Architectural Paper Model with Understanding of the Congenitally Blind Students:A Case Study of Phra Prang Sam Yod *

หุ่นจำลองงานสถาปัตยกรรมกับความเข้าใจของนักเรียนตาบอดสนิทตั้งแต่กำเนิด: กรณีศึกษา พระปรางค์สามยอด

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Abstract

Congenitally blind students have never experienced seeing architecture before. However, they can learn and understand the environment from school learning. They can use and travel to various parts of buildings by using 2D map perception and Orientation and Mobility (O&M), which is a core course in building skills by practicing the blind to be familiar with the environment. But, for the perception in the dimension of large shapes, the model is needed in teaching. This study was based on the experiment using architectural paper model in visual arts learning for blind students, which was constructed by using 3D forming technique. It was then unfolded by a computer program and printed on thick paper and folded up using glue or transparent tape. These techniques were used since it is easy for producing and repairing. It can also be shared to various schools with blind students.

The samples were the blind students from Khon Kaen School for the Blind who were studying in general schools. They can touch and recognize the shape of the model of *"Phra Prang Sam Yod"* with the help of the teacher. First, the teacher have to describe the difference of scale between the model and the real architecture, and further described the features of the model gradually from the entrance, the passageways, the openings, and the walls to the spires and explained the overall shape of Phra Prang. The samples can understand about the scale and the design of architectural features such as *"Yod"* (the Prang spire), *"Ruen That"* (the main body of the Prang) and *"Than"* (plinth), the porches or the

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entrance to the Main Prasat or the Principal Tower, the vaulted passageways connecting the three Prangs, the corridor, the recesses, the decoration and the spires of the three Prangs. This allowed the blind students to understand the shape and the architectural features well. It also created learning opportunities and equality.

Keywords: Folding Paper Model, Phra Prang Sam Yod, The Blind Students

บทคัดย่อ

นักเรียนตาบอดสนิทตั้งแต่กำเนิดไม่เคยมีประสบการณ์ในการมองเห็นงานสถาปัตยกรรมมาก่อน แต่พวกเขาสามารถเรียนรู้และเข้าใจสิ่งแวดล้อมได้จากการเรียนรู้ในโรงเรียน พวกเขาสามารถใช้สอยและเดินทางไปยังส่วนต่างๆ ของอาคารโดยใช้การรับรู้เชิงแผนที่ 2 มิติ ประกอบกับทักษะของวิชาความคุ้นเคยกับสภาพแวดล้อมและการเคลื่อนไหว (Orientation and Mobility : O&M) เป็นหลักวิชาในการสร้างทักษะโดยการฝึกฝนการสร้างความคุ้นเคยกับสภาพแวดล้อมของคนตาบอด แต่การรับรู้ในมิติของรูปทรงขนาดใหญ่นั้นมีความจำเป็นที่จะต้องใช้สื่อการสอนแบบหุ่นจำลองช่วยในการเรียนรู้และรับรู้ การศึกษานี้ได้จากการทดลองใช้สื่อการเรียนรู้วิชาทัศนศิลป์สำหรับนักเรียนตาบอดด้วยหุ่นจำลองงานสถาปัตยกรรมแบบกระดาษพับ โดยใช้เทคนิคการขึ้นรูปทรง 3 มิติ และคลี่แบบด้วยโปรแกรมคอมพิวเตอร์ จากนั้นจึงพิมพ์ลงกระดาษหนาแล้วพับขึ้นรูปโดยใช้กาวหรือเทปใสปะติด วิธีทำสื่อการสอนแบบนี้เพื่อให้ผลิตและซ่อมแซมได้ง่าย สามารถแบ่งปันและส่งต่อไปยังโรงเรียนต่างๆ ที่มีนักเรียนตาบอดเรียนรวม

กลุ่มตัวอย่างซึ่งเป็นนักเรียนตาบอดจากโรงเรียนการศึกษาคนตาบอดขอนแก่นที่ได้เรียนรวมในโรงเรียนทั่วไป สามารถสัมผัสและรับรู้รูปทรงของหุ่นจำลอง “พระปรางค์สามยอด” ได้ โดยจะต้องมีครูช่วยบรรยายลักษณะของหุ่นจำลองทีละส่วนอย่างค่อยเป็นค่อยไปตั้งแต่ทางเข้า ทางเดิน ช่องเปิด ผนังจนไปถึงยอดหลังคา และอธิบายภาพรวมของรูปทรง กลุ่มตัวอย่างสามารถเข้าใจเกี่ยวกับการเทียบสัดส่วน การออกแบบลักษณะเฉพาะของงานสถาปัตยกรรม เช่น ส่วนยอด ส่วนเรือนธาตุ ส่วนฐาน การเน้นหน้ามุขหรือประตูทางเข้าไปยังปราสาทประธาน ระดับทางเดิน ทางเดินเชื่อมต่อปราสาททั้ง 3 องค์ หลังคามุขกระสัน การย่อมุม ส่วนตกแต่ง จนไปถึงส่วนของยอดปราสาททั้งสามที่เรียงกัน เป็นต้น ซึ่งช่วยให้คนตาบอดเข้าใจรูปทรงและเข้าถึงลักษณะของงานสถาปัตยกรรมได้เป็นอย่างดี สร้างโอกาสและความเสมอภาคทางการเรียนรู้

คำสำคัญ: หุ่นจำลองกระดาษพับ, พระปรางค์สามยอด, นักเรียนตาบอด

1. Introduction

Congenitally blind students have never experienced seeing or touching architecture, but they learn and understand the environment from schools where they study with general students. They can travel to different areas of buildings using 2D map perception and Orientation and Mobility: O&M of the blind (Yam-iam, 1988: 9). However, they cannot recognize large shapes of buildings or architecture because they have never seen all the shapes, which is like the metaphor *"the blind touch an elephant"*. But, if there is a model of the elephant that is scaled down for the blind to experience, they will be able to link it with the shape of a real elephant by comparison, so does architecture. If the blind understand and have experience about buildings or architecture, in addition to being equal, the reflection from them can also be applied for appropriate architectural design for the blind.

Knowledge of architecture is a branch of art, which helps fulfill humanity and creates educational opportunities for blind students to learn and deeply understand the theoretical art, causing development and growth in various areas, namely emotional, intellectual and physical development, recognition, aesthetics and creative development (Tangcharoen, 1996: 69-75).

"Blind students" are the students who have visual impairment. Congenital blind is the loss of vision that the blind cannot use their eyes in doing activities. Low vision is vision impairment. People with low vision are able to look at things or perform certain activities, but they cannot see or use their eyes as much as those with normal vision. In this article, the samples were congenitally blind students.

The term *"inclusive education"* refers to the acceptance of children with impartment to study with normal children without discriminating or sorting them out from normal children. Also, children are managed to learn and develop based on individual needs appropriately. *"Mainstreaming"* means providing children with special needs and disabled children into the general education system so that they can participate in activities and spend certain period of time each day with general children. This term is different from inclusive education.

In this article, it was the use of an architectural model designed and manufactured using paper folding methods in a research project titled *"Media design for art education (Visual arts) learning management for the blind upper-secondary-school students."* with the aim to allow the blind students at a high school level studying in inclusive education to have the opportunity to learn visual arts and have equality in education, especially in the field of

architecture in art history. In this article, a case study of an architectural paper model of *"Phra Prang Sam Yod"* was presented.

2. Research objectives

2.1 To experiment the primary perception of the historical art architecture by using folding paper for high school blind students, which is the level studying advanced art education courses with a folding paper model *"Phra Prang Sam Yod"*.

2.2 To study the perception and understanding about architecture of congenitally blind people.

3. Research methodology and experiment

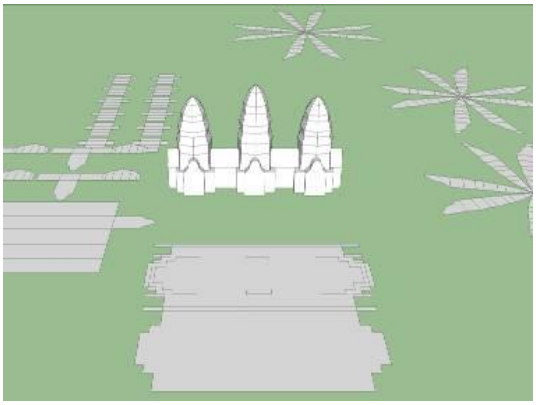
Qualitative research methods, including interview, participatory observation and note taking were employed. The data were analyzed with empirical photographs. According to the study, it was found that the blind students learned about Orientation and Mobility: O&M, which is a course teaching the blind to develop behavior and personality using the remaining perception, including sound, smell and touch to help them travel to various places safely on their own. It starts from having a caretaker to without a caretaker. Three principles are used in training skills for being familiar with the environment and movement: *"Where am I now ?" "Where is my target ?"* And *"How can I reach the target ?"* (Yam-iam, 1988: 35). These are the basic rules for the blind to understand their positions in a dimension or environment, which is called a *"Wayfinding learning system"*.

The blind, therefore, understand the context of space and correctly and safely move in various directions and positions in buildings or architecture as well as outdoor environment with the recognition of the 2D floor plan. In case of moving to the second floor, although moving to a different floor level: higher or lower is perceived vertically or in 3 dimensions, it is only to remember the path to the target of the floor plan of the building, where the space is used via the X and Y axes or 2 dimensions. This is consistent with the study by Sanchai Santiwes, that *"congenitally blind people perceive space and environment as a path and a floor plan or 2-dimensional map"* (Santiwes, 2014: 53-54).

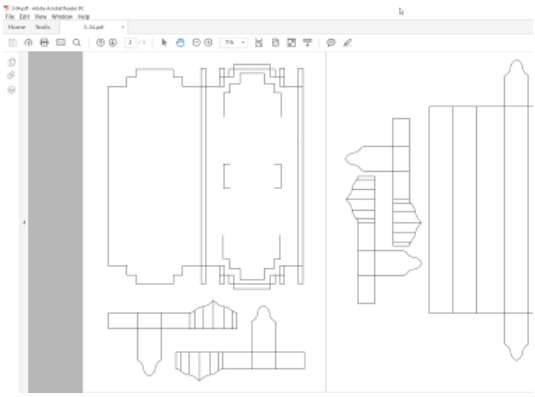
For the design and production of an architectural paper model, SketchUp, a computer program, was used to form the paper model (Trimble, 2013). The details of the 3D digital file of Phra Prang Sam Yod were reduced, but the important parts were still remained. After that, Plugins called *"Unfold Tool"* (Jim's [Plugins], 2007) was used to unfold the 3D shape

into planes and it was placed on A4 paper, which is the paper size commonly used. Then it was printed with the printer and cut into various parts before folding and assembling with simple equipment such as scissors and transparent tape. This model is used as a temporary learning material. If it is damaged, it can be repaired and reproduced. The digital file can also be shared to other schools easily. The 3D digital file of Phra Prang Sam Yod was downloaded from the *"3dwarehouse"* website, which is used for educational purposes only and it is distributed to schools for the use in learning art and creating educational opportunities for blind students.

(1) Searching for Phra Prang Sam Yod image for being the guidelines for making a model (Photography by author in 2007).



(2) Creating a paper model with Sketchup and unfolding it with Plugin Unfold.



(3) Placing it on A4 paper, which is the paper size commonly used.

(4) Folding the paper and attaching the parts together with transparent tape.

(5) Assembling the parts.

(6) Checking for completeness and testing the strength of the model.

Figure 1: The design and construction of the 3D architectural paper model of "Phra Prang Sam Yod" (Source: https://3dwarehouse.sketchup.com/model/fefb6e9c2ceb8b6183907b7e6e65a66d/พระปรางค์สามยอด-จังหวัดลพบุรี)

"Phra Prang Sam Yod" is located in Tambon Tha Hin, Lopburi Province. It was made of laterite and decorated with stucco relief. It was built in the 19th century when the Khmer power began to decline in Thailand. The compound comprises three Prangs with Khmer architecture linked to one another by the corridor (Sutthitham, 1999: 33). It was built in the reign of King Jayavarman VII, based on the Mahayana Buddhism. Later in the reign of King Narai the Great, King of Ayutthaya, Phra Prang Sam Yod was renovated. A brick *"Viharn"* (assembly hall) was constructed in front of the central Prang, showing the continuation of the use of this monastery until the Ayutthaya period (Pakdeekham, and others, 2011: 40). The researcher did a pilot study. The details of the architectural paper model of Phra Prang Sam Yod were reduced, but the important components of the artistic identity of Thai architecture, including *"Yod"* (the Prang spire), *"Ruen That"* (the main body of the Prang) and *"Than"* (plinth) were still remained.

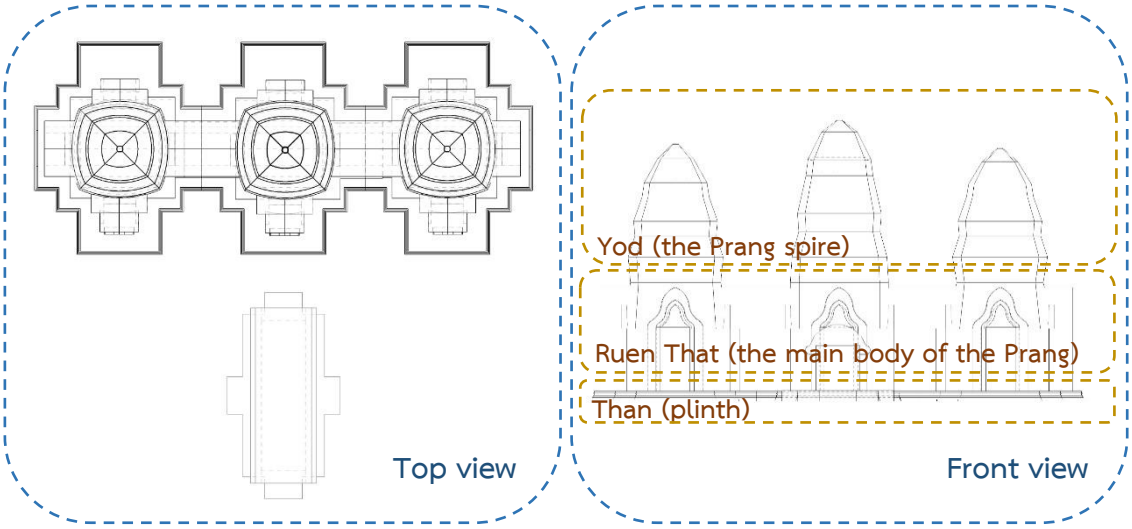


Figure 2: The Projection image of Phra Prang Sam Yod were reduced and removed Viharn (assembly hall), but its important components were still maintained.

Seven blind students who were the samples exposed the folding paper model and described what they had learned. The researcher interviewed and took notes. It was found that all seven blind students did not understand the shape of Phra Prang Sam Yod although some of them had already visited the place. However, the researcher started to hold the hands of the students to touch the model and explained the elements of Phra Prang Sam Yod, such as the path to the main Prang and the increased layers for explaining other parts of Phra Prang such as the entrance, the connection of three Prangs with the corridor, the recesses, the decoration and the spires of the three Prangs. Giving explanation while the blind students were touching the learning material allowed them to understand about Phra Prang more.

According to the information mentioned above, giving explanation while the blind students were touching the learning material corresponds to the "O&M" principles and was accordance with all 3 criteria mentioned above. That is, while touching to learn from the model, the blind students had a good understanding in comparing the size of various objects which is a basic skill. So, giving explanation can help the blind understand the shape of the architecture. They can also learn the details of the decoration of the building as well. But, it must be done gradually and give them time to learn and have haptic perception.

One of the important problems that schools do not have art learning materials for the blind students is that it is difficult to create art learning materials or they are expensive. Sometimes, the schools have to wait for support from other agencies to produce for them. Therefore, this research project created art learning materials with the ideas of using materials that are easy to buy in the areas and general stationery stores. The production process must be easy. The art learning materials can be reproduced and repaired. They must also be produced by staff or students in schools. Also, they must be shared as a sustainable network.

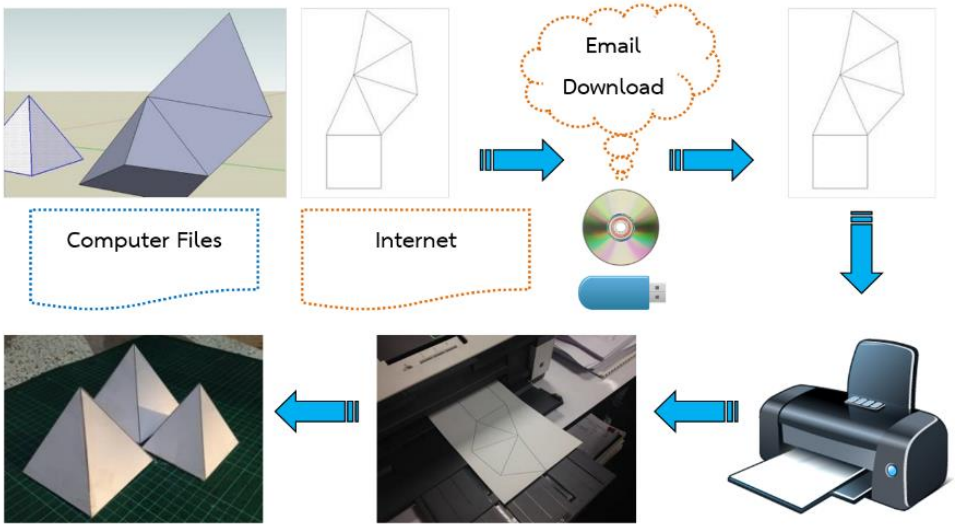


Figure 3: The process of making, share and produce paper models (Santiwes, and others, 2016: 144).

4. Conclusion

This study was based on the experiment using visual arts learning materials for the congenitally blind students. The architectural folding paper model of *"Phra Prang Sam Yod"* was constructed using 3D forming technique. The details of the 3D digital file of Phra Prang Sam Yod were reduced, but its important components and the overall form were still maintained. It was unfolded by SketchUp and Unfold Plugin and printed on thick paper and folded up using glue or transparent tape. These techniques were used since it is easy for producing and repairing. It can also be shared to various schools with blind students. This enables blind students to learn, understand and access architectural works. It also creates educational opportunities and equality for blind students. If a variety of models is used in the experiment and research using Pre and Post-Test, it will lead to the creation of knowledge gained from the research study. In addition, 3D object printer technology can also be used in the creation of art learning materials.

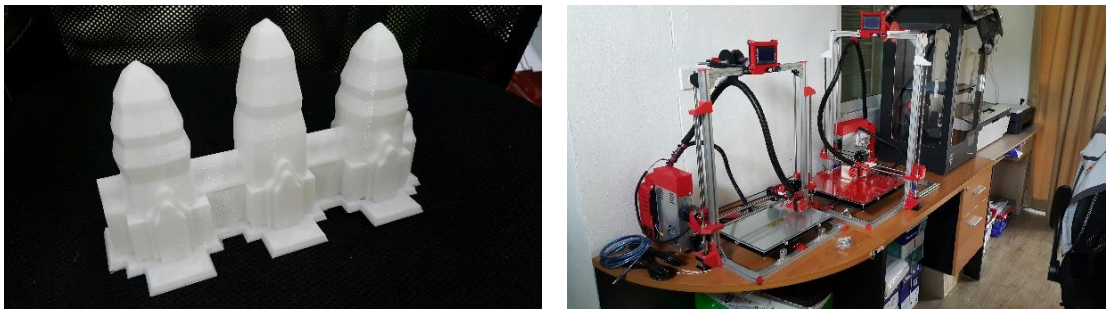


Figure 4: With the explanation for the difference of scale between the model and the real architecture, the model of Phra Prang Sam Yod was made with 3D Printing.

The congenitally blind students can touch and recognize the shape of the Phra Prang Sam Yod model, which is a famous Thai architecture, with the help of the teacher gradually describing the style and the shape of the model from the entrance of the main Prang (Than), the corridor connecting the three Prangs, the opening, the walls to the main body of the Prang (Ruen That) and the Prang spire (Yod). The blind students can understand the scale and the design of architectural features, such as the corridor, the entrance and the walkway level. Although the samples were still unable to recognize and understand all the elements of the architecture, the model can help them understand the shape of the overall architecture well. The conceptual framework of this research for creating learning materials included that they must be easy to produce, reproduce, repair and share in order to create networks and applications for schools with blind students. Therefore, the size and the method of production of an architectural learning material using folding paper model were defined.

Giving the opportunity for the blind to recognize and understand the shape of the architecture which is a valuable art is considered a great matter and creates knowledge and understanding, leading to educational opportunities and equality in society. Although this study is only a small part, it can be integrated into knowledge and lead to the creation of rules and theories of architectural design that are suitable for the blind.

Figure 5: Explaining the form of the model Phra Prang Sam Yod for blind students to have more understanding.

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