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INNOVATIVE APPROACHES TO ORGANIZING INDEPENDENT WORK OF STUDENTS IN THE PROCESS OF TRAINING MATHEMATICS TEACHERS

The strategic organization of independent student endeavors in the professional development of mathematics educators represents a critical element of the pedagogical framework, fostering the acquisition of professional proficiencies, the refinement of critical faculties, and the cultivation of self-directed learning. This article addresses the theoretical underpinnings and methodological approaches to the organization of independent study, surveys the historical landscape of research pertaining to this area, and posits recommendations for the optimization of its deployment within contemporary educational paradigms. The importance of independent work is especially evident in the preparation of future educators, as it fosters the development of skills such as analysis, planning, and the application of innovative educational technologies. The research is based on the analysis of scientific literature, student surveys, and the development of recommendations to improve organizational approaches. The results of a survey among second-year students in the 6B01510 – «Mathematics» program revealed the need for improved communication with instructors, better use of digital technologies, and the addition of supplementary educational resources.

The article also suggests creating an electronic educational environment to support independent work, which will include courses, materials, tests, video lessons, and feedback systems to enhance the learning process.

Keywords: innovative approaches, independent work, digital technologies, project-based learning, critical thinking, professional competence, pedagogical technologies.

Introduction

The organization of students' independent work in the process of mathematics teacher training is a key aspect of modern teacher education. It promotes the formation of professional competencies, the development of critical thinking and the ability to continuous self-education. This article will consider the need to organize independent work, the historical aspects of its research, the main researchers in this field, goals and objectives, as well as methods of effective organization of independent work in the process of training future mathematics teachers.

Students' independent work is an integral part of the educational process, especially in the training of future teachers. It allows students to develop the skills of independent information search and analysis, develop the skills to plan and organize their activities, make decisions and take responsibility for them. In the context of mathematics teacher training, independent work contributes to a deep understanding of the subject, the development of methodological skills and readiness to introduce innovative educational technologies [1, p. 5–7].

The issues of organizing students' independent work began to be actively investigated in the middle of the 20th century. The first studies were aimed at determining the role of independent work in the educational process and its impact on student academic performance. Over time, the focus has shifted to the development of techniques and technologies that contribute to the effective organization of independent activities. In the 1990s, special attention was paid to the introduction of information technology into the educational process, which opened up new opportunities for students to work independently [2, p. 1–3].

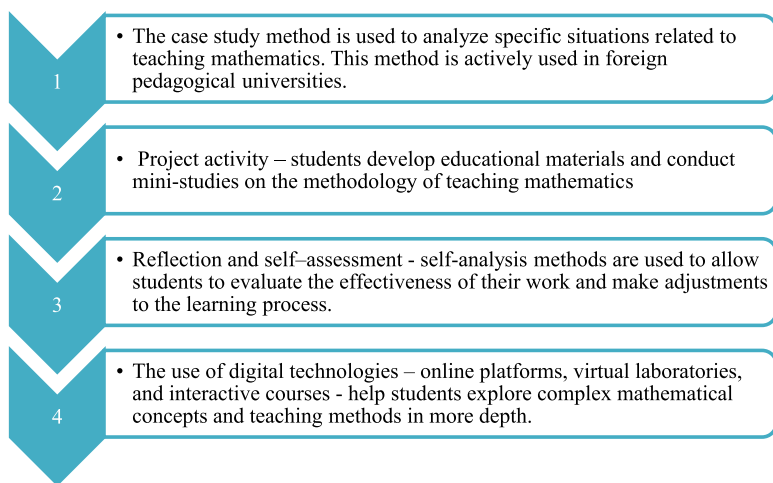
V. A. Dahlinger is a well-known Russian researcher, whose work has significantly enriched the study of the organization of independent work of students. He explores in detail the methods of stimulating students' independent work in teaching mathematics and presents practical suggestions for their organization. His works, such as «Students' independent activity and its activation in teaching mathematics», became the basis for many subsequent studies in this field [3, p. 1–7].

Independent activity of students is a process of active, purposeful and meaningful acquisition of knowledge, skills and abilities without direct supervision from the teacher. This type of activity promotes the development of critical thinking, responsibility for one's own learning and increases the level of professional training of future mathematics teachers. In pedagogical theory and

practice, students' independent activity is considered as one of the key factors of successful learning. Jean Piaget emphasized that independent environmental research and cognitive conflicts contribute to the formation of new knowledge. Lev Vygotsky singled out the concept of a «zone of immediate development», where independent activity plays a crucial role in the assimilation of new material and the formation of professional competence [4, p. 3–4].

John Dewey argued that learning is most effective when students are actively involved in the learning process through solving practical problems. His theory of «earning by doing» emphasizes that students' independent work helps them to better master the material, develop creative and critical thinking [5, p. 1–5]. David Kolb proposed the theory of experimental learning, where the student goes through four stages: concrete experience, reflection, abstract conceptualization and active application of knowledge. In the context of mathematics teacher training, this model allows students to independently develop teaching methods, analyze their effectiveness, and adapt learning approaches [6, p. 3–6].

Examples of organizing independent activities [7, p. 1–3]:



The main purpose of organizing students' independent work in the process of mathematics teacher training is to develop their professional competencies necessary for effective teaching [8, p. 1–4]. The main tasks include:

Professional skills development: independent work contributes to the mastery of mathematics teaching methods, the ability to develop educational materials and plan the learning process.

Formation of research skills: students learn to conduct pedagogical research, analyze their results and apply the data obtained in practice.

Development of critical thinking: independent work stimulates the analysis of various teaching approaches, assessment of their effectiveness and adaptation to specific learning conditions.

Preparation for continuous self-education: in the context of the constant development of educational technologies and teaching methods, the teacher must be ready to constantly update his knowledge and skills [9–10, p. 1–2, p. 4].

This research has theoretical significance, as it contributes to the development of pedagogical strategies for organizing independent learning for novice mathematics teachers. It is based on the fundamental theories of such thinkers as Dewey, Kolb, Piaget and Vygotsky, demonstrating their applicability to modern educational conditions. In practice, the study contributes by setting out methodological recommendations for improving students' independence in their academic activities using advanced educational technologies. Therefore, further study of this subject is crucial to increase the effectiveness of the professional development of future mathematics teachers by improving approaches to their independent work.

Materials and methods

The study employs a mixed-method approach to data collection, encompassing an analysis of pedagogical literature, a survey of students, and the formulation of recommendations for enhancing the organization of independent work. Materials:

1. Analysis of scientific research on innovative approaches to independent activity.

2. Make a survey of students of a pedagogical university about the organization of their independent work outside the educational process.

3. Development of an electronic environment to support students' independent work in the field of pedagogy.

Research methods:

Content analysis is the study of literature and best practices for organizing independent work in higher education institutions.

Questionnaires – surveys will be conducted among students in order to identify their needs in organizing independent work, the problems they face, and their expectations from teachers.

Pedagogical design method – based on the data obtained, the concept of an electronic environment for students' independent work will be developed.

After analyzing the collected data, it is planned to create an electronic platform that will allow students to manage their independent studies more effectively, quickly receive feedback from teachers and use innovative approaches to learning.

This tool will potentially become an important component of the educational process, improving the quality of training for future mathematics teachers.

The article used a questionnaire consisting of 15 questions, including both closed and open questions. The questions were evaluated using a Likert scale to identify students' attitudes to independent work, as well as a scale to determine their preferences in terms of teacher assistance. The survey was conducted online among second-year students of the educational program 6B01510 – «Mathematics» of the Korkyt Ata Kyzylorda University. The main purpose of the study was to assess students' attitudes towards independent work and their expectations from teachers in facilitating this process. Statistical analysis was used to process the data, which revealed the key trends and preferences of students regarding the organization of independent work.

Results and discussion

The pedagogical experiment was carried out at the Korkyt Ata Kyzylorda University at the Institute of Natural Sciences. The pedagogical practice of research work was implemented in the second academic period of the 2023–2024 academic year in the M-22-1 and M-22-1y study groups.

Subject: Student Independent Work and Instructor Support. The purpose of the survey was to examine students' attitudes towards independent study and their expectations of instructors. The survey was conducted online, utilizing a questionnaire consisting of 15 questions, which included both closed and open-ended items. Students completed the questionnaire over the course of one week, ensuring anonymity and voluntary participation. As a result of the survey, 45 responses were collected.

Table 1 – Survey results in percentages

№	Question	Answers (%)
1	How would you rate your ability to do independent math work?	Very bad – 5 %, Bad – 10 %, Normally – 25 %, Good – 40 %, Very good – 20 %
2	How much time per week do you usually spend on independent math assignments?	Less than 1 hour – 10 %, 1–2 hours – 25 %, 3–4 hours – 40 %, 5–6 hours – 15 %, More than 6 hours – 10 %

3	How comfortable are you doing assignments without the direct help of a teacher?	Not comfortable at all – 5 %, Rather uncomfortable – 15 %, Neutral – 30 %, Rather comfortable – 35 %, Very comfortable – 15 %
4	What form of teacher support is most effective for you when doing independent assignments?	Individual consultations – 25 %, Group consultations – 20 %, Electronic materials and video tutorials – 30 %, Forums and chat rooms for questions – 15 %, Feedback on completed tasks – 10 %
5	How often do you need help from a teacher when completing assignments?	Very often – 10 %, Sometimes it's 40 %, Rarely – 35 %, Almost never – 15 %
6	How important is it for you to receive teacher feedback on completed independent assignments?	It doesn't matter at all – 5 %, Not very important – 10 %, Neutral – 25 %, Important – 35 %, Very important – 25 %
7	What role does digital technology play for you in doing independent work?	A very important role – 40 %, They help, but not critically – 35 %, I prefer to work without technology – 15 %, Digital technologies are not important to me – 10 %
8	What digital tools do you use to complete independent math assignments?	Online courses – 40 %, Virtual laboratories – 25 %, Mathematical programs – 35 %, Video Tutorials – 30 %, Other tools – 10 %
9	What additional forms of support from teachers would you like to see when doing independent work?	(An open question)
10	What, in your opinion, can help you improve the effectiveness of independent work in mathematics?	(An open question)
11	How would you rate the overall organization of independent work within your training course?	Very bad – 5 %, Bad – 10 %, Normally – 25 %, Good – 40 %, Very good – 20 %

12	How much do the learning materials used in the course help you in independent work?	They don't help at all – 5 %, Not very helpful – 10 %, Neutral – 30 %, Help – 40 %, Very helpful – 15 %
13	What kind of feedback form would you prefer to improve your independent work?	Individual comments – 30 %, Group discussion – 25 %, Electronic performance reports – 20 %, Online sessions with a teacher – 25 %
14	What role does regular independent assignments play in your learning activities?	Very important – 50 %, Important – 30 %, Neutral – 10 %, Not important – 5 %, Not important at all – 5 %
15	What additional resources, in your opinion, can improve the organization of independent work?	(An open question)

The survey results show that the majority of students (40 %) devote 3–4 hours a week to independent work. In addition, 35 % of students recognize the significant impact of digital technologies on their independent work. Open responses often suggest improving online consultations and pointing out the need for additional resources, including video tutorials and discussion forums.

Statistical analysis using the Excel program was used to process the data. The percentages for each closed question were calculated and the main trends from the answers to the open questions were highlighted, which made it possible to form recommendations for teachers to improve the organization of students' independent work.

Conclusion

Throughout the research, several key findings emerged regarding student perspectives on self-directed tasks within the preparation of upcoming mathematics educators. Typically, learners dedicate approximately three to four hours weekly to these individual mathematical exercises, suggesting an appreciation for autonomous learning; however, this duration occasionally proves insufficient for comprehensive understanding of the subject matter. Additionally, the responses highlight the significant contribution of digital tools when tackling assignments, with students favoring online platforms and targeted math software for homework completion. Nevertheless, enhancing interaction between instructors and pupils remains crucial, especially via virtual guidance sessions alongside supplementary materials like instructional videos and collaborative discussion boards. Answers

to open-ended questions show that students want more support from teachers, especially in terms of getting feedback and clarification. The most popular forms of support are individual consultations and access to additional educational materials, which indicates the desire of students to study topics in more depth and improve the quality of their educational activities.

One of the important conclusions is the need to create innovative approaches to organizing students' independent work, for example, the introduction of an electronic educational resource system. This will significantly increase the activity of students, facilitate the process of teacher-student interaction, and receive timely feedback. Based on the results of the research, we plan to create an electronic environment that will support students in the process of independent work. This website will feature various tools to improve the learning process, such as electronic materials, video tutorials, and other resources. The electronic environment serves as a centralized platform for receiving support from teachers, sharing experiences, and increasing motivation to learn.

The electronic educational environment, created to support students' independent work, includes several main sections aimed at improving the learning process and improving learning efficiency. The main page displays general information about the site, project objectives, as well as statistics and available resources such as courses, materials, and consultations. For students to work independently, a section is organized containing educational materials, including video tutorials, tests, assignments, and virtual labs. You are also given the opportunity to participate in interactive tasks that promote deep learning of the topic. To empower students, a section is being created with additional educational materials, links to external resources, and platforms for completing practical online assignments. Interactive rating tables that can track student progress, as well as grades and task completion statistics, help motivate students and track their progress.

The creation of this website allowed students not only to organize their independent work more effectively, but also provided access to valuable educational resources, increasing their interest in the subject and improving interaction with teachers.

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МАТЕМАТИКА МҰҒАЛІМДЕРІН ДАЯРЛАУ ПРОЦЕСІНДЕ СТУДЕНТТЕРДІҢ ӨЗІНДІК ЖҰМЫСЫН ҰЙЫМДАСТЫРУДЫҢ ИННОВАЦИЯЛЫҚ ТӘСІЛДЕРІ

Математика мұғалімдерін даярлауда студенттердің өздік жұмысын ұйымдастыру білім беру процесінің маңызды аспектісі болып табылады, ол кәсіби құзыреттіліктерді, сыни ойлауды және өзін-өзі дамыту қабілетін қалыптастыруға ықпал етеді. Бұл мақалада өздік жұмысты ұйымдастырудың теориялық негіздері мен әдістері, осы саладағы зерттеулердің тарихи аспектілері және оның заманауи жағдайда жүзеге асырылуын оңтайландыру ұсыныстары қарастырылады. Өздік жұмыстың маңыздылығы әсіресе болашақ педагогтарды даярлау контекстінде айқын көрінеді, себебі ол талдау, жоспарлау және инновациялық білім беру технологияларын қолдану дағдыларын дамытуға ықпал етеді. Зерттеу ғылыми әдебиетті талдауға, студенттер арасында сауалнама жүргізуге және ұйымдастырушылық әдістерді жақсартуға арналған ұсыныстар әзірлеуге негізделген. «6B01510 – Математика» білім беру бағдарламасының екінші курс студенттері арасында жүргізілген сауалнама нәтижелері оқытушылармен қарым-қатынасты

жақсарту, цифрлық технологияларды тиімді пайдалану және қосымша оқу ресурстарын енгізу қажеттілігін көрсетті.

Сондай-ақ, өздік жұмысты қолдау үшін электрондық білім беру ортасын құру ұсынылады, ол курстарды, материалдарды, тесттерді, бейнемазмұнды және кері байланыс жүйелерін қамтиды, бұл оқу процесін жетілдіруге көмектеседі.

Кілтті сөздер: инновациялық тәсілдер, өзіндік жұмыс, цифрлық технологиялар, жобалық оқыту, сыни ойлау, кәсіби құзыреттілік, педагогикалық технологиялар.

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ИННОВАЦИОННЫЕ ПОДХОДЫ К ОРГАНИЗАЦИИ САМОСТОЯТЕЛЬНОЙ РАБОТЫ УЧАЩИХСЯ В ПРОЦЕССЕ ПОДГОТОВКИ УЧИТЕЛЕЙ МАТЕМАТИКИ

Организация самостоятельной работы студентов в подготовке учителей математики является важным аспектом образовательного процесса, способствующим развитию профессиональных компетенций, критического мышления и способности к самообразованию. В статье рассматриваются теоретические основы и методики организации самостоятельной работы, исторические аспекты исследований в этой области, а также предложения по оптимизации её проведения в современных условиях. Важность самостоятельной работы особенно очевидна в контексте подготовки будущих педагогов, так как она способствует формированию навыков анализа, планирования и применения инновационных образовательных технологий. Исследование основано на анализе научной литературы, анкетировании студентов и разработке рекомендаций для улучшения организационных подходов. Результаты опроса среди студентов второго курса образовательной программы «БВ01510 – Математика» выявили потребности в улучшении коммуникации с преподавателями,

улучшении использования цифровых технологий и добавлении дополнительных образовательных ресурсов.

Также предлагается создание электронной образовательной среды для поддержки самостоятельной работы, которая будет включать курсы, материалы, тесты, видео-уроки и систему обратной связи для улучшения учебного процесса.

Ключевые слова: инновационные подходы, самостоятельная работа, цифровые технологии, проектное обучение, критическое мышление, профессиональная компетентность, педагогические технологии.

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