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A Design of a Metadata for Edutech Tools Distribution

Yong KIM[1], Dinh Tuan LONG[2], Ock Tae KIM[3]

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Abstract

Purpose: Edutech, which is the application of information and communication technology to education, is being introduced in various ways across all levels, from primary and secondary education to lifelong education. The purpose of this study was to present metadata about Edutech tools to provide the method for providing various Edutech tools. **Research design, data, and methodology:** To achieve the research purpose, the necessary elements for the metadata of Edutech tools were first derived based on a literature review. A focus group interview (FGI) with experts was conducted to gather opinions on the developed metadata, further validating its appropriateness. **Results:** The metadata area consisted of "Basic Information", "Product Information", and "Utilization Information". The "Basic Information" section had 9 items, "Product Information" had 8 items, and "Utilization Information" was presented with 4 items. **Conclusions:** This study proposed metadata for Edutech tools, which can be utilized to develop distribution system to proliferate and harness various Edutech tools in the educational setting. For the future establishment of an Edutech tool distribution system based on this metadata, it's imperative to operate a credible platform to ensure a stable distribution framework.

Keywords: E-Learning, Edutech, Metadata, Distribution science

JEL Classification Code: A29, H52, I20, I29

1. Introduction

The activation and quantitative expansion of education utilizing Information and Communication Technology (ICT) contribute to the democratization of education, broadening educational opportunities and enhancing both the efficiency and effectiveness of the learning process.

In our current age, a society transformed from an industrial base to one centered around information, we access vast amounts of information via the internet and integrate it into our daily activities.

During the industrial era, education received during one's formative years was often deemed sufficient for acquiring the knowledge necessary for careers and general life navigation.

However, given the swift pace of societal change today, the education of our school years alone falls short. We now recognize the pressing need for a learning environment where continuous acquisition of fresh knowledge is facilitated.

Edutech, the amalgamation of information and communication technology with education, is entering the educational sector in a variety of innovative ways.

First of all, there is a way to use Edutech in solution system, content, and online education. Various studies have been conducted to consider the efficiency of learning by

1 First Author. Professor, Graduate School, Department of Edutech, Korea National Open University, South Korea.
Email: dragonknou@gmail.com, ORCID: 0000-0002-5305-2213
2 Second Author. Doctor, Faculty of Information Technology, Hanoi Open University, Vietnam.
Email: dinhtuanlong@hou.edu.vn, ORCID: 0009-0005-0752-8531
3 Corresponding Author. Professor, Department of Media, Arts & Science, Korea National Open University, South Korea.
Email: ocktopia@knou.ac.kr, ORCID: 0009-0006-9079-444X

developing e-learning content and operating online classes using deep fake technology using open-source software (Ho et al., 2021) and applying it to learning platforms such as question and answer search systems using IT such as blockchain technology and Doc2Vec (Lim et al., 2022; Cho et al., 2021).

Another form involves utilizing Edutech as individual products, like software or apps. Edutech tools in product form can be classified into those provided solely as software or those combined with hardware.

Various studies are underway to introduce these multifaceted Edutech tools into primary and secondary education. Surveys on teachers' perceptions of Edutech have yielded strategies for supporting Edutech in schools (Kim, 2022). Not only in-service teachers but also pre-service teachers have been studied through qualitative research, such as focus group interviews, to suggest both the utilization of Edutech in the school setting and the barriers to its application (Seo et al., 2021).

Various attempts are being made to enhance the efficiency and effectiveness of learning by applying Edutech from the perspective of teaching and learning methods (Kucirkova et al., 2023; Thao et al., 2023).

In the increasingly emphasized STEAM education, there are cases where Artificial Intelligence (AI) and Virtual/Augmented Reality (VR/AR) are used to merge creativity, science, career, and SW/AI education into experience-based and hands-on programs (Lee, J. H. et al., 2023).

Furthermore, it's not just in mainstream schools that these innovations are taking place. Special education schools are also adopting Edutech, proposing various strategies to elevate the learning efficiency of students with developmental disorders (Lee et al., 2022; Lee et al., 2023).

Edutech is anticipated to gain significant influence not only in primary and secondary education but also in areas of adult education, including higher education and corporate training (Lee, 2020). The rise of non-face-to-face education in the university sector and attempts to integrate Edutech into various subjects have led to enhanced student learning outcomes and more efficient lecture formats (Yoon, 2022; Jung, 2020).

Furthermore, in the realm of corporate education, discussions on the application of Edutech are progressing, targeting the educational needs of working professionals and emphasizing vocational skill development (Chin et al., 2022; Rim et al., 2022).

Edutech is increasingly applied across all educational fields and introduced through various methodologies. However, there's an evident deficit in foundational research concerning the supply and distribution of the multifaceted Edutech tools.

Consequently, for the effective distribution of Edutech tools within the educational fields, a structured system is imperative. Integral to the construction of this system is the incorporation of standard metadata.

The purpose of this study was to establish foundational groundwork for presenting a myriad of Edutech tools by providing pertinent metadata. It is anticipated that this will become pivotal data when constructing a distribution system in the future, catering to both Edutech tool producers and consumers.

2. Literature Review

2.1. Case Studies on Metadata in the Field of Education

For effective management and utilization of content on educational system, and to best serve learners, it's vital to have metadata designed both concisely and flexibly, ensuring consistent application across Edutech ecosystem. Furthermore, to deliver systematic and proficient services using the vast digital educational content available in both public and private sectors, establishing a comprehensive management system, such as one underpinned by metadata, becomes indispensable.

The Korean Educational & Research Information Service (KERIS) recognized this need and, in their guidelines, provided an expansive overview and sector-specific metadata. This facilitates the unified management of content spanning diverse educational sectors, from primary and secondary schooling to higher education and lifelong education processes (Kim et al., 2019).

The metadata is structured into categories: 'Basic Information', 'Learning Information', 'Environmental Information', and 'Copyright/Content Utilization Rights Information'. Within these categories, the content is tailored for primary/secondary, higher, and lifelong education sectors, specifying if each entry is essential or optional.

Moreover, the KERIS runs the KOCW (Korea Open Courseware) to promote shared utilization of instructional resources in higher education, presenting metadata to streamline content distribution (Chang et al., 2012). KOCW began as an initiative in December 2007, aiming to freely provide both domestic and international lecture materials. The resources on KOCW are systematically organized by university, institution, specialized fields, and overarching themes.

Furthermore, KOCW categorizes its users into groups such as middle and high school students, college freshmen, undergraduates, graduate students, students taking a leave of absence, military service students, recent graduates, job-seeking students, early-career professionals, current employees, retirees, and lifelong learners. Consequently,

users can either choose content from the university or institution providing it or search based on their field of study. Regarding themes, content is organized based on specific topics, making it user-friendly and easily accessible.

The metadata components of KOCW include contributor information, course startup path, year of production, operating semester, copyright information, main campus/ branch school division, domestic/overseas division, lecture language, lecture type, credits, course verification, lecture classification, course information, and lesson information.

K-MOOC, an online course platform for higher education, has perpetually expanded its range of superior courses, championing the vision of "Innovative University Education through an Open Higher Education Framework".

To elevate the nation's population's overall utilization of K-MOOC and discern directions for diverse course developments, metadata structures have been delineated, segregating them into content domains and content categorization system domains (Jung et al., 2022).

The metadata and categorization scheme within the K-MOOC content domain was conceived by considering the shared attributes of both domestic and international metadata and the current database landscape. The finalized metadata for the content domain is segmented into five categories: general information, classification information, technological information, resource information, and authority information.

In the lifelong education sector, due to the explosive increase in the demand for online content-based non-face-to-face education programs caused by the COVID-19 pandemic, the NIA (National Information Society Agency) established content-sharing guidelines for building a national digital sharing platform to develop and share high-quality videos (Kim et al., 2021).

These guidelines propose metadata specifications for content registration based on literature analysis of similar platforms and operational results from prototype platforms aimed at creating a learning content-sharing site. Such metadata encompasses attributes like item, description, whether it's mandatory, input format, data type, and size.

In addition, the “Digital Jiphyeongjeon” Project, which the South Korean government is pushing forward, serves as an online national knowledge information integration platform. It aims to link and enable users to search and utilize the national knowledge information provided by various education-related institutions in one place. This platform is scheduled to officially start its service in January 2024. To support this, metadata, instrumental in describing knowledge-based data, has been proposed for this platform. The management metadata items of the Digital Exhibition unified platform consist of 17 elements: field, type, source, title, keyword, description, issuing agency, author, date, language, identifier, format, associated resources, content range, usage terms, user data, and item ID (Song, 2023).

Metadata can be developed for sharing and managing educational content and resources, as well as for the purpose of teaching-learning and quality management, such as STEM and legal education (Zervas et al., 2016; Fry, 2015; Park et al., 2010).

2.2. The Case for Metadata Standards

In South Korea, the Korea Educational Research Information Service developed the KEM (Korea Educational Metadata) as a standard specification.

We defined specifications for representing metadata, including elements such as title, description, author, methods of educational use, file-related information, classification information, and the data types for the values recorded in these elements, to provide users with consistent descriptions and search services, and to allow for the systematic management of metadata. It was established as the national standard for primary and secondary education information metadata (KS X 7001) in December 2004. Additionally, metadata suitable for use in higher education was presented. While the metadata elements for primary and secondary education and higher education are largely similar, different data are entered according to whether they pertain to primary/secondary or higher education. The significance of the educational information metadata, KEM, lies in its attempt to conform to international standards, positioning it as a uniquely Korean educational metadata. The KEM is not in use currently.

The Learning Resource Metadata Initiative (LRMI) is a collaboration between the Association of Education Publishers (AEP) and Creative Commons (CC) to develop a common metadata framework for describing or tagging learning resources on the web. LRMI metadata attributes include 'educationalAlignment', 'educationalUse', 'timeRequired', 'typicalAgeRange', 'learningResource Type', 'interactivityType', 'useRightsUrl', and 'isBasedOnUrl'.

The Learning Object Metadata (LOM) standard is designed to describe the syntax and semantics of learning object metadata, defining the attributes necessary for appropriately describing learning objects. LOM is a standard for learning object metadata used to describe educational resources, developed through the joint efforts of the IEEE Learning Technology Standards Committee's Learning Object Metadata Working Group and the IMS Global Learning Consortium. LOM hierarchically structures metadata elements for the description of educational materials into nine categories based on their meaning. The nine categories are 'General', 'Lifecycle', 'Meta-metadata', 'Technical', 'Educational', 'Right', 'Relation', 'Annotation', and 'Classification'.

Metadata for Learning Resources (MLR) is a metadata

standard proposed by 'ISO/IEC JTC 1/SC 36 Information technology for learning, education, and training', a technical committee of the International Organization for Standardization (ISO). The purpose of MLR is to provide metadata elements and properties to facilitate the identification of metadata elements needed to describe learning resources and to make the development of specifications for these properties more accessible.

The data elements capable of describing an MLR (Metadata for Learning Resources) record are composed of four components: 'dataElement', 'SpecificationID', 'subjects', 'contentValue', and 'languageCode'. Additionally, the educational components of MLR are organized into six domains: 'annotations', 'target audiences', 'contributions', 'learning processes', 'learning activities', and 'learning resources'. Within learning activities, it is possible to describe the use of learning resources related to learning activities, the relationship between specific target groups and learning resources, and the connection between instructional plans or learning processes and learning resources.

3. Methodology

The research methodology employed a literature analysis to extract the essential components for the metadata of EduTech tools. Focus Group Interviews (FGIs) were organized with experts to obtain feedback on the developed metadata and ensure its validation.

Expert opinions were collected through a semi-Delphi process targeting experts based on the content derived from research and data analysis for metadata development. The first round of the semi-Delphi was conducted to extract components and attributes, while the second round assessed their necessity using a 5-point Likert scale. Based on the responses, the Content Validity Ratio (CVR) was derived to consider the validity of each metadata item.

The research methods and procedures are as follows.

Firstly, we analyzed the use cases and standard documents related to educational metadata, such as e-learning content. We also examined the utilization of metadata by e-learning-related educational service institutions. Furthermore, we also investigated overseas standard metadata documents for the distribution and management of e-learning content.

Secondly, the types of Edutech tools were introduced, and metadata areas and items based on literature analysis were structured. In order to categorize various Edutech tools used for educational purposes, we proposed a typology of Edutech tools. Based on this, metadata areas and items for Edutech tools were presented.

Thirdly, a validity verification for metadata areas and items was conducted, targeting 30 e-learning experts. The experts were professionals who have been active in the e-learning field for more than five years.

Fourthly, the average value and CVR value for each item were presented for the collected data, and the results were derived.

4. Results and Discussion

4.1. Design the metadata frame

With the advancement of Information Technology, the paradigm of education is not just changing but evolving into a form of integration. 'EduTech', a combination of the words 'Education' and 'Technology', or 'Edtech', signifies various services provided through the combination of technology and education. It also refers to services and software, including apps, that use ICT technology in the field of education and learning. To design metadata for EduTech tools, an operational definition of the EduTech tool is first required.

In South Korea, the term 'EduTech' sometimes refers to 'e-learning', which is a service utilizing ICT in education, training, and instruction. However, EduTech is perceived to encompass not only the technological domain implied by e-learning but also other technologies and structures beyond it.

From a socio-cultural perspective, EduTech can be seen as an evolved and advanced form of e-learning. However, this might suggest that e-learning has been too narrowly defined. EduTech encompasses not only primary and secondary education but also extends to higher education and lifelong learning. Instead of viewing EduTech merely as a term, it's more insightful to perceive it in the context of its technologies, services, or products. For example, any system or service that eases a teacher's workload or augments efficiency, leading to enhanced educational outcomes, can be categorized as an EduTech service. This implies that EduTech's role isn't confined to facilitating teaching and learning but also aims to amplify the overall efficacy of education. Thus, EduTech can be characterized as the incorporation of IT and emerging technologies in the educational sector to assist both learners and educators, streamline educational processes, and cultivate a sustainable tech-integrated educational environment.

Therefore, in this study, we define "EduTech tools (or products)" as those designed by integrating new technologies in education to elevate educational achievements, tailored specifically to the unique attributes of all stakeholders, including both learners and educators, thereby offering educational support. Additionally, based on various discussions in this paper, we have classified the

types of EduTech products into four main categories. The operational definitions and examples of products according to their types are summarized in Table 1.

Table 1: Edutech (Tools or products) Types

Term	Operational Definition	Example
HW type (Hardware type)	Tools that allow the operation of programmed software by downloading it.	Arduino, Micro:bit
HW + Content type (Hardware + Content type)	Tools that provide educational content on devices like tablets	Provides services with their own content along with hardware.
Content type	Provides educational content through installed apps or web-based platforms.	Provides services based on proprietary content such as Khan Academy, question banks, MATHia, Third Space Learning.
SW type (Software type	Tools provided for educational support (teaching and learning as well as educational operations) either as installed applications or platform-based.	Provides an environment for users to create content themselves, such as Padlet, mind mapping software, App Inventor, etc.

Early Edutech startups primarily focused on mobile application (app.) development, emphasizing video or game creation. Recently, there has been a diversification towards developing various educational apps, including specialized apps tailored to specific targets. Edutech products and tools are being produced from various perspectives, including teaching and learning support, study support, and educational operation support. Therefore, it seems necessary to have even more diverse categorizations.

The first type of Edutech is categorized as hardware, like Arduino and Micro:bit, which are products supporting software education. Hardware-based tools are used to run the software once it's been programmed and downloaded. The second type is a product that embeds content into the hardware to support education. A prominent example is the digital textbook, which provides both hardware and content.

The third type is "content-based," which provides educational content through installed apps or web platforms, similar to Khan Academy. The fourth type is software-based. What distinguishes the software type from other product types is that it is offered based on installed or platform-based systems. In particular, it provides an environment where users can directly adjust, run, and manipulate the software. Notable examples include Padlet and mind-mapping tools.

The metadata framework for Edutech tools is composed of 'Basic Information,' 'Product Information,' and 'Utilization Information.'

'Basic Information' is comprised of a total of 10 items. Each item is as follows:

- Identification Number: A unique code distinguishing the product.
- Product Name: The Edutech tool's product name.
- Keywords: The word that best represents the product when searching.
- Grade Level for Use: The school level that can use the product.
- Target user: The main entity using the product.
- Purchase Price: Product price.
- Subscription Cost & Type: Monthly or yearly cost if the product is subscription-based.
- Developer Name: The name of the company that developed the product.
- A/S Contact: Telephone number or email address for A/S service.
- Purchase-related URL: The representative website where the product can be purchased.

'Product information' is comprised of a total of 10 items. Each item is as follows:

- Product Description: Description of the product.
- Product Type: Type of the product.
- Product Usage Purpose: The main purpose for which the product is used.
- Product Description URL: Website providing materials related to product use, such as manuals.
- Language 1: The primary language provided in the product.
- Language 2: Another language provided in the product.
- Device Provision: Whether a device is provided when purchasing the product.
- Quality Certification Availability: Whether the product has passed quality tests conducted by the government or public/private institutions.
- Type of Quality Certificate: Type of the quality certificate.
- Quality Certificate Issuer: Name of the institution issuing the quality certificate.

"Utilization information" is comprised of a total of 4 items. Each item is as follows:

- Supported Device: The main device on which the product operates smoothly.
- Operating System: Type of the operating system on which the product runs smoothly.
- Operating System Version: Version of the operating system on which the product runs smoothly.
- Web Browser: Type of web browser in which the product operates smoothly.

4.2. Design of Metadata Components

Define attributes for the input values of each component for the metadata distribution of Edutech tools. This ensures the reliability of metadata values for Edutech tools and references the development of the distribution system.

The metadata components of the 'Basic Information' area are shown in Table 2.

Table 2: The metadata components of the 'Basic Information' Area

Item	Input Value/ Example	Attribute		
		Data type	Input type	Required/ Optional
Identification Number (ID)	Year_Product Serial Number	String	TextBox	Required
Product Name	K Learning Platform	String	TextBox	Required
Keywords	Learning, Platform, eLearning	String	TextBox	Required
Grade Level for Use	(1) Elementary School, (2) Middle School, (3) High School, (4) Special Education, (5) Higher Education, (6) Lifelong Education	Integer	CheckBox	
Target user	(1) Elementary Students, (2) Middle School Students, (3) High School Students, (4) Teachers, (5) College Students, (6) General Public, (7) People with Disabilities, (8) Others	Integer	CheckBox	
Purchase Price	20,000	Integer	TextBox	
Subscription Cost and Type	20,000 / Month	String	TextBox	
Development Company Name	KNOU	String	TextBox	
A/S Service Contact	02-3333-3333	String	TextBox	
Purchase-related URL	www.knou.ac.kr.co.kr	String	TextBox	

Among the metadata items in the 'Basic Information' area, the 'Identification Number' refers to the code number of the Edutech tool registered in the system. The code number rule is determined by the institution managing the system. For instance, it can be defined as 'Year_Category Number_Serial Number', and the identification number must be unique.

'Grade Level for Use' refers to the educational level for which the product is suitable, considering from elementary school up to lifelong education. Similarly, 'Target Audience' has been considered from elementary students to the general public, including those with disabilities. Both items allow selection during metadata entry through a checkbox feature.

With the recent increase in content services accessed via the internet in the form of subscriptions, the items 'purchase price' and 'subscription cost and type' have been introduced. For 'purchase price,' only numbers are to be entered, while for 'subscription cost and type,' inputs should be in text format.

The metadata components for the 'Product Information' area are as shown in Table 3.

Table 3: The metadata components for the 'Product Information' Area

Item	Input Value/ Example	Attribute		
		Data type	Input type	Required /Optional
Product Description	This product … (200 characters)	String	TextBox	Required
Product Type	(1) Hardware type, (2) Hardware plus Content type, (3) Content type, and (4) Software type.	Integer	Radio	
Purpose of Product Use	(1) For Teaching, (2) For Learning, (3) For Both Teaching and Learning, (4) For Administrative Purposes, And (5) Others	Integer	Radio	
Product Description URL	www.intube.co.kr/support	String	TextBox	
Language 1	(1) Korean (2) English (3) Japanese (4) Chinese and (5) others.	Integer	CheckBox	Required
Language 2	(1) Korean, (2) English, (3) Japanese, (4) Chinese and (5) others.	Integer	CheckBox	
Device Availability	(1) Yes (2) No	Integer	Radio	
Availability of Quality Certificate	(1) Yes (2) No	Integer	Radio	
Type of Quality Certificate	Edutech QA certificate	String	TextBox	
Issuing Institution of the Quality Certificate	Korea National Open Univ.	String	TextBox	

Among the metadata items in the 'Product Information' area, the 'Product Type' requires a selection based on the

types of EduTech tools presented in Table 1. The 'Purpose of Product Use' item allows users to select the primary instructional-learning situations in which the registered Edutech tool is used. While a product may be used in various ways depending on its purpose, the selection should consider the intended use for which the product was originally designed. Providing accurate information for 'Product Type' and 'Purpose of Product Use' ensures that users obtain the essential information needed to use the product for educational purposes.

The 'Availability of Quality Certificate' pertains to whether the registered product has been evaluated by a credible institution for its suitability for educational use. Quality certification evaluates aspects from the product's integrity (checking for errors) to its appropriateness for educational purposes. Products that obtain a quality certification gain trust from consumers and it serves as one of the ways to ensure consumer rights. Therefore, by structuring metadata items with 'Availability of Quality Certificate', 'Type of Quality Certificate', and 'Issuing Institution of the Quality Certificate', the reliability of the Edutech tool can be enhanced.

The metadata components for the Utilization Information' area are as shown in Table 4.

Table 4: The Metadata Components for the Utilization Information' Area

Items	Input Value/ Example	Attribute		
		Data type	Input type	Required /Optional
Supported Devices	(1) PC/Laptop (2) Smartphone/ Tablet (3) HMD (Head-Mounted Display) (4) Other	Integer	TextBox	
Operating System	(1) Windows (2) macOS (3) Linux (4) Android (5) iOS (6) Other	Integer	Radio	
Operating System Version	Example) Windows 7.0 or higher, iOS 11.2.6 or higher, Jelly Bean 4.1 or higher, Mac OS X 10.0 or higher, etc.	String	Radio	
Web Browser	(1) Microsoft Edge (2) Internet Explorer (3) Chrome (4) Safari (5) Others	Integer	TextBox	

The metadata items in the 'Utilization Information' area pertain to the devices and software required when using the Edutech tool. With the diversification of supported devices, the number of devices that users use has also increased. Hence, to ensure smooth and error-free usage of the registered Edutech tool, it is essential to provide information on the necessary devices and environments. Depending on the situation, users can utilize various information devices such as PCs, smartphones, etc., and the Edutech tool can support these devices. When entering metadata information, one should choose the best-supported device, Operating System, and Web Browser. Information regarding various supported device environments can be provided separately.

4.3. Validity Analysis

The necessity of metadata items was investigated, and a comprehensive analysis of both quantitative and qualitative research results was conducted to review their content validity. The Jaeger method was used to determine the necessity of metadata items, and the extent of the item's necessity was analyzed using the modified Angoff method. Opinions from each area were evaluated based on these methods.

The validity response data of the metadata items were analyzed, and the mean value (M) was calculated. The Content Validity Ratio (CVR) was derived to determine the necessity of the metadata items.

- CVR (Content Validity Ratio) Calculation Formula

$$CVR = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

  - ne is the number of panel experts who rated the item as 'essential'.
  - N is the total number of experts.

- CVR threshold for different numbers of experts:

Number of experts	7	8	9	10	11	12	13	14	15	20	25	**30**
CVR threshold	.99	.75	.78	.62	.59	.56	.54	.51	.49	.42	.37	**.33**

Given that there were 30 experts participating in the survey, a CVR threshold of 0.33 was set. Each item's CVR was then evaluated to determine if it met or exceeded this threshold.

Items were adopted as metadata items if they met two or more of the following conditions: a necessity frequency of 16 or more, an average necessity degree of 3.5 or higher, and a CVR threshold value of 0.33 or above.

4.3.1. Validity Analysis Results

The metadata categories were divided into three areas:

'Basic Information', 'Product Information', and Utilization Information'. Considering the characteristics of each area, expert opinions were sought on the suitability of the metadata items.

Table 5: Results of Metadata Area Opinion Analysis

(N=30)

Area	Description	Frequency (Percentage)
Basic Information	General information related to Edutech tools	30(100%)
Product Information	Specific information about Edutech tools	30(100%)
Utilization Information	Information required to operate Edutech tools	28(93%)

All respondents stated that both Basic Information and Product Information were necessary areas, and out of 30 respondents, 28 said that Utilization Information was necessary.

4.3.2. Necessity for Component Configuration by Metadata Area

The opinion analysis results for the items in the Basic Information area are shown in Table 6.

Table 6: Opinion Analysis Results of Basic Information Area

(N=30, CVR threshold = 0.33)

Item	Necessity Frequency (Percentage)	Degree of Necessity (Average)	CVR
Identification number (ID)	28(93%)	4.67	0.867
Product name	26(86%)	4.34	0.667
Keywords	26(86%)	4.42	0.733
Grade Level for Use	27(90%)	4.53	0.800
Target user	28(93%)	4.58	0.867
Purchase price	23(76%)	4.10	0.533
Subscription cost and type	24(80%)	4.22	0.600
Developer Name	17(83%)	3.11	0.133
A/ss Service Contact	25(83%)	4.35	0.667
Purchase-related URL	20(66%)	3.89	0.333

In the Basic Information area, after calculating the CVR for the 'necessity' and 'degree of necessity' of the items, the following items exhibited CVR values above the threshold: 'Identification Number (0.867)', 'Product Name (0.667)', 'Keyword (0.733)', 'Grade Level for Use (0.800)', 'Target Audience (0.867)', 'Purchase Price (0.533)', 'Subscription Cost and Type (0.600)', 'A/S Service Contact (0.667)', and 'Purchase-related URL (0.333)'. The average necessity value was highest for the 'Identification Number' and 'Target Audience' items at 4.67.

Among these, 'Developer Name' did not meet the standard in terms of necessity (18), degree of necessity (3.11), and CVR (0.133), so the item was removed.

The opinion analysis results for the items in the Product Information area are shown in Table 7.

Table 7: Opinion Analysis Results of Product Information Area

(N=30, CVR threshold = 0.33)

Item	Necessity Frequency (Percentage)	Degree of Necessity (Average)	CVR
Product Description	23(76%)	4.33	0.533
Product Type	25(83%)	4.34	0.667
Purpose of Product Use	26(86%)	4.65	0.733
Product Description URL	25(83%)	4.44	0.667
Language 1	24(89%)	4.13	0.600
Language 2	16(53%)	2.64	0.067
Device Availability	17(56%)	2.77	0.133
Availability of Quality Certificate	24(80%)	4.21	0.600
Type of Quality Certificate	22(73%)	4.11	0.467
Issuing Institution of the Quality Certificate	20(66%)	4.02	0.333

In the Product Information area, after calculating the CVR for the 'necessity' and 'degree of necessity' of the items, the following items exhibited CVR values above the threshold: 'Product Description (0.533)', 'Product Type (0.667)', 'Purpose of Product Use (0.733)', 'Product Description URL (0.667)', 'Language1 (0.600)', 'Availability of Quality Certificate (0.600)', 'Type of Quality Certificate (0.467)', and 'Issuing Institution of Quality Certificate (0.333)'. The average necessity value was highest for the ' Purpose of Product Use' item at 4.65.

Among these, 'Language2' did not meet the standard in terms of necessity (16), degree of necessity (2.67), and CVR (0.067), so the item was removed. Similarly, 'Device Availability' also did not meet the standard in terms of necessity (17), degree of necessity (2.77), and CVR (0.133), leading to its removal.

The opinion analysis results for the items in the Utilization Information area are shown in Table 8.

Table 8: Opinion Analysis Results of Utilization Information Area

(N=30, CVR threshold = 0.33)

Item	Necessity Frequency (Percentage)	Degree of Necessity (Average)	CVR
Supported Devices	26(93%)	4.67	0.733
Operating System	25(86%)	4.45	0.667
Operating System Version	22(73%)	4.1	0.467
Web Browser	22(73%)	4.13	0.467

In the Utilization Information area, after calculating the CVR for the 'necessity' and 'degree of necessity' of the items, the following items exhibited CVR values above the threshold: 'Supported Devices (0.733)', 'Operating System (0.667)', 'Operating System Version (0.467)', and 'Web Browser (0.467)'. The average necessity value was highest for the 'Supported Devices' item at 4.67.

Based on expert feedback, the metadata areas were structured into 'Basic Information', 'Product Information', and 'Utilization Information'. The 'Basic Information' area consisted of 9 items, 'Product Information' had 8 items, and 'Utilization Information' had 4 items. The final metadata for the distribution and management of Edutech tools is presented in Table 9.

Table 9: The metadata for Edutech

Category	Items	Attribute		
		Data type	Input type	Required/ Optional
Basic Information	Identification Number (ID)	String	TextBox	Required
	Product Name	String	TextBox	Required
	Keywords	String	TextBox	Required
	Grade Level of Use	Integer	CheckBox	
	Target User	Integer	CheckBox	
	Purchase Price	Integer	TextBox	
	Subscription Cost and Type	String	TextBox	
	A/S Service Contact	String	TextBox	
	purchase-related URL	String	TextBox	
Product Information	Product Description	String	TextBox	Required
	Product Type	Integer	Radio	
	Purpose of Product Use	Integer	Radio	
	Product Description URL	String	TextBox	
	Language	Integer	CheckBox	Required
	Availability of Quality Certificate	Integer	Radio	
	Type of Quality Certificate	String	TextBox	
	Issuing Institution of the Quality Certificate	String	TextBox	
Utilization Information	Supported Devices	Integer	CheckBox	
	Operating System	Integer	CheckBox	
	Operating System Version	String	TextBox	
	Web Browser	Integer	CheckBox	

There are two perspectives to consider when contemplating the application of metadata for Edutech tools. The first is from the supplier's point of view. From the standpoint of companies developing Edutech tools, they can easily make their tools accessible to users. Providing information utilizing metadata about the Edutech tool allows the consumer to have a wider range of choices, and by presenting a precise usage purpose, the supplier can seize opportunities to be chosen by the consumer.

Furthermore, the establishment of a distribution system for Edutech tools could allow for the use of data analytics, such as demand analysis for these tools, to improve or develop new products based on foundational data. While metadata provides only the essential information about an Edutech tool, it ultimately enables the collection of diverse feedback from users by utilizing this basic information, thus aiding in quality improvement efforts. The enhancement of Edutech tool quality has been an ongoing process, from setting quality benchmarks to e-learning content quality certification (Choi et al., 2019; Koo et al., 2019). Previous studies have focused on quality certification of the Edutech tools themselves, primarily content, and were centered on expert evaluations. In contrast, a quality certification utilizing metadata would involve users directly experiencing and providing evidence-based quality feedback, serving as foundational data for evidence-based quality certification.

The second perspective is from the consumer's viewpoint. If a metadata-based Edutech tool distribution system is established, users can easily find and purchase the Edutech tools. Additionally, through metadata, users can effortlessly locate the desired Edutech tool and acquire the fundamental information required to choose an Edutech tool. If various Edutech tools can be conveniently selected and used, not only can these tools rapidly spread and be applied in educational settings, but they can also potentially enhance the quality of education (Costa, 2023).

Based on the experts' opinions, there are several critical considerations for the utilization of metadata in Edutech tools and their distribution system:

In the process of collecting opinions from relevant experts, several considerations were suggested to build a distribution system utilizing metadata for efficient dissemination of Edutech tools.

First, for the distribution of Edutech tools, a platform operated by a responsible public institution is preferred over one managed by private companies. The reasoning behind this preference is the belief that if operated by a private company, the company's profit-oriented economic rationale would take precedence, which might undermine trust from consumers. Furthermore, it's argued that the operation by a public institution can ensure the credibility of metadata, fostering trust among users. Thus, the general consensus is that a trustworthy government or non-profit organization should manage such platforms.

Secondly, an accurate metadata management system

must be established. If the metadata is input initially and not managed subsequently, it can lose its credibility due to inaccuracies. Regular monitoring is essential to update the metadata, and the establishment of a distribution system that can offer data-based statistical services is crucial.

Lastly, a distribution system that can store user feedback is essential. The system should store information related to the user's usability evaluation of the Edutech tools. By providing this information to developers, it will foster the development of better Edutech tools. This approach will naturally create a virtuous cycle between product development and user evaluations, allowing for organic quality control of Edutech tools.

5. Conclusions and suggestions

Technologies, like AI, are anticipated to substantially drive the growth of the Edutech industry in the coming years. In the educational setting, an acceleration towards personalized educational services tailored to learners is anticipated. Educators are expected to leverage Edutech tools to deliver more streamlined and impactful educational experiences.

Thus, this study proposed metadata for Edutech tools that can be used to develop an Edutech distribution system, ensuring a wide range of Edutech tools can be disseminated and utilized in educational environments.

The research findings delineated the metadata categories into 'Basic Information', 'Product Information', and 'Utilization Information'. 'Basic Information comprised 9 items, 'Product Information' had 8 items, and 'Utilization Information' had 4 items.

Specifically, the "Basic Information" category encompasses items such as "Identification Number," "Product Name," "Keywords," "Grade Level for Use," "Target User," "Purchase Price," "Subscription Cost and Type," "A/S Service Contact," and "Purchase-Related URL." Second, the 'Product Information' field was 'Product Description', 'Product Type', 'Purpose of Product Use', 'Product Description URL', 'Language', 'Availability of Quality Certificate', 'Type of Quality Certificate', and 'Issuing Institution of Quality Certificate'. Lastly, the "Utilization Information" category consisted of "Supported Devices", "Operating Systems", "Operating System Versions", and "Web Browsers".

For the establishment of a metadata-driven Edutech tool distribution system in the future, the following considerations are essential:

Firstly, the operation of a reputable and trustworthy platform is crucial to ensure a stable distribution system. To safeguard Edutech users and to facilitate the dissemination of Edutech tools by providers, there's an imperative for a credible platform to be constructed and overseen at the governmental level. It's deemed effective for the distribution system to be managed by governmental bodies or non-profit organizations in the initial stages. Following stabilization, management can transition to private entities. Such an approach is strategic to promptly address and resolve potential challenges encountered in the early operational phases, thus ensuring a consistent and stable service operation.

Secondly, continuous maintenance of metadata is necessary. The Edutech tool metadata presented in this study provides basic items to describe various Edutech tools. Therefore, it is necessary to continue research on metadata that can accommodate various Edutech tools developed in the future. In addition, after the distribution system is established, a monitoring system is needed to ensure the reliability of the information entered in the metadata.

Thirdly, it's necessary to secure and provide teaching and learning methods utilizing Edutech tools. Rather than focusing solely on distributing Edutech tools using metadata, services that allow users to collect and share diverse teaching and learning methods are essential. For this, collaboration between Edutech tool developers and educational institutions is crucial, and a mediating organization should be designated. This ensures a virtuous cycle of product development, application cases, and product improvements or new developments through those cases. To achieve this, user services that can share related cases should be provided when building a metadata-based Edutech tool distribution system.

Lastly, there's a need to lay the groundwork for the Edutech industry to advance overseas by sharing and jointly utilizing metadata with similar foreign sites. For exporting high-quality Edutech tools developed domestically, the distribution system should consider linking with foreign institutions. Conversely, a basis should also be provided for domestic educational institutions to access various foreign Edutech tools. Solutions such as common utilization plans between systems for metadata are necessary. By doing so, it's believed that not only can the limitations of the domestic Edutech market be overcome, but also a foundation can be laid for the overseas expansion of our country's strong suit in the education sector's ICT utilization, namely the Edutech industry.

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