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INTEROPERABILITY GUIDELINES FOR LITHUANIAN E-LEARNING MANAGEMENT SYSTEMS

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Abstract

Purpose – the paper aims to analyse e-learning content and repositories along with the problems of learning organisation interoperability. The main objective of the paper is to analyse scientific research results and the newest international experience in the area and to provide interoperability guidelines and recommendations for the implementation of appropriate Lithuanian state programmes. The learning content and repositories recommendations are designed for the implementation of the Lithuanian education portal project as well as Lithuanian Virtual University (LVU) programme's information services' (LABT / eLABa) and e-learning services' (LieDM) sub-programmes. The whole education institution recommendations are designed for the maintenance and development of LVU programme's management services' (LieMSIS) system.

Design/methodology/approach – methods used for the general analysis of proposed interoperability guidelines (reccomendations) were bibliographic research and comparative analysis of Lithuanian and foreign scientific works published in periodicals and large-scale EU-funded interoperability projects deliverables. System analysis and comparative analysis methods were used in order to formulate and analyse systems' interoperability guidelines and recommendations. The author employed the experimental

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research method while working in the appropriate EU-funded interoperability projects to form the guidelines (recommendations). In order to summarize the results, the evaluative research method was used..

Findings – the international guidelines and recommendations presented in the paper could be suitable for implementation while developing Lithuanian state education information systems such as the Lithuanian education portal, the Lithuanian academic libraries' (eLABa) system, the Lithuanian distance learning system (LieDM), and the Lithuanian universities' management system (LieMSIS).

Research limitations/implications – the paper presents the author's viewpoint on the probable implementation of several well-known international approaches, standards and specifications to improve interoperability of the different components of the LVU programme.

Practical implications – the proper implementation of the proposed interoperability guidelines and recommendations could considerably improve the interoperability level of Lithuanian state e-learning management systems.

Originality/Value – this type of analysis has been performed and recommendations have been applied to the LVU case study for the first time in scientific literature.

Keywords: interoperability, standards and specifications, e-learning, education management, learning content and repositories; learning organisation

Research type: viewpoint, technical paper, case study, general review.

Introduction

E-learning systems are considered here to be aggregates of knowledge repositories, and services organised as complex information systems. Standards and interoperability are key factors in the success of the introduction of such systems, and therefore it is very important to investigate and propose interoperability recommendations (guidelines) for the system components. These guidelines and recommendations could be of interest for the implementation of several Lithuanian state programmes and projects such as the Lithuanian education portal project and the Lithuanian Virtual University (LVU) programme.

The Lithuanian education portal (2011) is a state-wide service aimed to provide e-learning services for the compulsory education system. The portal is run by the Centre of Information Technologies in Education under the Ministry of Education and Science. One of the main services provided by the portal is the learning object metadata (LOM, 2011) repository aimed at providing quick, convenient and informative access to all learning content and tools purchased by the Ministry of Education and Science and its institutions. The LOM repository is connected to the European Learning Resource Exchange (LRE, 2011) federation system for schools run by the European Schoolnet.

One of the main objectives of LRE is to provide quick and convenient (e.g., tags-based) access to reusable (so-called "travel well") learning resources across Europe.

The programme of the Lithuanian Virtual University (LVU) for 2007-2012 continues the implementation of the programme „Information Technologies for Science and Studies 2001-2006" and is devoted to science and academia. The main aim of the LVU programme is to expand the information infrastructure of Lithuanian science and academia, applying available resources that attempt to develop an effective and coherent, available and continuous educational system and to provide conditions to study throughout life; to ensure the quality of the educational system while integrating into the common European educational space; to prepare specialists of the highest quality; to carry out research, etc. (LVU, 2011). LVU consists of the information services (LABT), the e-learning services (LieDM), and the management services (LieMSIS) sub-programmes.

The main aim of LABT is to develop an IT-based Lithuanian science and academia integrated information space, combining traditional and e-libraries, e-publishing, information search and supply to users, and providing virtual services to employees of Lithuanian science and academic institutions, students, citizens and other e-systems (LVU, 2011). One of the main areas of LABT activity is a new Lithuanian Academic E-library (eLABa) project, which is to be partly funded by European structural funds.

The Lithuanian Distance Education Network (LieDM) connects more than 60 educational institutions all around Lithuania and provides the following services: organising video conferences, broadcasting video lectures and presentations, hosting and administrating several learning management systems, developing e-learning courses and implementing e-learning solutions, and providing technological and methodological e-learning consultations (LVU, 2011).

The main aim of LieMSIS is to provide services for educational institutions and their representatives (administrators, teachers and students), while planning and managing financial, human, study, research and continuous and professional learning resources, as well as to develop the tools necessary for self-service (LVU, 2011).

The main objective of the paper is to analyse scientific research results and the newest international experience in the area and to provide interoperability guidelines and recommendations for the implementation of the aforementioned Lithuanian state programmes.

The author of the paper is the leader of Lithuanian research and development teams in the appropriate EU-funded R&D projects such as FP6 CALIBRATE, FP7 iTEC, LLP eQNet, eContent*plus* ASPECT and EdReNe – projects mainly aimed at schools' sector interoperability issues as well as the external expert in eContent*plus* iCOPER project aimed at the universites' sector interoperability issues. The author is also an expert member of several international interoperability organisations such as LTSO and IMS.

The rest of the paper is organised as follows. The Theoretical background (literature review) section analyses different interoperability aspects. Methodology employed while researching the paper is presented in the Research Methodology section. The Interoperability recommendations section presents a short analysis of the different

aspects of interoperability problems in e-learning and education management for schools' and universities' sectors and recommendations for application of the appropriate interoperability strategies, standards and specifications in Lithuanian state programmes. The conclusion and future research trends are provided in the last section.

1. Theoretical background

1.1. What is Interoperability?

ISO 2382–01.01.47 defines interoperability as "the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units". Interoperability relies on agreements and the more these agreements are shared the greater the interoperability.

One of the requirements for a federated information system is interoperability, the ability of one computer system to access and use the resources of another system (Komatsoulis *et. al*., 2008). The informatics engineering community has recognized the importance of interoperability, the cooperation of two or more systems to enable the exchange and utilization of data, and has noted that the current lack of interoperability is a contributing factor to the lack of adoption of available infrastructures (Kraft *et. al.,* 2007). Where interoperability is concerned, standard development and implementation issues cannot be meaningfully separated (Egyedi, 2007).

Interoperability is the ability of two systems to interoperate. Whereas the term "system" is in this context often understood as a technical system, it applies to systems in the wider sense, i.e., including all actors in the educational system. Hence, interoperability can be examined in a semiotic framework that can help us understand different aspects of interoperability:

- Physical layer: the physical appearance, the media and amount of contact available.
- Empirical layer: the entropy, variety and equivocation encountered.
- Syntactical layer: the language, structure and logic used.
- Semantical layer: the meaning and validity of what is expressed.
- Pragmatic layer: the intentions, responsibilities and consequences behind the expressed statements.
- Social layer: the interests, beliefs and commitments shared as a result.

These layers can be divided into two groups in order to reveal the technical versus the social aspect division. Physics, empirics and syntactics, taken together, constitute a domain where technical and formal methods are adequate. However, semantics plus pragmatics plus the social domain can hardly be explored if those methods are used exclusively and without modification.

The physical and empirical layers are today well covered by achievements in the ICT industry on which any educational system making use of ICT can build. At the syntactic layer we are concerned with the language, structure and logic used in order

to have systems, subsystems and modules interoperate. The semantic layer addresses the interoperability of meaning (semantic interoperability); i.e., whether one actor can understand the information given by another in an educational system correctly. This might involve terminology aspects (homonyms, synonyms, scope) as well as human language aspects. The pragmatic layer is concerned with common intentions such as a common pedagogical goal, and with responsibility aspects such as trust. For example, for any Digital Rights Management system to work a certain amount of trust is always required. Likewise, when an educational institution is issuing a certificate then people will have to trust the validity of the certificate. Finally at the social layer, interoperability is concerned with the compatibility of beliefs and values of different educational systems. Whereas beliefs and values of education in Europe may vary from one country or region to another, in general we can say that they are compatible, grounded in a common European tradition (LIFE, 2006).

1.2. Technical Interoperability of Services

Complex IT systems are today often built following a service oriented architecture where each of the services knows technically how to interoperate with the other services by means of a well defined interface. The major advantage is that system builders can make use of services from different service providers given that they obey the service interface specifications. Just like printers are interchangeable, given that they have a Centronics or USB plug, a learning object repository could be accessed easily if it has implemented for example the Simple Query Interface – SQI. Service developers can develop their service the way they want as long as they obey the interface specifications. Obviously, the more these interface specifications are shared among service developers, the greater the interoperability (LIFE, 2006).

1.3. Semantic Interoperability

Semantic interoperability is achieved to the extent that users of interoperable services give the same or compatible meaning to information exchanged between the services. Semantic interoperability relates to information being exchanged between services and is achieved through several means. First, it requires a common conceptual model. Standards such as IEEE LOM and specifications such as various IMS specifications typically make use of a conceptual model or an information model and separate the what from the how; i.e., the conceptual model describes what information is exchanged in terms of concepts, their properties, and relationships between these concepts while a so-called binding expresses how this information is exchanged. Second, the concept properties may have values that require a common understanding. The values being exchanged are on the lexical level while semantics are at the conceptual level. Semantic interoperability is therefore also concerned with questions such as do different terms (possibly from different languages) express the same concept and does a specific term used by different users induce the same semantics? Therefore in order to achieve a higher degree of semantic interoperability, controlled vocabularies are often used. The

term vocabulary is used here in the broad sense, referring to value lists, classifications, taxonomies, glossaries, dictionaries, ontologies, and thesauri (LIFE, 2006).

1.4. Standards and Specifications for Interoperability

Interoperability relies on agreements and the more these agreements are shared the greater the interoperability. This is where standards and specifications come into play. In this paper the term "standard" is used for de jure standards, agreed by national bodies. For other written agreements concerning interoperability the term "specification" is used.

An educational system consists of a set of interoperable services, standards and specifications in the field of learning technologies. The following elements can be distinguished:

- the request identifier; for example a string such as "Synchronous Query" identifies the requested service;
- the parameters sent with the request; for example a query statement;
- the result; for example a set of LO metadata.

Service interface specifications can be defined in abstract terms and can be bound to a specific expression format such as an application programming interface – API, or a web service description.

The parameters and results may consist of complex information structures which themselves are subject to standards and specifications. For example, the result of a query to a learning repository may be a result set of learning object metadata instances following the well-known IEEE LOM standard. Standards for information structures typically consist of a set of assertion containers. For example the IEEE LOM standard contains assertions concerning: (1) General Information; (2) Life Cycle; (3) Meta–metadata; (4) Technical; (5) Educational; (6) Rights; (7) Relation with other material; (8) Annotation; (9) Classification. Learner information could have assertions about: (1) Competency; (2) Demographic Information; (3) Preferences; (4) Accessibility; (5) Performance and Achievements; (6) Plans/Goals/Reflections; (7) Activity; (8) Map of Relationships.

Typically a standard or specification will consist of rules on how to express such assertions; i.e., what assertions, by whom, when, etc. For example, it will be important to know who made the claim about a performance or achievement.

A specification will have an information model (sometimes called conceptual model) and one or more expression formats called a binding. For example, the IEEE LOM has several XML bindings. Sometimes the conceptual model and the expression format are integrated into a single specification; i.e., the conceptual model can be expressed only in a single way.

Each assertion will have an information structure. It might be more or less elaborated, depending on what is asserted. For example, data element 6.3 of the IEEE LOM "Rights' description" allows a free text while section 9 is fully elaborated in order to express taxonomies. Standards and specifications' builders will typically have to choose between a relatively free way of expressing the assertion, or a prescribed format such as a formal language, or something in between where a prescribed top structure is provided

but some details are in free format. In addition they will have to choose whether to allow more than one format or only a single one. For example, the rights applicable to an LO might be described in more than one Digital Rights Expression Language.

The major criterion of choice will be the extent to which agreement can be reached among stakeholders. Obviously, an agreement on the details and an agreement on a single information structure facilitate interoperability.

A number of standards and specifications are considered to be the most important for the educational sector in Europe. However, it is not sufficient just to identify these standards and specifications. More important is to understand at what stage of the adoption life cycle they are, and what should be done to improve adoption. While some specifications are only at the beginning stage of adoption, there are already a fair number of standards that have been well adopted, but too many islands exist. The analysis highlights the need for making old and new standards and specifications work together (i.e. interoperate).

The major issues here are: what standards, why, and clear guidelines aimed to improve e-learning standards and their application profiles (APs) and their adoption and application in e-learning practices as well as recommendations how to combine existing standards and specifications into complete solutions that address the needs of the schools' sector in terms of learning content discovery, exchange and reuse (LIFE, 2006).

2. Research Methodology

Bibliographic research and comparative analysis of Lithuanian and foreign scientific works published in periodicals and large-scale EU-funded interoperability projects deliverables were used for the general analysis of proposed interoperability guidelines (recommendations) for the development of state information systems and components. System analysis and comparative analysis were used to formulate and analyse systems' interoperability guidelines and recommendations. Experimental research was used by the author while working in the appropriate EU-funded interoperability projects to form the guidelines The evaluative research method was used to summarize the results.

3. Results and Findings – Interoperability Recommendations

3.1. Learning Content and Repository Interoperability

3.1.1. Lithuanian Education Portal

The main problem with e-learning systems is not identification of suitable standards and specifications, but how to adopt these standards and specifications and apply / implement them in e-learning practice. First of all, there are no good solutions for specific Aps of the IEEE LOM standard, which is necessary in order to make it

easier for educators to discover and use learning content that addresses the needs of their students, to maximise reuse of content and to minimise costs associated with its repurposing. Approaches concerning LOM APs and curricula mapping are the main topics while creating any metadata strategies, and therefore the author has given serious consideration to these issues here. These approaches should provide quicker and more convenient learning objects' search possibilities in the repositories. Several appropriate solutions are presented in (Kurilovas, 2009; Dagienė, Kurilovas, 2007; 2008; Kurilovas, Kubilinskienė, 2008).

It is not sufficient just to identify these standards and specifications. It is more important to understand at what stage of the adoption life cycle they are, and what should be done to improve adoption (ASPECT, 2011).

The main conclusions based on analysis of existing and emerging interoperability standards and specifications are: (1) the majority of standards and specifications are not adopted and do not conform with educational practice; (2) there exists a problem of complex solutions for application of standards and specifications in education; (3) standards and specifications often do not cooperate.

While some specifications are only at the beginning stage of adoption, there are already a fair number of standards that have been well adopted, but too many islands exist. The analysis highlights the need for making old and new standards and specifications work together (i.e., interoperate).

There are several ASPECT (2011) project experts' recommendations for the use of standards and specifications in e-learning systems. Fist of all, there are four core reasons to use standards and specifications: (1) they avoid dependency on single vendors (vendor lock-in); (2) their use facilitates interoperability; (3) their use lowers costs by making it possible to build higher-level services on top of proven and standard-compliant systems; (4) they represent best-practice solutions to known problems even when interoperability is not an issue. It is necessary to check conformance: standards and specifications are of little value when implemented poorly. Systematic conformance testing permits to verify that a specification is implemented correctly and ensures at least syntactical interoperability. It is also necessary to select appropriate standards – given the profusion of standards available, it is critical to identify the existing standards of communities with which one wants to interoperate. ASPECT experts propose to preserve interoperability when profiling. When profiling is unavoidable, it is necessary to keep any customization as limited as possible and profile in a way that preserves interoperability with the original specifications. For example, it is not suggested to make mandatory elements optional or to remove terms from an existing controlled vocabulary. If new elements must be introduced, one should do it only at the extension points foreseen in the specification. Several standardization organizations have created guidelines for application profiles. Examples of lists of dos and don'ts can be found at http://www.imsglobal.org/ap/index.html and http://www.cen-ltso.net/main.aspx?put=922. ASPECT experts propose to consistently combine standards and specifications. They also propose to use a progressive strategy – adopting a complete solution can be expensive but interoperability can be built gradually. It is suggested to build interoperability in

stages by adopting specifications most pertinent to the immediate requirements and to progressively add other complementary specifications. For instance, one should adopt first the most common protocol specification in a community for exposing metadata and to then add other protocols to address other needs.

3.1.2. Learning Object Repositories (LORs)

Many of the most successful repository initiatives in Europe – measured in terms of active users – are not heavily engaged with educational technology standards. Community based approaches tend to focus on solving user needs with already available tools – i.e., a focus on iterative "good enough" approaches instead of relying on implementation of specific standards. This leads to the question of whether current standardization bodies and organisations are in sync with actual user needs.

EdReNe (2011) project experts have made an attempt to take a look at standards from different user perspectives – with a broad scope for defining use cases not limited to a particular set of standards. Important needs expressed by content users include: (1) to minimize the number of repositories necessary to access; (2) to make it easier to find quality content; (3) to present clear and easy-to-understand information on usage rights; (4) to support the development of 'sharing as a culture' providing user friendly mechanisms for depositing and repurposing. The first item point clearly relates to interoperability of repositories, and indicates the importance of focusing on repository federations, including metadata harvesting and providing central indexes for searching for educational content.

The stability of content standards combined with central guidance is important for content suppliers. With the changes taking place in the content publishing industry in general, there is no doubt that establishing a solid, viable business model for digital content suppliers will have the highest priority, especially for new start-ups. And while standards can play a role, it may be that more fundamental changes to distribution/ production/ licensing/ innovative didactic design, etc. currently in focus must be made (EdReNe, 2011).

3.1.3. European Learning Resource Exchange

As a pan-European service, the LRE (2011) seeks to in particular identify the LOs that can "travel well" (i.e., are reusable) across national borders and can be used in a cultural and linguistic context different from the one in which they were created. The primary aim is to improve the quality of LOs in LRE. The eQNet (2011) project is doing this by establishing a network consisting of researchers, policy makers, and practitioners (teachers) that develops and applies "travel well" quality criteria to both existing LRE content as well as that to be selected in future from national repositories. The vision driving the LRE is that a significant percentage of high quality LOs developed in different countries, in different languages and meeting the needs of different curricula can be re-used at the European level. This approach should provide Lithuanian teachers a possibility to conveniently search, evaluate and reuse content created by the content

providers all over Europe. The author has analysed several scientific approaches, theories, methods and principles to minimise the subjectivity level in expert evaluation of LOs quality. Several scientific approaches on the topic are presented in (Kurilovas *et. al.,* 2011) and (Kurilovas and Dagiene, 2010; 2009).

3.1.4. LVU Information and E-learning Services Sub-programmes

The largest European project on interoperability issues in the Universities sector is iCOPER (2011). iCOPER is a Best Practice Network co-funded by the eContent*plus* programme of the European Community. Its mission is to collect and further develop best practices for higher education, tackling issues like creating learning designs and teaching methods, authoring content for re-use, transferring knowledge in an outcome-oriented way and assessing it, or evaluating learning activities.

iCOPER experts have identified the following standards and specifications relevant to e-learning systems of the European Universities sector:

OpenID (URL: http://www.openid.net/). OpenID is a shared identity service, which allows users to log on to many different web sites using a single digital identity. The specification is still in the adoption phase and is becoming more and more popular.

OAI-PMH (URL: http://www.openarchives.org/pmh/). Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) is a low-barrier mechanism for repository interoperability.

SPI (URL: http://ariadne.cs.kuleuven.be/lomi/index.php/SimplePublishingInterface). Simple Publishing Interface (SPI) is meant to make it easier for content developers to publish work into content repositories, and at the same time introduces a new approach to the exchange of information between repositories.

DOI/OpenURL (URL: http://www.doi.org/ and http://www.oclc.org/research/activities/openurl). The DOI or Digital Object identifier is a unique identifier given to a scientific publication. The DOI system provides a framework to: manage content and metadata, and links content providers with final users. OpenURL is a standard that, by using a Uniform Resource Locator (URL), provides an easy resolvable link for resources from a library service. Currently, it is most heavily used by libraries in order to connect users to subscribed content.

IEEE Reusable Competency Definitions (IEEE RCD) (URL: http://www.cen-ltso.net/Main.aspx?put=264) defines a data model for describing, referencing and sharing competency definitions, primarily in the context of online and distributed learning.

IMS Learning Design (LD) (URL: http://www.imsglobal.org/learningdesign/) provides a generic vocabulary for describing any pedagogical approach in technology-enhanced learning.

IMS Content Packaging (CP) (URL: http://www.imsglobal.org/content/packaging/) describes data structures that can be used to exchange data between systems that wish to import, export, aggregate, and disaggregate packages of content.

IMS Question & Test Interoperability (QTI) (URL: http://www.imsglobal.org/question/) describes a data model for the representation of question and test data and their corresponding results reports.

SCORM (URL: http://www.adlnet.gov/Technologies/scorm/) is a reference model that constitutes a collection of standards and specifications for e-learning.

3.2. Learning Organisation Interoperability

3.2.1. LVU Management Services Sub-programme

Learning organisation interoperability problems have been analysed mainly while implementing LIFE project (2006). The main objective of the LIFE project is to explore the topic of practice in e-learning interoperability, and to identify its dimensions of real importance to Europe, exploring the current state of art, the trends and challenges, the important issues to be addressed, and guidelines and recommendations for the target groups.

It is recommended:

- To support the development of plug and play software that can be incorporated into the already existing Education institution (enterprise) environment. Modularised learning environments, with clearly defined interfaces with the Enterprise world, must be produced in order to ease the development of a holistic approach based upon the combination of as few as possible software components.
- To develop reference models and frameworks for the Education institution. These must be as technology neutral and general (e.g., flexible) as possible. Too-detailed prescriptions of what (types of) services and components are to be included in the basic layers must be avoided.
- To discourage any proposals for monolithic system architecture; to adopt a distributed model made up of distinct, stand-alone components that communicate over open protocols/interfaces.
- To build or find applications that map between different languages and ontologies using:
  - Communication protocols (HTTP, SOAP, XML-RPC, Peer-to-peer, etc.).
  - Communication languages (OAI, ECL, eduSplash, etc.).
  - Metadata (i.e., IEEE LOM, Dublin Core).
  - Ontologies made up of vocabularies for metadata.
- To develop an appropriate system for unique identifiers. The EU should support and possibly fund the process to agree on a universal unique identifiers model as well as the research towards and eventual deployment of a suitable system to manage it.
- To support the development of standards and technology allowing any Web-enabled application to send and control learning-related information to learning-supporting systems and standards enabling a learning-supporting system to search for and compile such information. Many standards are needed to support this. A learning-supporting system must have a way to identify which application is

sending what information about which learners, and standards must be in place to enable the information to be collated and analyzed.

Conclusions

International guidelines and recommendations presented in the paper could be suitable for implementation while developing Lithuanian state information systems such as the Lithuanian education portal, the Lithuanian academic libraries' (eLABa) system, the Lithuanian distance learning system (LieDM), and the Lithuanian universities' management system (LieMSIS).

The proper implementation of these guidelines and recommendations could considerably improve the interoperability level of the aforementioned Lithuanian state e-learning and education management systems.

The author has analyzed only several possible interoperability aspects of e-learning systems.

The future research directions should be the more detailed analysis of the application possibilities of the existing and emerging standards and specifications in e-learning practice. Primarily, attention should be paid to learning activity interoperability as well as to the implementation of more profound content standards such as IMS Common Cartridge. Additional work is required to investigate the existing practice around the creation, sharing, housing, discovery and repurposing of Learning Designs.

Further research is also needed to map the curricula and link it to leaning objects in the repositories, and to establish LOM APs more convenient to search for the reusable LOs.

It is recommended that approaches for dealing with digital rights and their management should be further researched, tried out, and implemented.

It is also necessary to provide a new set of international support services that will facilitate the interoperability of learning content. These services should include at least: (1) a LORs registry; (2) a vocabulary bank for education; (3) a standards' application profiles registry; (4) an automatic translation service for LOM and content packaging formats such as IMS Common Cartridge; (5) standards compliance testing; (6) a transformer service, transforming metadata and vocabularies into another format; and (7) access to known interoperability issues.

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SĄVEIKUMO GAIRĖS LIETUVOS E. MOKYMOSI VALDYMO SISTEMOMS

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Santrauka. *Tikslas – straipsnyje nagrinėjamos mokomojo turinio ir saugyklų, taip pat švietimo organizacijos technologinio suderinamumo (sąveikumo) problemos. Straipsnio tikslas yra išanalizuoti šios srities mokslo tyrimus ir naujausią tarptautinę patirtį bei pateikti atitinkamas sąveikumo gaires ir atitinkamų Lietuvos valstybinių programų vykdymo rekomendacijas. Mokomojo turinio ir saugyklų sąveikumo rekomendacijos yra skirtos Lietuvos švietimo portalo projekto vykdymui ir Lietuvos virtualaus universiteto (LVU) programos informacinių paslaugų (LABT paprogramės ir eLABa projekto) bei e. mokymosi paslaugų (LieDM) paprogramių plėtrai, o švietimo organizacijos sąveikumo rekomendacijos – LVU programos valdymo paslaugų (LieMSIS) paprogramės sistemai palaikyti ir plėtoti.*

Metodologija – pasiūlytų sąveikumo gairių (rekomendacijų) bendrajai analizei taikyti literatūros analizės ir lyginamosios analizės metodai, nagrinėjant Lietuvos ir užsienio mokslo darbus, publikuotus periodiniuose žurnaluose ir didelių Europos Bendrijos finansuojamų sąveikumo projektų ataskaitose. Sistemų analizės ir lyginamosios analizės metodai taikyti nagrinėjamų informacinių sistemų analizei ir sąveikumo gairėms ir rekomendacijoms formuoti. Autorius sąveikumo gairėms ir rekomendacijoms formuoti taip pat taikė eksperimentinio tyrimo metodą – šis metodas taikytas autoriui dirbant daugelyje Europos sąveikumo projektų. Rezultatai apibendrinti vertinimo tyrimo metodu.

Rezultatai – straipsnyje pateiktos tarptautinės gairės ir rekomendacijos taikytinos plėtojant Lietuvos valstybines švietimo informacines sistemas, tokias kaip Lietuvos švietimo portalas, Lietuvos akademinių bibliotekų sistema (eLABa), Lietuvos nuotolinio mokymo sistema (LieDM) bei Lietuvos universitetų valdymo sistema (LieMSIS).

Tyrimo ribotumas – straipsnyje pristatomas autoriaus požiūris į kelių gerai žinomų tarptautinių sąveikumo teorijų, standartų ir specifikacijų taikymą įvairių LVU programos komponenčių sąveikumui tobulinti.

Praktinė reikšmė – tinkamas pasiūlytų sąveikumo gairių ir rekomendacijų diegimas galėtų gerokai patobulinti Lietuvos valstybinių e. mokymo valdymo sistemų sąveikumo lygį.

Originalumas / Vertingumas – pirmą kartą mokslo literatūroje buvo atlikta tokio tipo analizė bei pritaikytos rekomendacijos LVU atvejui.

Tyrimo tipas: požiūrio pristatymas, specifikacijų pristatymas, atvejo analizė, bendroji apžvalga.

Raktažodžiai: *sąveikumas, standartai ir specifikacijos, e. mokymosi valdymas, mokymosi turinys ir saugyklos, mokymosi organizacija.*