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Value System Formation Through Project and Research Activities Part of Science Lessons

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ABSTRAK

Masih terdapat kekurangan metodologi yang efektif untuk mencapai sebuah sistem yang dapat menginspirasi minat dan motivasi siswa, serta membimbing mereka ke arah sains dan penelitian. Hal ini mengakibatkan kurangnya pembentukan sistem nilai yang kuat di antara siswa di lingkungan pendidikan. Tujuan utama penelitian adalah mengembangkan dan mengimplementasikan teknologi pembentukan sistem nilai bagi anak sekolah dalam konteks pengajaran aktif, dengan fokus pada pendidikan biologi. Penelitian ini merupakan penelitian kualitatif yang melibatkan guru biologi dan anak sekolah di lingkungan pendidikan. sebuah sekolah. Metode pengumpulan data yang digunakan dalam penelitian ini adalah wawancara, observasi, dan analisis dokumen. Adapun instrumen yang digunakan adalah lembar observasi. Metode analisis data yang digunakan dalam penelitian ini adalah analisis tematik dan analisis isi. Hasil penelitian menunjukkan bahwa teknologi aksioma Monakhov efektif dalam meningkatkan keterlibatan dan minat siswa terhadap kegiatan proyek dan penelitian, serta membantu guru dalam mencapai tujuan pendidikan yang berorientasi pada pengembangan nilai-nilai siswa secara holistik. Sebagai kesimpulan, temuan penelitian ini menunjukkan peningkatan yang signifikan dalam jumlah karya ilmiah dan penelitian yang dilakukan oleh siswa sekolah yang berpartisipasi dalam kompetisi seperti DARYN dan MAN selama tiga tahun terakhir. Penelitian ini diharapkan dapat menginformasikan kebijakan pendidikan dan pengembangan kurikulum, mempromosikan integrasi kegiatan proyek dan penelitian sebagai sarana untuk mengembangkan individu yang memiliki pemikiran ilmiah yang kuat, nilai-nilai etika, dan rasa tanggung jawab terhadap lingkungan mereka.

ABSTRACT

More effective methodologies are still needed to achieve a system that can inspire students' interest and motivation and guide them toward science and research. This results in a need for more robust value system formation among students in educational settings. The study's main objective was to develop and implement a value system formation technology for school children in the context of active teaching, focusing on biology education. This research is a qualitative study involving biology teachers and schoolchildren in a school's educational environment. The data collection methods used in this study were interviews, observation, and document analysis. The instrument used was an observation sheet. The data analysis methods used in this research are thematic and content analysis. The results showed that Monakhov's axiom technology effectively increased students' involvement and interest in project and research activities and assisted teachers in achieving educational goals oriented towards the holistic development of students' values. In conclusion, the findings of this study show a significant increase in the number of scientific and research works conducted by students of schools participating in competitions such as DARYN and MAN over the past three years. This research is expected to inform educational policy and curriculum development, promoting the integration of project and research activities to develop individuals with solid scientific thinking, ethical values, and a sense of responsibility towards their environment.

1. INTRODUCTION

Modern transformations in the Republic of Kazakhstan have significantly changed teacher training content for general education schools. The priorities, goals, and content of contemporary school education are determined by documents that shape the activities of teachers. Developing a new educational paradigm and an updated school education program highlight the importance of educating individuals with new ways of thinking, exceptional abilities, and a robust value system. Kazakhstan's updated school education program emphasizes active learning, where knowledge and skills are applied in practical situations and everyday life, promoting the development of an established value system. According to pedagogical practice, active learning is most effective if it inspires students to action, fostering their interest and motivation in science and research. As John Dewey said, "Education should impart knowledge to students

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and help them acquire new skills. These skills will help in the child's adult life and give them the tools to solve various problems"(González-pérez & Ramírez-montoya, 2022; González-salamanca et al., 2020). This approach is crucial to cultivating well-rounded individuals who can contribute to the country's development.

The gap between expectation and reality lies in the current state of value formation for school students in active teaching, particularly in biology education. The expectation is for a system to inspire students' interest and motivation, guiding them towards science and research. However, more effective methodologies must be used to achieve this goal, which leads to areas for improvement in forming a solid value system among schoolchildren in an educational environment. The urgency of this research arises from the crucial need to bridge this gap and address the shortcomings in current approaches to value formation. This research aims to equip future biology teachers with the necessary skills and mindset to effectively engage and inspire their students by developing and implementing technologies that encourage active teaching and nurture students' interest in biology. This urgency stems from the recognition that an improved system of value formation is essential for fostering responsible, curious and motivated individuals who can actively contribute to advancing science and society.

Modern schoolchildren should have qualities such as entrepreneurship, competence, independence, and high morality (Boldureanu et al., 2020; Shahzad et al., 2021). Training teachers, especially future science teachers, is crucial to develop these qualities in school students. Only well-trained teachers can effectively teach and educate school students while facilitating the formation of their value systems (Aboluwarin, 2023; Islam et al., 2022; Ojo & Yusuff, 2023; Syed Murad Ali & Saadia Abid, 2021). However, there is an emerging contradiction in university pedagogical practices between the need to introduce project management and research to train future biology teachers and the need for such technologies in university programs. To address this, an appropriate model is needed to teach future biology teachers project management skills and work with school students in project activities, aligning with the new concept of biology education development, emphasising scientific thinking and creative approaches.

The theoretical model of project and research activities, together with the stages of action for biology teachers and school students, as well as criteria and indicators for the formation of leadership skills in future biology teachers, will contribute to several things: fostering interest in managing schoolchildren's project and research activities, developing cognitive skills, ensuring competent leadership, rationally choosing a project subject, and using scientific methodology. In addition, the formation of scientific and educational values in the motivational system of youth generated by society will represent individuals' socially determined and selective attitude to common material, spiritual and universal goods (Kulbaka, 2022; Mel'nichuk et al., 2019). The organization and implementation of project-based research activities in modern schools highlight the leading role of the teacher in providing methodological support to students in their independent and cognitive activities (Bulueva et al., 2021; Knifsend & Juvonen, 2023). The formation of motivation for project-based research activities among students working in micro-groups and individually, as well as its significant decrease, has been studied (Alekseeva et al., 2020; Blankenstein et al., 2019; T.A. & Yu.N, 2020).

The impact of STEAM (Science, Technology, Engineering, Arts and Mathematics) in education has been determined through bibliometric analysis of performance and collocation in the Web of Science as well as new requirements for the education system as a whole and in learning spaces, based explicitly on flipped learning (J. A. Marín-Marín et al., 2021; Moreno-Guerrero et al., 2021). The general concept of STEM education, the application of STEAM concepts, and the challenges educators face in its implementation (Holmlund et al., 2018; Lestari et al., 2023; J.-A. Marín-Marín et al., 2020). STEAM concepts are essential for teachers to master as they involve integrating materials from various disciplines, fostering higher-order thinking and analytical skills in students during the learning process. Students enjoyed the 3D design project in the STEAM context, and their positive experience of working on it confirmed the connection between art and STEM and indicated the potential for further research (Mou, 2023; Song, 2020).

Other researchers identified substantive aspects and their relationship to the teacher's research results. The application of a team-based project learning model in a geography program leads to an improvement in students' critical thinking skills. This is achieved through problem analysis and identification, integration with current knowledge, action design, presentation of results, and creation of high-quality reports in project activities (Aristin & Purnomo, 2022; Sudiana et al., 2023). The importance of considering non-cognitive elements in education and illustrating ways in which instructors promote creative self-expression, personal initiative, and collaboration in long-term projects, as well as identifying strategies to sustain youth engagement through the creation of a supportive community environment and encouraging a more creative society (Bassachs et al., 2020; Bulueva et al., 2021). However, a contradiction has developed in university pedagogical practice between the need to introduce project management and research (in the training of future biology teachers) and the need for such technologies in university practice

programs. It is necessary to create an appropriate model for teaching future biology teachers (by developing their skills in working with schoolchildren) project management activities (by the new concept of biology education development, aimed at developing scientific thinking and creative approach to project tasks).

Theoretical models of project and research activities, stages developed from the actions of biology teachers and schoolchildren, as well as criteria and indicators for the formation of leadership skills in future biology teachers, will contribute to the following, such as instilling interest in the management of project and research activities of schoolchildren and cognitive skills and ensuring competent leadership, rational choice of the project subject, and the use of scientific methodology. Educational innovation should become the leading research principle in learning (in particular, subject education) to demonstrate the newest and most severe relationship between an increase in the level of education and the economic growth of the country. Research activities are necessary for both future biology teachers and school students studying biology to meet modern requirements for the quality of education. To improve the quality of life in the future, schoolchildren must develop all the skills necessary today. Therefore, it is necessary to pay attention to the training of future biology teachers, that is, teaching them to manage projects and research activities of schoolchildren.

The novelty of this research lies in its holistic approach to value formation by linking active teaching methodology with biology education. By utilizing V.M. Monakhov's axiomatic system, this research presents an innovative way to develop a value system aligned with the educational environment. The integration of interviews, observations, and document analysis as data collection methods also contributed to the novelty of this research, allowing for a comprehensive understanding of teachers' and students' experiences and perspectives. The results of this study have the potential to revolutionize the way values are instilled among school students, setting a precedent for future research in active teaching and biology education. This research aims to shape the value system of school students through projects and research activities integrated into biology lessons. The ultimate goal is to develop and implement technologies for forming value systems in the educational process at school. The values formed by society represent individuals' socially determined selective attitude towards material and spiritual public goods.

2. METHODS

The research conducted in this study is a mixed-methods research design. This research combines descriptive research methods, such as theoretical analysis of scientific and pedagogical literature, modelling, and surveys, with correlational and experimental methods (Mukarramah, 2024; Sari et al., 2022). This design allows a comprehensive investigation of technology's pedagogical mechanisms and effectiveness for forming schoolchildren's value systems through project and research activities. The research subjects involved in this study were prospective biology teachers and school students. Prospective biology teachers were selected from teacher education programs at universities, particularly those undergoing training in biology education. School students were selected from secondary schools to participate in project competitions and research activities, such as DARYN and MAN. The selection criteria for both groups included their willingness to participate and relevance to the research objectives. The methods and instruments used to collect data and information were theoretical analyses of scientific and pedagogical literature. At this stage, a comprehensive review and analysis of relevant literature sources, including books, journal articles, and educational guidelines, was conducted to identify pedagogical mechanisms and theoretical frameworks for forming school children's value systems through project and research activities.

A theoretical model of forming school students' value systems through project activities and research was developed based on the identified pedagogical mechanisms. This involved creating a conceptual framework outlining the stages, actions, and criteria for forming leadership skills. Questionnaires and surveys were administered to prospective biology teachers and school students to gather information regarding their experiences, attitudes and perceptions regarding the project and research activities and their impact on their value systems. The questionnaires were designed specifically for this study and have undergone validity testing to ensure their reliability. Data collected from the surveys and questionnaires were analyzed using quantitative and qualitative analysis techniques. Quantitative analysis involves statistical analysis, including descriptive statistics and inferential statistics, to examine relationships and patterns between variables. Qualitative analysis involved thematic analysis, identifying common themes and patterns in the qualitative responses to understand participants' experiences and perceptions better. The research design, subject selection, data collection methods, and analysis techniques used in this study aimed to provide a comprehensive and systematic investigation of technology's pedagogical mechanisms and effectiveness in forming school children's value systems through project activities and research).

3. RESULT AND DISCUSSION

Results

The technology of forming a schoolchild's value system is related to the system of formation procedures, including the development and organization of the process of forming a schoolchild's value system through project and research activities and creating favourable conditions. The development of the technology for the formation of the value system of schoolchildren during biology lessons is based on the axiom system. Subsequently, we processed and adapted this system into the school's educational environment and implemented it into the educational process (in this study, biology lessons). The main goal of this research is to form the value system of school students through teaching biology. The axioms of the technology for the formation of the value system of schoolchildren during biology lessons through project activities and research in one educational space in Kazakhstan include several points. First, the relevance with which this technology has a positive trend and contributes to the formation of the value system of schoolchildren through a particular discipline (biology in this case). Secondly, the adequacy of pedagogical thinking, for which this technology is of great pedagogical interest as it ensures the pedagogical and professional growth of teachers, the development of writing and research projects, criteria and indicators of the level of formation of the value system of schoolchildren, evaluation options, and so on.

Third, flexibility, where this technology can be used individually or centrally by all teachers in a school's holistic pedagogical environment to improve the quality of the educational process. Fourthly, the axiom of modelling the holistic educational environment of the school or hierarchy, which this technology implies the interconnection of the entire educational system in the formation of the value system of schoolchildren such as goals, objectives, the content of lessons, methods, means and forms of organization, control, as well as methods of evaluation and correction. Fifth, staging implies the development of a step-by-step project for the formation of a schoolchild's value system through project activities and research (including "what to form," "why to form," and "how to form"). In the development of the value system of schoolchildren in biology lessons, the steps include determining the value system of students, justifying the formation of the value system, and forming a specific value system. In the development of a specific project, the steps include setting the project's purpose, determining the project's content or research work's content, and selecting appropriate methods, means and forms. In addition, assessment, analysis, diagnostics, and correction are required to ensure that the project is successful and meets the set objectives.

Sixth is the axiom of technology normalization, which is the integrity and cycle of technology for forming school students' value systems during biology lessons through projects and research activities. This technology allows versatility in specific disciplines, sections, or subject topics. Finally, versatility and technology imply the creation of projects in specific research work and the interconnection of the main structures to implement the formation of the value system of schoolchildren in each project and research work. Such a project is a means of implementing the technology of forming a schoolchild's value system. Analysis of the methodological foundations of the project and research activities allowed us to develop the main components of this technology. The typology of projects and research activities includes research, creative, role- or game-based, information-seeking, and applied or practice-oriented projects. The methodology of projects and research activities involves the definition of the research problem, justification of the relevance of the research, choice of topic/title, thinking about the object and subject of research, research objectives as a vision of the result, identification of research conditions as hypotheses/assumptions, definition of tasks to achieve the goal, identification of knowledge gaps that are solved by research (theoretical relevance), as well as determination of the practical relevance of research.

Methods of project or research activities include observation, experimentation, measurement, comparison, modelling, conversation, interview, questioning, sociometry, testing, historical method, logical method, and formalization. Project or research activities include academic and research work, educational and research work, and academic or educational reports. Project or research activity characteristics include topic choice, goal setting, leadership, novelty, practical relevance, and results. The presentation of a project or research activity may take the form of an academic work, glossary, thesaurus, slide film, video film, photo album, guidebook, catalogue, after-school activity (e.g., humour club, quiz, competition), model, moulage, exposition, collection, herbarium, installation, situation plan, and others. Stages of project or research activities include a beginning, planning, decision-making, completion of objectives, processing of results, proposal defence, defence, and debriefing. The project or research work structure includes a title page, table of contents, bibliography, appendices, and supervisor review. The main assessment criteria include the level of individual work, justification of the choice of topic, practical relevance, the freshness of problem-solving, artistry and expressiveness of performance, depth and breadth of knowledge of the research problem, competence (answers to questions), and use of visualization and technical means.

Standardization and normalization by teachers/supervisors, workplace comfort for teachers/supervisors in educational spaces, and application of technology in a psychologically supportive environment, considering individual age characteristics, expressed abilities, and skill levels of schoolchildren, are all important. The technology aims to obtain guaranteed results and is applied in a psychologically supportive environment, considering the individual's age characteristics, expressed abilities, and skill level of schoolchildren. The technology helps teachers/supervisors achieve the goals of forming a schoolchild's value system, instilling interest in schoolchildren's project management and research activities, developing cognitive skills, ensuring competent leadership, rationally choosing a project subject, and using scientific methodology. For schoolchildren, technology helps to achieve the goals of forming a value system, instilling interest in the implementation of projects and research activities, developing scientific research skills, ensuring a rational choice of the project subject and the use of scientific methodology, as well as ensuring competent information search, problem-solving, processing of results and concluding.

The technology is presented as a five-step model with the primary goal of shaping the value system of school students during biology lessons through projects and research activities. The goals for achieving the objectives are formulated clearly; each teacher conducts obvious and result-oriented goal setting. Each teacher aims to ensure that students understand and master specific topics, receive a certain level of knowledge, and learn to apply this knowledge in everyday life. These goals include forming and developing children's ability to think, analyze and justify their knowledge; influencing and helping to develop children's motivation in acquiring knowledge; developing students' interest in the formation of a value system; contributing to the development of self-discipline, consolidating all acquired knowledge with specially designed tasks, creating a psychologically favourable attitude among schoolchildren to receive and consolidate educational material, forming and creating personal psychological qualities of schoolchildren, and forming and creating personal social qualities of schoolchildren.

Teachers can evaluate the extent of goal achievement only if there is a reliable way. These primary objectives are achieved at each stage of the designed technology. Typology development in schoolchildren's projects and research activities involves research projects, creative projects, role-based projects (games), information-seeking projects, and applied (practice-oriented) projects. Teachers help students determine the typology needed in their project or research at this stage. The next step is the development of scientific methodology. Teachers work with school children to explain, direct and discuss the scientific apparatus of their project or research work. The generally accepted methodology includes research problem, research relevance, research topic, research object, research subject, research objective, research hypothesis, research goal, research method, theoretical relevance, and practical relevance. The scheme of student value formation is presented in Figure 1.

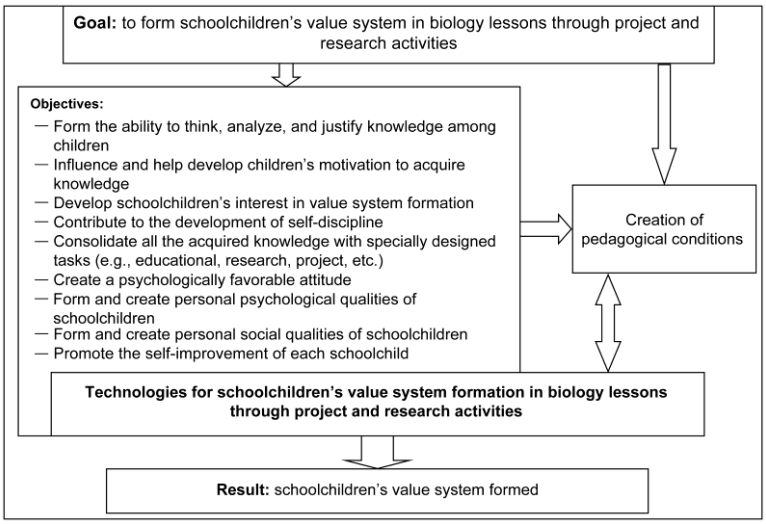

Figure 1: Formation of Schoolchildren's Value System

The definition of scientific research methods in schoolchildren's projects and research activities, along with a brief explanation, includes several methods that can be applied. School children are taught various scientific research methods to be applied in projects or research activities, namely, observation. At this stage, data is collected using the senses. Types include direct and indirect, continuous and discrete,

overt and covert, elongated and reversed. Observation requirements include regularity, purpose, activity, and consistency. Second, experimentation. At this stage, special conditions are created to obtain data. Types of experiments include full-scale and laboratory. Requirements include the availability of theory, hypothesis setting, object selection, material base preparation, experience and control, and description and analysis of results in graphs, tables and statistics. Third, measurement. At this stage, procedures are carried out to determine the numerical value of the required quantity using instruments and other tools, providing accurate quantitative data about an object or phenomenon.

Fourth, comparison. At this stage, the similarities and differences are revealed with the requirement of similarity of the things being compared and highlighting the most essential features. Fifth is modelling. The activity involves replacing the actual object with a model in which its properties are presented in "pure form". Types of modelling include material (layout, moulage, model) and ideal (symbolic, mathematical, computer). Sixth, conversation. The activity is testing the dialogue between the researcher and the person being tested according to a pre-designed program. Conversation requirements include respondent competence, justification of conversational motives, and the presence of direct and indirect questions. Seventh, interview. The activity is a study regarding the dialogue between the researcher and the person under study on a specific topic to clarify their perspectives and evaluations. Requirements include creating conditions that encourage respondents' earnestness.

Eighth, questionnaires are written surveys of respondents to collect information researchers need. Types include specific, correspondence, and press. Questionnaires can be open, closed, or mixed. Ninth, sociometry examines hidden interpersonal relationships in a team where partners know each other, determining the sociometric personality index. Tenth, testing is diagnosing people who are tested according to specially designed questions and tasks with a value scale to identify individual differences. Types include achievement, professional inclination, and creativity. The eleventh is the historical method, the activity carried out to produce historical events in all their complexity, considering the most minor details, used when the research object is the history of an object or phenomenon. Twelfth, the logical method to support this activity requires the help of thinking procedures (i.e., analysis, synthesis, abstraction), reproducing the object or phenomenon while maintaining its essence. Finally, formalization represents objects or phenomena using synthetic languages of mathematics, physics, computer science, chemistry, and others.

In the structure of the scientific method, the teacher explains the structure of the student's project or research work, such as observation, data (qualitative and quantitative), hypothesis, experiment, and results. The forms of scientific creativity of schoolchildren include research work, which includes academic and research work, as well as educational and research work, project work, and reports, which include academic and educational reports. Furthermore, the teacher explains the forms of scientific creativity to schoolchildren and helps them make choices. Furthermore, teachers explain the comparative characteristics of academic/educational and research work; for example, the indicator of research work is practical relevance. The stages of work on a research project or activity include starting, planning, making decisions, completing objectives, verifying and processing results, proposal defence, defence, and debriefing.

Furthermore, there are activities for the primary presentation forms of scientific and research projects, which include academic work, vocabulary, thesaurus, glossary of terminology, slide film, video film, photo album, guidebook, catalogue, after-school activities, model, moulage, laboratory installation, collection, herbarium, exposition, website (telecommunication project). The suggested project structure consists of a title page, table of contents, contents consisting of introduction, theory section, summary of theory section, practical section, summary of practical section, conclusion, bibliography, appendices which include photographs, drawings, tables, graphs, diagrams, tests, questionnaires, maps, and reviews or supervisor comments. Furthermore, in this study, teachers explained the structure of scientific and research projects to school students and helped them organize this work correctly. The main evaluation criteria for the project or research work include evaluation of the scientific project or research work, the level of individual work, justification and relevance of the choice of topic, practical relevance, the freshness of problem-solving. There is an evaluation of the presentation of the work: artistic and expressiveness, depth and breadth of knowledge of the research problem, competence of the presenter (answering questions), use of visualization and technical means.

Thus, we have presented a step-by-step technology for projects and research activities that can be used during biology lessons to shape the value system of school students. These technologies can be applied to almost any discipline at school. Future teachers should be trained not only to teach subjects but also to develop children's scientific and creative thinking and motivate them to seek and find answers to questions. Thus, one can educate individuals with an embedded value system, which can help them in their daily lives and later in their professional careers. The technology for the formation of the value system of school students during biology lessons through projects and research activities is presented in Figure 2.

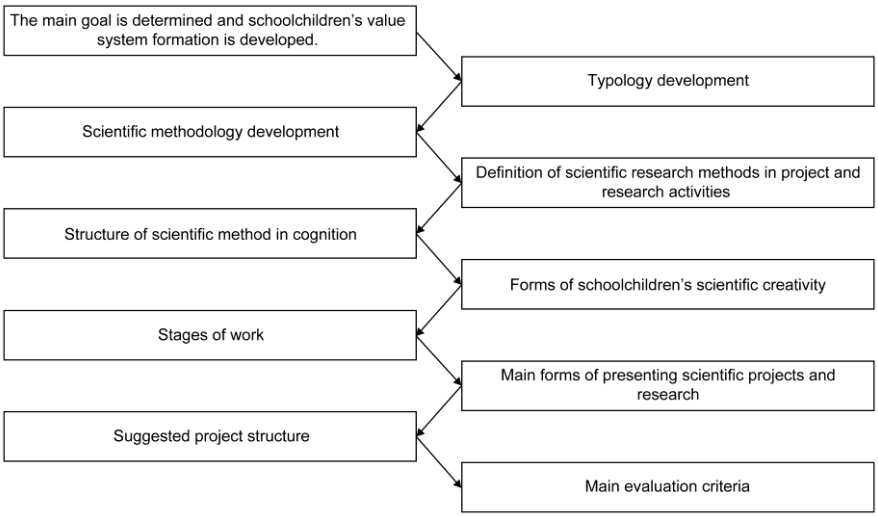

Figure 2. Technology for Shaping the Value System of School Students During Biology Lessons Through Project and Research Activities

In addition, according to the principal and biology teachers, the number of scientific and research projects has almost tripled. In Table 1, and Figure 3, you can see data on the increase in the number of scientific and research works of school students in competitions such as DARYN, MAN, etc. over the past three years. This was achieved by implementing the technology of value system formation through project and research activities into the holistic pedagogical process at the university.

Table 1. Data on the Increasing Number of Schoolchildren's Scientific and Research Works for Competitions Such as DARYN, MAN, etc., in the Past Three Years

School No.	2020	2021	2022
School No. 1	1	-	2
School No. 2	-	2	4
School No. 3	-	1	3
School No. 4	1	1	5
School No. 5	-	–	4
School No. 6	2	1	3

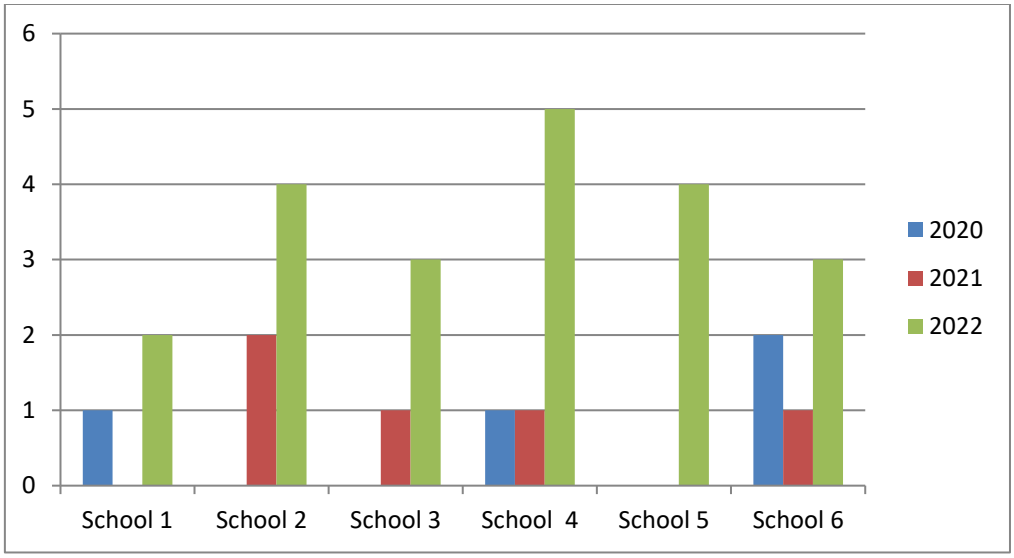

Figure 3. Data on the Increasing Number of Schoolchildren's Scientific and Research Works Over Three Years

The increase in the number of works submitted for the competition reflects the impact of technology on the active participation and achievement of school students in scientific projects. The growth observed from 2020 to 2022 shows a steady upward trajectory, with a 72% increase in the submitted works. This demonstrates the effectiveness of the technology in fostering scientific thinking, creativity, and the formation of a value system centred on love for the motherland, nature, and environmental preservation.

Discussion

We have integrated biology teacher training, including training in forming the value system of schoolchildren through project and research activities, into a holistic pedagogical process. The educational program for biology teacher training includes such disciplines as the organization of after-school work in biology, new concepts for the development of biology education, organization of research work of schoolchildren, etc., implying the study of technologies for projects and research activities of schoolchildren. In this research, we studied the results of student teaching practice and received feedback on the training of biology teachers from school principals. The graduates of this educational program, who are employed as biology teachers in schools in Aktobe and Aktobe regions, use technology for schoolchildren's research projects and activities in the form of three scientific projects, namely, MAN-Regional Research and Practice Centre for elementary school students and DARYN-National Research and Practice Center-for secondary school students. Several works have received prizes in this competition. Four scientific projects received prizes in the 2019-2020 academic year, four in 2020-2021, and seven in 2021-2022. These prize-winning projects are based on value system components such as love of the motherland, love of nature, environmental protection, protecting the homeland's biodiversity, and cultivating a cautious attitude towards nature.

In order to identify the formation of the value system of schoolchildren through project activities and research, we conducted a pedagogical experiment. The primary purpose of this experiment was to study the issue of the formation of the value system of schoolchildren and identify this formation after the application of technologies for projects and research activities of schoolchildren. Therefore, we conducted a questionnaire survey of biology teachers and school students before and after the experiment (including those preparing for scientific or research projects). This survey was conducted online through the Zoom platform. Of the 21 biology teachers, more than 80% of the respondents answered that it is impossible to adequately develop the school students' grading system during biology lessons. This task requires special pedagogical conditions (for example, contact with nature outside the classroom, visits to factories, competitions, opening a scientific centre at school, etc.). In contrast, 20% of respondents believe that traditional biology lessons can adequately form the value system.

Of the 78 schoolchildren, 82% of the respondents said that they would like to have more contact with nature and that they would learn a lot through activities (e.g., searching, finding, calculating, acting, identifying, exploring, etc.). In contrast, 18% stated that they were delighted with biology lessons. After the application of technology for the formation of the value system of schoolchildren through project activities and research in the holistic pedagogical process of the educational program for biology teacher training, we also conducted a questionnaire survey to the program graduates. During their pedagogical activities, they used this technology to prepare schoolchildren for competitions such as DARYN, MAN, and so on. We also conducted a questionnaire survey of the school students who worked on the scientific project. We found that 100% of the teacher respondents (15 teachers from city and regional schools) stated that this technology is very effective and helpful in writing and designing projects and research. They also noted that the recommendations on this technology serve as instructions for step-by-step actions for supervisors and schoolchildren. In turn, 100% of schoolchildren (48 people) noted that they work with supervisors in full accordance with this technology and that they like working with projects because they observe tangible results, win, and develop motivation to participate in grant projects in the field of biology in the future. Some schoolchildren (7 people from grades 9 and 10) want to study biology at university.

The findings from this study demonstrate the successful integration of school students' value system formation through project and research activities into the holistic pedagogical process for biology teacher training. The implementation of technology for project and research activities has shown positive results in school students' engagement, motivation, and value system development. (Berliana et al., 2024; Novitasari, 2023; Said, 2023). Results from pedagogical experiments and questionnaire surveys provide valuable insights into the effectiveness of this technology. Before implementation, most biology teachers (more than 80%) believed it was impossible to adequately develop school students' grade systems during traditional biology lessons alone. This highlighted the need for special pedagogical conditions, such as hands-on experience in nature, excursions, competitions, and establishing scientific centers in schools. On

the other hand, 20% of respondents believe that traditional biology lessons are sufficient to form a value system.

From the perspective of school students, most respondents (82%) expressed their desire for more contact with nature and emphasized the importance of active learning through various activities. This shows their enthusiasm for project-based learning and its potential to facilitate learning and value system formation (Diba & Hindun, 2024; Husna & Ependi, 2024). However, it should be noted that 18% of students were already satisfied with traditional biology lessons. After the application of the technology, both biology teachers and school students gave positive feedback. All participating teachers (100%) recognized the effectiveness and usefulness of this technology in facilitating projects and research. They considered the recommendations provided as step-by-step instructions for themselves and their students. Likewise, all school students (100%) reported that they followed the technology closely and appreciated the tangible results, motivation, and potential to participate in future grant projects. The positive responses from the teachers and students of this school demonstrate the impact of this technology on their engagement and enthusiasm for biology education.

The increase in the number of scientific projects and research works, as reported by principals and biology teachers, further supports the effectiveness of the implemented technology. The data show a significant growth in the number of projects over the past three years, which indicates the positive influence of the value system formation technology on the active involvement of school students in competitions such as DARYN and MAN. This increase demonstrates the successful integration of the technology into the holistic pedagogical process at the university level. Comparing these findings with previous relevant research, it is evident that this study contributes to an existing knowledge base (Bulueva et al., 2021; Daiva Jakavonytė-Staškuvienė & Kudinovienė, 2023; Mel'nichuk et al., 2019). The emphasis on project and research activities for forming school students' value systems is in line with the modern educational paradigm that focuses on active learning and the development of scientific thinking. The findings of this study reinforce the importance of integrating such activities into biology education and highlight the positive outcomes for teachers and students.

In conclusion, this study demonstrates the successful implementation and effectiveness of technology for the formation of value systems of school students through project and research activities in the process of holistic pedagogy for biology teacher training. Positive feedback from teachers and school students, as well as increased scientific projects, emphasized the impact of technology on engagement, motivation, and value system development. These findings contribute to existing research and support ongoing efforts to improve biology education through project-based learning approaches. Further research could focus on comparing the results of this study with similar studies to strengthen the novelty of the findings and provide more comprehensive insights into the benefits of integrating project activities and education research.

The study used qualitative and quantitative data collection methods, including interviews, observations, document analysis and questionnaires. This multi-method approach enabled a comprehensive understanding of the phenomenon under study and enhanced the validity of the findings. The research instruments underwent a rigorous validation process involving experts in education, biology, and research methodology. This ensured that the instruments used were aligned with the research objectives and effectively captured relevant information, thus enhancing the validity of the data collected. The study involved various subjects, including biology teachers, students and school documents. By examining multiple perspectives and data sources, this research provides a thorough understanding of value formation and active teaching in biology education, one of the critical educational issues namely value formation and active teaching in biology education. By exploring effective teaching methods and strategies, this research has practical implications for educators and curriculum developers to increase student engagement and motivation. This research explores a relatively under-explored area, focusing on the intersection between value formation and active teaching in biology education. This novelty value makes the findings valuable to the academic community and adds to the existing literature.

This study is limited to a specific geographical area or educational setting. As a result, the findings may need to be more readily generalizable to other contexts or regions, and caution should be exercised when applying them to different populations. Despite efforts to ensure data collection and analysis reliability, the qualitative nature of some data collection methods, such as interviews and observations, introduces subjectivity. Interpretations may vary based on individual perspectives and biases, and the comprehensive nature of the research may require significant time and resources. This may limit the sample size or scope of data collection, potentially affecting the representativeness and depth of findings. Respondents may provide answers they perceive to be socially expected, leading to potential biases in self-reported data from questionnaires and interviews. A longitudinal approach can provide insights into changes in values and teaching strategies over time. However, the study may face challenges related to

external factors beyond the researcher's control, such as changes in school policies or curriculum adjustments, which may affect the results. While the quantitative data provides valuable insights, the questionnaire design and sampling methods may limit the generalizability of these findings to the broader population.

Despite the weaknesses, this study contributes to biology education and value formation. The study offers deep insights into practical biology teaching approaches and methods and demonstrates how values can be harmoniously integrated into the learning process. The findings from this study can be a valuable guide for educators in designing more holistic and inclusive curricula and teaching strategies. In addition, this research opens up opportunities for follow-up studies that can further test and develop these findings, thus enriching educational practice and research in the future. Thus, despite some limitations, the contribution of this study remains significant in enriching the academic literature and educational practices in biology.

4. CONCLUSION

The research shows a significant increase in scientific work and research conducted by school students over the past three years, thanks to participation in competitions such as DARYN and MAN. This trend reflects the effectiveness of technology in shaping students' value systems through projects and research activities in biology lessons. Teachers, students and principals provided positive feedback, emphasizing that the technology provided clear guidelines for executing projects and research, increasing students' motivation and interest in biology. Overall, this study highlights the importance of integrating project and research activities in biology lessons to shape students' value systems and encourage their interest in science. This research contributes to the field of biology education, proving the effectiveness of project-based learning in shaping students' value systems and fostering their interest in science. The findings may influence educational policy and curriculum development, encouraging the integration of project and research activities to develop individuals with solid scientific thinking, ethical values, and a sense of responsibility towards the environment.

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