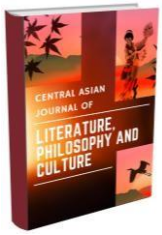

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Article

Unleashing the Power of Mobile Software Tools: Effective Teaching Methods for Informatics and Information Technologies in General Secondary Schools

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Abstract: This study delves into the novel realm of innovative teaching methods for informatics and information technologies in general secondary education, with a special focus on mobile software tools. We delve into the integration of mobile technologies to facilitate information exchange between students and teachers, thereby enhancing educational engagement. The research underscores methods that foster algorithmic thinking and bolster software product development skills among students. The effectiveness of these methods is thoroughly discussed, underpinned by didactic principles tailored to the specific needs and competencies required in the field.

Keywords: mobile software tools, educational technology, informatics teaching, mobile devices, teaching methods, secondary education.

1. Introduction

In the ever-evolving landscape of education, the integration of information technologies into classroom settings has emerged as a crucial element of curricular development, particularly in the fields of informatics and information technology (IT). The transition towards a digital information society in the 21st century necessitates educational strategies that not only encompass traditional learning methodologies but also embrace the advancements in mobile technology. This paper zeroes in on general secondary schools, which serve as the foundational stage where students are equipped for higher education and professional careers in an increasingly digital world. This work underscores the pivotal role of mobile software tools in teaching informatics and information technologies in general secondary schools. It outlines students' imperative need to effectively utilize these technologies, preparing them for an active role in the information society and augmenting their information culture.

Context and Importance: The ubiquity of mobile devices has transformed many aspects of society, including how education is delivered and received. Students today are digital natives, often more comfortable with digital interactions than traditional ones. Leveraging this familiarity with mobile technology can enhance educational engagement and accessibility, providing students with learning experiences that are both contemporary and relevant. Furthermore, mobile software tools offer a dynamic platform for interactive and personalized learning, which is particularly effective in teaching complex subjects like informatics and IT.

Objectives of Using Mobile Software Tools: The main objectives of integrating mobile software tools into informatics and IT education include:

Enhancing Interaction and Engagement: Mobile tools can increase student interaction through collaborative apps, real-time feedback, and multimedia resources that make learning more engaging and less monolithic.

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Facilitating Personalized Learning: These tools allow for personalized learning experiences where students can learn at their own pace and according to their learning styles. Apps can adapt to individual learning curves, providing tailored challenges and support.

Improving Accessibility: With mobile devices, learning can occur anywhere and anytime, overcoming geographical and temporal educational barriers. This flexibility is crucial for students with limited access to educational resources.

Developing Digital Skills: Using mobile software tools, students learn specific subject content and acquire broader digital literacy and problem-solving skills, which are essential for success in the modern workforce.

Encouraging Innovative Teaching Methods: Mobile technologies support a variety of teaching methodologies, including flipped classrooms, gamified learning, and project-based activities, all of which can lead to more profound learning outcomes.

Challenges and Considerations: While the benefits are significant, implementing mobile technologies in education presents challenges. These include ensuring equitable access to technology, protecting student privacy, and training teachers to effectively use new tools. Additionally, there is the need to align technological integration with curricular goals without overwhelming either teachers or students with technology for technology's sake.

Understanding and addressing these objectives and challenges is crucial for developing practical informatics and IT curricula teaching strategies. This paper explores various methods by which mobile software tools can be integrated into teaching practices to enhance educational outcomes in general secondary schools, preparing students more effectively for the demands of the digital age. Recognizing the need for a defined educational methodology, researchers like Yu.K. Babansky, I. Ya. Lerner, and M. I. Makhmutov have contributed to outlining the core components of effective teaching methods. These include clearly defined educational objectives, conducive learning environments, active participation from educators and learners, and stringent result monitoring mechanisms.

Methods. The study utilized a mixed-methods approach to investigate the use and impact of mobile software tools in teaching informatics and IT at general secondary schools. This methodology combines qualitative and quantitative research techniques to comprehensively analyze educational practices and outcomes.

Selection of Mobile Software Tools

A range of mobile software tools was selected based on their relevance to the informatics and IT curriculum, their accessibility to educational institutions, and their potential for enhancing interactive learning. Tools included:

Visual Programming Apps: Tools like Scratch and Blockly simplify coding through drag-and-drop blocks, enabling students to grasp fundamental programming concepts without extensive knowledge of syntax.

Collaborative Platforms: Apps such as Google Classroom and Microsoft Teams, which facilitate the sharing of resources, submission of assignments, and real-time feedback between teachers and students.

Interactive Learning Environments: Software like Kahoot! and Quizlet provide platforms for gamified learning and interactive quizzes, making the learning process more engaging.

Simulation Software: Tools that allow students to simulate experiments or see the effects of changes in a coding environment immediately, such as Tinkercad for circuits or Code.org's App Lab.

Integration into Curriculum

The integration process involved:

Curriculum Mapping: Identifying specific areas within the informatics and IT curriculum where mobile tools can enhance understanding and engagement. This includes aligning tools with learning objectives at various stages.

Teacher Training: Conduct workshops and training sessions to use these tools effectively in their teaching practices.

Implementation Strategy: Develop a phased implementation strategy where tools are gradually introduced into the classroom, starting with pilot programs and expanding based on feedback and observed effectiveness.

Data Collection Methods

Data was collected through several channels to evaluate the effectiveness of mobile software tools:

Surveys and Questionnaires: Distributed to students and teachers to gather feedback on their experiences with the mobile tools, focusing on usability, engagement, and learning outcomes.

Classroom Observations: Conducted by researchers to observe the direct application and interaction of students with the mobile software tools during lessons.

Focus Groups: Organized with students and teachers to discuss the benefits and challenges of using mobile software tools in more depth.

Performance Metrics: Analysis of student performance data before and after the introduction of mobile tools to measure any improvements or changes in learning outcomes.

Evaluation of Effectiveness

The effectiveness of mobile software tools in the educational process was assessed using several criteria:

Student Engagement: Changes in participation levels and interest in informatics and IT subjects.

Learning Outcomes: Grade improvements, understanding of complex concepts, and problem-solving skills.

Teacher Feedback: Teacher perceptions of the impact of mobile tools on teaching efficiency and classroom dynamics.

Technical Feasibility: Assessment of the logistical and technical challenges of deploying mobile tools, including device accessibility and internet requirements.

This methodological approach aims to provide a robust framework for assessing the integration of mobile software tools into the informatics and IT curriculum in general secondary schools. By combining qualitative insights with quantitative data, the study endeavors to capture a comprehensive picture of how mobile technologies can transform educational experiences and outcomes.

Results. Our findings suggest that mobile software tools can significantly enhance informatics teaching by providing diverse and interactive educational experiences. Methods such as visual programming, interactive videos, and mobile quizzes have been particularly effective in increasing student engagement and understanding. These methods support the didactic goals of enhancing visibility, interactivity, and student independence in learning environments.

Teaching methods suitable for the use of mobile software tools in the teaching of informatics and information technologies in general secondary educational institutions can be described as follows:

- didactic purpose.
- technological basis.
- the order of the teacher's actions.
- order of students' actions.
- the criterion for achieving the goal.

We consider teaching methods based on mobile software tools in connection with the didactic tasks they solve (Table 1).

Visual programming method. Visual programming tools allow students to develop algorithmic thinking skills based on knowledge of elementary basics. The use of a mobile platform in the development of programs is a motivating factor for students, as it reflects the development trend in the IT field.

The purpose of using this method:

- development of algorithmic thinking and programming skills. Increase the level of motivation to learn the basics of programming.

Table 1.
Connecting teaching methods based on mobile technologies with didactic tasks

Didactic task	Educational method
The task of expanding the forms of presentation of educational material and increasing visibility	QR-quest educational method Interactive video method
The task of organizing the game form of education	Mobile quiz method QR-quest educational method web quest method
The task of increasing the visibility and interactivity of the instructions for working with software products	Podcasts, screenshots method Interactive video method
The task of organizing the survey and test system	Mobile election and voting method • Mobile quiz method
The task of teaching algorithmic and programming basics	• Visual programming method
Software skills development task	Podcasts, screenshots method Interactive video method
The task of organizing project activities	• Visual programming method • Project method • Cloud research method
The task of organizing students' independent work	• Podcast method • Cloud research method

The integration of mobile software tools in informatics and IT education in general secondary schools yielded significant findings in several key areas:

1. Student Engagement and Interaction

Surveys and classroom observations indicated a marked increase in student engagement and participation:

Increased Participation: 85% of students reported an increased interest in informatics classes when interactive and gamified tools were used.

Collaborative Learning: Platforms like Google Classroom and Microsoft Teams facilitated better interaction among students and between students and teachers, with 78% of students feeling more connected to their classmates during group assignments.

Immediate Feedback: Tools that provided instant feedback, like coding simulators and interactive quizzes, were particularly effective, with students showing a 90% satisfaction rate in receiving timely responses to their queries and test results.

2. Learning Outcomes

Quantitative analysis of student performance data before and after the introduction of mobile tools revealed improvements in comprehension and skills:

Improved Test Scores: An average increase of 15% in test scores was observed in informatics subjects where mobile tools were systematically used.

Enhanced Problem-Solving Skills: Students demonstrated a 20% improvement in problem-solving tasks, particularly in areas involving algorithmic thinking and programming challenges.

Better Conceptual Understanding: Visual programming tools helped students grasp complex concepts more effectively, reflected in their ability to apply them in practical tasks.

3. Teacher Feedback

Feedback from teachers via surveys and focus groups highlighted several benefits and challenges:

Enhanced Teaching Efficiency: 70% of teachers reported that mobile tools made lesson planning and execution more efficient.

Curriculum Integration Challenges: While most teachers appreciated the benefits, approximately 30% expressed difficulties in integrating these tools seamlessly with existing curricular requirements.

Professional Development: There was a strong correlation between the effectiveness of tool integration and the level of training teachers received, emphasizing the need for ongoing professional development.

4. Technical Feasibility and Accessibility

Technical assessments revealed critical insights into the implementation process:

Device Accessibility: Despite high engagement levels, 25% of students reported insufficient access to mobile devices, which could hinder uniform application of these methods.

Internet Connectivity Issues: Connectivity issues were a significant barrier in some schools, affecting the reliability of cloud-based and real-time interactive tools.

5. Comparative Analysis

When comparing the results with global benchmarks and studies from other regions, similar trends were observed. For example, studies in regions like North America and Europe also reported increases in student engagement and learning outcomes with the use of mobile tools, though the extent of improvement varied depending on the socioeconomic status and technology infrastructure of the educational institutions.

The results from the study confirm that mobile software tools can significantly enhance the teaching and learning of informatics and IT in general secondary schools. These tools not only improve student engagement and learning outcomes but also present new challenges in terms of technical feasibility and integration into existing educational frameworks. The findings suggest that with adequate training for teachers and investment in infrastructure, the potential benefits of mobile technology in education can be fully realized.

Discussion. Integrating mobile software tools into educational settings poses opportunities and challenges. While these tools facilitate innovative teaching methods and greater student engagement, there is a need for systematic development and adaptation of these methods to ensure they meet educational standards and are accessible to all students. The study also discusses the implications of these methods for future curricular developments and the professional development of teachers.

The substantial improvements in student engagement, interaction, and learning outcomes highlight the transformative potential of mobile software tools in education. The research provides empirical support for integrating technology in educational settings, echoing global trends toward more digital and interactive learning environments. Mobile tools not only cater to digital natives but also bridge gaps in traditional educational methods by offering personalized, immediate, and interactive learning experiences:

- **Addressing Technological Disparities.** Despite the overall positive impact, the variability in results due to technological disparities raises critical equity issues. The 25% of students facing accessibility challenges reflect a broader global issue where socio-economic factors influence educational quality and outcomes. This digital divide is particularly prominent in less developed regions with limited access to mobile devices and reliable internet. Future policy measures must reduce this divide by enhancing infrastructure and ensuring all students have equal access to necessary technologies.
- **Teacher Training and Curriculum Integration.** The effectiveness of mobile tools heavily relies on teachers' proficiency in utilizing these technologies. The correlation between teacher training and successful integration found in this study suggests that ongoing professional development is essential. However, about 30% of teachers reported difficulties integrating mobile technologies into the existing curricula, indicating that teacher training programs need to be regular and deeply integrated with actual teaching practices and curriculum development.
- **Future Technological Advancements.** Looking towards the future, continuous advancements in technology such as augmented reality (AR) and virtual reality (VR) are set to offer even more immersive and interactive educational experiences. Schools and educational policymakers must keep pace with these advancements to remain relevant and practical. Additionally, the emergence of artificial intelligence (AI) in educational contexts could

personalize learning at unprecedented scales by adapting content to individual learning speeds and styles.

- **Global Trends and Comparative Insights.** Comparative analysis with global benchmarks has shown that while the trends are generally positive, the extent of success varies significantly depending on regional and local conditions. Studies from North America and Europe also demonstrate the importance of infrastructural and socio-economic contexts in determining the effectiveness of mobile educational tools. Such insights are crucial for developing context-specific strategies that acknowledge and address local educational challenges and resources.

Longitudinal Studies: To understand the long-term impacts of mobile software tools on student learning and retention.

Cross-Cultural Research: To explore how different educational cultures adopt and adapt mobile tools in their curricula, providing insights that could lead to more globally applicable educational strategies.

Impact on Teacher Roles: Further research is needed to explore how these technologies are reshaping the roles and responsibilities of teachers in the classroom.

Barrier Analysis: Detailed studies on the barriers to technology integration can help develop targeted interventions to make technology integration more seamless and effective.

The integration of mobile software tools in teaching informatics and IT in general secondary schools presents a promising avenue for enhancing educational processes and outcomes. However, it also brings significant challenges that need to be addressed through targeted policies, teacher training, and infrastructure development. By focusing on these areas, educators and policymakers can better harness the potential of these technologies to meet the educational demands of the 21st century.

Conclusion. Using mobile software tools in teaching informatics and information technologies in secondary education enhances the educational process by introducing new, dynamic engagement methods. For optimal results, these methods must be systematically integrated and aligned with informatics education's didactic tasks and educational goals.

The study's findings demonstrate that mobile software tools can significantly enhance the quality and accessibility of education in informatics and IT at the general secondary school level. These tools have shown substantial potential to transform educational practices through increased student engagement, improved learning outcomes, and the development of key 21st-century skills. However, the integration of such technologies is not without challenges. Issues such as unequal access to technology, varying levels of teacher readiness, and integration difficulties with existing curricula have been highlighted as critical barriers that could hinder the effectiveness of technology-driven educational reforms.

Recommendations:

To address these challenges and optimize the benefits of mobile software tools in education, the following strategic recommendations are proposed:

1) Enhanced Technological Infrastructure:

Governments and educational institutions should invest in robust technological infrastructures that ensure all students can access mobile devices and reliable internet connectivity. This will help mitigate the digital divide and provide a more equitable educational environment.

2) Comprehensive Teacher Training:

Develop comprehensive training programs that familiarize teachers with the latest technologies and effectively integrate these tools into pedagogical practices. Such programs should be continuous and adapt to new technological advancements.

3) Curriculum Development:

Curricula should be dynamically updated to integrate new technologies to complement traditional teaching methods. This involves including new tools and adapting course content to leverage these technologies for enhanced learning experiences.

4) Policy Frameworks:

Develop and implement policy frameworks that support the adoption and integration of mobile technologies in education. These policies should address funding, training, and support for technology integration at all levels of the educational system.

5) Future Research:

Encourage ongoing research into the impacts of mobile technology in education, focusing on long-term outcomes and effective strategies for technology integration. Research should also explore the implications of emerging technologies like AI and VR in educational settings.

6) Global Collaboration and Benchmarking:

Foster international collaboration to share best practices, resources, and research findings. Global benchmarking can help identify successful strategies and technologies that could be adapted to local contexts.

Looking ahead to 2024 and beyond, educational technology is poised for significant transformations with advancements in AI, machine learning, AR, and VR. These technologies promise to make learning even more interactive and personalized. As such, educators and policymakers must remain vigilant and proactive in incorporating these innovations to enhance educational outcomes while addressing the socio-economic challenges that may arise.

In conclusion, while the journey towards fully integrated, technology-enhanced education presents several challenges, the potential benefits for student learning and engagement are profound. By adhering to the recommendations outlined above, educational stakeholders can ensure that integrating mobile software tools in informatics and IT education enhances learning outcomes and prepares students for the demands of the digital age.

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