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Evaluating the impact of augmented reality of augmented reality systems for model-making in architectural education and design studios

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ABSTRACT

Architectural models are the easiest way of emphasizing the architectural plans, but it may not be easy to teach model-making in architectural education and design studio. Recently, computer aided design models, virtual and augmented reality techniques are used ascendant in every field of education. Therefore, the aim of this study is to determine an effective way of model-making for architectural education by using Augmented Reality tools.

Keywords: architectural education, augmented reality, model-making

Mimarlık eğitimi ve tasarım stüdyosundaki maket yapımı yerine artırılmış gerçeklik sistemlerinin kullanımın etkisinin değerlendirilmesi

ÖZ

Mimari maketler, mimari planların anlaşılması için etkin bir yol olmasına karşın, mimarlık eğitiminde ve tasarım stüdyosunda maket kullanımın öğretilmesi kolay değildir. Günümüzde bilgisayar destekli modeller, sanal ve artırılmış gerçeklik teknikleri eğitimin her aşamasında etkin bir şekilde kullanılmaktadır. Bu çalışmada, mimarlık eğitiminde maket kullanımını, Artırılmış Gerçeklik araçlarını kullanarak daha etkin hale getirilmesi amaçlanmıştır.

Anahtar Kelimeler: mimarlık eğitimi, artırılmış gerçeklik, maket yapımı

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1. INTRODUCTION

A model is generally considered as a presentation tool and it is essential for communicating within many disciplines including architecture. The use of models in design is different than its use in other disciplines. Models are frequently used as the basis of communicating, assessing, and realizing design intentions. [1]. The scaled model or a tangible representation of a building referred to study, share the aspects of an architectural design and to interpret the design opinions to the customer, committees, and the general public. Architectural models may be used for architectural education, , fundraising, obtaining permits, and sale purposes, for presentation of the design process. [2, 3].

Although architectural models are the best way of emphasizing the architectural plans, it is not easy and efficient to teach and use physical model-making in architectural education. Nevertheless computer aided design, virtual and augmented reality technologies are used in most fields of education nowadays. Model-making for architecture refers to both physical and digital model making unless a clear distinction is performed within the context of this study. The introduction of digital media like Augmented Reality (AR) changes the nature of the conversation. This research based on the role of digital three-dimensional architectural models and animated representations in the design conversation. This paper presents experiences with students in the use of Augmented Reality (AR) technologies versus manually made physical models in design tasks. Therefore, the aim of this study is to determine an effective way of model-making for architectural education by using AR. [4, 5, 6].

In this study students were able to use their tablets, smart phones in the three dimensional visualization of architectural projects through Augmented Reality and linking the desired information via Quick Response codes (QR codes). These codes are some barcode that may be seen in smart phones, tablets. (Fig. 1)

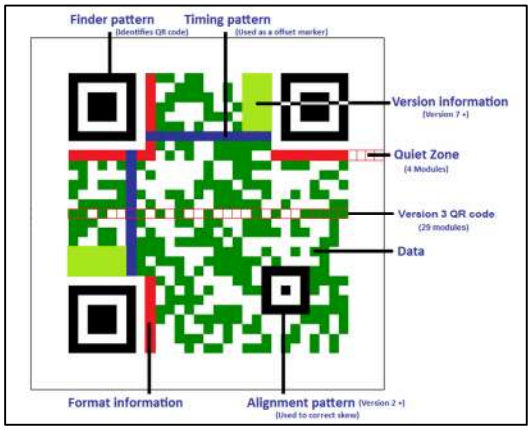

Figure 1. Understanding a QR-Code by QRMe

Augmented Reality uses displays. Head mounted displays are worn on the head within the virtual environment as video-see-through or optical see-through over the user's scene (Fig. 2). [7].

Figure 2. Head Mounted Display [6].

Handheld displays are computing tools with a display, which may be hold (Fig. 3). [8].

Figure 3. Vuzix Wrap™ 920AR Augmented Reality Eyewear

2. AIM

Architectural students are asked to build some physical models in their education system. Although it takes time and energy, the most effective way to have a 3D look to their project still seems to be these models. Nowadays the AR systems develop very fast and integrate in most educational platforms. Thus, the aim of this study was to determine the use of AR in architectural education for model-making. The main objective is also to state of satisfaction and student's adaptation to the use of technological developmental tools in their education.

3. MATERIALS AND METHODS

3.1. Survey

The survey design was focused on the measurement of the efficiency, effectiveness of the workshop and the fulfillment degree with the attendants' preferences. In the evaluating progress the knowledge of the emerging computer aided software and hardware, the use of cloud technologies, and use of Augmented Reality were considered to improve the use of digital models during the architectural design phase. [9, 10, 11, 12].

3.2. Workshop and Attendants

A digital modelling workshop was set-up to develop this research as an open course for, bachelor, masters and PhD architecture students, at Istanbul Technical University. A profile was designed to select the attendants of this study and the inclusion criteria were having basic 3D software knowledge. [13]. No exclusion criteria were determined at this time.

The attendants were all chosen from academically environment with architectural background. They were all volunteers and instructed about the contents before the study. Mostly students and academics were participated to the workshop and survey via online and social network announcements. Before the workshop, it was asked to have basic knowledge of CAD software experience. By this way, the attendants were able to bind with in a specific type of users to focus on the desired topics. [14, 15]. The age range was also being considered because of the effect on evaluation. [16].

3.3. Augmented Reality Design Studio Use

This was a two-step studio workshop. The first step was asking the attendants to fill out a survey. The second step was designing the model using AR technology. The attendants were asked to answer the level of their 3D design knowledge, whether they had made physical architectural models, the time they had spent on physical architectural models etc. After the first survey, a brief introduction was given about the tasks in the following workshop. Then, the use and the specifications of Augmented Reality plug-in AR-media™ were tutored. The attendants were free to use by choosing the suited 3D modelling tool for them. Mostly preferred 3D modelling tools were Autodesk 3ds Max® and Trimble SketchUp™. In the beginning of the workshop, a conceptual design of a building was asked to design directly in 3D medium. The task was to design the model within a pre-modelled, sloped terrain with an environmental data of trees, houses, landscape and view, which was provided before the design stage. Furthermore, an appendix was designed. The design process was limited with a specific time and the basic architectural programming.

Attendants were inspired of learning by real time and modelling directly in 3D. After the design process 3D models were prepared for the augmented reality display. Some attendants had more than one proposal so they registered each proposal in different layers. Some of them had animated the sequence of the design process. All these possibilities were exported to the augmented media. The augmented media designed by the participants were simultaneously uploaded to a cloud storage client. This opportunity was used to storage all files performed during the workshop, and turned into a cloud workspace to share with colleagues, exchange documents, track changes and assign some tasks.

Cloud storage files helped accessing, sharing and collaborating on files anywhere through mobile apps. Also we could exchange feedback and save these files. There is also opportunity for offline access.

For viewing the augmented reality objects a Wrap™ 920AR augmented reality eyewear and personal smart handheld devices were used during the workshop. The survey data were analyzed with SPSS 14.0 as calculating the frequencies and percentages.

4. RESULTS

The results of the present study revealed 47.37% of the students spend at least 5 days for physical model-making. (Fig. 4).

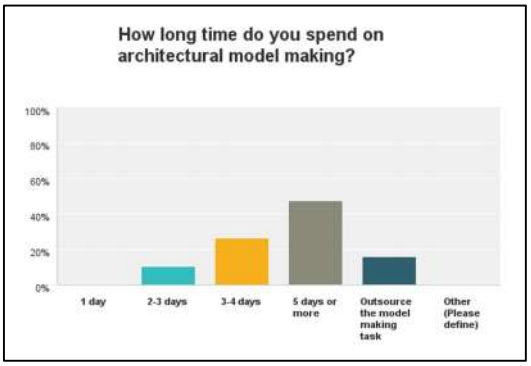

Figure 4. The percentage graphic about time consumption for model-making

Besides spending that time, 52.63% of the students were determined to spend €10.00-20.00 while 42.11% of them spend €20.00 or more. (Fig. 5)

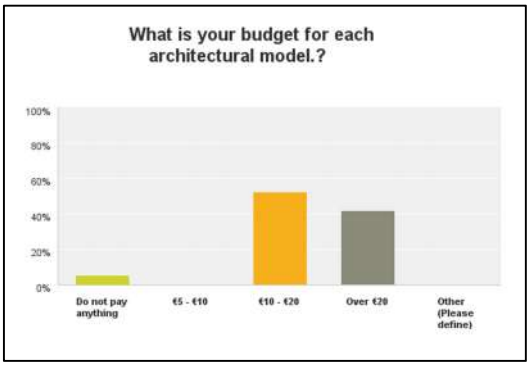

Figure 5: The percentage graphic about budget of models

An interesting result came up which shows that 36.84% of the students did not physically get their models back after their submission and finalize their projects.

The survey results revealed 70% of the students to spend more time for physical model-making and architectural design process then the AR systems and architectural design process. But the rest of them did not have the same opinion due to lack of tangibility of the models. 95% of the students were already using AutoCad, 85% of them were able to use 3D modelling softwares. All the students were determined to agree that AR designed models gave highly detailed digital projects then the physical models. The ability of exhibiting an interactive project was found to be more affective then physical model making. The percentage graphics of the remarkable anwers to the survey are displayed at Figure 6A and 6B.

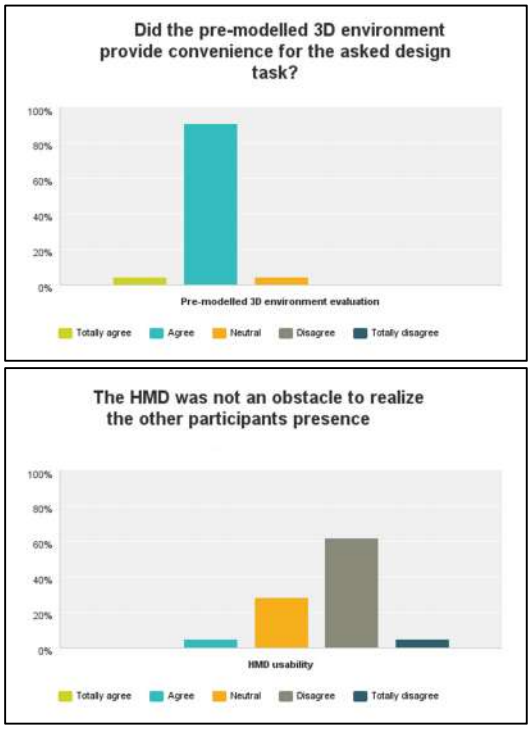

Figure 6. (A,B). Percentage Graphics of the Remarkable Anwers to the Survey

5. DISCUSSION

Regarding the project in its educational aspect, using AR versus pyhsical model-making in architecture showed very acceptable results for the students with no prior training of AR. The AR technology was used within the combination of visualization and 3D modelling, incorporating with a high level of usability digital graphics tools. Studying on a pre-modeled 3D environment provided convenience for the time consuming of the designing process. Therefore, using AR may decrease the time that is going to be spend for building-up a physical model. This result may reflect the increasing presentation quality of the designs and projects for both architectures and students as well. Redondo et al., asserted that the AR technology visualize architectural projects and also has great potential for users of that area. [17]. The present study also revealed AR technology has a potential to be used in architectural education. Redondo et.al., stated at their another study that the digital model-making helped to verify feasibility since proposals became more understandable, once virtual information was overlapped on real space. [18]. The attendents of the present study also claimed that it was more clear to see the overall design with AR sofware. In architectural education the models that have been designed by the students are considered as very important in their portfolios. Thus, providing a digital portfolio as having visualization of the 3D models is a

reputation and may be defined as top-line for the architectural education.

6. CONCLUSION

Considering the results of the present study it is concluded that the experience using AR technology has contributed new educational values that have a direct impact on model-making for architectural design courses. Students and educators are required to develop their knowledge as well as their utilization of the advancing technology. Regarding these reflections, architectrural academic staff might take more challenging tasks and consolidated designs as technology develops.

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