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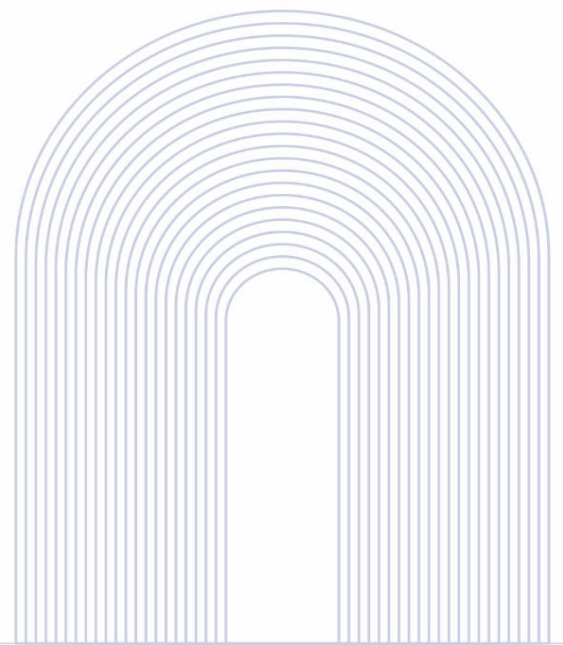
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Research on the Implementation of a System for Monitoring Processes in Educational Institutions

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Abstract

This research focuses on the development and implementation of a web-based system for monitoring and managing the work environment in educational institutions in North Macedonia. Given the growing challenges in the integration of information and communication technologies (ICT) in education, this study presents innovative solutions aimed at optimizing the teaching process, enhancing administrative activities, and increasing student engagement. Through a detailed analysis of existing systems, such as e-dnevnik, Moodle, and iLearn, the research proposes new methodologies and technologies that can significantly improve the effectiveness of the educational system. The aim of this study is to identify specific challenges in the current application of ICT and to offer strategies for overcoming them, particularly in all schools. The analysis of surveys and interviews with teachers, administrators, and students will help uncover key areas for improvement, leading to the formulation of recommendations for the development of an integrated web-based system. This study not only seeks to identify shortcomings in existing systems but also proposes new solutions for improving educational processes, which is essential for supporting 21st-century learning in Macedonia.

Keywords: Web-Based System, Monitoring, Management, Educational Institutions, ICT

I. INTRODUCTION

The evolution of information and communication technologies (ICT) has transformed modern education systems, enabling more interactive, flexible and efficient management systems.

These technologies not only enable faster and more efficient exchange of information, but also create new opportunities for monitoring, management and optimization of educational processes. Web-based systems for monitoring and managing working environments in educational institutions enable a detailed and systematic review of educational processes, student success, resource allocation, as well as more efficient management of administrative activities.

Information and communication technologies not only improve the effectiveness of the teaching process, but also play a key role in creating a more cohesive and dynamic educational environment. In the context of the Republic of North Macedonia, where the digital transformation is in constant development, the educational system began to gain momentum after 2002 with initiatives aimed at modernizing the educational system. Initiatives such as "A computer for every child" aimed to increase the digital literacy of students from an early age. Although this project has brought significant benefits, serious challenges have also emerged in terms of its sustainability and applicability in the long term.

To illustrate the key events in the development of ICT in education, the following timeline shows the main initiatives and projects implemented in the past years.

ICT evolution in education in North Macedonia

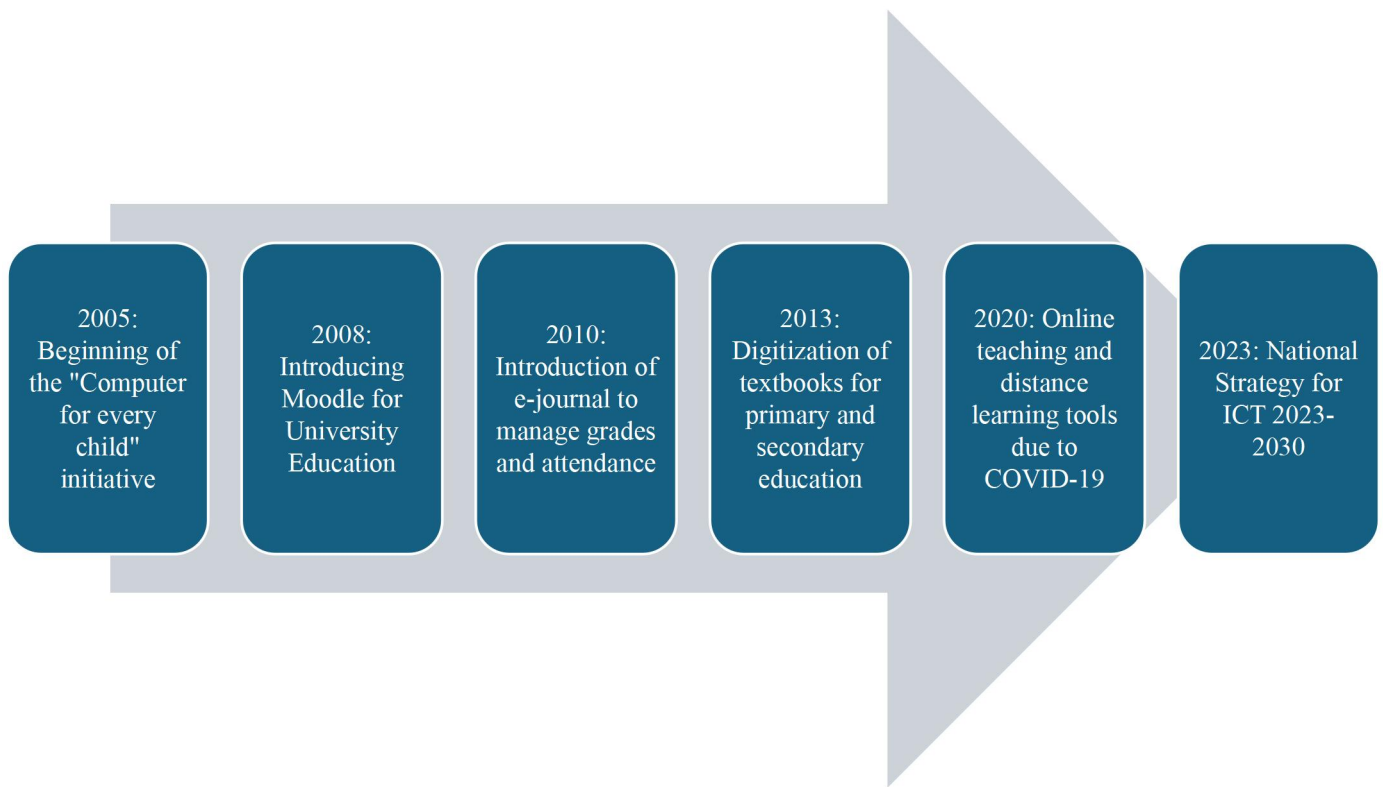


Figure 1. ICT evolution in education in North Macedonia

Explaining the key events of the evolution of ICT in education

1. 2005: The "Computer for Every Child" initiative begins, which aims to increase the digital literacy of students and provide computers to schools across the country.
2. 2008: Moodle is introduced to universities to support blended learning, enabling digital interaction between students and professors.
3. 2010: The introduction of an e-diary simplifies the process of monitoring attendance and assessment, which contributes to better management of the teaching process.
4. 2013: Textbooks are digitized, and digital resources are provided for primary and secondary education, which allows students better access to educational content.
5. 2020: The COVID-19 pandemic is causing increased use of online learning tools and the development of distance learning for all educational levels.
6. 2023: The National Strategy for ICT 2023-2030 defines the vision for the integration of technology in education to achieve greater efficiency and innovation.

II. OBJECTIVES OF THE RESEARCH

This thesis aims to achieve more specific goals related to improving the management of the working environment in educational institutions in North Macedonia through a unified web-based system. Analysis of existing systems, such as e-diary, Moodle, and iLearn, will serve as a basis for designing a new solution that will overcome their current limitations and ensure wider implementation in all educational levels.

1. Comprehensive review of existing systems: To make a detailed review of the current use of ICT in Macedonian schools, with an emphasis on the shortcomings in the integration of management and monitoring systems, such as e-diaries for primary and secondary schools, and Moodle and iLearn on university level. This will include an analysis of previous studies, research papers and available data on the application of ICT in educational institutions.
2. Defining the problems and developing a research plan: To define the specific problems, such as the non-functionality of the e-diary and infrastructural limitations in underdeveloped regions, as well as the lack

of integration between different platforms. This will include the formulation of research questions and hypotheses, as well as the proposal of tools and methodologies to be tested and explored in the context of software engineering.

3. Web-based system design and planning: To prepare a plan for the design and development of a web-based system that will provide student performance monitoring, resource management and real-time administration. This plan will include the necessary phases for the development of the software system, including the selection of tools, methodologies and time frame.
4. Analysis of existing implementation (e-diary): Instead of re-testing, an analysis will be made of the already existing implementation of e-diary, which is used in Macedonian schools for monitoring grades, attendance and administrative tasks. This analysis will assess the strengths and weaknesses of the system and identify potential improvements to fully integrate management processes in schools.
5. Proposal for improvements and recommendations: Based on the collected data and the results of the analysis, to propose recommendations for overcoming infrastructural and cultural barriers for the application of systems such as Moodle, iLearn, and e-journal in different educational environments, especially in schools with a weaker infrastructure network. These recommendations will consider the integration of best practices from existing systems and their adaptation to local needs.

III. THE IMPORTANCE OF RESEARCH

This research is of exceptional importance for the future development of the educational system in North Macedonia. The analysis of systems such as Moodle, which is implemented at GotseDelchev University (UGD), iLearn at the University of St. Cyril and Methodius (UKIM), and e-diary, which is used in primary and secondary schools, will investigate their applicability and propose improvements for wider implementation in all educational institutions. These systems have a significant role in the digitization of education, but face challenges related to infrastructure and limited integration between them.

From a practical point of view, the development of a unified web-based system that integrates e-dnevnik, Moodle, and iLearn will enable greater efficiency in educational institutions, simplify administrative tasks, and help overcome challenges related to inefficient infrastructure. Such an integrated system could facilitate communication between teachers, students, and administrators, while optimizing resource management and student performance evaluation.

In addition, this research will contribute to the expansion of knowledge about the application of ICT in education, especially in developing countries such as North Macedonia. The implementation of a unified web-based system, in which the existing platforms would be integrated, will be in accordance with the goals set in the National ICT Strategy 2023-2030, which focuses on the modernization of educational institutions and the improvement of the ICT infrastructure. This strategy aims to improve the digital infrastructure of schools across North Macedonia and create a more cohesive system for monitoring performance and managing resources, which is key to the future success of the education system.

IV. INTEGRATION OF ICT IN EDUCATION IN NORTH MACEDONIA AND GLOBALLY

Globally, many countries have seen great progress in the integration of ICT in education. Countries such as Finland and Singapore are known for successfully implementing national strategies for integrating ICT into teaching and school administration. These countries use ICT to personalize instruction, monitor student progress, and automate administrative tasks. In Singapore, for example, the Ministry of Education has introduced a national ICT program in schools, giving teachers and students access to digital tools and resources.

In North Macedonia, the implementation of e-diary, Moodle, and iLearn is part of the national modernization effort, but there are still challenges in terms of infrastructure and adequate training for teachers.

In North Macedonia, the process of ICT integration started in the early 2000s in addition to national policies and international collaborations. The National ICT Strategy in Education (2005-2015) predicted the growth of global demand for digital literacy and bringing Macedonian education in line with European standards.

The strategy included initiatives such as computerization of all schools, training of teachers in the use of information technologies, and adoption of digital content. However, this implementation faced several challenges, including lack of infrastructure, limited access to resources in rural areas, lack of training for teaching staff.

Despite the successes achieved, large disparities between more remote and urban schools continue to be an obstacle to the full integration of ICT. While schools in urban areas have access to advanced technologies and better infrastructure, there are also schools that often face a lack of basic resources, such as stable internet and computers.

V. PROBLEMS AND LIMITATIONS IN EXISTING SYSTEMS

Despite long-term digitization efforts, the e-diary, which has been operating in Macedonian schools for more than 10 years, still faces significant problems. One of the most common technical problems is the frequent non-functionality of the system at critical moments, such as the beginning of the new school period, which makes it difficult to enter and monitor students' grades and attendance. Research shows that teachers have great difficulty using this system, complaining about its inflexibility and frequent work interruptions.

In addition to technical challenges, teachers also point out that insufficient training and support from the authorities make it even more difficult to use the system. Although e-diary significantly automates the process of evaluating and monitoring attendance, there are limitations in integration with other systems, which creates a fragmented approach to the management of educational processes.

- **Lack of infrastructure:** With the current situation in schools in North Macedonia, schools face a lack of basic infrastructure, such as internet connection and modern equipment. This limits their capacity to exploit the full potential of ICT.
- **Insufficient training:** Many teachers expressed concern that they had not received adequate training in the use of new technologies, leading to ICT tools not being used to their full potential.
- **Fragmented approach:** Instead of a unified system for tracking student progress and managing resources, many schools use different, often incompatible systems, which creates additional administrative challenges.

VI. NEW TRENDS IN WORK ENVIRONMENT MONITORING SYSTEMS

In recent years, new technologies such as artificial intelligence (AI) and data analysis have begun to shape the development of work environment monitoring systems. These advances allow institutions to collect and analyze large amounts of data on student engagement, educational outcomes, and operational efficiency. For example, predictive analytics can help teachers identify students at risk of falling behind, allowing for timely interventions.

In addition, the shift to hybrid and distance learning models, driven by the COVID-19 pandemic, has led to the need for more flexible monitoring systems that can adapt to different educational environments. This trend highlights the importance of adaptability in educational technology, providing systems that will effectively support both physical and online learning.

Examples of modern implementations:

- **The application of AI for predictive analytics:** Platforms like DreamBox and Knewton use algorithms for personalized learning. They recognize which students are struggling and automatically recommend additional resources or activities.

- Hybrid learning models: Systems like Google Classroom and Microsoft Teams are used to combine traditional and online learning. Through automatic activity tracking, they allow teachers and administrators to receive up-to-date reports on student participation.
- Real-time data analysis: The Moodle platform introduces modules that analyze activities in real-time and enable intervention when needed, such as sending alerts to students who are lagging behind.

Modern platforms allow easy integration with existing systems and support for physical and online learning. For example, software solutions like iLearn enable adaptive learning, adapting the content to the needs of each student.

North Macedonia has a clear vision for the digital transformation of public services and education. The strategy for the period 2023-2030 foresees significant investments in digital infrastructure and development of digital skills, especially in the education sector. This will enable better use of new technologies such as artificial intelligence (AI) and big data (Big Data), with the aim of more efficient management of educational institutions.

These technologies will help automate administrative tasks and improve resource management and student performance, in order to meet the challenges of hybrid and distance learning models.

VII. CONCLUSION

The results of the analysis of existing management systems, such as e-diary, show that digital tools can significantly improve the management of educational institutions and the teaching process in North Macedonia, but only if current infrastructural and organizational limitations are overcome. The following aspects were identified as key:

- Teacher productivity: ICT systems, such as e-diary, help reduce the administrative burden on teachers but are limited by technical obstacles and non-functionality at certain times. With the implementation of more advanced systems, it is possible to further reduce administrative tasks, which will allow teachers more time to focus on teaching and individual work with students.
- Student engagement: Interactive and digital tools, such as real-time progress tracking, show potential for increasing student engagement. Systems like e-diary, which focus on administrative tasks, do not allow for this kind of interaction, which limits their full effectiveness.
- Resource management: Current systems, such as the e-diary, lack tools for managing school resources. The introduction of software that would monitor the use and distribution of teaching materials could significantly improve the management of resources in schools.

Contribution to knowledge in systems engineering and software development

This research represents an important contribution to the field of systems engineering and software development in education. By using modern technologies for the development of web-based systems, such as Laravel and Vue.js, it is shown that it is possible to significantly improve administrative and teaching processes in educational institutions.

- Modular design: This system enables easy adaptation and scalability, which is especially important for educational institutions with different infrastructure capacities.
- Data management: By implementing databases and automation, educational institutions can optimize their processes and gain better insight into the performance of students and resources.

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