6 **Linder K.E. Fundamentals of Hybrid Teaching and Learning** [Text] / K.E. Linder// *New Directions for Teaching and Learning.* – 2017. – No. 149. – Pp. 11-18.
7 **Saichaie K. Blended, Flipped, and Hybrid Learning: Definitions, Developments, and Directions** [Text] / K. Saichaie // *New Directions for Teaching and Learning.* 2020. Vol. 2020 (164). Pp. 95-104.
8 **Vo H.M., Zhu C., Diep N.A. The Effect of Blended Learning on Student Performance at Course-Level in Higher Education**: A Meta-Analysis [Text] / H.M. Vo, C. Zhu, N.A. Diep // Studies in Educational Evaluation. – 2017. – Vol. 53. – Pp. 17-28.
9 **Bonk C.J., Graham C.R. Blended Learning Systems: Definition, Current Trends, and Future Directions** [Text] / C.J. Bonk, C.R. Graham // Handbook of Blended Learning: Global Perspectives, Local Designs. Pfeiffer. – 2006. – Pp. 3-21.
10 **Graham Ch., Dziuban Ch. Blended Learning Environments** [Text] / Ch. Graham, Ch. Dziuban // *The Handbook of Research on Educational Communications and Technologies. New York: Lawrence Erlbaum Associates*. – 2008. – Pp. 269-276.

REFERENCES:

1 **Kliagin A.V. et al. Shtorm pervy'kh nedel': kak vy'sshee obrazovanie shagnulo v real'nost pandemii** [The storm of the first weeks: how higher education stepped into the reality of the pandemic]. Moscow, Vy'sshaia shkola e'konomiki, 2020, 112 p. (In Russian)
2 **Sukhanova E.A., Frumin I.D.**. **Kachestvo obrazovaniia v rossijskih universitetah: chto my' poniali v pandemiyu** [Quality of education in Russian universities: what we learned during the pandemic]. Tomsk, Tomskij gosudarstvenny'j universitet, 2021, 46 p. (In Russian)
3 **Kliagin A.V., Makareva A.Yu. Kejsy' by'stry'h reacij vuzov v period pandemii** [Cases of rapid responses of universities during the pandemic]. Moscow, Vy'sshaya shkola e'konomiki, 2022, 28 p. (In Russian)
4 **Alkanova O.N., Ananin D.P., Baizarov A.E. et al. Belaia kniga. Gibridnoe obuchenie** [White Book: Hybrid Learning]. Moscow, Saint Petersburg, Grin Print, 2022, 120 p. (In Russian)
5 **Margulieux L.E., McCracken W.M., Catrambone R.A. Taxonomy to Define Courses That Mix Face-to-Face and Online Learning.** *Educational Research Review*, 2016, vol. 19, pp. 104-118.
6 **Linder K.E. Fundamentals of Hybrid Teaching and Learning**. *New Directions for Teaching and Learning*, 2017, no. 149, pp. 11-18.
7 S**aichaie K. Blended, Flipped, and Hybrid Learning: Definitions, Developments, and Directions**. *New Directions for Teaching and Learning*, 2020, vol. 2020 (164), pp. 95-104.
8 **Vo H.M., Zhu C., Diep N.A. The Effect of Blended Learning on Student Performance at Course-Level in Higher Education**: **A Meta-Analysis**. *Studies in Educational Evaluation*, 2017, vol. 53, pp. 17-28.
9 **Bonk C.J., Graham C.R. Blended Learning Systems: Definition, Current Trends, and Future Directions.** *Handbook of Blended Learning: Global Perspectives, Local Designs. Pfeiffer*, 2006, pp. 3-21.
10 **Graham Ch., Dziuban Ch. Blended Learning Environments**. The Handbook of Research on Educational Communications and Technologies, New York, Lawrence Erlbaum Associates, 2008, pp. 269-276.

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EFFECTIVE METHODS OF TEACHING PHYSICS IN STEM EDUCATION: EXPERIENCE OF GRADUATE TEACHERS OF THE “JANA TALAP 2.0” PROGRAM

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This article explores effective methods for teaching physics within STEM education, focusing on the experiences of science teachers who participated in the “Jana Talap 2.0” program and became STEAM trainers. The study reflects these teachers’ knowledge on STEM educational technologies by analyzing their views and identifying best practices for integrating STEM approaches into physics lessons. STEM education has emerged as one of the most innovative and rapidly expanding fields, with initiatives like "Caravan of Knowledge," supported by Chevron, playing a pivotal role in advancing STEM education in Kazakhstan. This initiative develops methodological guidelines, organizes STEAM video lessons, decades, and conferences, as part of the “Roadmap for the Development of STEAM Education for 2021-2025.” The research involves a multi-method approach, including literature review, teacher surveys, qualitative analysis, and comparative methods, to identify and evaluate effective physics teaching practices. Feedback was collected from 20 teachers specializing in physics, chemistry, and biology across diverse regions, ensuring a representative dataset. The findings contribute to understanding the integration of STEM methods in physics education and provide recommendations for educators and institutions aiming to enhance STEM-based teaching practices.

Key words: *STEM education, physics experiments, STEM centers, natural sciences, and physics.*

STEM-БІЛІМ БЕРУДЕ ФИЗИКАНЫ ОҚЫТУДЫҢ ТИІМДІ ӘДІСТЕРІ: «ЖАҢА ТАЛАП 2.0» БАҒДАРЛАМАСЫНЫҢ БІТІРУШІ МҰҒАЛІМДЕРІНІҢ ТӘЖІРИБЕСІ

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Бұл мақала Jana Talap 2.0 бағдарламасына қатысып, STEAM тренерлері болған жаратылыстану пәні мұғалімдерінің тәжірибесіне назар аудара отырып, STEM білім беру жүйесінде физиканы оқытудың тиімді әдістерін қарастырады. Зерттеу осы мұғалімдердің STEM білім беру технологиялары бойынша білімдерін олардың көзқарастарын талдау және STEM тәсілдерін физика сабақтарына интеграциялаудың озық тәжірибелерін анықтау арқылы көрсетеді. STEM білім беру ең инновациялық және ең жылдам дамып келе жатқан салалардың біріне айналды және Chevron қолдайтын Білім керуені сияқты бастамалар Қазақстанда STEM білім беруді ілгерілетуде маңызды рөл атқарады. Бұл бастама «2021–2025 жылдарға арналған STEAM білім беруді дамытудың жол картасы» аясында әдістемелік ұсыныстар әзірлейді, STEAM бейнесабақтарын, онкүндіктерін және конференцияларын ұйымдастырады. Зерттеуде физиканы оқытудың тиімді тәжірибесін анықтау және бағалау үшін әдебиеттерге шолу, мұғалімдер сауалнамасы, сапалы талдау және салыстырмалы әдістерді қоса алғанда, әртүрлі әдістер қолданылды. Әр өңірден келген физика, химия және биология пәндерінен сабақ беретін 20 мұғалімнен кері байланыс жиналып, репрезентативті деректер жиынтығы ұсынылды. Зерттеу нәтижелері физиканы оқытудағы STEM тәжірибелерінің интеграциясын түсінуге ықпал етеді және STEM негізінде оқыту тәжірибесін жақсартуға ұмтылатын оқытушылар мен мекемелер үшін ұсыныстар береді.

Түйінді сөздер: *STEM- білім беру, физикалық тәжірибелер, STEM-орталықтар, STEM, жаратылыстану бағыттары, физика.*

ЭФФЕКТИВНЫЕ МЕТОДЫ ОБУЧЕНИЯ ФИЗИКЕ В STEM-ОБРАЗОВАНИИ: ОПЫТ УЧИТЕЛЕЙ-ВЫПУСКНИКОВ ПРОГРАММЫ «ЖАНА ТАЛАП 2.0»

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В этой статье рассматриваются эффективные методы преподавания физики в рамках STEM-образования с упором на опыт учителей естественных наук, которые участвовали в программе «Jana Talap 2.0» и стали тренерами STEAM. Исследование отражает знания этих учителей об образовательных технологиях STEM, анализируя их взгляды и выявляя лучшие практики для интеграции подходов STEM в уроки физики. STEM-образование стало одним из самых инновационных и быстрорастущих направлений, а такие инициативы, как «Караван знаний», поддерживаемый Chevron, играют ключевую роль в продвижении STEM-образования в Казахстане. Эта инициатива разрабатывает методические рекомендации, организует видеоуроки STEAM, декады и конференции в рамках «Дорожной карты развития STEAM-образования на 2021-2025 годы». В исследовании использованы разные методы, включая обзор литературы, опросы учителей, качественный анализ и сравнительные методы, для выявления и оценки эффективных методов преподавания физики. Отзывы были собраны у 20 учителей, преподающих физику, химию и биологию из разных регионов, что обеспечивает репрезентативный набор данных. Результаты исследования способствуют пониманию интеграции методов STEM в преподавание физики и предоставляют рекомендации для педагогов и учреждений, стремящихся улучшить практику преподавания на основе STEM.

Ключевые слова: *STEM-образование, физические эксперименты, STEM-центры, естественнонаучные направления, физика.*

Introduction. In recent years, there has been an increase in the implementation of Science, Technology, Engineering, and Mathematics (STEM) education worldwide. STEM education has gained the attention of researchers and educators alike, as it is seen as a way to develop students' problem-solving skills, critical thinking skills, and workforce readiness. A systematic review of international experiences identified four key clusters in STEM education: general training, teacher preparation, surveys, and e-learning integration [1, p. 9]. The implementation of STEM approaches in pedagogical education is crucial for developing teachers' competencies to meet modern educational demands [2, p.8]. Effective strategies include problem-oriented learning and research-based activities in physics education, which foster students' interest and activate their learning process [3, p.7]. STEM education has been shown to be beneficial in addressing real-world issues and connecting students' learning to real-life problems. Actually, STEM education has the potential to provide students with an education that is more relevant to their daily lives, as well as to the needs of the workforce. Despite the complexity of STEM education, effective teaching practices can be applied across various STEM activities, focusing on principles that promote effective learning [4, p.8].

Furthermore, there is a lack of consensus on the precise definition of STEM education, making it challenging for researchers and educators to develop clear guidelines for the implementation of STEM education. As a result, each study tends to provide its own unique interpretation and recommendations for implementing STEM education, adding to the complexity of the field. Nonetheless, STEM education is an area of growing importance that warrants further research and exploration to enhance its effectiveness and ensure its long-term success in promoting students' critical thinking and problem-solving skills, as well as workforce readiness [5, p.115, 6, p.12].

We have provided our own interpretation of the STEM education technology through research and observations, which serves as a contemporary and innovative approach to education. This method aims to resolve concrete, real-world issues in the fields of Science, Technology, Engineering, and Mathematics, while satisfying the demands of society. STEM education, therefore, represents a modern, interdisciplinary educational framework that responds to the pressing needs of our world [7, p.129, 8, p.215, 9, p.14].

Physics education plays a crucial role in equipping students with scientific knowledge and analytical skills. To further enhance the learning experience, integrating STEM principles into physics education has become increasingly popular [10, p.207].

The integration of STEM principles into physics education brings numerous advantages and opportunities for students. It promotes the integration of knowledge, emphasizes practical application, develops problem-solving skills, enhances technological literacy, fosters collaboration, and prepares students for future careers. By embracing STEM, educators can provide a dynamic and engaging learning experience that equips students with the skills and mindset necessary for success in an increasingly complex and technology-driven world.

Methods and materials. This study aims to identify effective methods and approaches to teaching physics within the framework of STEM education based on the analysis of opinions and experiences of science teachers who participated in the Jana Talap 2.0 program. Within the framework of this goal, the following tasks were set:

1. To study the modern theoretical basis of STEM education, including its principles and approaches to teaching physics.
2. To analyze the teaching experience and opinions of teachers who completed the Zhana Talap 2.0 program on the issues of introducing STEM methods into the educational process.
3. To determine the most effective methods and approaches to teaching physics used within the framework of STEM education.
4. To develop recommendations for integrating STEM approaches into teaching physics.

To solve these problems, theoretical and experimental research methods were used:

- Literature analysis: study of scientific publications devoted to STEM education, physics teaching methods and the features of the Jana Talap 2.0 program.
- Survey: conducting a survey among teachers participating in the program to collect data on the methods they use and their effectiveness.
- Qualitative data analysis: processing and interpreting the survey results to identify general trends and highlight effective approaches.
- Comparative analysis: comparing the data received from teachers with existing STEM teaching methods.

The study was conducted based on the opinions and experiences of 20 science teachers (physics, chemistry, biology, etc.) who were trained under the Jana Talap 2.0 program. Participants represent different regions and educational institutions, which ensures a representative sample. The survey was conducted remotely using the Google forms online platform, which made it possible to cover participants from different regions and collect the most complete data on the use of STEM methods in teaching physics.

Results. The questionnaire was administered to educators who were actively engaged in the Jana Talap 2.0 project, a program facilitated by the Caravan of Knowledge organization. The participants constituted a diverse sample of 20 teachers selected from various regions across Kazakhstan.

Questions for teachers	
1. What does "STEM-education" mean to you?	5. How is it advisable to conduct the subject"Physics"?
2. What areas do you think "STEM-Education" unites?	6. Is it worth using modern methods and techniques when conducting the subject" Physics"?
3. When conducting a laboratory lesson, which methods do you find most effective?	7. What knowledge areas are necessary for teaching the subject of "Physics"?
4. Do you use scientific principles in the process of conducting a lesson in physics?	8. What do you think is necessary to deepen knowledge in the field of "Physics"?

Based on the provided options and the number of people who chose each option, here is an interpretation of what *"STEM education"* means to the surveyed teachers:

The majority of the teachers (6 people) perceive STEM education as the integration of science, technology, engineering, and mathematics in education. They recognize the importance of combining these disciplines to provide students with a comprehensive learning experience.

Additionally, a significant number of teachers (5 people) view STEM education as a multidisciplinary approach that combines real-world applications with scientific concepts. They value the practical and hands-on aspects of STEM education.

Some teachers (2 people) believe that STEM education fosters critical thinking, problem-solving, and innovation skills through hands-on activities. They acknowledge the importance of these skills in preparing students for future challenges.

A few teachers (1 person) see STEM education as a means to prepare students for careers in STEM fields by developing a strong foundation in science, technology, engineering, and mathematics. They emphasize the career-oriented aspect of STEM education.

Furthermore, a notable number of teachers (5 people) consider STEM education as a way to encourage creativity, collaboration, and inquiry-based learning through STEM-focused projects. They believe in engaging students in active learning experiences.

A smaller number of teachers (3 people) perceive STEM education as equipping students with the skills and knowledge needed to address complex global challenges using STEM solutions. They emphasize the problem-solving aspect of STEM education.

Some teachers (4 people) view STEM education as bridging the gap between theoretical knowledge and practical applications through STEM-based curriculum and activities. They value the connection between classroom learning and real-life situations.

A few teachers (1 person) believe that STEM education inspires interest and curiosity in STEM subjects and careers among students. They see it as a means to engage students and spark their enthusiasm.

Lastly, a couple of teachers (2 people) recognize that STEM education enhances digital literacy and technological competency. They emphasize the importance of technology in STEM education.

Based on the given options, it seems that all the listed interpretations have received support from at least one respondent, suggesting that multiple perspectives are acknowledged among the surveyed teachers.

Using the given choices and the frequency of selection for each option, we can derive an understanding of the domains that the surveyed educators perceive *as encompassed by "STEM education":*

The majority of the teachers (8 people) perceive mathematics as a unifying element in STEM education. They recognize the importance of mathematical concepts and their integration into STEM learning.

Physics and chemistry are also considered significant areas that STEM education unites, as indicated by 7 people who chose these options. This suggests that teachers see the integration of physics and chemistry principles as essential components of STEM education.

Engineering, robotics, and coding/programming are selected by 6 people each, indicating that these areas are seen as integral to STEM education. This suggests that teachers acknowledge the importance of problem-solving, design thinking, and hands-on application of knowledge in STEM fields.

Technology, computer science, and information technology are chosen by 5 people each, implying that these areas are seen as interconnected with STEM education. This suggests that teachers recognize the role of technology and computer-related skills in STEM learning.

Biology, data analysis, and coding/statistics are chosen by a smaller number of teachers, ranging from 4 to 5 people. This suggests that these areas are still considered relevant to STEM education but may not be as universally emphasized as mathematics, physics, chemistry, engineering, and technology.

Environmental science is selected by only 1 person, suggesting that it may be perceived as less commonly associated with STEM education among the surveyed teachers.

Overall, the interpretations indicate that the surveyed teachers perceive STEM education as a multidisciplinary approach that unites various fields, including mathematics, physics, chemistry, engineering, robotics, computer science, technology, and coding/programming. These areas are recognized as integral components of STEM education, fostering critical thinking, problem-solving, and hands-on learning experiences.

Considering the available options and the corresponding responses from the surveyed teachers, we can draw conclusions about the preferred approaches that these educators consider most effective when implementing *a laboratory lesson*:

An equal number of teachers (5 people each) find hands-on experiments and practical demonstrations, as well as inquiry-based learning and student-led investigations, to be the most effective methods for conducting laboratory lessons. This suggests that these teachers value experiential and inquiry-based approaches that actively engage students in the learning process.

Collaborative group work and teamwork, as well as problem-based or project-based learning approaches, are chosen by 6 people each. This indicates that these teachers emphasize the importance of collaboration, teamwork, and problem-solving skills in laboratory settings. They value the opportunity for students to work together, apply their knowledge, and tackle real-world problems.

Using technology and virtual simulations, data analysis and interpretation activities, as well as engaging with real-world applications and case studies, are selected by 2 people each. This suggests that while these methods are not as widely favored, some teachers recognize the value of incorporating technology, data analysis, and real-world connections to enhance laboratory lessons.

Only 1 person chose encouraging critical thinking and problem-solving skills as the most effective method. Although this response had the lowest number of selections, it still indicates the importance placed on fostering critical thinking skills during laboratory lessons.

Overall, the interpretations suggest that the surveyed teachers value a combination of hands-on experiences, inquiry-based learning, collaborative group work, and problem-based or project-based approaches in laboratory lessons.

They also recognize the potential benefits of using technology, data analysis, and real-world applications to enhance the learning experience.

Analyzing the given options and the corresponding number of respondents who selected each option, we can derive an interpretation regarding the extent to which the surveyed teachers *incorporate scientific principles in their physics teaching practices*:

A majority of the teachers (12 people) responded that they definitely use scientific principles to guide discussions and promote understanding of physics principles. This suggests that these teachers actively incorporate scientific principles as a foundation for teaching physics concepts and fostering conceptual understanding among students.

A significant number of teachers (11 people) emphasized the application of scientific principles in conducting experiments and analyzing data. This indicates that they recognize the importance of connecting theoretical principles with practical applications in physics lessons.

Similarly, 9 people stated that they connect scientific principles with real-world examples to enhance understanding in physics. This suggests that these teachers value the relevance of physics principles in everyday life and strive to make these connections for their students.

7 people indicated that they integrate scientific principles to explain phenomena and concepts in physics. This implies that they focus on using scientific principles as a means of explanation and exploration in their lessons.

Overall, the interpretations suggest that the majority of surveyed teachers actively utilize scientific principles in the process of conducting a lesson in physics. They emphasize the application, relevance, and connection of scientific principles to enhance students' understanding and engagement in the subject.

Based on the options provided and the number of people who chose each option, here is an interpretation of *how it is advisable to conduct the subject of "Physics"* according to the surveyed teachers:

Incorporate hands-on experiments and practical demonstrations to illustrate concepts: This approach was chosen by 3 people, suggesting that these teachers value the use of hands-on activities to help students visualize and understand physics concepts through direct experience.

Engage students in inquiry-based learning by encouraging them to ask questions and explore solutions: 4 people chose this option, indicating that they believe in fostering students' curiosity and critical thinking skills by encouraging inquiry and exploration in the learning process.

Use real-world examples and applications to make physics relevant and relatable: Similarly, 3 people selected this option, indicating their belief in connecting physics concepts to real-life situations to enhance student engagement and understanding.

Provide opportunities for students to engage in problem-solving and applying physics principles to different contexts: 4 people chose this option, suggesting that they emphasize the development of problem-solving skills and the application of physics principles to various scenarios.

Provide opportunities for students to engage in experimental design, data collection, and analysis: 5 people chose this option, indicating the importance they place on allowing students to design and conduct experiments, collect data, and analyze results as part of the learning process.

Relate physics to other STEM disciplines and interdisciplinary connections to broaden students' understanding: 5 people also selected this option, suggesting that they recognize the value of integrating physics with other STEM subjects to provide a more comprehensive and interconnected learning experience.

The remaining options received 2 or fewer selections, indicating that they were not as widely emphasized by the surveyed teachers.

Based on the response from all the participants, it is evident that they strongly believe that *using modern methods and techniques can enhance student engagement and understanding in the subject of physics*. This implies that the surveyed teachers recognize the value of incorporating innovative approaches, technologies, and instructional methods to make physics more interactive, relevant, and accessible for students. By embracing modern methods, teachers can potentially create a more dynamic and effective learning environment, fostering student interest, critical thinking, and deeper understanding of physics concepts.

Drawing from the options presented and the responses received from the survey participants, we can deduce an interpretation regarding the knowledge areas deemed essential by the surveyed teachers for *effectively teaching the subject of "Physics":*

A strong understanding of fundamental physics principles and concepts was chosen by 6 people. This suggests that teachers recognize the importance of having a solid foundation in the core principles and concepts of physics to effectively teach the subject.

In-depth knowledge of different branches of physics, such as mechanics, electricity, magnetism, optics, and thermodynamics, was also chosen by 6 people. This indicates that teachers value a comprehensive understanding of the different subfields of physics in order to provide a well-rounded education to their students.

Familiarity with experimental methods and data analysis techniques used in physics received the highest number of selections, with 10 people choosing this option. This implies that teachers recognize the significance of practical experimentation, data collection, and analysis as integral components of teaching physics.

Understanding of scientific inquiry and the scientific method was chosen by 6 people, suggesting that teachers value teaching students the process of inquiry, critical thinking, and problem-solving in the context of physics.

Knowledge of interdisciplinary connections between physics and other STEM fields received the highest number of selections, with 12 people choosing this option. This indicates that teachers recognize the interconnected nature of physics with other STEM disciplines and value the ability to make interdisciplinary connections to enhance students' understanding of physics concepts.

The remaining options, including proficiency in mathematical skills and their application to physics problems, knowledge of historical developments and key milestones in the field of physics, the ability to explain complex concepts in a clear and concise manner, and the understanding of the applications and real-world relevance of physics principles, received fewer selections.

Overall, the interpretations suggest that the surveyed teachers advocate for a student-centered approach to teaching physics through using STEM methods, such as Inquiry-Based Learning (IBL), Project-Based Learning (PBL), Use of Simulations and Virtual Labs, Engineering Design Challenges, Cross-Disciplinary Integration, Integration of Technology like Arduino.

Taking into account the provided options and the responses from the surveyed teachers, we can derive an interpretation of the perceived requirements for *deepening knowledge in the field of "Physics"* based on the number of individuals who selected each option:

Collaborating with other physicists and experts in the field through networking and professional associations received the highest number of selections, with 19 people choosing this option. This suggests that teachers recognize the value of collaboration and networking with peers and experts in physics to deepen their knowledge and stay updated with the latest advancements in the field.

Engaging in interdisciplinary studies to understand the connections between physics and other scientific disciplines also received a high number of selections, with 19 people choosing this option. This indicates that teachers value the ability to make connections between physics and other scientific fields, enhancing their understanding and expanding their knowledge base.

Engaging in critical thinking and problem-solving exercises related to physics received 18 selections, implying that teachers believe that actively practicing critical thinking and problem-solving skills is crucial for deepening knowledge in physics.

Participating in hands-on experiments and laboratory work to gain practical experience was chosen by 15 people, suggesting that teachers value practical experience and recognize the importance of engaging in hands-on activities to deepen their understanding of physics.

Actively seeking opportunities for professional development in the field of physics received 16 selections, indicating that teachers understand the importance of continuously seeking learning opportunities, workshops, and courses to expand their knowledge and skills in physics.

The remaining options, including continued study and exploration of advanced physics concepts and theories, engaging in research projects and scientific investigations, pursuing higher education degrees in physics or related fields, regularly reading scientific literature and staying updated with current advancements in physics, and developing strong mathematical skills and their application to physics problems, received fewer selections.

Overall, the interpretations suggest that the surveyed teachers consider collaborative networking, interdisciplinary studies, critical thinking, practical experience, and active pursuit of professional development opportunities to be important for deepening knowledge in the field of physics.

Discussion. This article explores the advantages and opportunities of teaching physics within the STEM framework, highlighting its benefits for students and their future careers.

Integration of Knowledge:

By incorporating STEM principles, physics education goes beyond isolated subject areas. It allows for the integration of knowledge from various disciplines, such as science, technology, engineering, and mathematics. This interdisciplinary approach enables students to see the interconnectedness of these subjects and develop a holistic understanding of their applications.

Practical Application:

STEM-based physics education emphasizes practical application. Students have the opportunity to apply theoretical concepts in real-world situations and projects. By engaging in hands-on experiments and projects, they develop practical skills and gain a deeper appreciation for the relevance and applicability of physics principles.

Cultivating Problem-Solving Skills:

STEM education fosters critical thinking and problem-solving skills. Students are challenged to analyze complex problems, think creatively, and develop innovative solutions. Physics, within the STEM framework, encourages students to apply scientific methodologies and develop a systematic approach to problem-solving, preparing them for real-life challenges.

Technological Literacy:

Incorporating STEM into physics education exposes students to modern technologies and tools. They learn to utilize computer simulations, programming, sensors, and other technological resources to conduct experiments, analyze data, and draw meaningful conclusions. This enhances their technological literacy and equips them with valuable skills for future careers.

Collaboration and Teamwork:

STEM-based physics education promotes collaboration and teamwork. Students work in groups, exchanging ideas, sharing responsibilities, and collaborating on projects. Through this collaborative environment, they develop effective communication skills, learn to appreciate diverse perspectives, and enhance their ability to work effectively as part of a team.

Preparation for Future Careers:

Physics education within the STEM framework prepares students for future careers in science, technology, engineering, and mathematics. It equips them with the necessary skills and knowledge demanded in these fields. STEM-based physics education nurtures analytical thinking, problem-solving abilities, and a strong foundation in scientific principles, providing students with a competitive edge in the job market.

Fostering Creativity and Innovation:

STEM education encourages creativity and innovation. By engaging students in open-ended projects and challenges, it stimulates their imagination and nurtures their ability to think outside the box [8]. STEM-based physics education cultivates an environment where students can explore innovative ideas, experiment with new approaches, and develop solutions to real-world problems.

Conclusion. The analysis of survey responses from a diverse sample of teachers regarding STEM education yields significant insights. STEM education is perceived as a multifaceted approach that integrates diverse disciplines such as mathematics, physics, chemistry, engineering, robotics, computer science, technology, and coding/programming. These fields are recognized as essential components of STEM education, fostering critical thinking, problem-solving skills, and experiential learning.

In the context of laboratory lessons, teachers employ a combination of effective methods, including hands-on experiments, inquiry-based learning, collaborative group work, and problem-based or project-based approaches. Additionally, the utilization of technology, data analysis, and real-world applications is acknowledged as beneficial for enhancing the learning experience.

The findings indicate that teachers consciously apply scientific principles in physics instruction, emphasizing their application, relevance, and interconnectedness to augment students' comprehension and engagement. Consequently, students are encouraged to perceive physics as a subject that embodies scientific inquiry and logical reasoning.

Furthermore, a comprehensive understanding of physics necessitates a strong foundation in fundamental principles, proficiency in experimental techniques and data analysis, and an awareness of interdisciplinary connections. These knowledge areas are considered essential for effective physics instruction.

To deepen knowledge in the field of physics, teachers emphasize the importance of collaborative networking, interdisciplinary studies, critical thinking, practical experience, and active engagement in professional development opportunities. By leveraging these strategies, educators can enhance their expertise and pedagogical skills, thus enriching the educational experience for students.

In summary, these findings underscore the significance of hands-on experiences, inquiry-based learning, real-world applications, interdisciplinary connections, and continuous professional growth in the realm of STEM education, particularly in physics instruction. This research contributes valuable insights to inform educational practices and promote effective teaching strategies in the context of STEM education. However, our study is limited by the number of survey participants. Further research is needed to examine effective STEM methods in teaching physics.

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REFERENCES:

1 **M. Mintii. Stem education and personnel training: systematic review.** *Journal of Physics: Conference Series,* 2023, pp. 1-11. https://doi.org/10.1088/1742-6596/2611/1/012025.

2 **Kyrylenko V.V., Kryzhanovskyi A.I., Kyrylenko N.M., Maidanyk O.V., Medvediev R. P. Implementation of STEM education in the process of professional training of future teachers.** *Modern Information Technologies and Innovation Methodologies of Education in Professional Training Methodology Theory Experience Problems*, 2024, pp. 1-14. https://doi.org/10.31652/2412-1142-2024-71-30-39.

3 **Martyniuk O., Myronchuk H., Stetsiuk O. Development of research skills of students in Physics lessons as a way of implementing STEM education.** *Academic Notes Series Pedagogical Science,* 2023, pp. 1-10. https://doi.org/10.36550/2415-7988-2023-1-208-37-43.

4 **Williams P.J. The principles of teaching and learning in STEM education.** *AIP Conf. Proc.* 2081, 020001, 2019, pp. 1-12. https://doi.org/10.1063/1.5093996.

5 **Imangaliev N., Sagadatova D., Omasheva M., Hairieva G., Turdaly D., Karımova N., Akkısev E. STEM obrazovanie v Kazahstane: tekushhee sostoyanie i perspektivy' razvitiya. Issledovanie provedeno pri podderzhke kompanii "Chevron" v ramkah proekta "Karavan Znanij"** [STEM education in Kazakhstan: current state and prospects of development. The study was supported by Chevron within the framework of the Caravan of Knowledge project], 2020, 133 p. (In Russian).

6 **Bryan L.A., Guzey S.S. K-12 STEM Education: An Overview of Perspectives and Considerations.** *Hellenic Journal of STEM Education*, 2020, pp. 1-14. https://doi.org/10.51724/HJSTEMED.V1I1.

7 **Abdrakhmanova Kh.K., Kudaibergenova K.B., Yamak H. Bolashak fizika mugalimderinin STEM-adisimen bilim beruge daiyndygy** [The readiness of future physics teachers for STEM education]. *Bulletin of the Karaganda university*, 2022, no 4(108), pp.138–147. https://doi.org/10.31489/2022Ped4/138-147. (In Kazakh).

8 **Kadirbaeva R.I., Abdrahmanova H.K., Kudaibergenova K.B. Bilim berudi cifrlandyru zhagdaiynda STEM-okytudy koldanudyn didaktikalyk nuskaulary** [Didactic Recommendations on the Use of STEM Approachin the Digital Education]. *Iasaui universitetinin habarshysy*, 2024, no 2 (132), pp. 204–217. https://doi.org/10.47526/2024-2/2664-0686.55. (In Kazakh).

9 **Li Y., Wang K., Xiao Y., Froyd J.E. Research and trends in STEM education: a systematic review of journal publications.** *International Journal of STEM Education, 7*, 2020, pp. 1-16. https://doi.org/10.1186/s40594-020-00207-6.

10 **Aji C.A., Khan M.J., Khan, M.J. The Impact of Active Learning on Students' Academic Performance.** *Open Journal of Social Sciences*, 2019, pp. 195-210. https://doi.org/10.4236/JSS.2019.73017.

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ТОЛЫҚ ЕМЕС ОТБАСЫЛАРДА ТӘРБИЕЛЕНЕТІН БАЛАЛАРДЫҢ ПСИХОЛОГИЯЛЫҚ ЕРЕКШЕЛІКТЕРІ

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Мақалада отбасы баланың жеке басын қалыптастырудың негізі болып табылатын белгілі бір моральдық-психологиялық климатты қамтамасыз ететін негізгі институт ретінде қарастырылып, балалар үшін отбасы адамдармен қарым-қатынастың алғашқы мектебі болып табылатындығы, осы аспектілердің баланың дамуына әсері жан-жақты қарастырылған. Мақалада толық емес отбасылардағы балалардың жеке ерекшеліктеріне қатысты психолог М.И. Буяновтың, А.В. Петровский және М.В. Полеваяның, отбасылық психотерапевтер Э.Р. Эйдемиллер және В.В. Юстицкистің және психоаналитик В. Бурианның және басқа да ғалымдардың ғылыми көзқарастары жан-жақты қарастырылады, дәйектер келтіріледі. Отбасының түрлері: үйлесімсіз отбасы, бұзылған отбасы, бір ата-анасының отбасынан кетіп қалып, соның салдарынан пайда болған дұрыс емес ата-ана тәрбиесінің жиі кездесетін түрлері: гиперпротекция, гипопротекция, эмоционалды қабылдамау, қатал қарым-қатынас жағдайы және моральдық жауапкершіліктің жоғары болуы деп қарастырылып, осы әр типтің бала тұлғасының қалыптасуына тигізетін әсері талқыланған. Ата-анасының біреуінің болмауы баланың психикалық дамуының бұзылуына, оның әлеуметтік белсенділігінің төмендеуіне, тұлғалық деформацияларға және гендерлік-рөлдік сәйкестендіру процесінің бұзылуына, сондай-ақ мінез-құлық пен психикалық денсаулықтың әртүрлі ауытқуларына әкелетіндігі дәлелденген. Толық және толық емес отбасылардағы балалардың негізгі айырмашылықтары қарастырылған.

Түйінді сөздер: *отбасы, бала, толық емес отбасы, психологиялық ерекшеліктер, гиперпротекция, гипопротекция, эмоционалды қабылдамау.*

ПСИХОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ДЕТЕЙ, ВОСПИТЫВАЮЩИХСЯ В НЕПОЛНЫХ СЕМЬЯХ

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В статье рассматривается семья как основной институт, обеспечивающий определенный морально-психологический климат для детей, являющийся основой формирования личности ребенка. Речь идет о том, что семья является первой школой общения с людьми, всесторонне рассматривается влияние этих аспектов на развитие ребенка. В статье всесторонне рассматриваются научные взгляды психологов М.И. Буянова, А.В. Петровского и М.В. Полевой, семейных психотерапевтов Э.Р. Эйдемиллера и В.В. Юстицкиса, психоаналитика В. Буриана и других ученых, касающиеся индивидуальных особенностей детей в неполных семьях, приводятся аргументы. Типы семьи: несовместимая семья, разрушенная семья, уход из семьи одного родителя и, как следствие, часто встречающиеся формы неправильного воспитания: гиперпротекция, гипопротекция, эмоциональное отторжение, состояние жестокого обращения и высокая моральная ответственность – обсуждается влияние каждого из этих типов на формирование личности ребенка. Доказано, что отсутствие одного из родителей приводит к нарушению психического развития ребенка, снижению его социальной активности, личностным деформациям и нарушению процесса гендерно-ролевой идентификации, а также различным отклонениям в поведении и психическом здоровье. Рассмотрены основные отличия детей в полных и неполных семьях.

Ключевые слова: *семья, ребенок, неполная семья, психологические особенности, гиперпротекция, гипопротекция, эмоциональное отторжение.*

PSYCHOLOGICAL CHARACTERISTICS OF CHILDREN BROUGHT UP IN SINGLE-PARENT FAMILIES

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The article examines the family as a fundamental institution that provides a specific moral and psychological climate, serving as the foundation for a child's personality development. For children, the family is described as the first school of social interaction. The influence of these aspects on a child's development is analyzed comprehensively. The article provides a comprehensive analysis of the scientific perspectives of psychologists such as M.I. Buyanov, A.V.