



The Role of International Standards in Education

Vladan Pantović^{1*}, Dragorad Milovanović²

¹ Faculty of Information Technology and Engineering, Belgrade, Serbia

⁽¹⁾ IEEE Education Society, Serbia & Montenegro

² Sports Academy AFB, Belgrade, Serbia

*vladan@pantovic.rs

Abstract: *Well-organized education and training are the initiators of smart, sustainable, and inclusive growth. The new economy, characterized by constant and quick changes, requires constant improvements in the education system. Continued technological progress and the digital transformation of education require a systematic approach in line with international standards. There are numerous initiatives and activities for the development of standards and technical specifications. Standards ISO 21001 and ISO 29993 may help educational institutions to properly recognize the needs and expectations of various interested parties. Through an adequate application of a quality management system defined by the requirements of these standards, all the challenges faced by organizations that provide formal and informal education would be more easily overcome and achieving goals would be more effective and efficient. The technical specifications of IoT multimedia technologies and 5G immersive applications have a positive effect on the motivation and dedication of students, enabling real-time interaction in personalized environments. The global infrastructure and advanced services are the basis of success. It is necessary to continue the research of integrating new technologies into the process of education, the harmonization of standards and effective frameworks.*

Keywords: Standards; ISO 21001; ISO 29993; 5G; IoT.

1. INTRODUCTION

In the digital economy, the readiness and ability to constantly learn are becoming crucial for success, but also for survival, on the global market. The new economy, characterized by constant and quick changes, requires constant modifications to the education system. Successful modifications in education are carried out in accordance with the generally accepted standards. Technical standards are used in engineering courses by universities worldwide [1].

Organizing the planning, realization and evaluation processes of the provided education and training services, their advancement as well as improvement of all connected activities, competitiveness and comparability with the international instances and market [2], and most importantly – user satisfaction and the applicability of the acquired knowledge on all markets, taking into account the well-known criteria and demands, are sufficient reasons and justify the necessity of implementing and certifying standards ISO 21001 Educational organizations – Management systems for educational organizations – Requirements with guidance for use [3] and/or ISO 29993 Learning services outside formal education – Service

requirements [4] within institutions of higher education, as well as in all other subjects included in the formal and informal education system [5].

ISO standards contribute to the implementation of the Goals of sustainable development set by the United Nations (SDG – Sustainable Development Goals), among which is SDG 4 – Education quality, which anticipates the securing of inclusive and quality education and the promotion of a possibility of lifelong learning [6]. The key initiators of smart, sustainable and inclusive growth are education and training, since they facilitate employment, improve productivity, innovation, competitiveness, reduce poverty, inequality and contribute to the achievement of gender equality [7].

Governments are investing in the digital literacy of their citizens. The EU European Commission's Joint Research Centre (JRC) has developed a digital competences framework called Digicomp [8] to help harness digital technologies' potential to innovate education and training practices. The United Kingdom Department for Education has created the National standards for essential digital skills [9]. These standards are intended to be used by organizations in the development of new essential digital skills qualifications.

2. CERTIFICATION OF EDUCATIONAL INSTITUTIONS

Standards ISO 21001 and ISO 29993 are based on standard ISO 29990 [10] whose goal is to unify the quality management systems and which was the foundation for the further development of the field of systematization and certification of education, both formal (through the implementation and certification of standard ISO 21001) and informal (ISO 29993). Constant technological changes and the emergence of new business models, the digital transformation of all fields of business, with particular implications for education, demand constant changes, whether formal in academic or vocational institutions, or informal through the development of „soft & hard skills“, obtaining professional certificates which will gain additional importance through certification programs. Constant changes in education need to be carried out systematically, respecting certain principles which are primarily reflected and defined through the demands of the standards [11].

When it comes to the demands themselves, both standards recommend, but do not in any way limit or condition through the previous implementation of ISO 9001. ISO 21001 is a completely independent standard with a high level structure, completely harmonized with the settings of ISO 9001, while ISO 29993 is conceived as an addition to ISO 9001, but can also be certified completely independently, without any need for the previous implementation and certification of a quality management system according to ISO 9001. The focus in both is on facilitators and recipient of knowledge, i.e. the adequate analysis and distribution of user demands, with the defining of unique criteria of evaluation and assessment of the acquired knowledge. The biggest benefit is the classification and unification of the confirmation of achieved competences, which gains significance and recognition through the act of certification.

Through the implementation and certification of these two standards, comparability and transparency of services offered at the national and international level, increased efficiency and effectiveness thanks to the continued processes and evaluation tools which are a component of these international standards, as well as the final result – an increase in credibility of the educational organization which has the certified system are achieved. Of course, the certification of the management system always recognizes a certain group of interested parties as an end user, which is in this case the education service user, which has the aim of increasing the user's competences.

Educational institutions which apply ISO 21001 and ISO 29993 will more easily deal with challenges, achieve sustainable development and bigger credibility and influence in society.

2.1. ISO 21001:2018

ISO 21001 (Educational organizations – Management systems for educational organizations – Requirements with guidance for use) is adapted to the ISO 9001 structure and follows the existing trend of harmonization concerning coordinating and achieving a high level structure. ISO 21001 is clearly focused on students' needs, as well as on the constant improvement of the very service. The standard also includes advice which facilitates and increase the practicality of the very implementation within the service provider's organization.

As is mentioned in the ISO 21001 [3], the standard determines the demands for the management system for educational organizations (EOMS – Educational Organizations Management System) when such organizations have to show the abilities to support development and achieving competences through lectures, studying or research, aim to increase students' and other service users' (e.g. sponsors) satisfaction through the effective application of EOMS, including the processes for improving systems and securing harmonization with students' and other service users' demands, i.e. user competences achieved based on the education services provided. All demands of this standard are generic and intended for application on any organization which, through its educational programs, supports the development of competences through lectures, studying and research, no matter the type, size or method of education. Also, the standard can be applied on educational organizations within a larger organization whose basic activity is not education as such, but is not applicable to organizations which only produce or manufacture products for education and training, not providing any kind of education and training services.

2.2. ISO 29993:2017

The focus of ISO 29993 (Learning services outside formal education – Service requirements) is on processes and fields of system application concerning providing specific services. This standard [4] determines the demands for education services outside of formal education, including all kinds of lifelong learning (vocational training and in-house training, whether it is outsourced or provided in the company itself). All the aforementioned includes any kind of education service provided by the education service provider (LSP – *Learning Service Provider*), as well as sponsors who provide a service instead of the organizations themselves. The basic characteristic of this type of service is the defining of the goals of education and the assessment of services provided, as well as their performance through interacting with service users (the trained). The standard includes all education methods and techniques: face-to-face, e-learning or a combination of both.

3. IMMERSIVE MEDIA IN ONLINE EDUCATION

The application of IoMT (Internet of Media Things) technology has a positive effect on students' motivation and dedication, enables real-time interaction with abstract computer models and a complete personal experience of the education process [12, 13]. The Immersive Multimedia Experience is based on available and accessible AR (*Augmented Reality*) / MR (*Mixed Reality*) / VR (*Virtual Reality*) systems of augmented / mixed / virtual reality and telecommunication (5G mobile) conference systems [14, 15, 16, 17]. Continued technological advancement enables different alternatives with different levels of interaction and immersive experience. A high level of interactions and 3D reconstruction quality of a natural environment is desired. However, there is still no clear vision on how to integrate IoMT technology and immersive media in the education process in a stable way.

3.1. Internet of Media Things

The IoT (Internet of Things) is a concept of connecting different objects (physical and virtual) onto the Internet infrastructure [18]. Interoperable information and communication technologies (ICT) enable the activation, transfer and analysis of data in intelligent advanced services environments. IoT characteristics support multimedia communications. However, multimedia applications are bandwidth-hungry and delay-sensitive. The rapid growth of multimedia traffic in IoT has paved the way for the innovation of new techniques to meet its requirements [12].

Internet of Multimedia Things (IoMT) devices are different from IoT devices. They require a bigger memory, higher computational power, and are more power-hungry with a higher bandwidth. The main characteristic of IoMT is the timely and reliable delivery of data. Therefore, it imposes strict quality of service (QoS) requirements and demands efficient network architecture. The users' perspective of QoS is known as quality of experience (QoE). IoMT enables applications based on the interaction between humans and devices (built-in, transferable and portable) in a complex multimedia environment based on global standards and effective frameworks. The key aspect of the IoMT based solution is massive scalability, widespread availability and cost-effectiveness of communication technologies [19].

The success of the IoMT depends greatly on the existence and effective operation of global standards. The standardization initiative, research projects, national initiatives and industrial activities are outlined in this section. There are already many standardization activities related to the IoMT, covering broad research areas. However, what is needed is a harmonization of standards and effective frameworks for large-scale deployment.

Several contributions to the full deployment and standardization of the IoT come from the scientific community. Among them, the most relevant are provided by the European Standards Organizations (ETSI, CEN, CENELEC, etc.), by their international counterparts (ISO, ITU), and by other standards bodies and consortia (IETF) [18].

The International Telecommunication Union (ITU) published Recommendations with the aim of promoting a unified approach in ITU-T for the development of technical standards enabling IoT on a global scale.

The ISO/IEC Moving Picture Experts Group (MPEG) is a working group formed by to set standards for audio and video compression and transmission. The Internet of Media Things and Wearables (IoMT) is a collection of interfaces, protocols and associated media-related information representations that enable advanced services and applications based on human to device and device to device interaction, in physical and virtual environments. The information refers to data sensed and processed by a device, and/or communicated to a human or another device. The MPEG IoMT standard covers five aspects addressed in individual parts as follows:

Part 1. Global architecture, use cases and common requirements

Part 2. System aspects (discovery, communication)

Part 3. Individual IoMTs, data formats and APIs (sensors & actuators, media processing & storage).

Part 4. Wearable IoMTs, data formats and APIs (smart glasses, camera, gesture recognizer, microphone, display).

Part 5. IoMT Aggregates combining individual IoMTs, eventually with other IoTs (smart offices).

The IETF is intensively working on a set of IoT-related standards. The IETF already has a decade of history specifying and documenting key IoT standards and guidance. IP and particularly IPv6 are the obvious choice for the IoT networking part, but the rest of the IETF IoT stack is currently undergoing a dynamic standardization process. The core IETF IoT protocol stack, as published in RFCs, is mature and suitable for deployment.

IEEE is a global, professional engineering organization whose mission is to advance technological innovation. The IEEE Standards Association (IEEE-SA), a globally recognized standards setting body within the IEEE, develops consensus standards through an open process that engages the industry and brings together a broad stakeholder community. IEEE standards set specifications and best practices based on current scientific and technological knowledge. The IEEE-SA has a portfolio of over 900 active standards and more than 500 standards under development. In its research into IoT, it has identified over 140 existing standards and projects that are relevant to the IoT.

Also, IEEE has created a Working Group VRAR (Virtual Reality and Augmented Reality) under the P2048 standard. Part 1 specifies the taxonomy and definitions for VR and AR devices. Part 2 specifies the taxonomy and quality metrics for immersive video. Part 9 specifies the taxonomy and quality metrics for immersive audio. By dividing immersive video/audio into different categories and levels, this standard could reduce the confusion nowadays.

3.2. 5G Immersive Applications

In terms of standardization, immersive media experiences (IMEx) has triggered multiple activities in the areas of coded representation of immersive audio, image, and video signals, as well as quality metrics for immersive services and applications. The goal of SDO activities is to document requirements, collect material to assess algorithm performance in reference models under common test conditions, and study methods for QoE assessment. Experts groups specify the taxonomy and quality metrics, develop a test methodology, study models of immersion, experience metrics and their measurability in immersive services. Industry forums and consortia develop frameworks for the interoperability of services and applications, establish and recommend best practices and guidelines.

As new use cases for a fully immersive AR and VR experience are introduced on the market, service providers will need to address bandwidth limitations, reduce E2E network latency and improve the overall QoS/QoE for streaming media services. The increased bandwidth capacity and decreased latency of new generation 5G networks will allow access to complex 3D immersive AV experiences [20]. These cutting-edge technologies superimpose digital data onto the physical world and enable computers to generate simulations of 3D images or create 3D environments.

Exploiting the immersion that it offers, VR technology is being increasingly used in fields such as entertainment, video games, training, and design. Early AR applications focused mostly on the entertainment and gaming industries, but current advances in the field have led to major interest from sectors such as education, professional training, knowledge sharing and collaborative environments.

5G wireless multimedia communication is a technology enabler for a massive market and ecosystem. It rather requires standard organizations and industry consortiums to work collaboratively with their own expertise and requirements for 5G in order to develop a healthy ecosystem with a unified 5G standard. 3GPP as the core standard developing organization for 5G communication technology has been at center stage of cross-industry efforts and has been evolving to be more open and flexible.

The 3GPP has been conducting standardization work on immersive media since its launch of 5G-targeted standardization activities in 2015, starting with the completion items in SA1 (*Requirements*) and SA4 (*Codecs and Media*) working groups.

- SA1 developed a set of use cases on immersive media in Release 14 TR22.891 and later in Release 15 TS22.261 for 5G stage 1 development, which described requirements toward supporting VR and interactive conversation use cases, including relevant latency requirements for video and audio.
- SA4 technical report TR26.918 documented a broad range of on-demand and live streaming, broadcast and conversational VR use cases, relevant VR technologies for audio and video and various subjective quality evaluations.

Immersive services such as AR/VR, UHD and 3D video have a crucial requirement, and the 5G network will be able to transfer this data traffic in a flexible and efficient manner. It is necessary to take into account the following three aspects: content quality, network constraints and device limitations. The user's device plays an important role in the E2E user experience. Therefore, 3GPP is working on

- Technical evaluation of the subjective quality of the relevant parts of the E2E system needs to be performed to assess the overall QoE.
- The full technical description and either an implementation of these blocks and/or performance requirements are required to ensure the tested QoE.

Higher picture quality is a general trend for all services and devices. With the expected increase of personal HMDs and new content generation devices, researchers have recently started to quantify, model and manage QoE when the user consumed content is beyond traditional audio and video materials. On the other hand, service providers seek to deliver as high a quality as possible, despite the growing associated costs and issues related to network capacity. Defining VR service-specific QoE metrics will allow 5G operators to understand and manage how end users are experiencing specific VR services. Based on these QoE metrics, operators may also perform problem analysis and troubleshooting. A VR-oriented E2E network operation and management system become crucial for understanding the user-perceived quality of immersive multimedia experiences. The VR video quality can be degraded by various faults which can be hard to separate or distinguish between. This necessitates the development of effective QoE-oriented E2E solutions at various points of the VR video delivery system for real-time monitoring, detecting and demarcating faults. This would enable service providers to enhance VR video streaming service experience through solution that can model and measure the perceivable media quality.

4. CONCLUSION

Standards ISO 21001 and ISO 29993 can aid educational institutions to recognize the needs and expectations of various interested parties and provide them with quality education throughout all phases in life the right way. Through an adequate application of quality management systems defined through the demands of standards ISO 21001:2018 and ISO 29993:2017, all challenges which organizations providing formal and informal education services face will be more simply overcome and achieving goals will be more effective and efficient.

Well-organized education and training are the initiators of smart, sustainable and inclusive growth. Special attention must be paid to digital transformation and changes in all spheres of life, including the digital transformation of education itself.

The global infrastructure and advanced services are the basis of success. The technical specifications of IoT multimedia technologies and 5G immersive applications have a positive effect on the motivation and dedication of students, enabling real-time interaction in personalized environments.

It is necessary to continue the research of integrating new technologies into the process of education, the harmonization of standards and effective frameworks.

Including education on standards and standardization integrated within the appropriate vocational courses into the programs of academic institutions, primarily in technical-technological fields, is also recommended.

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