Multi-media Assisted Teaching Method for Building Construction Quantity Take-off

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Abstract

New generation is used to handling the electronic systems such as computer and mobile devices. They are acquiring the information and knowledge as well as communicating each other through computerized smart tools. Thanks to technological advances, blackboard in the class is replaced by overhead projector (OHP) in 1980s and power point becomes a universal presentation tool nowadays. According to the improvement of advanced IT technology, teaching methods have evolved in terms of communication and contents expression. A combined multi-media tool among pictures, 3D animation, and video as well as conventional texts are used for better communication between the teacher and students in the university. It is strongly required to develop a new teaching method to understand the basics of building components and sequence of construction easier than the conventional method. The paper discusses the process of developing the web-based lecture contents using multi-media tools including texts, 3D visual model, picture and video for building construction quantity take-off.

Keywords: *Multi-media Tool, Quantity Takeoff, BIM.*

1. Introduction

A web-based online lecture makes the world closer thanks to the internet communication protocol. It is possible to take honorable lectures anytime, anywhere. A combined multi-media tool among pictures, 3D animation, and video as well as conventional texts are used for better communication between the teacher and students in the university. It is strongly required to develop a new teaching method to understand the basics of building components and sequence of construction easier than the conventional method. It is not easy for undergraduate students to imagine the final shape of constructed facility with floor plan, section and elevation. From the lecturer's viewpoint, it is also not easy to explain the dynamic process and components with flat information. The paper discusses the process of developing the web-based lecture contents using multi-media tools including texts, 3D visual model, picture and video for building construction estimation. It is expected that the result of this paper will contribute to an innovative teaching method to angle the viewpoint of the new generation.

The idea of the new teaching method mentioned in this paper is to develop a dynamic and visual lecture contents using BIM (building information modeling) and multi-media tools to provide practical guidelines and teaching aids. This paper aims to develop a web-based Visual Manual for building quantity take-off for university education purpose.

2. BIM based quantity takeoff

Quantity take-off is the most essential process for construction project cost estimation in the preconstruction stage. Take-off begins with measure plans and blueprints. It is so complex and time-consuming work that human errors are frequently found out. [5]

BIM can integrate design and take-off process. The integration is beneficial in saving time in quantity take-off and cost estimation and receiving rapid feedback from design change. [2] However, it has no manual including sufficient guideline or instruction.

Trouble of tedious repetition, unavailability of automation and difficulty in building database is the most difficult in cost estimation. The difficulties can be relieved by using BIM. Information extraction from 2D based drawings does not allow efficient management and application of information in each stage. But 3D based BIM makes it possible. Also, change in quantity caused by design change can be easily measure. In BIM based quantity take-off, the take-off can be carried out in any design stage required as well as the initial design stage. It is better than conventional take-off work, which requires whole revision at every interim take-off. BIM take-off can manage drawing information of final design, construction and maintenance stage as well as design progress and develop a database. [4]

3. Needs Analysis

A survey is conducted to undergraduate students to recognize the needs of new generation' learning at university.

3.1. Survey outline

The survey asked undergraduate students to develop a Visual Manual. The outline of survey is like Table 1. The survey questions were organized based on interview of undergraduate students who attended a lecture on cost estimation.

Table 1. Outline of survey.

Type	Contents
Purpose	Draw out reform plans and configuration of electronic manuals through investigating the learning pattern and difficulties in studying cost estimation
Method	Questionnaire and interview
Questions	
1	Learning method
2	Effective learning media
3	Understanding of quantity takeoff
4	Difficulty in learning
5	Necessity of manual and textbook

3.2 Survey Results

The result of the survey is like below. The survey asked 56 students. 78.6% of the answerers stated that they learn through textbooks as shown in Figure 1. However, 50.0% of the answerers, the most common answerers chose video as the most effective learning tool, and text with illustration and 3D simulation was chosen as the second common answer by 21.4% as shown in Figure 2. Based on the survey, it is obvious that the multimedia learning tools are easier to understand than text based printed media though they are not enough available. Therefore, multimedia type of manuals including video and 3D simulation shall be sufficiently provided for learning quantity take-off.
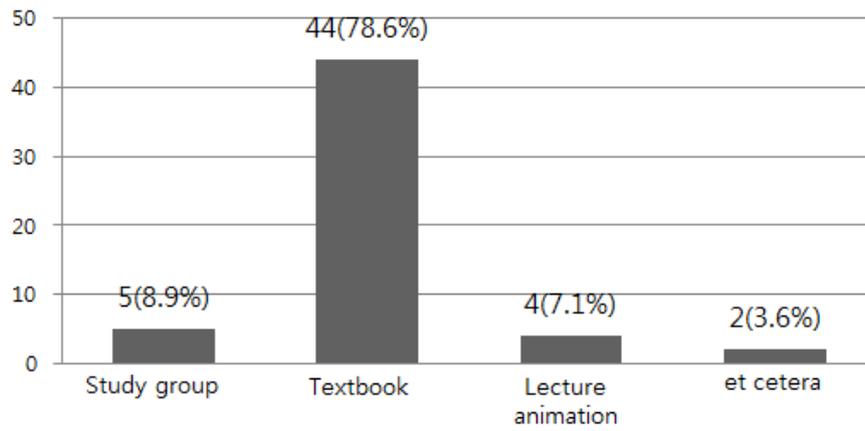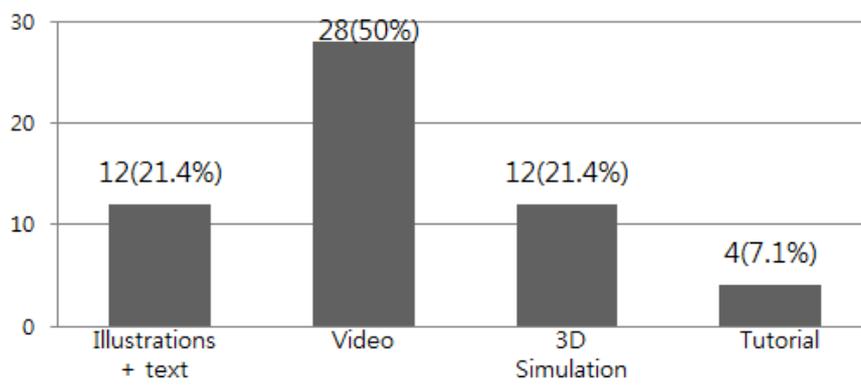
Figure 1. Learning method.

Figure 2. Effective learning media.

76.5% of the answerers stated that they have low understanding of quantity take-off as shown in Figure 3. 55.9% chose their poor understanding for drawings as an obstacle for learning as shown in Figure 4.
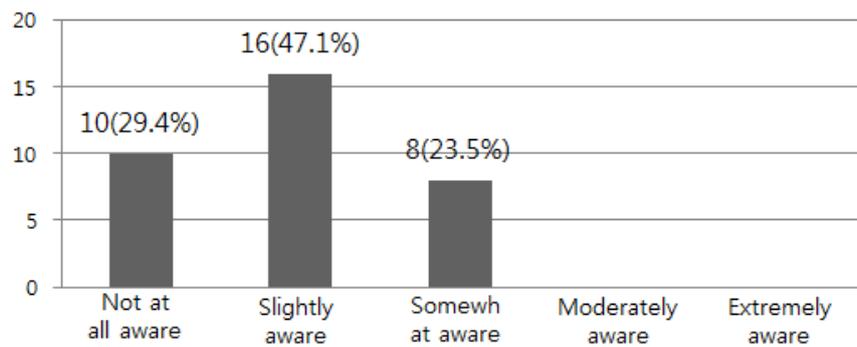

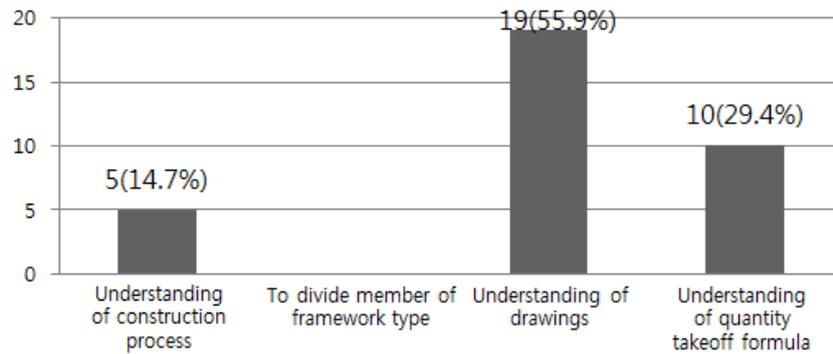Figure 3. Understanding of quantity take-off.

Figure 4. Difficulty in learning.

To clarify their difficulty in reading drawings, the 19 students who had the choice were interviewed with. They had difficulties in interpreting drawings and catching information of the building from conventional 2D drawings. Visual Manual will include 3D modeling and simulation for easy interpreting and understanding of drawings. It will cover the demand for manual and textbook shown in Figure 5.
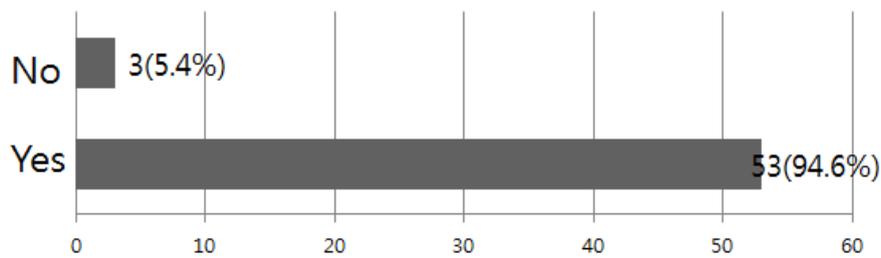

Figure 5. Necessity of manual and textbook.

4. Visual Manual

As mentioned above, non-standardized instruction of take-off and restricted contents of conventional take-off manual makes the take-off work less efficient. Visual Manual will be developed to enhance the efficiency of take-off work. Visual manual focuses not only on efficient take-off procedure but also on inclusions for each task and their work sequence.

4.1. System Configuration

Construction process, quantity take-off outline, quantity take-off procedure and quantity take-off formula were adopted as contents of Visual Manual based on a manual that analyzed of 5 different practical manuals. Contents of construction process enable the user to understand overall construction process and know what item will be used and when the item will be used. Content of quantity take-off outline, procedure and formula make the work more efficient by providing the clear reference guide. Video and 3D simulation as well as conventional text and illustration are adopted as content type for better understanding of user as shown in Figure 6.
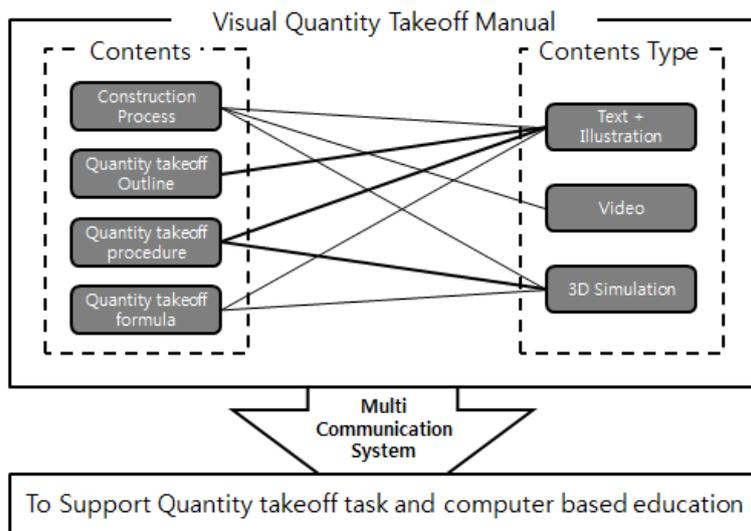
Figure 6. Visual Manual Overview.

4.2. Major Contents and Implementation

Visual manual consists of the 5 different functions as shown in Figure 7. The tasks are classified by trades and building elements in a hierarchical format. The categorized work tasks are linked with multi-media based databases to explain the sequence of detail activities, inclusions, formula for extracting materials quantities and so on.
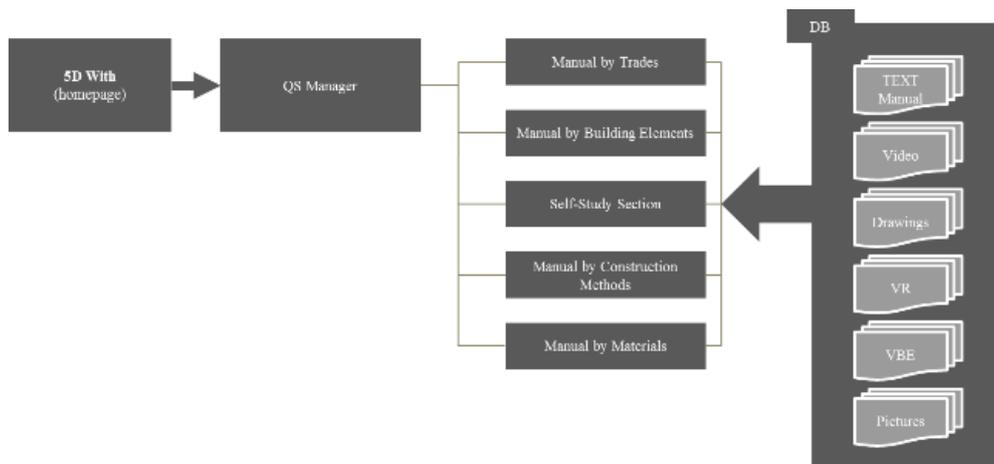

Figure 7. Visual Manual Overview.

As an advanced work, conventional printed form of manual information is displayed at text manual, as shown in Figure 8. Also, 3D simulation, video and related information will be displayed with the text manual in multiple ways. The manual is developed for user to find and use all information at one time.
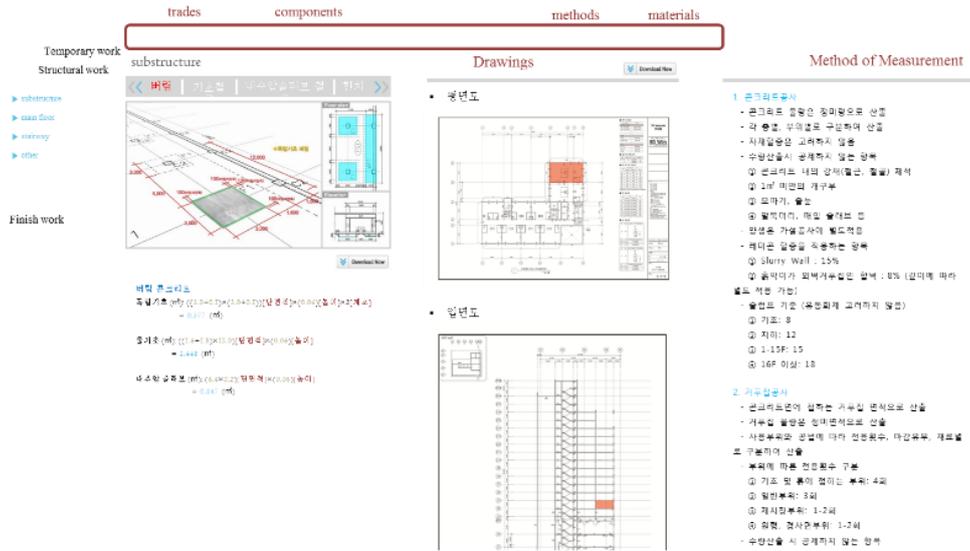
Figure 8. Main User Interface.

Figure 9 shows that the measurement method for beam rebar installation is explained with 3D visual drawings. Floor plan and elevation is also displayed for better understanding.
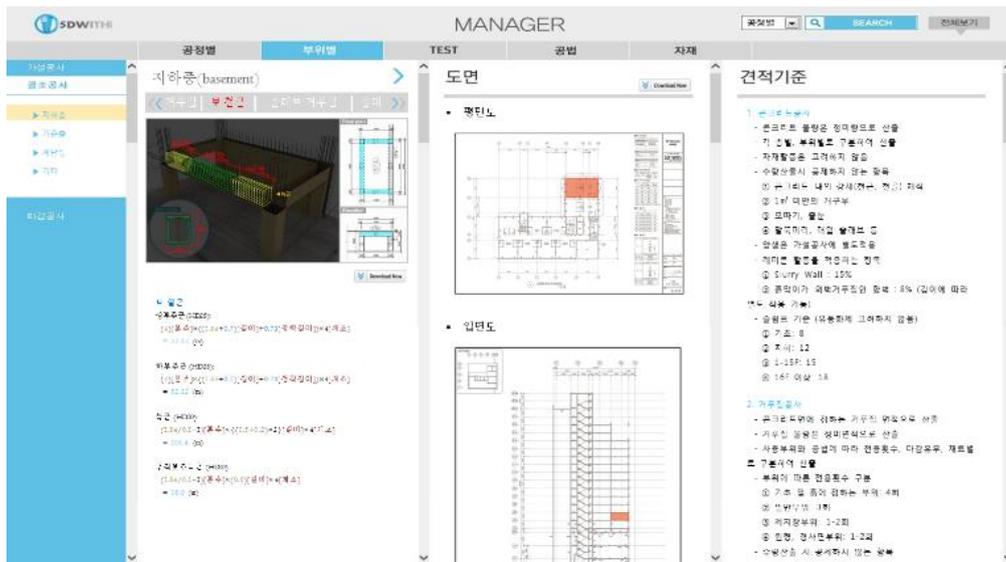

Figure 9. QS-structural rebar example.

Flash VR (virtual reality) and VBE (virtual building explorer) are applied to navigate the drawings thru zoom-in and -out and walk thru from various viewpoints (see Figure 10, and Figure 11).

Figure 10. QS-Flash VR example.

Figure 11. QS-Video and VBE example.

It is nice to have a self-test section that helps the students to do double check the understanding by oneself as shown in Figure 12.

Figure 12. QS-Video and VBE example.

5. Conclusions

This is the on-going study for developing Visual Manual and aims to suggest system outline of the manual. The current state of quantity take-off and BIM was investigated. System configuration of the manual was established through survey.

Visual manual is developed to support quantity take-off work in which human errors are frequent and learning quantity take-off which needs help in interpreting and understanding drawings. The manual is based on 3D BIM and includes text, illustration and multimedia such as video and simulation for better understanding. The initial system targets one unit of apartment house which is most common building in Korea.

Based on this study, developing the Visual Manual system including contents and interface will be used in the class of the spring semester, 2014. The system, furthermore, will be evaluated in terms of functionality and usability. In addition, the system will be upgraded through feedback from lecturer and students.

The developed system will become a framework to make an expanded system applicable overall construction work, through supplement and expand of contents, configuration and communication measure verified by experts. Visual Manual will make take-off work and education more efficient.

6. Acknowledgements

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