Visualization and deepened understanding of the pattern language inherent in the Higashino High School campus as demonstrated through digital models

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This is a practical research project aimed at digitizing the Eishin Campus of Higashino High School, where the philosophy of Christopher Alexander's Pattern Language is concretely reflected and realized, into three-dimensional digital data. It creates a virtual space through which users can move, virtually experiencing the spatial characteristics of each location while simultaneously visualizing the patterns that give rise to those characteristics, with the goal of deepening understanding. The project allows for a game-like virtual experience, enabling users to enter into learning without realizing it, making the learning curve lower. It is expected that people from all fields can concretely learn about pattern language, regardless of their discipline, thanks to the reduced barriers to learning.

1 INTRODUCTION

In recent years, software for creating three-dimensional digital models of architecture has become more practical. Furthermore, when combined with game engines, it has become possible to perform various dynamic operations within the virtual spaces created. While exploring these possibilities, we, the students, learned from our instructors about the architectural complex and exterior spaces of the Higashino High School campus, designed by Christopher Alexander and others, realized through the use of Pattern Language, sparking our interest. However, it is not possible to directly see where and what patterns are used within the actual physical spaces. Thus, we, the students, came up with the idea that it would be meaningful to virtualize the Higashino High School campus and visualize the patterns used there.

This empirical research involves digitizing the Higashino High School campus, designed using Pattern Language by Christopher Alexander and his colleagues, into three-dimensional digital data. It allows for free movement within this space and attempts to visualize the patterns used in each location at the time of design.

The intention is to preserve the only architectural complex in Japan that Christopher Alexander was involved in designing as a digital archive and to use it as a teaching material for learning Pattern Language in context.
This practical research was conducted with the following components:
The purpose of this paper is to outline a new curriculum design methodology practiced in architectural education that

(1) Creation of 3D Digital Data (Virtual Space)
   Reading existing drawing data and other sources, the buildings and external spaces of the Higashino High School campus were digitized into a 3D virtual model.
(2) Pattern Extraction

By comparing C. Alexander's book "A Pattern Language" [1], which presents 253 patterns, with on-site observations and existing documentation, patterns utilized in the Higashino High School campus were extracted.

(3) Overlay of Virtual Space and Pattern Language

Within the created virtual space of the Higashino High School campus, a user can freely navigate and virtually experience the specific patterns used in each location. This overlay allows users to confirm the patterns employed in each place during their virtual exploration.

As a result, the digital archiving of the Higashino High School campus is realized, simultaneously providing a visualization of the patterns used during the design process. This not only achieves a digital archive of the campus but also serves as an educational tool, allowing users to learn about the implemented pattern language in the space by contrasting it with the physical environment designed using pattern language.

2 CREATION OF THREE-DIMENSIONAL DIGITAL DATA (VIRTUAL SPACE)

The formation of three-dimensional digital data involved reading basic information such as dimensions and structures from two-dimensional drawings (floor plans, elevations, sections, etc.) and manually entering this information into a PC while adding details about materials to construct a 3D model. The CAD (Computer Aided Design) software used for this purpose was ARCHICAD. Photo 3 shows the 3D model of the entire campus in production, and Photo 4 demonstrates how the names and summaries of patterns used in an enlarged part of the 3D model pop up.

The original data used includes:

(1) Drawings featured in the record of the design and construction of the Higashino High School campus by C. Alexander, published in the book "the Battle for the Life and Beauty of the Earth : A Struggle between Two World-systems" (2012)[2].

(2) Drawings published in the architectural magazine "Shinkenchiku" (June 1985 issue) [3].

(3) Insights and photographs obtained during on-site surveys in December 2023. (Figure1 shows the situation of investigating the facilities at Higashino High School.)

(4) Drawings and other materials provided by the Higashino High School campus in December 2023. (Figure2 displays the design drawings and other materials used during the construction of the facility.)

Figure 1: On-Site Survey

Figure 2: Drawings and Other Documents

Figure 3: 3D models of Campus (under construction)

Figure 4: a Pop-up in 3D models

3 PATTERN EXTRACTION

After careful examination of the original data and field surveys, followed by immediate review, patterns believed to have been used in the design of the Higashino High School campus were extracted from Christopher Alexander's book "A Pattern Language." It was found that 164 out of the 253 patterns presented in "A Pattern Language" were used. (As of December 2023)

   The main patterns from "A Pattern Language" that are used on-site at Higashino High School are as follows:

   (The numbers and pattern names are quoted from "A Pattern Language.")

Table 1: The number of patterns from "A Pattern Language" used in the Higashino High School campus

Category	Number of Usage Patterns	Number of patterns in "A Pattern Language"
Town	42	94
Building	78	110
Construction	44	49
Sum	164	253

Town: 53 Large entrance gate, 60 Nearby greenery, 64 Pond and stream
Building: 107 Building with natural light, 158 Blue sky staircase, 159 Two-sided lighting in every room
Construction: Window glass for 239 small divisions.

   Additionally, information provided by the Higashino High School campus revealed the existence of a thinking process that can be called an original pattern.
（1）The first gate, (2) Over 100 cherry blossom trees, (3) Drum bridge, and so on.

4 OVERLAY OF VIRTUAL SPACE AND PATTERN LANGUAGE

   Settings are made within the formed virtual space to visualize the Pattern Language. Specifically, Unreal Engine, a game engine (software that delegates the main processing commonly used in computer software, optimizing efficiency), is used to:

   (1) Set up the avatar (a character representing the user) to freely move around the virtual space of the Higashino High School campus.

   (2) Move the avatar in front of a location that uses a pattern, and when the user interacts with the PC there, display a popup summarizing the pattern used. To implement this, identify in advance the extracted patterns and the locations where they are used.

As a result of steps (1) and (2), in the virtual space, avatars move, and game-like actions are added, such as patterns used at the location the avatar reaches popping up. Users can deeply understand the design intent and the content of the patterns by simultaneously comparing the spatial characteristics read from the location they reach and the patterns that pop up.

5 CONCLUSION

   We believe there are two significant aspects to this practical research. One is its significance as a digital archive. It holds value in digitally preserving the architectural complex designed by C. Alexander, the only one of its kind remaining in Japan, by associating it with the concrete application of the fundamental design philosophy, the Pattern Language. The second aspect is its significance as educational material for learning the Pattern Language. By studying the patterns believed to have been used in the design and contrasting them with the realized architectural complex and external spaces, a deeper understanding can be gained. Additionally, by incorporating a game-like feel, it is reasonable to expect that the learning derived from pattern language will become more accessible and familiar.

The future challenges include completing the ongoing work, clarifying the rationale and describing the extraction process for the patterns believed to have been used during the campus design, and additionally expressing the original patterns of Higashino High School campus. This is a project at Nihon Kogakuin College of Hachioji that collaborates with curriculum design using pattern language.[4] [5]

ACKNOWLEDGMENTS

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