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COMPARATIVE ANALYSIS OF STANDARDS IN DISTANCE LEARNING: ADVANTAGES, DISADVANTAGES AND RECOMMENDATIONS FOR USE

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Abstract. *This article provides an in-depth analysis of various standards used in the field of distance learning. The relevance of the study is due to the rapid development of online education and the need to ensure its quality and effectiveness. The purpose of the study: to compare existing distance learning standards, identify their strengths and weaknesses, and determine the most promising areas of development in this area. Research objectives: to conduct a systematic review of existing national and international standards regulating distance learning; to identify the main principles and criteria laid down in various standards; to compare standards by such parameters as coverage, detail of requirements, flexibility and adaptability; to assess the compliance of existing standards with modern trends in the field of online education; to develop recommendations for the optimization and harmonization of distance learning standards. The following results were obtained as a result of the study: key differences between various standards related to their historical development, national characteristics and focus on specific aspects of distance learning were identified; the basic principles underlying most standards were determined, such as accessibility, quality, flexibility, efficiency and consideration of the individual needs of students; an analysis of the advantages and disadvantages of various standards was conducted, their limitations and areas for improvement were identified. Promising directions for the development of standards related to the integration of new technologies, ensuring accessibility for all categories of students and adaptation to the changing needs of the labor market have been identified.*

Key words: *distance learning, SCORM, xAPI, cmi5, LTI, AICC, LMS*

Introduction.

In recent years, distance learning has become an important component of the educational process. Rapid technological development and the growing need for flexible and accessible forms of learning have led to an increase in the number of standards and systems designed to support distance learning. Understanding the advantages and disadvantages of these standards and systems, as well as their competent use, is key to ensuring high quality education. The relevance of this article is as follows. Modern distance learning standards and systems are constantly updated and improved, which requires users to constantly update their knowledge. With the growth of international cooperation in the field of education, distance learning standards and systems should ensure compatibility and integration of various educational programs. Analysis and selection of optimal standards and systems can significantly improve the quality of education and make it more accessible to various categories of users. The article offers a comprehensive analysis of distance learning standards and systems, including their comparative characteristics, advantages and

disadvantages, as well as recommendations for their use, which makes it useful for a wide audience, including teachers, administrators, course developers and students.

The purpose of this article is to provide a comprehensive analysis of distance learning standards and systems, as well as recommendations for their use to achieve the greatest efficiency and quality of the educational process.

Main text. Overview of Distance Learning Standards

SCORM (Sharable Content Object Reference Model). SCORM is a set of technical standards for eLearning software products1. It was developed by the Advanced Distributed Learning (ADL) Initiative of the United States Department of Defense2. SCORM ensures that eLearning content and Learning Management Systems (LMS) can work together seamlessly [1]. *Key Features of SCORM*. SCORM allows eLearning content to be shared across different LMS platforms without modification. SCORM defines how to package content into a transferable ZIP file called the Package Interchange Format (PIF) [2]. Run-Time Communication: SCORM specifies how content communicates with the LMS during runtime, including tracking learner progress and scores. There are several versions of SCORM, including SCORM 1.1, SCORM 1.2, and SCORM 20041. SCORM 2004 introduced features like sequencing, which controls the order in which learners experience content [2]. *Advantages of SCORM.* Ensures that eLearning content is compatible with various LMS platforms. Allows for the creation of reusable learning objects that can be used in different courses and contexts [3]. Tracking and Reporting: Provides robust tracking and reporting capabilities, making it easier to monitor learner progress and performance [2]. *Disadvantages of SCORM.* Implementing SCORM can be complex and may require technical expertise. SCORM is primarily focused on tracking and packaging content, which may limit its flexibility for more advanced instructional designs [1].

xAPI (Experience API). xAPI, also known as the Tin Can API, is a standard developed by the Advanced Distributed Learning (ADL) Initiative of the United States Department of Defense1. It is designed to track and record learning experiences, both online and offline, in a consistent format [4]. *Key Features of xAPI.* Interoperability: xAPI allows different learning technologies to communicate with each other by capturing and sharing data about learning activities. Learning Record Store (LRS): xAPI uses an LRS to store and retrieve data about learning experiences1. An LRS can exist independently or within an LMS. Statement Structure: xAPI records data in the form of "statements" that follow the structure of "actor verb object" (e.g., "I did this"). Device and Platform Independence: xAPI can track learning experiences across various devices and platforms, including mobile devices, simulations, and real-world activities. xAPI is more flexible than previous standards like SCORM, allowing for the recording of a wide range of learning activities. *Advantages of xAPI.* Comprehensive Tracking: xAPI can track a wide range of learning activities, including those that occur outside of traditional eLearning environments. Learning experiences can be transferred between different LRSs, allowing learners to carry their learning records with them. Enhanced Reporting: xAPI provides detailed and flexible reporting capabilities, making it easier to analyze and improve learning outcomes. *Disadvantages of xAPI.* Implementation

Complexity: Setting up and integrating xAPI can be complex and may require technical expertise. Establishing an LRS and configuring xAPI statements can be time-consuming.

cmi5. Cmi5 is a specification designed to bridge the gap between SCORM and xAPI. It is aimed at providing a standard approach to launch content in LMS environments that leverage xAPI for tracking and recording learning activities. Developed by the Advanced Distributed Learning (ADL) Initiative, cmi5 ensures compatibility with xAPI while maintaining some of the structure and simplicity of SCORM. *Key Features of cmi5.* Interoperability: cmi5 is designed to be compatible with xAPI, allowing it to track a wide range of learning activities both online and offline. Structured Content: cmi5 introduces a defined structure for course packaging and launching, similar to SCORM, ensuring a standardized approach to eLearning content delivery. Launch Mechanism: cmi5 specifies how to launch and track content, providing clear guidelines for how LMSs should handle learning activities. Integration with xAPI: cmi5 uses xAPI statements for tracking learning activities, enhancing the ability to capture detailed learning *data. Advantages of cmi5.* Combines Best of Both Worlds: By integrating features of SCORM and xAPI, cmi5 offers a robust solution that provides structured content delivery and detailed tracking capabilities. Flexibility and Scalability: cmi5 allows for tracking a wide range of learning activities across different platforms and devices, making it suitable for diverse learning environments. Simplified Implementation: cmi5 provides clear guidelines for content packaging and launching, simplifying the implementation process compared to using xAPI alone. Disadvantages of cmi5. Complexity of Transition: Organizations using SCORM may face challenges transitioning to cmi5 and xAPI, requiring investment in new tools and training. Implementation Effort: Although cmi5 simplifies some aspects, it still requires a thorough understanding of both SCORM and xAPI principles for effective implementation.

LTI (Learning Tools Interoperability). LTI is a standard developed by the IMS Global Learning Consortium that facilitates the integration of learning applications with learning management systems (LMS). The main goal of LTI is to establish a seamless and secure connection between tools and platforms used in educational settings. *Key Features of LTI.* LTI allows different educational tools and platforms to communicate and exchange data, promoting integration and compatibility. With LTI, users can access various learning tools and platforms using a single login, simplifying the user experience. LTI provides a standardized way to pass data between tools and systems, ensuring consistency and reliability. LTI includes security protocols to ensure data protection and secure communication between integrated tools and LMS. LTI is designed to be scalable, accommodating institutions of all sizes and supporting a wide range of learning tools. *Advantages of LTI.* LTI simplifies the process of integrating new learning tools into existing LMS platforms, reducing the technical complexity and time required. By providing SSO and consistent data exchange, LTI improves the overall user experience, making it easier for students and educators to access and use various tools. LTI supports a wide range of learning tools, from assessment platforms to interactive simulations, allowing for a diverse and enriched learning environment. *Disadvantages of LTI.* Dependent on Adoption: The

effectiveness of LTI depends on the adoption of the standard by tool providers and LMS vendors. Limited adoption can restrict the available integrations. Initial Setup: Implementing LTI may require initial setup and configuration efforts, including ensuring compliance with security protocols and data exchange standards. With LTI, institutions can create a more integrated and streamlined learning ecosystem, leveraging a variety of tools to enhance the educational experience.

AICC (Aviation Industry CBT Committee). AICC is a standard originally developed by the aviation industry to regulate and promote interoperability of computer-based training (CBT) and learning management systems (LMS). Although SCORM has largely superseded AICC in many industries, AICC is still relevant and used in specific contexts due to its strong legacy in aviation and compliance training. *Key Features of AICC.* AICC ensures that eLearning content can be used across different LMS platforms, promoting widespread compatibility. AICC defines methods for packaging and delivering content, similar to SCORM, but with a focus on simplicity and robustness. AICC specifies data communication protocols between LMS and content, ensuring consistent tracking and reporting. AICC includes specifications for both local (LAN-based) and web-based delivery of training content. *Advantages of AICC.* AICC has been around for a long time and is well-understood, with extensive documentation and industry support. AICC is known for its robustness and reliability, particularly in compliance-heavy industries such as aviation. AICC content is designed to be highly compatible with various LMS platforms, ensuring ease of integration. *Disadvantages of AICC.* Compared to newer standards like xAPI, AICC is less flexible in terms of the types of learning activities it can track. AICC has largely been replaced by SCORM and other modern standards, which may offer more advanced features and capabilities. Implementing AICC can be complex, requiring adherence to detailed specifications and protocols.

Standard	Advantages	Disadvantages
SCORM	Ensures the compatibility of training content with various LMSs. Create learning objects that can be used in different courses and contexts. Provides reliable tracking and reporting, making it easy to monitor student progress.	Implementing SCORM can be complex and requires technical expertise. SCORM is mainly focused on content tracking and packaging, which can limit its flexibility for more complex training methodologies.
xAPI	xAPI can track a wide range of training activities, both online and offline. Learning experiences can be transferred between different LRSs, allowing students to transfer their learning records. xAPI provides granular and flexible reporting capabilities, making it easier to analyze and improve learning outcomes.	Setting up and integrating xAPI can be complex and requires technical expertise. Creating LRS and configuring xAPI records can be time-consuming.

cmi5	The integration of SCORM and xAPI features provides a robust solution for structured content delivery and granular tracking. cmi5 allows you to track a wide range of training activities across multiple platforms and devices. cmi5 provides clear guidelines for packaging and running content, simplifying the implementation process compared to using a single xAPI.	Organizations using SCORM can find it difficult to migrate to cmi5 and xAPI, which requires investment in new tools and training. While cmi5 simplifies some aspects, it still requires a thorough understanding of SCORM and xAPI principles to implement effectively.
LTI	LTI simplifies the process of integrating new training tools into existing LMSs, reducing technical complexity and time. By providing SSO and consistent data exchange, LTI improves the overall user experience by making it easier to access and use various tools. LTI supports a wide range of learning tools, from assessment platforms to interactive simulations, allowing you to create a diverse and rich learning environment.	The effectiveness of LTI depends on the adoption of the standard by tool vendors and LMS. Limited adoption may limit available integrations. An LTI implementation may require initial setup and configuration, including ensuring compliance with security protocols and communication standards.
AICC	AICC has been around for a long time and is well understood, with extensive documentation and industry support. AICC is known for its reliability and resilience, especially in highly compliant industries such as aviation. AICC content is designed to be highly compatible with different LMS platforms, simplifying integration.	Compared to newer standards such as xAPI, AICC is less flexible in tracking the types of training activities. AICC has largely been replaced by SCORM and other modern standards that may offer more advanced features and functionality. The implementation of AICC can be complex, requiring compliance with detailed specifications and protocols.

AICC remains a relevant standard in specific industries due to its strong track record and reliability. Its focus on interoperability and robust communication protocols makes it a valuable tool for organizations that require strict compliance and reliable performance.

Summary and conclusions.

A comprehensive analysis of distance learning standards and systems has been conducted. We have reviewed key standards such as SCORM, xAPI, cmi5, LTI, and AICC, and highlighted their main features, advantages, and disadvantages. Each distance learning standard has its own unique features and applications, which allows

you to choose the best option depending on specific needs and goals. Compatibility of different standards and LMS plays a key role in creating an effective and flexible learning environment. It is important to consider the needs of users and ensure seamless integration. The introduction of AI and machine learning in distance learning will allow you to create more personalized and adaptive learning programs.

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Abstract. *У цій статті проводиться поглиблений аналіз різних стандартів, які застосовуються у сфері дистанційного навчання. Актуальність дослідження обумовлена стрімким розвитком онлайн-освіти та необхідністю забезпечення його якості та ефективності. Мета дослідження: порівняти існуючі стандарти дистанційного навчання, виявити їх сильні та слабкі сторони, а також визначити найперспективніші напрями розвитку в цій галузі. Завдання дослідження: провести систематичний огляд існуючих національних та міжнародних стандартів, що регулюють дистанційне навчання; виявити основні принципи та критерії, закладені в різних стандартах; порівняти стандарти за такими параметрами, як охоплення, деталізація вимог, гнучкість та адаптивність; оцінити відповідність існуючих стандартів сучасним тенденціям у галузі онлайн-освіти; розробити рекомендації щодо оптимізації та гармонізації стандартів дистанційного навчання. В результаті дослідження було отримано такі результати: виявлено ключові відмінності між різними стандартами, пов'язані з їх історичним розвитком, національними особливостями та фокусом на конкретних аспектах дистанційного навчання; визначено основні принципи, що лежать в основі більшості стандартів, такі як доступність, якість, гнучкість, ефективність та врахування індивідуальних потреб учнів; проведено аналіз переваг та недоліків різних стандартів, виявлено їх обмеження та галузі для покращення; визначено перспективні напрями розвитку стандартів, пов'язані з інтеграцією нових технологій, забезпеченням доступності для всіх категорій учнів та адаптацією до потреб ринку праці, що змінюються.*

Key words: *дистанційне навчання, SCORM, xAPI, cmi5, LTI, AICC, LMS*

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