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БАЯНДАМАЛАРЫ

ДОКЛАДЫ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ КАЗАХСТАН»
ЧФ «ХАЛЫҚ»

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ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
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INTEGRATION OF MODERN INFORMATION TECHNOLOGIES TO IMPROVE EDUCATION IN PHYSICS.

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Abstract. In a rapidly changing world, usage of digital technology is a key factor in society affecting greatly physics education from primary school to higher degree. Among significant achievements in this trajectory are the extensive digitalization and development of students' digital literacy. This study will discuss pre-service physics educators' anticipated problems and benefits while integrating technology in education. Physics educators often utilize digital resources in implementing the educational curriculum for students. In the interview obtained during the research, the pre-service physics educators considered some possible dangers or disadvantages associated with the use of ICTs as well as some possible strengths or benefits that might result from this utilisation. It is quite noteworthy that pre-service physics educators have confidence in themselves that they can easily integrate ICTs into the physics education. However, this unexpected finding contradicts existing study findings and calls for more advanced research on emerging technologies in physics education.

Keywords: education, teachers, physics, teacher training, technology-based learning, teacher trust, technology integration

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ФИЗИКА БОЙЫНША БІЛІМ БЕРУДІ ЖАҚСАРТУ ҮШІН ЗАМАНАУИ АҚПАРАТТЫҚ ТЕХНОЛОГИЯЛАРДЫ ИНТЕРАЦИЯЛАУ

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Аннотация. Қарқынды дамып келе жатқан әлемде цифрлық технологияның бастауыш мектептен жоғары оқу орындарына дейінгі қолданылуы физикадан білім беруге әсер ететін негізгі фактордың бірі. Бұл бағыттағы маңызды жетістіктер білім беруді жаппай цифрландыру және әрбір оқушының цифрлық сауаттылығының дамуы. Ұсынылған зерттеу аталмыш технологиялардың білімге интеграциялауда физика мұғалімдерінің мәселелері мен артықшылықтарын талқылайды. Физика мұғалімдері мектеп оқушыларына арналған білім беру бағдарламасын жүзеге асыруда цифрлық ресурстарды жиі қолданады. Зерттеу барысында алынған сұхбатта, физика мұғалімдері АКТ-ны қолданумен байланысты кейбір ықтимал қауіптер мен кемшіліктерді және туындауы мүмкін кейбір қажеттіліктер мен артықшылықтарды қарастырды. Бір қызығы, физика мұғалімдері оқытуды бастамас бұрын, олар АКТ-ны физиканы оқытуға оңай біріктіре алатынына сенімді. Алайда, бұл жағдай қолданыстағы зерттеулердің нәтижелеріне қайшы келеді және физика бойынша білім берудегі жаңа технологияларды тереңірек зерттеуді қажет етеді.

Түйін сөздер: білім беру, педагогтар, физика, мұғалімдерінің дайындығы, технологияларға негізделген оқыту, мұғалімдердің сенімі, технологияларды интеграциялау

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ИНТЕГРАЦИЯ СОВРЕМЕННЫХ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ ДЛЯ УЛУЧШЕНИЯ ОБРАЗОВАНИЯ ПО ФИЗИКЕ

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Аннотация. В быстро развивающемся мире использование цифровых технологий от начальной школы до высшего образования является одним из основных факторов, влияющих на обучение физике. Важными достижениями в этом направлении являются массовая цифровизация образования и развитие цифровой грамотности каждого учащегося. В предлагаемом исследовании обсуждаются проблемы и преимущества учителей физики в интеграции данных технологий в образование. Учителя физики часто используют цифровые ресурсы при реализации образовательной программы для школьников. В интервью, полученном в ходе исследования, учителя физики рассмотрели некоторые потенциальные риски и недостатки, связанные с использованием ИКТ, а также некоторые потребности и преимущества, которые могут возникнуть. Примечательно, что преподаватели физики до начала обучения уверены в том, что они могут легко интегрировать ИКТ в обучение физике. Однако это неожиданное открытие противоречит результатам существующих исследований и требует более углубленных исследований новых технологий в образовании по физике.

Ключевые слова: образование, педагоги, физика, подготовка учителей, обучение на основе технологий, доверие учителей, интеграция технологий

Introduction

State Programme for Digital Kazakhstan, running from 2018 to 2022, was designed to improve digital literacy among Kazakhs and supply all schools in Kazakhstan with computer, multimedia and high-speed internet network facilities. It was an incremental blueprint of minimum digital skills. Implementation of the program will offer the chance to create electronic textbooks and online educational portals in order to ensure equality of opportunity in educational resource use. One of the main concepts in education digitalization is called “The paper-free principle” and means digital documenting with the help of “Kundelik”. This also applies in education where systems are designed to seamlessly connect to the “National Educational Database” for complete tracing of students’ achievements. Digitization is not limited to work environments but includes online queues for kinder gardens, schools, colleges, and universities such as the e-queue in Almaty since 2018. This aim is to use technology to foster universal schooling system reforms aimed at improvement. The goal is to ensure that schools catch up with the rest of a sophisticated society where most modern youth live it. The phenomenon that technology usage is an established tradition in the area of education (Batrakova, 2019).

Nevertheless, issues still exist with respect to technology’s historical incorporation into physics education. Barriers include teacher confidence, competencies, and access to resources, as noted by Bingimlas’s (2009) observations in 2009 and the findings of (Mailizar et al., 2020) show that, among other barriers, educators’ confidence, competence, and availability of materials are a problem. This was done through highlighting educators’ barriers including loss of confidence and non-mastering of the required competencies consistent with its expected worries and expected advantage in using technology to teach physics.

By late 1990s, research continued to demonstrate that science was interested integrating technologies with physics education. Building on the Teacher-Learner-Knowledge Triangle, (Trgalová et al., 2018) proposed the Teacher-Learner-Technology Tetrahedron. This widened milieu provides a techno-physical learning space that is technologically sophisticated, wherein students and educators converse in unison using both physical input and output.

This study outlines why it is important for pre-service physics educators to understand anticipated problems and benefits associated with using modern methods in the teaching of physics. This provides an insight of how instructional settings for pre-service physics educators may be developed and improved on this. The pre-service physics educators’ perspectives must be examined because it is anticipated that the country will implement changes due to calls by both national and international stakeholders for mainstreaming of information technology in education. The study employs a grounded theory methodology to explore what pre-service physics educators anticipate will be their benefits and fears before implementing these technologies.

Literature review

The use of calculators, computers, and virtual apps for physics education have been triggered by a revolution involving rapid technological developments. (Flood et al., 2020) state that technologies, including augmented reality, should be used to promote interaction between the student and computer and, ultimately, build their acceptance within the educational contexts.

According to (Borba et al., 2016), there are four stages, which can be recognized during the process of applying technology in physics education. Lastly, these two points indicate changes in communications, collaborative learning possibilities, qualitative shifts on the internet, and finally envisaging the total transformation of physics class after all technology assimilation.

Nevertheless, it is not certain that including novel technologies would be effective and successful, especially when considering the cases related to COVID-19 and homeschooling. The challenges crop up due to lack of experience using technologies in formal learning setup for both physical and virtual barriers (Almanthari, Maulina, & Bruce, 2020).

The provision of a single digital device to each school student on the part of the Ministry of Education highlights the role of the physical and non-physical factors in integrating technology (Tokzhigitova & Omarova, 2022).

The basis that pre-service physics educators' knowledge and beliefs, from the Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006), is laid. TPACK refers to the confluence of content knowledge, pedagogical knowledge, and technological knowledge in shaping the relationship between educational content and technology in instruction. The contextual background of pre-service physics educators informs their beliefs regarding integrating technology into the classroom and subsequently shapes their practices.

This study concentrates on the anticipated concerns and benefits perceived by pre-service physics educators' as they integrate technologies into physics education. The significance of pre-service physics educators' Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) is paramount, as they shape the purposes for which technologies are employed and the anticipated outcomes. The novelty of the study lies in its nationwide scope, enabling an examination of pre-service physics educators' beliefs on a broader scale.

The expected concerns and benefits anticipated by pre-service physics educators' while integrating technologies in physics education are examined in this study. Therefore, the TPK and TPACK of teachers define the goals behind technological use and expected outcomes. The main distinction is that this research has a national basis, so it is possible analyse about ideas of pre-service physics educators at the more widespread scale.

Finally, this study examines technologies integration in physics education addressing the possible pros and cons including expected benefits and fears of pre-service physics educators in Almaty, Kazakhstan.

Kazakhstan has undertaken an exemplary project whereby it provisioned students with modern gadgets equipped with digital pens and keyboards. The introduction of this initiative along with the continuing application of learning or content management systems due to COVID-19 presents a remarkable change in the learning arena (Mausumbaev & Toleubekova, 2022). Together with departments of education universities (Almaty Educational Universities) we are working out understanding, what is the place of these technologies, mostly interacting digital learning resources, in content of physics course for pre-service physics educators.

All seventeen interviewed skilled educators came from varied urban and rural schools with varying social class positions. Purposively, we chose schools having different socioeconomic features such as urban private ones, and those that were affected by migration. There were 10 women and 7 men from the start to the mid-teaching career who participated in the study, contributing to an array of viewpoints.

The qualitative interviews, guided by a semi-structured approach, explored three thematic complexes: issues related to the anticipated concerns and benefits of pre-service physics educators with modern information technologies, required support for preparation to teach with the new devices in the future, and preparation strategies for the next school year. For this purpose, grounded theory principles were used for the data analysis, considering a constructivist point-of-view in the interpretation.

The research design incorporates features of a qualitative interview study as well as grounded theory. Due to using a non-standardized technique of interviewing skilled educators, these data obtained are not simple, but rather complex text. Pure case sampling in case study methodology was used by the study in a unique way — extreme cases on both ends of the socioeconomic continuum — which provides important information about how to build theories.

In brief, our study investigates the everyday lives of the beginning of the pre-service physics educators involved in implementing modern information technologies of physics educators. Our study seeks help to understand the expected concerns and benefits arising because of the transformative initiative within Almaty schools by considering specific situations through case studies.

Research methodology

Our study takes the form of a case study, concentrating on the expected challenges and advantages experienced by specific pre-service physics educators as they grapple with the introduction of modern information technologies at the onset of education. Within the framework of case studies, genuine individuals in authentic settings undergo deliberate interventions, shaping a constrained system. Our investigation centres on pre-service physics educators and their classes as the real participants in genuine settings, with the introduction of modern information technologies constituting the intervention.

In line with the perspectives presented by Eisenhardt (1989), we consciously highlighted extreme cases, exemplifying schools situated at opposite ends of the socio-economic spectrum. This intentional emphasis corresponds to purposive sampling, a method commonly employed in case studies and grounded theory approaches. Our objective in scrutinizing cases with potentially high and low socio-economic backgrounds is to extract valuable insights for expanding existing knowledge and building theoretical frameworks.

Our study combines elements from interview studies and grounded theory to form our methodology. We used a standardized interview approach to give skilled educators the opportunity to express themselves openly which resulted in detailed textual data. This methodology as explained by Charmaz (2006) highlights the connection, between grounded theory research and qualitative interview studies. For data collection and analysis, we followed grounded theory principles by allowing skilled educators to explain their perspectives and priorities on the given subjects. The detailed texts that emerged from this process serve as the basis, for our understanding of the challenges and benefits that preservice physics educators encounter when integrating information technologies at the beginning of their education.

Research results

In the methodology section of our study we followed a three step process commonly used in grounded theory approaches (Charmaz, 2006);

1) We began with coding

2) Followed by axial coding

3) And finally selective coding.

During the phase of coding, we applied inductive thematic principles and open coding techniques to break down the new data into 72 distinct units of meaning. Each unit represents an aspect. These units were then grouped into 21 level codes based on shared descriptions and definitions.

Moving to the second step, axial coding, we systematically analyzed the higher-level open codes. This involved organizing codes around a central phenomenon, considering cause, activities, consequences, and framework conditions. The goal was to synthesize the open codes, achieving a heightened level of generalizability and abstraction. The result of this process is akin to creating a structured framework, enhancing our understanding of the relationships between various aspects.

Finally, in the third step of selective coding, we evaluated initial assumptions, identified, and closed research gaps, and established connections or dependencies between categories obtained from axial coding. By refining and integrating categories, we developed core categories that represent the central themes of the study. In our case, these core questions include:

(A) How can educators address and minimize the impact of technology-related discrimination in the learning environment?

(B) How can educators strike a balance between leveraging technology and ensuring the retention of fundamental physics knowledge and skills?

(C) How can the integration of technology be made more engaging and enjoyable for educators to enhance their competency?

(D) What are the potential challenges or limitations associated with using technology for differentiation in physics education?

This systematic and iterative approach to qualitative data analysis ensures a comprehensive understanding of the anticipated concerns and benefits of pre-service physics educators in the context of integrating modern information technologies in education.

Implementing technology in the early stages of education may hinder students from mastering fundamental arithmetic skills, leading to a lasting gap in physics. Educators' express concerns about students' decreasing ability to solve basic problems when relying on digital devices, fearing a widening gap that may persist throughout their academic journey.

In interviews, skilled educators acknowledge the importance of technology in physics education but express reservations. They highlight students' diminishing numeracy skills and an increased reliance on internet research for information in physics. Concerns include students not memorizing formulas and potential misinformation online.

Teachers worry that technology impedes the learning of basic knowledge in physics, including memorization of formulas and the structured approach to problem-solving. The fear is that students, given laptops at a young age, may struggle to document solution paths, hindering their development of work and structured problem-solving skills.

A critical concern is that the integration of technology may compromise students' foundational competencies in physics at the onset of school, potentially leading to a lack of structured work and increased difficulties in physics lessons.

This study has shown that educators in our sample viewed technology integration as a way of learning for them. And particularly those who are skilled, they have been using only high-quality technologies starting from the year 2015 in which these were mandated to be used in the nationwide examination leading toward leaving school. Thus, while they acknowledge their experience with technologies at the upper secondary level, they highlight the disparities when integrating them with younger learners.

When it comes to further training needs concerning early secondary school technology use however, teachers prefer doing it alone through trial and error method or within their own schools. In addition, individual learning is when teachers themselves look for and adapt new technological tools or teaching strategies often by googling and searching other sources on the internet. They anticipate problems which may come up on their first attempt to use such tools. Similarly, inter- school collaboration is also important whereby teachers can share resources and support each other through informal methods like emails or meetings.

Educators must improve their knowledge and skills since physics education increasingly uses technologies. Educators prefer personal and informal strategies for the acquisition of technological-didactic knowledge such as independent searches and trial-and-error adoption of new tools. Besides, they engage in school-internal cooperation to share knowledge.

In conclusion, the integration of technologies provides pre-service physics educators with opportunities to acquire new competencies whereby experienced educators appreciate their benefits but also understand that they need to be adjusted for young children. The preferred ways for further training among the pre-service physics educators include individual learning and informal intra-school cooperation.

Educators express their greatest hope for integrating technologies at the beginning of secondary school: facilitating differentiation and individualization in education. According to skilled educators feedback, achieving this involves enhancing educator autonomy, incorporating diverse media, offering varied tasks, making physics more relevant to reality, and allowing learning to be independent of time and place.

According to the research, teacher autonomy implies pre-service physics educators are not limited to explanations or tasks directly taken from the physics students' book. Teachers hope that this will allow them more flexibility in giving additional explanations and tasks through students' technologies.

In addition, teachers wish that the ever presence of modern information technologies will aid in more media integrated in teaching of physics like instructional videos, interactive worksheets among others which entail real time feedback and tips.

Educators argue against traditional teaching aids such as physics students' books that often contain pseudo-realistic tasks. Educators thus aim to address this problem by using technologies to get a wider range of exercises much closer to student's lived experiences.

Educators also express a desire for increased ease in integrating actual artifacts or facts from students' everyday lives into lessons using modern information technologies. They highlight the potential for students to conduct surveys and collect data more conveniently.

Additionally, educators hope to make physics lessons more independent of time and place by leveraging technologies. They envision using modern information technologies to facilitate repetition and deepening of content in physics outside the classroom, such as through learning videos or tasks with automatic feedback.

In the pursuit of differentiation and individualization in physics teaching, teachers emphasize increasing the quantity and quality of tasks. This involves sourcing tasks from various online and offline platforms, eliminating pseudo-realistic tasks, and adapting the learning process to better suit students' needs through independent practice and real-time feedback from digital tasks.

Conclusion and Discussion

The data analysis revealed that educators expressed concerns and interests before introducing technologies at the beginning of secondary school. These such questions: (A) How can educators address and minimize the impact of technology-related discrimination in the learning environment? (B) How can educators strike a balance between leveraging technology and ensuring the retention of fundamental physics knowledge and skills? (C) How can the integration of technology be made more engaging and enjoyable for educators to enhance their competency? (D) What are the potential challenges or limitations associated with using technology for differentiation in physics education?

Despite the increasing variety of technologies used for physics education, Educators in the study initially perceived technologies as traditional tools like calculators. Clarification was needed regarding the broader definition of technologies, encompassing virtual apps and augmented reality.

Educators acknowledged the complex nature of physics education with technologies, seeing both opportunities and risks. The manifold possibilities offered opportunities for differentiation and individualization in learning processes, but integrating technologies was perceived as an additional burden for students.

The study indicated that pre-service physics educators, confident in their technological capabilities, preferred individual, and in-school approaches for acquiring knowledge and competencies. They played a pivotal role in creating supportive environments, consisting of both hard and soft factors, facilitating the integration of technologies.

Contrasting results were found concerning pre-service physics educators' confidence and competencies in using technologies. Unlike previous studies reporting educators' lack of confidence, this study revealed that pre-service physics educators considered themselves capable of integrating technologies into physics education. This confidence might stem from the long-standing use of technologies in standardized exams, creating a positive self-assessment among teachers.

Regarding the various uses of technologies in physics education, the study highlighted those pre-service physics educators focused on specific aspects, such as resource distribution, organization, and communication. Some advanced uses, like technology-supported collaborative learning or personalization, were less emphasized.

Pre-service physics educators attributed servant or partner roles to technologies, expressing concerns about the negative connotations associated with the servant approach. They hoped for positive outcomes through the partner approach, expecting technologies to facilitate individualized and differentiated physics education processes.

In conclusion, educators' concerns, and benefits regarding integrating technologies into physics education were well-balanced. While fears were often associated with traditional approaches, hopes were linked to contemporary uses of technologies, anticipating individualization, differentiation, and enhanced learning experiences. State-of-the-art technologies, such as augmented reality or 3D printing, were not yet widely associated with school-based learning by educators.

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