Design principles of learning spaces for learner-centered learning: Focus on affordance

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Abstract: The purpose of this study was to investigate the principles of learning space design with emphasis on the concept of affordance that induces learners' behavior. To achieve purpose, four researches have been conducted. First research was to investigate the design principles of learning space based on technological affordance. Second research was to investigate the design principles of learning space based on educational affordance. Third research was to investigate the design principles of learning space based on social affordance. Fourth research was to investigate the design principles of learning space for learner-centered learning. The precedent research and learning space design examples were analyzed. The results of this study are significant in investigating the principles to design and construct a learning space for improving the learning performance of the learner-centered learning. Specially, it is meaningful to investigate the learning space design principles according to class type and instructional media type.

Keywords: learning space, affordance, design principle, design principle of learning space

INTRODUCTION

Educational environment influences students' learning attitudes. The learning space conveys an image of educational philosophy about teaching and learning for learners(Park & Choi, 2011). The learning space can enable or control varies styles of teaching and learning(Donovan, Bransford, & Pellegrino, 1999). Learners in the space designed for active learning have higher learning outcomes than traditional classroom's learners(Baepler, Walker, Brooks, Saichaie, & Peterson, 2016). In addition, learners gain high learning outcomes when they experience learner-centered learning such as project-based learning, problem-based learning and action learning in the learning space designed to solve problems or interact with others. Therefore, it is necessary to design the learning space for successful learner-centered teaching. Nonetheless, the learning space designs remained largely unexamined and unchanging in their basic orientation.

JISC(2006) suggested that factors that directly affect teaching-learning methods should be considered when designing the learning space. Specifically, to increase learners' learning flow, the educational space should be designed to allow flexible thinking in a creative and emotional environment.

There are three factors to consider when designing the learning space(Thomas, 2010). First, it is necessary to redesign existing instruction according to changes in teaching methods and then design the

learning space suitable for new instruction. Second, it is necessary to design the learning space that can improve learner's competence in accordance with the change of competence required by society. Third, the learning space should be designed considering the affordance to induce the learner's behavior.

Affordance means an attribute that induces behavior by interaction between object and object(Gibson, 1979). Affordance exists naturally, it doesn't need to be seen or known. The environment perceived by user includes information about the environment itself, and they can't be separated. That is, as the user perceives the affordance, the behavior of the user can be determined through the perceived affordance.

Norman(1988) focused on how to design and adjust the environment for the utility of affordance, and he also paid attention to the user's purpose, culture, and past experience. Norman emphasized the affordances perceived as a cognitive psychologist, introducing the concept of affordances in the field of design(Min, 2007). Norman proposed the concept of perceived affordance, which is separated by the physical affordance provided by the object(Song & Park, 2009). In addition, Norman developed Gibson(1979)'s concept of affordance into a more prescriptive form, providing guidelines about affordance which objects could provide. In other words, Norman's affordance is a concept that provides a clue that a user can perform a specific action, and it includes both the cognitive attributes of the

environment and the physical attributes that induce the user's behavior.

Kirschner, Kreijns and Beers(2004) suggested that education is always a combination of technological, social and educational context and affordances. In addition, they classified the affordances in the learning space into technological, educational, and social affordances. Specifically, affordance in a learning space was classified as technical affordance, educational affordance, and social affordance. Technological affordance is an important factor in determining usability, and it is related to design and is required for learner-centered design. Educational affordance is to determine possible learning behaviors within a given educational context. Social affordance is to provide social contextual stimulation related to learners' social interaction.

From this point of view, it is necessary to consider the affordance to induce the learner's behavior when designing the learning space. The purpose of this study is to derive the principles of learning space design with emphasis on concept of affordance which induces learners' behavior. Specifically, four researches have been conducted. First research was to investigate the design principles of learning space based on technological affordance. Second research was to investigate the design principles of learning space based on educational affordance. Third research was to investigate the design principles of learning space based on social affordance. Fourth research was to investigate the design principles of learning space for learner-centered learning.

RESEARCH DESIGN & METHODS

The purpose of this study is to derive the principles of learning space design with emphasis on concept of affordance which induces learners' behavior. To achieve this study, three researches have been conducted. Specifically, the precedent research and study space design examples were analyzed by the following methods. First, in the academic database, prior researches and cases were searched using keywords such as 'affordance', 'learning space', 'learning space design', and 'learner - centered class'. Second, the data were selected according to the authority, power, and relevance criteria of Hart (2008). Third, the selected data were analyzed by three researchers based on the learning space affordance classified by Kirshner et. al(2004). The data used in the analysis are 40 academic papers and case of learning space design.

RESULTS

The design principles of lerning space based on technological affordance

<Table 1> shows the principle of designing the learning space based on technological affordance investigated from previous studies and case studies.

Table 1. The design principles for learning space based on technological affordance

Reference	Technological Affordance	
Gee (2006)	adaptable	flexibility, adequate space, welcoming and familiar, user ownership, changeable focal point, mobile display, diverse information communication, technology tools, power/date access
	diverse stimulation	sensory cues, elements of surprise, transparency and visual access, connection to nature, color and texture, diverse shapes
	healthful	lighting, ergonomic consideration
Pearlman (2010)	extended learning area	corridors, alcove, project planning room, media library, breakout area, commons studio, learning plaza
	furniture	rolling tables and chairs, flip-up tables, mix-and-match tables, cushioned seats, modular tables, mobile lecture style amphitheater seating
	Etc	robust wireless environment(both inside and outside)
Bines & Jamison (2013)	flexibility	movable table and chair, triangular table has no installed IT devices, wireless internet, though IT and electrical services on the tables can be readily disconnected and movable should the need arise
	space for teaching and learning	digital display screens to accommodate group use of computers and other technologies, writing wall, table with long rectangular surface and rounded ends, two computers on the table for collaborative IT-based learning
	space for control	switch to presenter mode

Reference	Technological Affordance	
Choi & Kim (2014)	smart learning space	AP WLAN management switch, unified authentication management, cloud storage, display device, smart table, RFID card, monitoring system, projector, touch panel
	flexibility	open staircase, variable boundary, glass wall, high accessibility
Kim (2015)	separated space	meeting zone, administrative zone, transition zone
	support structure	possible to movement of learner and furniture according to different teaching and learning methods. illuminance, celling height, whiteboard

According to <table 1>, the common design principles of learning space based on technological affordance are flexibility, removable furniture, separated space, support structure, extended learning area, and smart learning space. Furthermore, technological affordance are diverse stimulation, lighting, ergonomic consideration, celling height.

The design principles of lerning space based on educational affordance

<Table 2> shows the principle of designing the learning space based on educational affordance investigated from previous studies and case studies.

Table 2. The design principles for learning space based on educational affordance

Reference	Educational Affordance	
Brown & Lippincott (2003)	mutually dependent of learning spaces and the support services	computing centers, teaching and learning centers, libraries
JISC (2006)	separated space	present, investigate, exchange , develop, create, and interact zone
Gee (2006)	provides quiet moment in private spaces	individual space, spaces for quiet, focused thinking, creating opportunities and spaces for private, thinking time, consider ways to modulate the level of privacy, such as seated-height panels, rolling screens, and plants, provides private spaces in a variety of degrees of enclosure, shapes, and forms
Kim & Moon (2011)	induce space use to suit learning objectives	physical, logical, cultural, meaningful,
	induce interaction with environment in physical and cognitive dimension	strengthen experience in the activity space, human emotions, structure of perceptual characteristics
Pearlman (2010)	separated space	small-group collaboration zones, project rooms, facilitator collaboration zones, single-subject-matter learning environments, dual-subject-matter learning environment, digital media library, large multigroup collaboration zones
	learning plaza	collaboration between teachers and students
Kim & Moon (2011)	induce arbitrary experience in learning space	utilizing learners' potential memory, unconfirmed space utilization
Kim (2015)	method of teaching and learning	learning objective, participants, learning activities, support for team-based learning,
	space	places, properties, component
	technology	media lab, smart classroom, teaching of experimental

<table 2> shows the common design principles of learning space based on educational affordance. The specific design principles are separated space according to teaching methods, teaching and learning support space, and learners' behavior inducement space according to learning objectives.

The design principles of lerning space based on social affordance

<Table 3> shows the principle of designing the learning space based on social affordance investigated from previous studies and case studies.

Table 3. The design principles for learning space based on social affordance

Reference	Educational Affordance	
Matthews, Andrew & Adams (2011)	informal social learning space	commons room, comfortable furniture, controlled temperature, open space, eating facilities, location and large tables
	comfortable furniture	padded seats and padded chairs, with backs and big tables
Bines & Jamison (2013)	intentional furniture placement	flexibility for teachers interacting with students on tables of different heights, collaborative learning space featuring tables of varying shapes and heights.
	lounge	staff and students to a generously open, relaxed lounge with hospitality
Murray & Fujishima (2013)	lounge	learning opportunities available to another learner
Oblinger (2005)	design learning spaces around people, spaces adjacent to classrooms, such as hallways, may be used for informal gatherings, support multiple types of learning activities. enable connections, inside and outside, make space flexible, accommodate information technology, design for comfort, safety, and functionality.	

According to <table 3>, the common design principles of learning space based on social affordance are informal learning, comfortable furniture, accommodate information technology.

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<Table 4> shows the principle of designing the learning space for learner-centered learning based on affordance.

Table 4. The design principles of learner-centered learning for learning space

Index	Design principle for learning space
technological affordance	flexibility, removable furniture, separated space, support structure, extended learning area, and smart learning space
educational affordance	separated space according to teaching and learning methods, of educational affordance are flexibility, teaching and learning support space, and a space where learners' behavior can be induced according to learning objectives
social affordance	informal learning, comfortable furniture, accommodate information technology

SUGGESTIONS FUTURE RESEARCH

The purpose of this study is to derive the principles of learning space design with emphasis on concept of affordance which induces learners' behavior. This study identified design principles of learning space for learner-centered learning through precedent study and case analysis. In a future study, the principles design of learning space for learner-centered learning will be derived by focus group interview. And the design principle of learning space will be confirmed on the basis of the results of the survey. The results will be helpful to design and redesign a learning space to enhance the learning outcomes on learner-centered learning.

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