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Active Learning Environment for the Heritage of Korean Modern Architecture: a Blended-Space Approach

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ABSTRACT

This research proposes the composition logic of an Active Learning Environment (ALE), to enable discovery by learning through experience, whilst increasing knowledge about modern architectural heritage. Linking information to the historical heritage using Information and Communication Technology (ICT) helps to overcome the limits of previous learning methods, by providing rich learning resources on site. Existing field trips of cultural heritages are created to impart limited experience content from web resources, or receive content at a specific place through humanities Geographic Information System (GIS). Therefore, on the basis of the blended space theory, an augmented space experience method for overcoming these shortages was composed. An ALE space framework is proposed to enable discovery through learning in an expanded space. The operation of ALE space is needed to create full coordination, such as a Content Management System (CMS). It involves a relation network to provide knowledge to the rule engine of the CMS. The application is represented with the Deoksugung Palace Seokjojeon hall example, by describing a user experience scenario.

Key words*: Blended Space, Active Learning Environment, Augmented Place, Content Management System, Modern Architectural Heritage*

1. INTRODUCTION

Modern architectural heritage in the city center, still existing from the door opening era, functions as a space for contemporary citizen. Over time, most of heritage buildings have been altered by previous owners for functional or aesthetic reasons. The old supreme court built in a 1920's style was rebuilt with the original facade and is now the Seoul Museum of Art. The interiors of Kwangtongkwan and the former Korea First Bank were remodeled into contemporary styles while retaining their original functions. Seokjojeon Hall in Deoksugung Palace, especially, underwent a restoration project led by the Cultural Heritage Administration to preserve the Seokjojeon's architectural heritage and celebrate its historical period because the Seokjojeon is regarded as a cultural asset and historical space. The Seokjojeon, as a historical space, provides a special tour service every two months with different themes to provide visitors with impressive experiences.

Common methods of learning architectural history, particularly modern architectural heritage, in university classes are explanations by instructors using materials such as texts, pictures, and videos. Field trips guided by an architectural historian are the most active method of learning because students directly see and experience architecture with explanations. However, this method of teaching is hard to conduct for every class due to temporal, spatial and cost limitations. In addition, personal interests and capabilities of individuals in a group differ and there are limitations to the depth of learning of each student. Therefore, discovery learning with self-exploration is proposed as an effective method to learn the architectural history of historical and cultural places. Discovery learning is an education method that enables students to achieve their learning goals independently without instruction from teachers. This education method also creates a synergy effect, in the terms of experience, by providing active and realistic experiences using Information and Communications Technology (ICT) such as Augmented Reality (AR) and Virtual Reality (VR), which are gaining popularity as advanced technologies [12]-[14].

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The ICT technology applied to cultural heritage learning lets cultural heritage open to be "discovered", rather than "taught", supporting active experience learning approaches and personalization of learning itineraries [1]. An augmented space creates discovery learning more effectively in historical and cultural places by providing various multimedia contents. However, in providing content in an augmented space, the method pushes the same content in the same place unilaterally, similar to most Location Based Services (LBSs) nowadays that do not offer proper learning content to learners in an adaptive way. Providing content for discovery learning could give learners evolving content by considering the learning tasks, contexts, conditions, etc. of each learner.

Methods of composing an experience environment are limited to creating similar experience content from web resources or receiving content at a specific place through human GIS. The purpose of this research is to compose an augmented space based on blended space theory to create a rich experience environment for a user in the learning space of architectural history, and to provide a framework for an active learning environment (ALE) to enable discovery learning in the augmented space. The proposed ALE is an augmented space composed to improve learning by providing learning content and by evolving from each experience as well as to customize information to the context or task of the user. The augmented space is created based on the user experience proposed by blended space theory. The augmented space is composed of orchestrating elements such as physical objects and virtual objects. The composition logic of the elements is defined as one ALE unit and an augmented space is made from a sequence of the units. A system creating whole coordination such as a Content Management System (CMS) is needed in operating the augmented space. The ontology presents relation networks among working elements of the augmented space that enable providing knowledge to the rule engine of the CMS. The ontology should be linked to the digitized data and information about the modern architectural heritage by containing layers of physical space that have temporal layers of modern architecture. Its linkage process involves complex processes to organize various contexts that consider the learning activity as the main agent. However, organization of this complex relation network is needed because it would be the background used to create an augmented space for users in a systematic way rather than with the overuse of non-contextual AR content.

This research proposes an ALE framework to enable the combination of customized content for a learner, a CMS, and an ALE ontology that is known to the CMS. The proposed ontology model is implemented using Web Ontology Language (OWL). The model acts as a knowledge map to create experience types with an ALE framework and presents its application using the Seokjojeon in Deoksugung Palace as a typical modern architecture.

2. RELATED WORKS

2.1 Previous Research related to Learning Architectural History by Linking Information

Previous research and application services represented utilization as a learning space by connecting digital data and historical cultural resources with the purpose of delivering cultural information to improve user learning through specific linking methods or to support a rich experience with less learning achievement. When looking at the purpose of this research related to focusing on a composition of an experience environment for a user, previous research was found to be largely divided into three types of experience ways of learning: connecting specific targets with specific information, attracting learners by having them participate in a quiz or an event, and immersing learners by having them directly tour in a blending space between real and virtual world. These ways represent how to deliver the information of deep learning content and historical and cultural places to a learner by using each application. The scope of the previous research that was reviewed targeted historical cultural places, including buildings, and covered formal learning and tour application cases of informal learning in historical cultural places.

The simplest experience method is to link a specific historical cultural resource with text or image information about the resource. "Suwon Hwasung mobile guiding service for smartphones" utilizes QR code and NFC. This service provides information by connecting places, buildings, historical information, and user location rather than targeting only buildings. Users receive general information about the target object through their device when they access the QR code and NFC, which are installed to explain specific buildings and objects. The service also delivers information through a type of simple information linkage with push alarm at a specific point. The user receives previously fixed information unilaterally and passively. Therefore, immersion of learners is seen as the lowest aim because it is difficult for a user to receive customized information and the application requires the user's actions to initiate the learning experience.

In contrast, a way to increase participation and activity of users is through participation in a game or an event. Bertuzzi and Zreik [2] proposed an AR using a simple serious social game to analyze the cultural environment of researchers and improve the experience of the user in an augmented cultural heritage space. "U-Seum" [3] has information delivering method to explain heritages displayed in the museum through a push service when a smartphone user arrives at a specific point in the museum. This service tries to enhance the user's interest of learning by linking quizzes or augmented objects to the user's mobile device, requiring the user's participation and interaction. A user could explore a historical place and enhance understanding of the targets by simply responding to a quiz or playing a role in a game. This could also lead to concentrations of users at the target because of characteristics that require users to continuously respond and perform. However, the user cannot lack a self-directed learning ability because this experience way requires that the learner defines and performs tasks by himself.

Lastly, the third way encourages a learner to immerse in a space and content by utilizing an augmented reality digital device. The AR@Prambanan application is made to help informal learning of a user in the cultural heritage site [4]. This

application uses AR content to provide location and historical information in the temple district. It also tries to increase interaction by offering quizzes or creating connections with other visitors. Moreira and Ruschel made an AR application to establish a link to a site history, approaching cultural heritage issues by simulating the metaphor of a time tunnel [5]. By using AR devices, this research presented location information, building information, and other learning content by augmenting virtual objects or unseen images in the physical environment and overlapping them with the physical environment. This experience way provides an immersing experience environment with the most realistic way to explore the physical space because the user can see real space and virtual elements simultaneously. However, using of an AR device does not guarantee high learning effect by itself. The effect of an immersed learning environment could be represented by designing experience content to consider devices and place properties, and processing the content to prioritize the achievement of the learner.

2.2 Blended Space Theory and Digital Tourism

To create an evolved space experience for learning architectural history, this research introduced the blended space theory by Benyon [7] and its application to digital tourism. The blended space theory presents an experience way of a user through the coordination of physical space and digital space. The theory can be a suitable background theory for developing experience content because the theory considers user activity in a space and focuses on the whole design of the experience at the human scale. Blended space is a theory presented on the basis of the conceptual blending theory [6]. It is used to formulate a mixed-reality experience focusing on the response between the digital space and the physical space [7]. This theory has four key characteristics for describing the information space, spanning the digital space and the physical space: ontology, topology, volatility, and agency. Benyon described digital tourism as the utilization of blended space. Digital tourism involves the design of a user experience (UX) through the blended space framework in the context of historical content combined with personal interests. The four core features used in digital tourism are as follows [8].

- Ontology is concerned with the object of the target space. The core point of ontology for a tourist attraction is high-level points of interests (POIs). They are natural objects, buildings of historic sites, squares, and utilities. Ontology can relate to other POIs with a story or a temporal method for considering the property and the function information of the object.

- Topology explains how different POIs are associated with each other in a given position. The relation of POIs is derived from a restriction of various levels of the physical environment, tour, educational program, individual preference, and interest.

- Volatility is a concept related to the time of a place. The objects and people move through the space, and the topology changes according to the time flow. The space regularly changes depending on the day, time, and certain events. Each season can bring a new attraction.

- Agency is a core feature that affects the usefulness and enjoyment of the blended space in the digital space. It describes the possible ways of interacting with visitors in the space. Tourists typically rely on street signs or hire a guide. However, in a blended space, they can use the digital agency properly and pivotally. The digital agency can guide the tour with certain POIs by relying on ontology, topology, historical context, and the user's profile to guide users to specific POIs.

Benyon tried to create an improved user experience by applying these four features of blended space. The key point was to use these four features in a blended space UX and to find corresponding features between the physical space and digital space.

3. FRAMEWORK OF ACTIVE LEARNING ENVIRONMENT (ALE) USING BLENDED SPACE APPROACH

ALE is an augmented space to enable users using discovery learning to explore a learning space of architectural history. Discovery learning in this ALE space plays a role as a customized instructor when learners explore space independently and by using their learning abilities. The ALE space plays a role to lead the direction of the whole learning experience of the learner by representing needed information with suitable ways for the learner at the backend. In order to operate, the ALE space requires a context such as tasks (assignment, research, visiting, etc.) and profile (age, job, academic background, areas of interest, recent visiting information, etc.) of the learner. The user's contexts are combined with topologies of the space. Thereby, the ALE space determines the suitable experience content, provides an experience procedure to a learner, and composes experience sequences. The topology of a space proposes exploring routes by considering connections, obstacles, etc., which are classified as spatial properties in a building interior such as walls, stairs, and corridors, for moving from one room to another.

Table 1 presents the classification of physical objects existing in a space and examples of various spatial experiences for combinations of physical objects and virtual objects. This table classifies various types of physical objects (which exist in modern architecture) based on their physical presence, continuity, and mobility. The table also demonstrates corresponding examples of virtual objects, and explains example situations to apply the virtual objects to each type of physical object. Each situation in Table 1 illustrates one ALE unit that combines a physical object and one or more virtual objects and contains cultural content for historical learning. In addition to the illustrated examples, an ALE unit is able to combine various physical objects, content types, and substances.

Table 2 presents types of possible virtual objects. A person is a virtual object in place of an actual human. A visible object describes every virtual thing as augmented objects except a person (such as artifacts, furniture, buildings, building components, etc.). An ambient object is an object type that uses special effects such as sound, light, scent, smoke, temperature, etc. to augment the mood. Lastly, an information object

delivers information by voice, text, image, or movie. Each situation could apply to one or multiple virtual objects. Possible combinations of virtual objects with physical objects are demonstrated in Table 1.

Compositions of ALE units are presented through classifications of types and examples of combinations of physical objects and virtual objects in the above tables. Although the ALE space has the same content resources, the structure of each experience is made differently according to what a user chooses first such that each ALE space provides a customized experience pattern to each learner. This concept is a type of "evolution of experience". The origin of this structure can be found from the structure of interactive digital storytelling. Intelligent Video Editor, the most similar system to the "evolution of experience," has a structure that automatically classifies and extracts existing fragmentary information by rules defined by the user through multimedia and combines it with more advanced subjects to restructure it into a useful informational resource [9]. Manovich said it was hard to see users making their own route by choosing the records of the database in a certain order to make their distinctive narrative structures. They had to adjust the meaning of elements and the logic of the connection to satisfy the narrative standards [10].

This research applies the framework of blended space ontology, topology, volatility, and agency to create ALE spaces that area series of ALE units. An ALE space, using the framework of blended space, is described by the scenario through the Seokjojeon Hall in Deoksugung Palace shown blow.

Table 1. Classification of physical objects and examples of various spatial experiences using varied combinations of a physical object and virtual objects

Object	**Physical Presence/ Non-presence**	**Continuity of presence**		**Example**	**Situational examples of applying virtual objects to each physical object**	
Physical Object (P.O)	Presence	Continuous presence	Immobile	Corresponding elements of building components (floor, wall, ceiling, door, window, etc.)	• P.O. - A fixed door in the space • V.O. -Virtual PERSON (guide, related person) with content delivery through VOICE. (e.g. if the bars in a window are important, then other types of bars are shown with IMAGEs in comparison to the physical bars.	
			Mobile	Every movable physical object (existing chair, desk, picture, etc.)	• P.O. - non-fixed desk • V.O. - Virtual PERSON (e.g. Emperor Gojong) who had used this desk is shown sitting at it. Written papers on the desk are augmented by TEXT, a VOICE (as a virtual object) recites the TEXT, and LIGHT augments the mood at the moment (e.g. expressions of national crisis).	
		Temporary presence	For a period of time	Introduced physical object for a period of time to some activity or event (e.g. temporary exhibition of pictures or objects)	• P.O. - Photograph exhibitions show the space temporarily • V.O. - A MOVIE delivers content related to the photograph. Other physical objects in the photograph that are not exhibited in this space are delivered as augmented VISIBLE OBJECTs.	
	Non-presence	Presence only in the past,	Immobile	Demolished among corresponding elements of Building component	• P.O. - Current space (after restoration) • V.O. - A MOVIE delivers information process about the restoration project. Augmented IMAGE delivers parts that were not restored.	
			Mobile	Every movable physical object that was used previously, but has been moved permanently	• P.O. -An instrument related to a historical story in the space • V.O. - A historical person who used this instrument is augmented as a virtual PERSON with related music (SOUND). LIGHT augments the mood of the music. A score of the music is delivered as an IMAGE and a performance is delivered as a MOVIE.	
			For a period of time	Physical objects required for activities or events in the space (e.g. important documents written in the space at the time.)	• P.O. - An empty space. • V.O. - Content related to an activity in this space at the time is delivered as a MOVIE and an IMAGE. Physical objects that are not present are delivered as augmented VISIBLE OBJECTS.	

Table 2. Types of Virtual object

Object	Type	
Virtual Object (V.O)	Person	
	Visible Object	
	Ambient Object	Sound/ Light/ FX (special effects)
	Information Object	Voice/ Text/ Image/ Movie

• ALE space scenario of the Seokjojeon Hall in Deoksugung Palace

A learner is interested in learning about the construction styles and histories of the first western-style royal palace through the recently restored Seokjojeon in Deoksugung Palace. The pediment of the building facade is the starting point of learning and acts as the physical object. The pediment is connected to other physical objects such as columns (used to brace the pediment), original blueprints, and exhibited archives (ontology). The learner will see augmented images of the original blueprint of the pediment. The learner wants more information about the original blueprint and the ALE platform provides routes (topology) to move to the exhibit of the original blueprint. While moving to the next space, the ALE platform delivers information about textiles or furniture of a plum blossom design in another room to the leaner. The learner then stops by the audience chamber decorated with the plum blossom design to watch the applications about the decoration. The ALE platform re-searches and guides the learner from current location to the basement exhibit room for the original blueprint (topology). In the exhibit room of the original blueprint, an augmented digital agency of the architect John Reginald Harding who drew the original blueprint welcomes the learner. Harding delivers information about the 'Seokjojeon Restoration Record' (the original design drawings, excavated objects, and referred documents of the restoration) with corresponding physical objects and explanations through voice and video (virtual object). Harding tells the learner the story behind the restoration and any differences between the current form and the original drawing. The learner is then guided to the next related place in the building.

In the next exhibit room, the learner is able to watch an exhibition about 'Modern Reforms by Emperor Gojong'. The learner selects the 'Constitution of the Korean Empire' (the physical object) and listens to explanations by Emperor Gojong (the digital agency). The learner is told that the book *Public Law of All Nations* was referenced to make the 'Constitution of the Korean Empire' and that the original book The Element of International Law is in the Emperor's library. Emperor Gojong guides the learner to the Emperor's library and the book *The Element of International Law* is lying on the table. If the learner selects the book as the physical object, Emperor Gojong's explanations continue as the augmented reality.

During different seasons, the learner is able to experience different aspects of the Seokjojeon from modern forms to before/after restoration forms in the central lobby (volatility).

4. IMPLEMENTATION OF ACTIVE LEARNING ENVIRONMENT (ALE)

4.1 Content Management System (CMS) of ALE

The operation of an augmented space of the proposed active learning environment (ALE) framework requires a content management system (CMS). The CMS plays a critical role in the delivery, combination, and conversion among ALE rule engines, databases, and learners as a part of an ALE space platform.

Fig. 1 presents the structure of an ALE space platform focused on the CMS. The ALE rule makes logistical combinations based on knowledge of the user's profile, task, topology of the space, and learning content in order to create the user experience. In this process, the ALE rule refers to the relation network of ALE ontology, which specifies the operating elements of the augmented space. The ALE space description format generator produces the ALE space description format, which describes the combination to generate the ALE space of a specific type.

The CMS interprets the description format delivered by the ALE space description format interpreter, and searches for the multimedia content needed in the AR multimedia content database through the directory service. Lastly, the media stream converter delivers the interpreted content combination and the multimedia content to a user device through conversion. This process allows the space database to represent information about the real space. This space database can relay the information structures of a building used in Building Information Modeling (BIM). The proposed scenario involves a structure of the ALE space platform. The choice of the pediment as a physical object extracts the AR multimedia content of the original blueprint based on knowledge about the learning content of the ALE rule from the database. This is delivered to the learner in suitable forms through a media stream converter. The learner sees the delivered blueprint as a virtual object and wants to learn more because of an interesting element. The platform searches the space of the blueprint and guides the learner to go to the space focused on an interesting element (topology).This exploration and guidance are possible because the platform can relay the information structures of a building, such as BIM.

Fig. 2 represents how an ALE space experience has a different sequence for each learner. There are various ALE spaces in a building. The learner could have a different experience route according to their own task, profile, space topology, and individually linked cultural learning content. Through this, the learner is able to learn by discovering a space through self-direction rather than standardized education. Fig. 2 represents the sequence examples of three learners, but the order and the number of the sequences may appear as different results.

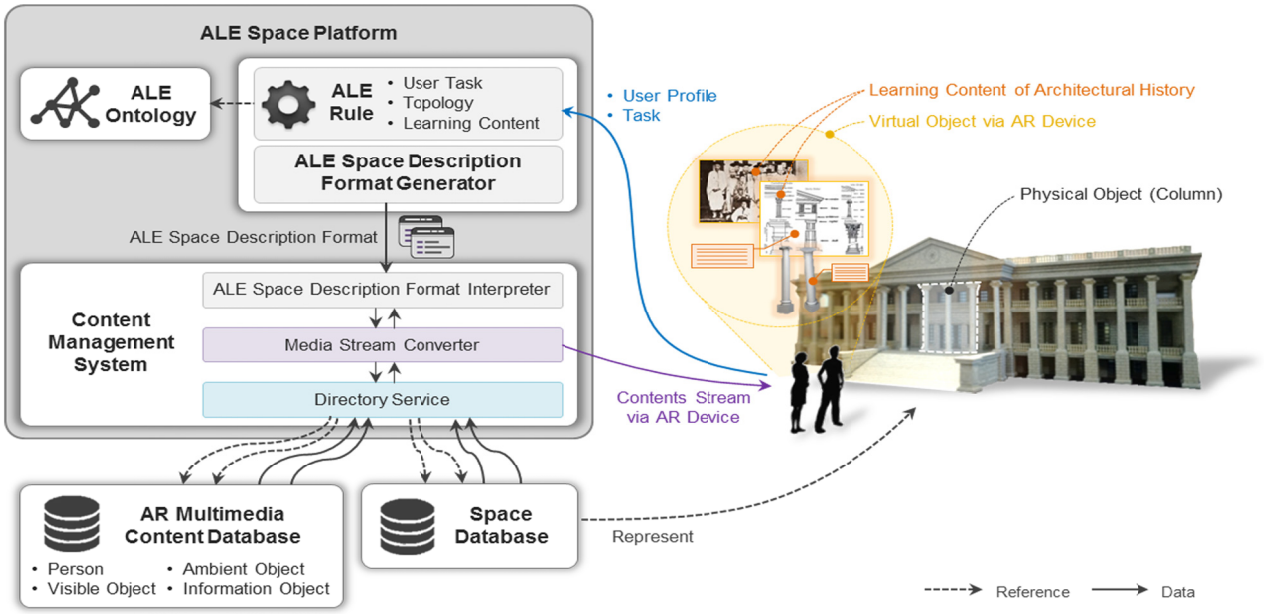

Fig. 1. ALE Space Platform

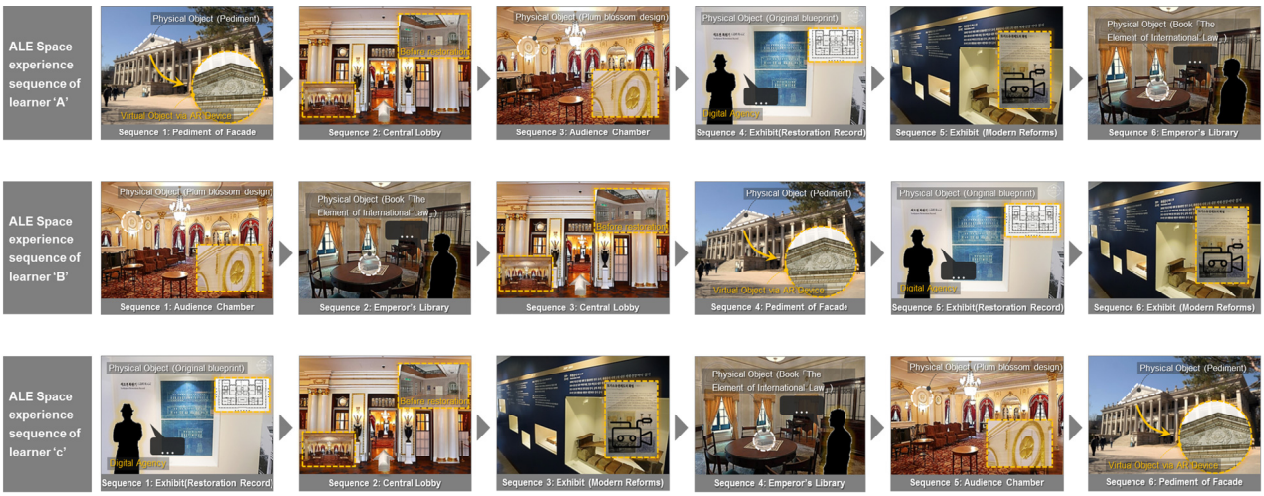

Fig. 2. Combinations of ALE Space Experience

4.2 ALE Ontology

The ontology of ALE should represent linkages of data and information about digitized modern architectural heritage by containing physical spaces with historical layers as modern architecture. The linkage process is accompanied by complex processes to organize various contexts for considering the learner's learning ability and experience as the main features of the experience. The ontology of ALE representing the relation networks of ALE space is shown in Fig. 3. The ALE space consists of a physical object and a virtual object. The learner experiences the ALE space through the implementation of an AR device. The physical object and the virtual object belong to one space. The space is enclosed by building components, such as walls, ceilings, and slabs, and it belongs to a floor. The relations of space could specify definitions clarified in previous BIMs. The virtual object is limited to the AR device environment of the user's view. The virtual object is classified by the virtual person, the visible object, the ambient object, and the information object (Table 2). Content is a concept as one set to experience ALE space, which is defined by combining a physical object and a virtual object. The experience of the ALE space does not completely create a physical object and virtual object. Historical information should also be connected to this. Historical information appears as expressions of a virtual object in relation to a physical object as humanistic knowledge, such as history and culture. If this historical information is absent, the virtual object becomes a meaningless object that does not help learning due to its unrelated place and historical context, even though it is a sophisticated virtual object. The event of this ontology is the historical information. The detailed components of the event are people, places, time, activities, and objects. The elements are found by analyzing sentences of a book that explain historical facts (Table 3).

Table 3. Deduction of detailed components of the event

Sentence	*Seoul Anglican Cathedral was built at the current location of 3, Jeong-dong in 1922.*			
Historical information	Seoul Anglican Cathedral	1922	3, Jeong-dong	Was built
Detailed components of the event	Object	Time	Place	Activity

Sentence	*The design is Arthur Dixon, and the taskmaster is Brock. It was completed on May 2, 1926.*					
Historical information	Design	Arthur Dixon	Task-master	Brock	May 2, 1926	Com-pleted
Detailed components of the event	Activity	People	Activity	People	Time	Activity

Table 4. Application examples of detailed components of the event

Sentence	**Historical information**		**Detailed components of the event**	
Emperor Gojong accredits Yoon-sik Kim and 38 international students to the Qing dynasty to learn manufacturing methods for new weapons in the 1880s.	• 1880s • Emperor Gojong • the Qing dynasty • Yoon-sik Kim	• 38 international students • new weapon • manufacturing method • learn	• Time • People • Place • People	• People • Object • Activity • Activity
They built the Beonsachang as a weapons manufacturing plant after returning in 1884.	• in 1884 • weapon manufacturing plant	• Beonsachang • built	• Time • Object	• Object • Activity
The Sangryangmoon, which knows about the functions and uses of the building, was founded with repair work in 1984.	• 1984 • repair work	• Sangryangmoon • founded	• Time • Activity	• Object • Activity

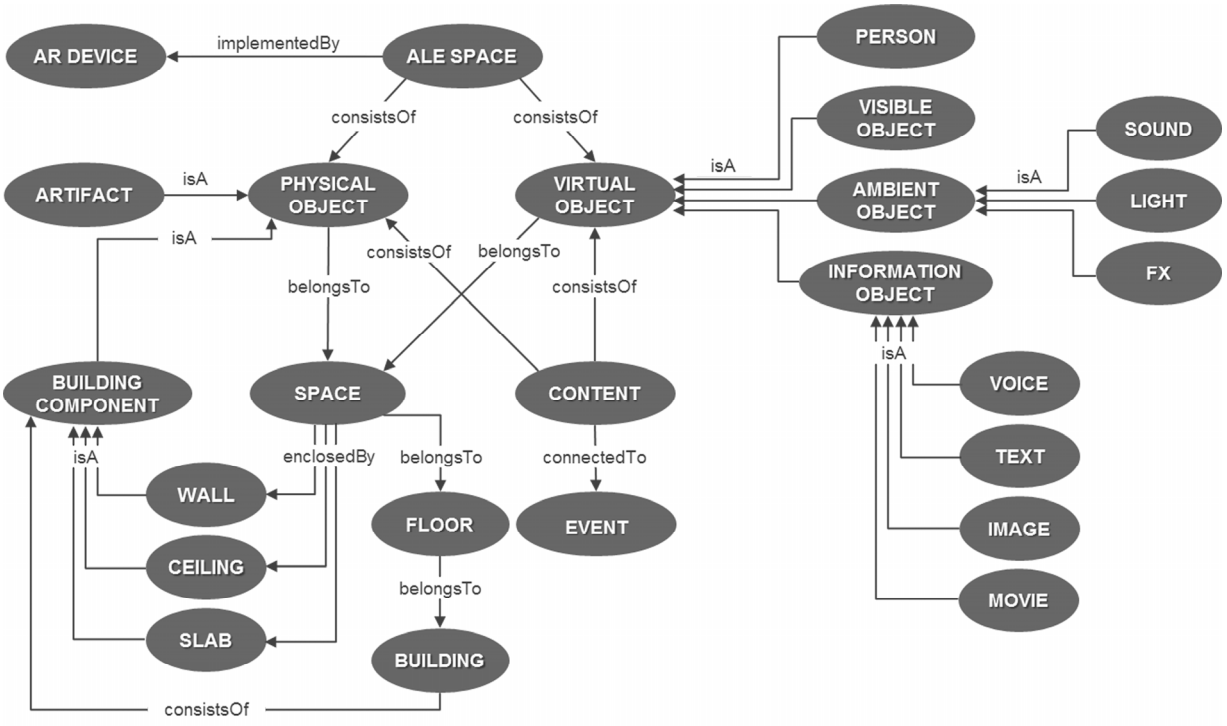

Fig. 3. ALE Ontology

A sentence explaining historical facts contains elements of historical information, which can be structured into relation networks. Example sentences are quoted in [11].

The elements of information in the sentences, as shown in Table 3, can be explained as detailed components of the event. Most sentences describing historical facts can be explained with this structure. Table 4 applies other sentences. The repeated core structure can be found in this process.

• Pilot Case - Deoksugung Palace, Seokjojeon

The methods of composition and delivery represented are based on the relation network of ontology by applying the proposed ALE space to the target place. The target place is the Deoksugung Palace Seokjojeon, a typical modern architectural

heritage site. The Seokjojeon is the first western-style building built in the Deoksugung Palace. This building was damaged while being used for another purpose after the Japanese occupation period in the 1930s.Therefore, the Cultural Heritage Administration conducted restoration work on the damaged Seokjojeon from 2009 to 2014 to celebrate the historical period of the Korean Empire and to preserve its architectural heritage. The Seokjojeon opened as the 'Seokjojeon Daehan Empire Historical Museum' in October 2014. The architectural style of the Seokjojeon is based on neoclassical design. This represents the history of the Korean Empire as a symbol of the attempts of Emperor Gojong to modernize the nation during the Joseon Dynasty. The learning values of the Seokjojeon are to describe a turning point as adopting a new style in architecture and to enable learning about modern history as containing the historical background and the person who wanted to build the architecture.

Therefore, an application in the ALE space is represented by the highly valuable Seokjojeon as an architectural heritage site. The scenario about utilizing Seokjojeon in the ALE space was presented previously.

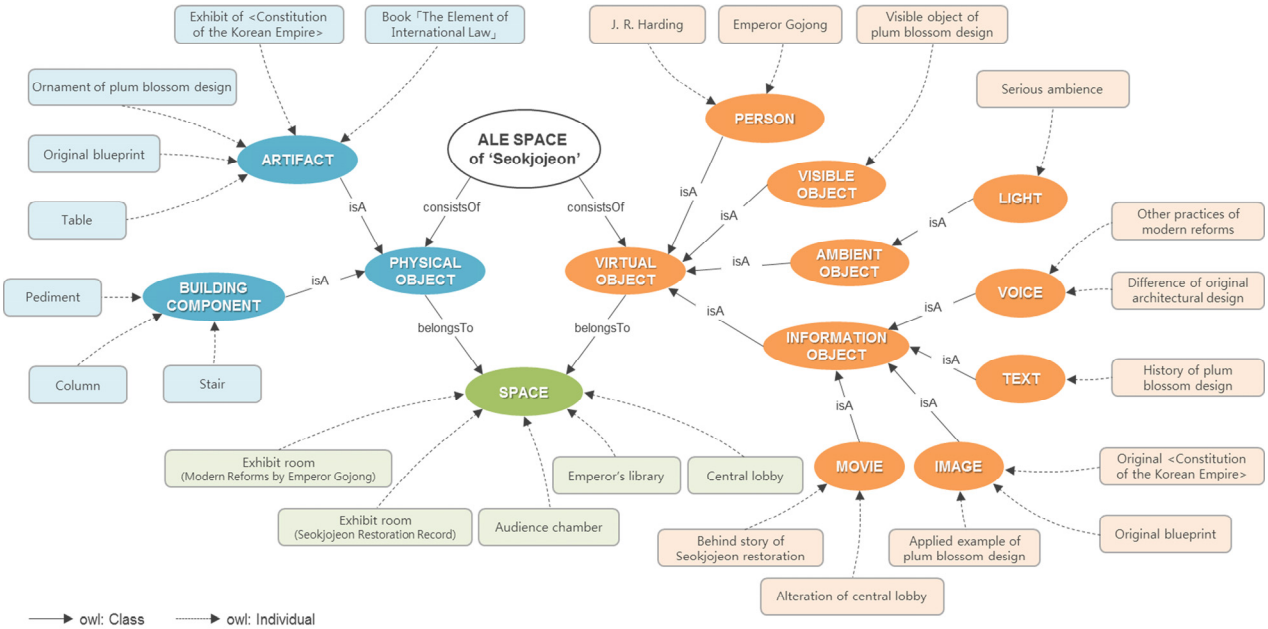

Fig. 4. ALE Space Ontology of 'Seokjojeon'

Fig. 4 describes the utilization of ALE space in the proposed scenario to an ontological model. The ontological model of Seokjojeon in the Deoksugung Palace appears in the utilization of the physical object, the virtual object, and the space based on the logic structure of Fig. 3.The physical object contains detailed sub-elements limited to this place, such as the original blueprint and the pediment. The objects belong to the space. The space contains places for the learning activity of a learner, such as an audience chamber or an exhibit room. The virtual object is presented as a specific form-related content about the place, object, and historical information. For example, the Emperor Gojong as an augmented digital agency and the visible object of the plum blossom design. The relation among the sub elements are defined based on historical facts.

5. CONCLUSION

This research proposed the composition logic of an ALE to enable discovery through learning in an experience manner in augmented space for learning about modern architectural heritage. In architectural history learning, a field trip is the most active method of learning, but it is difficult to conduct frequently. Linking information to the historical heritage using ICT could help to overcome the limits of previous learning methods by providing rich learning resources on a site or by using a simulation method in another place away from the site. However, existing field trip cases of cultural heritages applying ICT is composed by creating limited experience content from web resources or receiving content at a specific place through humanities GIS. Therefore, on the basis of the blended space theory, which has been suggested as a methodology regarding a limitation, an augmented space experience method for overcoming these was composed. An ALE space framework is also proposed to enable discovery through learning in an augmented space. The operation of ALE space is needed to create full coordination, such as a CMS. It should involve relation networks to provide knowledge to the rule engine of the CMS. Therefore, the structure of the CMS and use of ontology to consider various contexts of modern architecture are proposed. The ontology for the ALE space should be especially considered for the compositional information of architecture, the historical information, the expression of AR technology, and the context of learner multiplication. The relation network is a foundation for creating a systematic experience of an augmented space, which enables more

effective learning, rather than providing AR content without context. The application of the proposed ontological model is represented with the Deoksugung Palace Seokjojeon hall case by describing a user experience scenario.

This research proposed the composition logic of an ALE with a system structure, but it has limited utilization in real space. The planned future research based on this result is to conduct an experiment partially targeting a learner by setting up an environment of the small experiment. The evaluation and verification are carried out in this experiment by examining the experience of the learner in historical cultural places. This smart learning environment is complemented by the evaluation and verification. It can be implemented in a differentiated learning system, which is not only a current way of heightening the accessibility of knowledge through the formation of a dynamic experience, but also a method of real-time sharing from various contexts and contributes to the reproduction of knowledge by inducing civil participation. While the existing smart services provided technology that was anticipated to be useful for the introductory stages, in the present, the services demand is increasing beyond information delivery and the advanced technology of AR/VR makes it possible to provide more realistic experiences as it becomes more affordable.

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