education and sustainable development.

Keywords: SDG, geographical education, evaluation, teacher self-efficacy, climate change.

I. INTRODUCTION.

According to the United Nations (UN), today, humanity is actively destroying the environment and natural resources. At the beginning of the 48th session of the Human Rights Council, the UN High Commissioner for Human Rights, Michelle Bachelet, named three planetary threats: climate change, environmental pollution, and destruction of nature [1, 2]. The global vectors of the UN are water resources, climate change, world ocean, nuclear energy, child development, health, and others; environmental issues account for more than 40% of the UN tasks [3]. UN Council recognized the human right to a clean environment for the first time in 2021, and resolutions on the human right to a healthy and clean external environment were adopted at the UN European office in Geneva [4]. Although the UN highlights environmental issues as global priorities, accounting for over 40% of its agenda, there is limited research on how these are integrated into national education systems. This study addresses that gap through the lens of geography teacher training.

The Sustainable Development Goals (SDGs) adopted in 2015 in Paris, consisting of environmental, social, and economic sectors, cover all spheres of humanity. To develop a pro-environmental attitude, it is vital to

teach these SDGs. Education for Sustainable Development is a complex and constantly evolving concept. The quality of modern education depends on the level of satisfaction when education meets the existential needs of the individual and society. At the beginning of the 21st century, these needs include preserving the environment for both present and future generations.

Since the management and interaction between people and the biosphere requires balancing economic, social, and environmental requirements, education should assist society in these matters and in building a fair, harmonious world. Sustainable development can be conceptualized pedagogically as a system of philosophical concepts, scientific knowledge, skills, and values shaped at all stages of individual human life, from preschool to adult education. Considering the importance of SDGs implementation in the system of geography teacher training in Abai Kazakh National Pedagogical University, the discipline "Climate Change and its Consequences" was introduced. The research team also conducted SDG-oriented activities. To assess the effect of using these integrated measures for ESD development, we set the following research objectives:

- Will the delivery of SDG-oriented courses, webinars and activities be effective in developing the literacy of future geography teachers?
- Does this work change the methodological approaches of future geography teachers in teaching SDGs?
- How vital are self-efficacy and personal development of future teachers in achieving sustainable development?

Despite widespread global endorsement of the Sustainable Development Goals (SDGs), their effective integration into geography teacher education curricula remains limited and insufficiently studied. While education is recognized as a key driver for achieving sustainability, there is a gap in understanding how future geography teachers are being prepared to teach SDG-related content. This study addresses this gap by exploring the development of self-efficacy and methodological preparedness among geography education students through targeted SDG-based interventions and curriculum innovations.

This study directly supports SDG 4.7, which focuses on ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, including education for sustainable development (ESD) and global citizenship. By enhancing the literacy and self-efficacy of future geography teachers in Sustainable Development Goals, the research contributes to achieving quality education that fosters sustainability. Moreover, the study also aligns with SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities) through the integration of related national policies and education reforms, promoting inclusive and equitable learning environments.

II. LITERATURE REVIEW

Following the Sustainable Development Goals, the modern world harmonizes to balance social, economic, and environmental imperatives. Our research is guided by UNESCO documents, which have recognized ESD as a critical tool for achieving sustainable development and increasing public awareness and understanding of SD principles [5]. As noted in the Reference Paper prepared for the Global Education Monitoring Report 2017-2018, teacher education can contribute to increasing understanding of SDGs within education [5]. In this regard, we believe that the role of schoolteachers in educating the younger generation is significant, as only education allows each individual to acquire the knowledge, skills, attitudes, and values necessary to create a sustainable society. School teachers are called upon to introduce sustainable development ideas into general education by providing materials on sustainable development and facilitating the formation of students' skills and competencies to achieve the SDGs.

Pauw et al. presented the results of an evaluation of the impact of a professional development program on ESD for compulsory schoolteachers in a Swedish municipality [6]. Given the challenges for teachers to integrate ESD into educational practice, continuous professional development is necessary, and evaluation of such initiatives is crucial. The study has clear strengths, particularly its longitudinal nature and the intertwining of the design with workshops and surveys. However, we must also recognize several limitations. First, this study only has quantitative data from participants reflecting their competence and practice. As with all data collected through surveys, there may be cognitive bias here; for example, some teachers may misunderstand some subjects. Second, personal identifiers were not used. Personal identifiers

would have allowed more sophisticated analysis of the evolution of dependent variables over time (latent growth analysis, cluster analysis). Also, the article suggests that ESD promotes competencies such as critical thinking, envisioning a better future, and shared decision-making. However, the researchers note that due to the complexity of ESD in terms of educational goals and principals, teachers feel unprepared to apply it in their schools and their teaching [7]. Ferguson et al. presented the development of systems thinking and citizen participation in realizing sustainable development ideas [8]. This study used a survey to gather the views of 296 teachers from 12 secondary schools in rural and urban areas of Jamaica. The data showed that the views of most of the teachers demonstrated systems thinking. However, the study also showed that teachers were less likely to associate citizen participation with sustainable development, which is also an unresolved issue.

On the other hand, Kang notes that teacher education institutions should try to train future teachers to acquire competencies in ESD, and in-service training courses in ESD should be developed [9]. Several significant findings from this study contribute to understanding teachers' perceived barriers to ESD waiting to be addressed. For example, one barrier is that many teachers are unclear about the relevance and impact of their efforts to implement ESD. Lack of knowledge and the need to constantly update teaching materials and learn new methodological approaches also influences teachers' choices not in favor of ESD implementation. Kang's survey of Korean teachers revealed that one of the main obstacles to implementing ESD in educational practice is the lack of pedagogical knowledge and competence.

Researchers from different countries have identified various psychological reasons for teachers' reluctance to use sustainable development learning materials in their subjects actively. Teachers' readiness to teach for sustainable development is the most critical criterion in assessing the effectiveness and quality of teacher training and retraining. The results of previous studies show that it is vital to address critical issues related to the global education project of ESD. The research presented above focuses on critical educational research on ESD and shows why it is crucial to ask critical questions about the implicit ideas of education for sustainable development. We have tried to include these unresolved questions in our research where possible. To train geography teachers in sustainable development, we considered it necessary first to define the criteria for assessing effectiveness and quality. For this purpose, it is important to highlight two essential components of this problem: the analysis of the content of geography teacher education programs and the development of tools for assessing teacher competence in sustainable development.

Geography teacher education programs differ from country to country in many aspects, including integrating materials into the content of geography disciplines [10, 11]. One hundred seven training programs for geography specialists and geography teachers in Germany were investigated for the presence of subjects and topics on sustainable development [12]. In this study, a quantitative analysis of a text was conducted in which keywords related to sustainable development were searched for. The methodology used here was to identify sustainable development topics and materials in geography teacher education programs; however, there was a great deal of heterogeneity in the programs, varying degrees of implementation of the SDGs in program modules, varying understanding of sustainability principles, and heterogeneity in required courses and electives.

In Sweden, the issues of sustainable development are included in the content of teacher training programs and are also present in the requirements for future teachers [13]. This is because universities and secondary schools must form competencies related to sustainable development in the young generation [14]. The analysis in this article is based on focus groups with teacher educators where participants discuss how they work with education for sustainable development. However, the article focuses on how teacher-instructors discuss their students, making relevant research impractical.

Sund and Gericke [15] note that according to the Swedish national curriculum for nine-year schools, teachers of all subjects and subject areas in grades 7-9 are responsible for teaching and promoting sustainable development. The researchers examine their activities in their study based on three criteria: What, How, and Why. In doing so, the researchers identify the need to focus on ESD-related topics (What), methods of learning and cooperation for sustainable development (How), and teachers' starting points and long-term goals for their ESD teaching (Why). The results show that teachers from different subject areas emphasize different but complementary aspects of ESD teaching and perspectives. The implications of interdisciplinary

teaching in ESD are also discussed. Nevertheless, it seems that the geographical education aspect is more effective in achieving the goal. Environmental education (pro-environmentalism), or ESD-oriented education, protects the environment. Modern research shows the necessity of integrating environmental direction into standard educational programs of natural sciences [16]. Therefore, we have also taken this point into account.

Emphasizing the importance of ESD, researcher Thao Phuong Nguyen from Vietnam notes that there is no universal education model for sustainable development. In his opinion, each country should define its priorities and actions in ESD [17]. However, his assertion that teachers' perceptions of ESD in Vietnam differ from the ESD dimensions proposed by UNESCO is controversial as it contradicts the principles of global citizenship education for the younger generation. The emphasis on sustainable development goals may differ from country to country, but it should be remembered that the Earth is a typical home for all humanity, and human development challenges are common to all.

To develop criteria for assessing geography teachers' competence in ESD in our study, we examined the experience of foreign countries. Literature analysis showed that scholars from different countries attempt to develop reliable, measurable criteria for assessing teachers' competence in ESD. The integrated structure of competence of professional actions in ESD developed by Belgian scientists includes three main characteristics: readiness, knowledge of pedagogical approaches, and teacher self-efficacy [18]. However, whether the large-scale survey has proved effective is an open question.

Bandura defines self-efficacy as "belief in one's ability to organize and perform the actions necessary to achieve given results" [19]. In this context, teacher self-efficacy is characterized as a qualitative component of the teacher's portrait, the presence or absence of which can be revealed through psychological tests, questionnaires, and expert and situational assessments. Nevertheless, scholars have attempted to apply quantitative methods of assessing self-efficacy. The article suggested that high self-efficacy, high personal interest, and peer support can influence learning behavior. However, it should be considered that a student may encounter positive and negative factors in one particular lesson.

Thus, Malandrakis [20] and co-authors developed a scale for assessing elementary school teachers' self-efficacy in education for sustainable development (TSESSD). It includes four competency domains: values and ethics, systems thinking, emotions and feelings, and actions. The development of the scale is consistent with fundamental research principles in educational and social psychology. The researchers point out that in the evaluation; it is essential to consider only those indicators that characterize the teacher as a person. The scale is a good measurement tool that could be used to assess the current abilities of teachers in ESD, but we see objective difficulties in its application.

III. METHODS AND MATERIALS

The study was conducted at Abai Kazakh National Pedagogical University. The discipline "Climate Change and its Consequences" and SDG activities for future geography teachers aim to develop literacy, learning motivation, methodological preparedness, and self-efficacy. Methods of questionnaires, interviews, descriptive and logical statistics, and diagnostic tests of self-efficacy determination according to A. Bandura's theory [19], the personal development methodology of S. Kunkiewicz [21], the methodological approach, and descriptive and logical statistics on criteria for assessing the effectiveness of geography teacher training on sustainable development were used. Online questionnaires and surveys were prepared in Google Forms.

1. RESEARCH DESIGN AND SAMPLING

The sample population consisted of 121 students. 67% were girls, and 33% were boys; their average age was 20.78±1.25. They were randomly divided into experimental group (n=60) and control group (n=61). The course on sustainable development goals in educational programs, "Climate Change and its Consequences," developed and implemented by the authors, was studied during one semester and consisted of 60 hours of study, of which 15 - lectures, 30 - practical classes, 15 - independent work of students.

The main topics covered in this discipline are the causes of climate change, Climate models, scenarios, and forecasts for the territory of Kazakhstan, Formation of sustainability of socio-ecological systems, and

problems of adaptation to climate change. This knowledge will allow future teachers of geography to get new knowledge about climate change, its consequences, and ways of adaptation to the economy and population. Also, through these activities, learners learned about ecological concepts and procedures used to conserve and renew natural resources in terrestrial and aquatic systems. The webinar revealed how SDG research can solve global natural problems. Also, the causes of environmental disasters and potential strategies to address and mitigate anthropogenic factors (habitat fragmentation, disease, climate change) were discussed. The activities focused on ensuring ecological principles and ecological phenomena of natural systems at local and global scales, demonstrated tasks, functions, and opportunities for cooperation with international organizations: Global Nest, World Society for the Protection of Animals, Greenpeace, and European Environment Agency.

2. *RESEARCH TOOLS*

We identify three criteria categories as a research tool Figure 1. They allow us to assess the effectiveness and quality of geography teacher training in sustainable development.

Knowledge	Methodological approaches	Self-efficacy
SDG knowledge Subject matter competence in SD aspect Searching and selecting SD learning materials from different sources of information	Mastery of modern ESD methods Integration of SD learning materials into school geography content Skills for building global citizenship among learners through ESD	Readiness for ESD Ability to master new teaching methods Willingness to develop professional competencies in ESD Emotions and critical thinking

FIGURE 1. Criteria for assessing teacher effectiveness in ESD.

It should be noted that different measurement tools are used for individual criteria categories. For example, the knowledge block can be assessed using a point system based on questionnaires. For example, the availability of knowledge on SDGs and identification of competence level on SD are assessed using open-ended tests with one or more correct answers. Summarizing the correct answers and ranking them by level will objectively assess teachers' knowledge. The ability to search and select SD training materials is identified and assessed based on a questionnaire on methodological approaches. The questionnaire is compiled considering two evaluation criteria: 1) determination of mastery of data search, analysis, and processing; 2) evaluation of the ability to create learning content based on various information sources. The methodological block includes teachers' research of their self-reports on implementing ESD teaching methods.

Self-efficacy is revealed using psychological tests, reflection, self-assessment, etc. In further research to assess the effectiveness and quality of training and retraining of geography teachers, we believe that contrasts can be identified by considering the length of labor experience, age, spatial (urban, rural), and gender differences. As a result of the research, we have developed samples of tests, questionnaires, interview sheets, and evaluation sheets in tables. To measure self-efficacy, we used the questionnaire "My Personal Development," according to the method of S. Kunkiewicz, which consists of 15 questions. Then, it was checked with tests to study self-confidence and self-esteem according to Albert Bandura's social-cognitive theory of learning. Instruction: "Rate the statements according to the degree of your agreement with them and put any sign in the box with symbols:

- untrue;
- hardly true;
- most likely true;

- true."
  Methodology form
- If I try hard enough, I can always find a solution to even a difficult problem.
- If something gets in my way, I still find ways to achieve my goal.
- I manage to achieve my goals quite easily
- In unexpected situations, I always know how I should behave.
- When unexpected difficulties arise, I believe that I can cope with them.
- If I put in enough effort, I can handle most problems
- I am prepared for any difficulties because I rely on my own abilities
- If I am faced with a problem, I usually find several ways to solve it
- I can think of something even in seemingly hopeless situations
- I am usually able to keep a situation under control
  Processing of results:
- "Absolutely wrong" - 1 point;
- "Hardly true" - 2 points;
- "Probably true" - 3 points;
- "Absolutely true" - 4 points.

IV. RESULTS

1. EFFECT OF SDG-ORIENTED COURSES, WEBINARS, AND ACTIVITIES ON FUTURE TEACHERS' LITERACY DEVELOPMENT

No statistically significant differences were found between the experimental group and the control group on the Knowledge of Sustainable Development Goals questionnaire on environmental literacy either before (p-value = 0.1 at $p<0.05$) or after the course, (p-value = 0.5 at $p<0.05$), so data will be reported for the entire sample of study participants (n=121). When examining the SDG literacy level of the participants, it was found that the respondents' opinions changed before and after the course "Climate Change and its Impacts" Table 1: in general, for the questionnaire "Knowledge of Sustainable Development Goals" p-value 0.049 ($p<0.05$).

Table 1. Results of the survey of learners on knowledge of SDG basics.

№	Question/Answer	Before the course		After the course		p-value
		Number of respondent N=121	%	Number of respondents N=121	%	
1.	Within the framework of the 70th UN General Assembly in September 2015, what document was signed by the President of Kazakhstan for further global development?					
	Holding of "Astana EXPO-2017"	37	30,6	31	25,6	0,058
	Commitment to green building	22	18,2	23	19	0,042
	The development agenda	62	51,2	67	55,4	0,052
2.	The 17 SDG goals to be achieved by 2030 consist of related targets and indicators. How many are there?					
	150 tasks and 200 indicators	20	16,5	25	20,7	0,032
	169 tasks and 242 indicators	69	57	83	68,6	0,054
	100 tasks and 50 indicators	32	26,5	13	10,7	0,049
3	The SDGs are designed to promote sustainable development by integrating three components. Which ones?					
	Environmental	96	79,3	101	83,5	0,063
	Social	80	66,1	97	80	0,056
	Production	27	22,3	7	5,8	0,048

	Technical	20	16,5	13		2,5	0,057
	Spiritual	18	14,9	8		6,6	0,053
	Economic	81	66,9	84		69,4	0,049
	Entertainment	3	2,5	0		0	0,037
4	With the assistance of the UN, which center was created based on the international exhibition "Astana EXPO-2017", which is a substantive contribution of Kazakhstan to international efforts to implement the SDGs?						
	Center for Green Technologies and Investment Projects "Energy of the Future"	89	73,6	94		77,7	0,063
	Center "Zhasyl Damu"	21	17,4	13		10,7	0,028
	Center "Energy of the Future"	11	9,1	14		11,6	0,042

When assessing knowledge of Sustainable Development Goals in general, compared to the questionnaire before and after studying the course "Climate Change and its Impacts," the increase of correct answers was 4.2% ($p<0.05$). The majority knew the structure of the 17 SDGs, their objectives, indicators (changes from 69% to 83%), and their main sectors (average indicator growth of 6.9%). For the 4th question, almost everyone (77.7%) knew that the Center for Green Technologies and Investment Projects "Future Energy", with the assistance of the UN, was established based on the international exhibition "EXPO-2017", which is a substantive contribution of Kazakhstan to the international efforts to implement the SDGs. This is because, among the SDG-oriented events, the course of the head of this center, G. Mediyeva, where many respondents were listeners, was a landmark. The lectures were held in online and offline formats. The next group of questions concerned the implementation of SDGs in Kazakhstan Table 2.

Table 2. Results of the survey of learners' knowledge of the implementation of SDGs in Kazakhstan.

1	What is the purchasing power of Kazakh people, according to statistics?					
	10 US dollars	21	17,4	6	5	0,043
	5.5 US dollars	86	71,1	102	84	0,054
	3.5 US dollars	14	11,6	13	11	0,046
2	What is the number of hungry people in Kazakhstan today?					
	0.4 million	83	68,6	98	81	0,039
	1 million	28	23,1	11	9,1	0,045
	2 million	10	8,3	12	9,9	0,056
3	What is the strategic document of the state planning of Kazakhstan on SDG-4 "Quality education"?					
	Ranking of universities in the world QS	35	28,9	7	6	0,032
	The concept of entering the top 30 competitive countries in the world	83	68,6	108	89	0,047
	Business Roadmap 2030	3	2,5	6	5	0,062
4	What is the strategic document of the state planning of Kazakhstan in the direction of SDG-5, "Gender equality," and SDG-10, "Reducing inequality"?					
	The concept of family and gender policy of the Republic of Kazakhstan	96	79,4	103	85,1	0,048
	The state program for the development of agriculture	9	7,4	9	7,4	0,057
	Program for the development of productive employment and mass entrepreneurship	13	10,7	7	5,8	0,053
	The state program "Nurly Zher."	3	2,5	2	1,7	0,054
5	How much has the poverty level decreased in Kazakhstan since 1996?					
	From 34.6% to 4.6%%	82	67,8	90	74,4	0,058
	From50% to 10%%	30	24,8	20	16,5	0,037
	From 70% to 20%%	9	7,4	11	9,1	0,046
6	In what year was the first Environmental Code of Kazakhstan developed?					
	2002	32	26,4	2	1,7	0,052

	2007	80	66,1	116	95,8	0,051
	2015	9	7,4	3	2,5	0,053
7	The main innovation of the new Environmental Code -2021 of Kazakhstan?					
	Implementation of the ecological principle "the polluter pays and corrects."	84	69,4	106	87,6	0,052
	Environmental quality standards	15	12,4	7	5,8	0,046
	Environmental education and education	22	18,2	8	6,6	0,038

The correct answers are how much the poverty level in Kazakhstan has decreased since 1996 and the purchasing power of Kazakhstanis has increased accordingly (6.6% and 12.9%). The number of hungry people in Kazakhstan today has been correctly shown by 98 respondents. This is most likely because the advisors asked to pay attention to the actual data for further analysis. The number of participants in the experiment who believe that the Strategic Document of the State Planning of Kazakhstan for SDG-4 "Quality education" is a Concept for entering the top 30 competitive countries of the world has increased by 20.4% ($p<0.05$). The indicators were high, even before the experiment Figure 3.

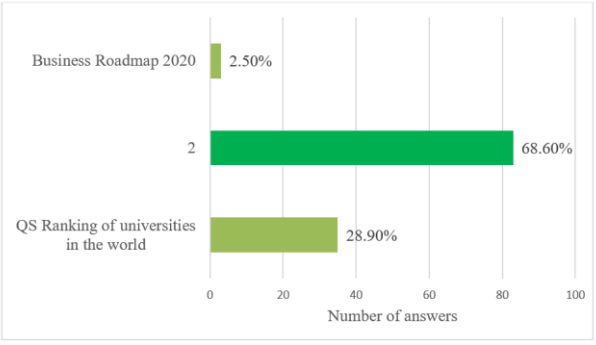

FIGURE 3. Answers to the question on the SDGs "Quality education".

The fourth issue, the Strategic Document of the State Planning of Kazakhstan in the direction of SDG-5 "Gender equality" and SDG-10, "Reducing inequality," is the Concept of Family and Gender Policy of the Republic of Kazakhstan. This change of opinion is likely because after studying the course, students began to think and understand the global nature of world and national environmental problems. Regarding the first developed Environmental Code of Kazakhstan and the main innovations of the new environmental Code transformed in 2021, the responses were positive (the indicators are higher by 29.7% and 18.2%, respectively). The group of questions on climate change included four questions Table 3.

Table 3. Results of the survey of students' knowledge of climate change.

1.	By how many degrees is it not permissible to exceed the global average annual temperature on the planet by 2100, according to the Paris Climate Agreement?					
	An increase of 2°C from the pre-industrial level	66	54,5	89	73,6	0,057
	An increase of 1.5°C from the pre-industrial level	43	35,5	29	24	0,052
	An increase of 0.5°C from the pre-industrial level	12	10	3	2,4	0,037
2.	What was the main goal of the Kyoto Protocol, which preceded the Paris Climate Agreement?					
	Reduce greenhouse gas emissions of industrialized countries	96	79,3	110	90,9	0,035
	Reduce poverty	16	13,2	9	7,4	0,052
	Strengthen the economy	9	7,4	2	1,7	0,043
3	Where and when was the UN Climate Change Conference COP 27 held?					
	Sharm El-Sheikh (Egypt), 2022	71	58,7	86	71,1	0,052
	Glasgow, 2021	16	13,2	14	11,6	0,053

	Madrid, 2019	12	9,9	14	11,6	0,045
	Katowice (Poland), 2018	10	8,3	2	1,7	0,052
	Bonn (Germany), 2017	12	9,9	5	4	0,057
4	What is the name of the UN Environmental Monitoring program?					
	UNESCO	23	19	7	5,8	0,052
	UNEP	67	55,4	101	83,5	0,051
	UNICEF	19	15,7	6	5	0,046
	FAO	8	6,6	5	4	0,043
	WHO	4	3,3	2	1,7	0,056
Total		0.049				

* statistically significant at $p < 0.05$

On the first question, 89 respondents knew that the stated goal of the Paris Climate Agreement was to prevent the global average annual temperature on the planet from exceeding by more than 20 of the pre-industrial level by 2100. On the second question, was the share of the response on reducing greenhouse gas emissions of industrialized countries to the main goal of the Kyoto Protocol preceding the Paris Agreement 11.6% higher? On the third question, it was delighted that the participants began to follow the conferences; for example, 71.1% were able to answer that the UN Climate Change Conference COP 27 was held in Sharm El-Sheikh (Egypt) in 2022. On the fourth question, the majority (101 students) could distinguish between UNEP and the UN Environmental Monitoring Program, although many were inclined to think that it was UNESCO.

2. *METHODOLOGICAL APPROACH*

The methodological approach includes teachers' research and answers about implementing ESD teaching methods. This innovation provides valuable information about the effectiveness of teachers' professional development in ESD (a questionnaire on methodological approaches to teaching ESD is attached in Appendix A). The questionnaire made it possible: 1) determine the degree of mastery of the methods of search, analysis, and data processing; 2) evaluate the ability to create educational content Figure 4.

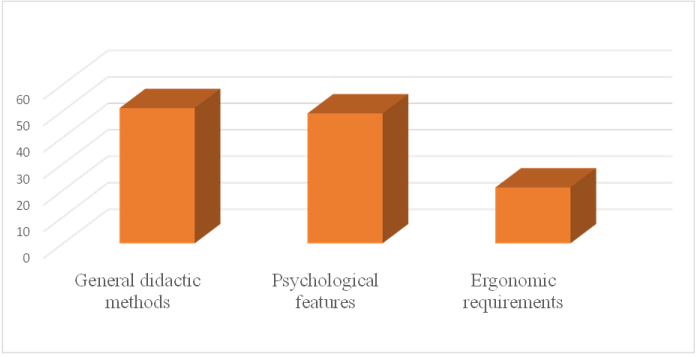

FIGURE 4. Diagram of the distribution of answers to the question "What do you pay more attention to when preparing educational content?".

The answers were not evaluated since the respondents, although they have experience in teaching practice, do not work. The questionnaire on methodological approaches was included as a motivational component for the practical work of future teachers in ESD. The answers to the question "What motivational phrase for achieving the SDGs do you pronounce before the lesson?" were very diverse and made you think and move on to action. For example, "We do not have a planet In", "Act locally, think globally", "Everything starts with you, take care of your environment", "The Earth can satisfy the need, but not everyone's greed",

"Tomorrow starts today", "Efficiency will increase if we cooperate", "Education gives birth confidence", "Everything starts with ourselves", "Through sustainable development, we will change the future of Kazakhstan".

3. THE METHODOLOGY "MY PERSONAL DEVELOPMENT" FOR THE STUDY OF THE ACTIVITY OF STUDENTS IN SELF-DEVELOPMENT (ACCORDING TO S. S. KUNKEVICH) AND SELF-EFFICACY ACCORDING TO THE THEORY OF A. BANDURA.

There is a correlation between self-efficacy in ESD and ESD practices.

Table 2. Descriptive statistics and results of the rank correlation of Spearman's Rs between the control and experimental groups regarding self-efficacy.

	The experimental group (n=60)		**The control group (n=61)**		**p-value**
	Mean	**SD**	**Mean**	**SD**	
1 question	3,46	0,35	2,90	0,63	0,02*
2 question	3,11	0,37	3,06	0,71	0,07
3 question	3,23	0,56	3,24	0,54	0,05
4 question	3,74	0,41	3,15	0,52	0,01*
5 question	3,56	0,45	2,89	0,67	0,01*
6 question	3,12	0,39	3,05	0,73	0,07
7 question	3,28	0,61	3,32	0,56	0,06
8 question	3,84	0,40	3,10	0,53	0,02*
9 question	3,53	0,47	2,92	0,65	0,02*
10 question	3,13	0,37	3,05	0,72	0,06
11 question	3,23	0,60	3,32	0,55	0,07
12 question	3,83	0,38	3,13	0,54	0,03*
Total	3,42	0,45	3,09	0,61	0,04*

* Statistically significant at p<0.05.

Comparison of the results of the experimental and control groups showed statistically significant differences in the self-efficacy of students Table 2: in general, according to the questionnaire, p-value = 0.04 (p<.05).

The experimental group was significantly ahead of the control group by the 1-st question (The experimental group Mean = 3,46, SD = 0,35, The control group Mean = 2,90, SD = 0,63); by the 4-th question (The experimental group Mean = 3,74, SD = 0,41, The control group Mean = 3,15, SD = 0,52); by the 5-th question (The experimental group Mean = 3,56, SD = 0,45, The control group Mean = 2,89, SD = 0,67); by the 8-th question (The experimental group Mean = 3,84, SD = 0,40, The control group Mean = 3,10, SD = 0,53); by the 9-th question (The experimental group Mean = 3,53, SD = 0,47, The control group Mean = 2,92, SD = 0,65); and by the 12-th question (The experimental group Mean = 3,83, SD = 0,38, The control group Mean = 3,13, SD = 0,54). The final indicators (The experimental group Mean = 3,42, SD = 0,45, The control group Mean = 3,09, SD = 0,61). The results obtained were correlated with the indicators of other methods, particularly diagnostic tests according to the theory of A. Bandura is aimed at studying self-confidence and self-efficacy.

V. DISCUSSIONS

The results obtained confirmed the conclusions of previous studies that webinars and events aimed at achieving specific educational results could improve students' literacy in formal education (Kang [9], Sprenger et al. [12], Sjögren [13]), to promote learning motivation in methodological approaches of teaching ESD (Ferguson et al. [8]), as well as the role of self-efficacy as an orientation towards action in achieving the

SDGs (Pauw et al. l 2022 [6], Malandrakis, G. [20]). Education for sustainable development should cover all areas of students and fill their educational space.

A team of scientists from Sweden, Korea, Belgium, Vietnam, and other countries studied the formation of literacy of future teachers in ESD. As a result of the study, it was found that the development of SDG-oriented knowledge and skills is facilitated by the support of teachers and management, as well as lectures, training and professional courses on the protection and preservation of ecosystems in the future, the formation of a humane society focused on sustainable development. The more courses on sustainable development topics students study, the more knowledge they gain. This is also confirmed in our study – after studying the course "Climate change and its consequences", the number of students who improved their knowledge indicators increased by 13.6%.

The problems of ESD were studied by scientists Ampuero, Miranda and Goyen (2015) [22]. They believe ESD is one of the most vital tools for modeling our future and a critical factor in societal and cultural changes. They also note that one of the main goals of education for sustainable development is the development of cognitive and affective skills, and they, in turn, influence the formation of empathy and critical thinking. All SDG-oriented activities of our study are aimed at developing these skills. Jackson, L. and Vare, P. It is argued that the main direction of ESD in primary school is the transfer of knowledge and relevant values; it is essential to focus on teaching skills that, in the future, will allow to participate in dialogue and solve problems with others, given the scale and dynamism of today's environmental and sustainable development problems [23,24]. Every teacher should be able to teach vital skills, which was also revealed and highlighted in our study.

In their works, Tilbury and Wortman [25] and Mogren, Gericke, and Scherp share their teacher training experience [26]. In our work, we work with just students - future teachers. Although our work considers the importance of developing a methodological approach for geography teachers, it is not evaluated because the respondents are students in the final courses of study and are not yet working. Jelle Boeve has worked with teachers in Sweden for three years and monitors their motivation level [6]. Our article also highlights motivation issues in using highly methodically completed content in SDG classes. Motivation is consonant with the personal development of the future teacher, which is also very important, according to our research.

Sund P. and Gericke N. based on the study of the orientation to students' actions, their self-efficacy is explicitly discussed [15]. Self–efficacy is a student's belief or belief that he can perform the tasks facing him. It is one of the vital factors of educational achievements. This is a factor that a teacher can influence through a particular organization of learning conditions. In our article, we make a correlation between theoretical knowledge and practices of ESD with self-efficacy.

A feature of environmental education in Japan [27] formatting of "green consumers" the population with environmentally conscious principles; for this purpose, eco-festivals are held, children's eco-clubs are created, and special information centers with interactive environmental education are formed. In Finland, the formation of environmental education begins at the age of 5 [28]. Environmental services, environmental camps, and schools create and provide knowledge of nature protection and provide a "green" infrastructure.

In Kazakhstan, environmental education requires development and severe changes. As the leading pedagogical university in the country, we consider it our duty to begin the transformation by training future geography teachers. Since geography is the subject that has the most comprehensive opportunities for ESD, all 17 Sustainable Development Goals have significant geographical content. The subject itself is the only discipline related to both the social and natural cycle of disciplines, which makes it possible to make a significant contribution to the formation of a humanistic worldview to the education of civic responsibility and patriotism.

Geography, as a discipline that bridges natural and social sciences, plays a key role in promoting Education for Sustainable Development (ESD). Its focus on spatial thinking and place-based learning allows future teachers to analyze sustainability issues both globally and within their local context. Through activities such as regional climate mapping, environmental data analysis, and the use of geospatial technologies, geography supports the development of critical skills needed to understand and teach the SDGs effectively.

VI. CONCLUSIONS

As a result of the conducted research, the following conclusions can be drawn:

- Training course activities aimed at achieving the SDGs effectively improve students' literacy. One hundred twenty-one respondents showed an average increase in results by 13.6%.
- The study of the methodological approach by the survey method provided valuable information about the effectiveness of the professional development of future teachers, as well as increased motivation to apply new methodological approaches in the field of ESD to identify and evaluate the ability to search and select educational materials on SD for the preparation of educational content.
- Identifying respondents' self-efficacy levels using diagnostic tests and techniques gave an understanding of the correlation between knowledge and ESD practices.

This study asserts that to form ecological, cultural education in modern conditions of the model, it is necessary to actively introduce specialized individual courses into the education system. Conduct and participate in all SDG-oriented educational webinars and events. Such events not only provide the formation of the necessary knowledge and skills but also allow students to use them in everyday life actively.

The results of the study make it possible to form and integrate into the education system the need for educational activities to improve students' environmental literacy, increase their motivation to conduct lessons with methodological approaches focused on ESD and understand the importance of self-efficacy in achieving the SDGs. In the future, it is planned to introduce and study a separate course of advanced training for geography teachers according to the SDGs. The results made it possible to change educational and training programs to form and improve the necessary knowledge and skills to achieve sustainable development goals. This research was funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP14871476) project "Implementation of Sustainable Development Goals in the Training and Retraining of geography teachers".

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Authors Contribution

All authors made an equal contribution to the development and planning of the study.

Conflict of Interest

The authors have no potential conflicts of interest or such divergences linked to this research study.

Data Availability Statement

Data are available from the corresponding author upon request.

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Appendix A.
Questionnaire

The questionnaire was developed specifically for this study to assess future geography teachers' engagement with SDG-related resources, teaching methods, and attitudes toward Education for Sustainable Development (ESD). It includes questions on preferred information sources, mental and operational methods, lesson types, educational content creation, and motivational strategies related to SDGs. The items were designed based on relevant literature on ESD and teacher education and were reviewed by experts to ensure content validity. This approach helped tailor the questionnaire to capture key aspects of SDG integration in geography teacher training.

A QUESTIONNAIRE TO DETERMINE THE DEGREE OF MASTERY OF SEARCH, ANALYSIS AND DATA PROCESSING; THE ABILITY TO CREATE EDUCATIONAL CONTENT FOR ESD.

1. Which sites of intergovernmental organizations on ESD do you view?
- unfccc.int
- wmo.ch
- ipcc.ch
- wnep.org
- iea.org
- fao.org

2. Whose lectures and webinars on SDGs do you listen to on the YouTube channel?

3. Which scientific search engines do you prefer to use?
- Google Scholar
- scirus.com
- scienceresearch.com
- infotrieve.com
- sci. cuide

4. Websites of non-governmental organizations related to the SDGs you use to search for educational materials.
- oxfam.org
- greenpeace.org
- wwf.ru
- panda.com
- other

5. What mental and operational methods do you most often use when analyzing information?
- analysis
- synthesis
- analogy
- modeling
- abstraction
- comparison

- generalization
- other

6. Which tasks do you pay more attention to at the data processing stage:
- the ordering of the source material, the transformation of a set of data into a complete system of information;
- detection and elimination of errors, shortcomings, and gaps in information;
- identification of trends, patterns and connections hidden from direct perception;
- the discovery of new facts;
- finding out the level of reliability, reliability and accuracy of the collected data and obtaining scientifically based results based on them.
- other

7. What type of lesson on SDG topics do you consider the most effective?
- a lesson in discovering new knowledge
- reflection lesson
- a lesson of general methodological orientation
- a lesson in developing control
- other

8. What do you pay more attention to When creating educational content on SDGs (interactive notes, multimedia, presentations, etc.)?
- General didactic principles of preparation of educational materials
- Psychological features of information perception
- Ergonomic requirements for the presentation of information
- Other

9. What personality-oriented advantages of modern educational information technologies do you use more often for ESD?
- Flexibility
- Modularity
- Availability
- Profitability
- Mobility
- Coverage
- Adaptability
- Social equality
- Internationality
- Other

10. What motivational phrase to achieve the SDGs do you say before the lesson?

11. In your opinion, the most effective format for submitting information on ESD
- news
- analytical articles
- industry reviews
- interviews, expert opinions

- ratings
- other

12. For which of the 17 SD goals, within the framework of the discipline, can you prepare educational content?
- Poverty eradication
- Elimination of hunger
- Healthy lifestyle and well-being
- Quality education for all
- Gender equality
- Clean water and sanitation
- Low-cost and "clean" energy
- Decent work and economic growth
- Industrialization, innovation, infrastructure
- Reducing inequality
- Sustainable cities and settlements
- Responsible consumption and production
- Combating climate change and its consequences
- Conservation of marine ecosystems
- Preservation of terrestrial ecosystems
- Peace, justice, and effective institutions
- Partnership for Sustainable Development
- Other

13. Do you get targeted reflection from the students?
- yes
- no
- sometimes