A REAL WORLD PROJECT- BASED LEARNING COMPONENT: INTERACTION WITH END-USERS THROUGH 3D MODELS

Suining Ding
Indiana University Purdue University Fort Wayne, Fort Wayne, Indiana; Email: dings@ipfw.edu

1. INTRODUCTION

Many users may have experienced difficulties to imagine and visualize three dimensional spaces through two dimensional drawings. This creates communication problems between designers and users. In order to solve this problem, an alternative approach of space planning by using computer generated 3-D models to help users visualize three dimensional spaces was utilized. In addition to the advantage of 3D visualization, users are able to see different furniture arrangements as well as different interior finishes during the design process. This alternative space planning method has been integrated into a real world project-based learning process in an interior design course: CAD for Interior Design. This paper presents the course design, the space planning process and student work as well as feedbacks from student-user interaction session. In the meantime, recommendations were made for future course improvement. One of the objectives of this course is to let students experience a real space planning process while using 3-D AutoCAD. To achieve this goal, a real project was assigned in this course. Students have interacted with end-users through 3D models. The project assignment is to redesign an existing conference room with 3D models. The existing conference room is a dull and plain looking interior space without any decorative element. Students were taken to the conference room site to verify the existing conditions with measuring tapes. Photos were also taken by students.

The requirement for this project is to create an attractive and appealing interior space with required furniture and caseworks. Students were required to apply different finishes to the interiors and be able to move furniture around during the design process. The end users were invited to the class. Students presented different perspective views of the interior space and their design concepts. Feedbacks are very positive. Users are very pleased with the design solutions.

The significance of this process is that it provides the opportunity for students to work on a real space planning project. Using 3D models instead of 2D drawings solved the communication problems between designers and users in the design process. Students not only learned 3D AutoCAD, but also went through a real space planning process with a real world project. They have a better understanding of the space planning and interaction with end-users by using 3D models.

2. SPACE PLANNING PROCESS

2.1. Traditional Space Planning method and Process

Space planning is one of the major steps in schematic design. Traditional space planning method is using two dimensional drawings to convey design concepts. Usually, designers meet with end users and present two or more alternatives. End users can express their needs and preferences by words. Designers get feedbacks from end users and make changes or provide new design ideas to users during the next client meeting. The communication problem may exist between designers and users because some users may not be able to interpret 2D drawings and visualize a 3D space. This process can be described as the following:

- Step 1 – Programming. The goal of this phase is to identify user needs and preferences regarding the project as well as project objectives. The methods used in this phase are interview, questionnaire and observation. At the end of programming phase, a written document need to be created, this is called program. Sometimes it is called project brief or problem statement (Pile, 2003).
- Step 2 – Space Planning with Rough Sketches. During this phase, square footage will be assigned to each room. Adjacent Matrix will be used for the analysis of functional relationship. Bubble diagrams will be used for a functional space layout. When there is more than one floor, stacking plan will be used for layout the functional relationship. The method used is 2D drawings.
- Step 3 – After floor plan layouts are finalized, furniture will be arranged in each room. The method used is 2D drawings.
- Step 4 – The last step in space planning process is to prepare 2D drawings for meeting with end-users. The 2D drawings include floor plans with furniture layout.

The traditional space planning method and process can be summarized as the following diagram shown as Figure 1.

2.2 Alternative Space Planning Method and Process

The alternative space planning method that was integrated into this AutoCAD course is to provide three dimensional visual images to end-users during the design process. Since a lots of end-users had experienced difficulties to visualize a three dimensional space from two dimensional drawings, therefore, computer generated 3D models are utilized as a design tool to ensure a good communication between designers and users. Users can understand designers' intent better so that it enhances the collaboration between designers and end-users. In addition to this advantage, users are able to see different furniture arrangement as well as different interior finishes during this process. The major change in this alternative approach can be described as the following:

- Step 1 : Programming – No change

- Step 2 : Space Planning Rough Sketches – No Change
- Step 3: Furniture Layout – During this phase, the alternative method is to create 3D models of furniture. The furniture can be moved by both designers and users. The meeting is no longer a designer-centered meeting. Instead it is a user - designer collaboration session
- Step 4: Space Planning Drawings – The alternative method used during this phase is building 3D models of interior space. Interior finishes and lighting designs can be changed at anytime. It also provides different perspectives for end-users. The meeting actually is a designer-user collaboration session.

Figure 2 outlines the changes in traditional space planning method and process.

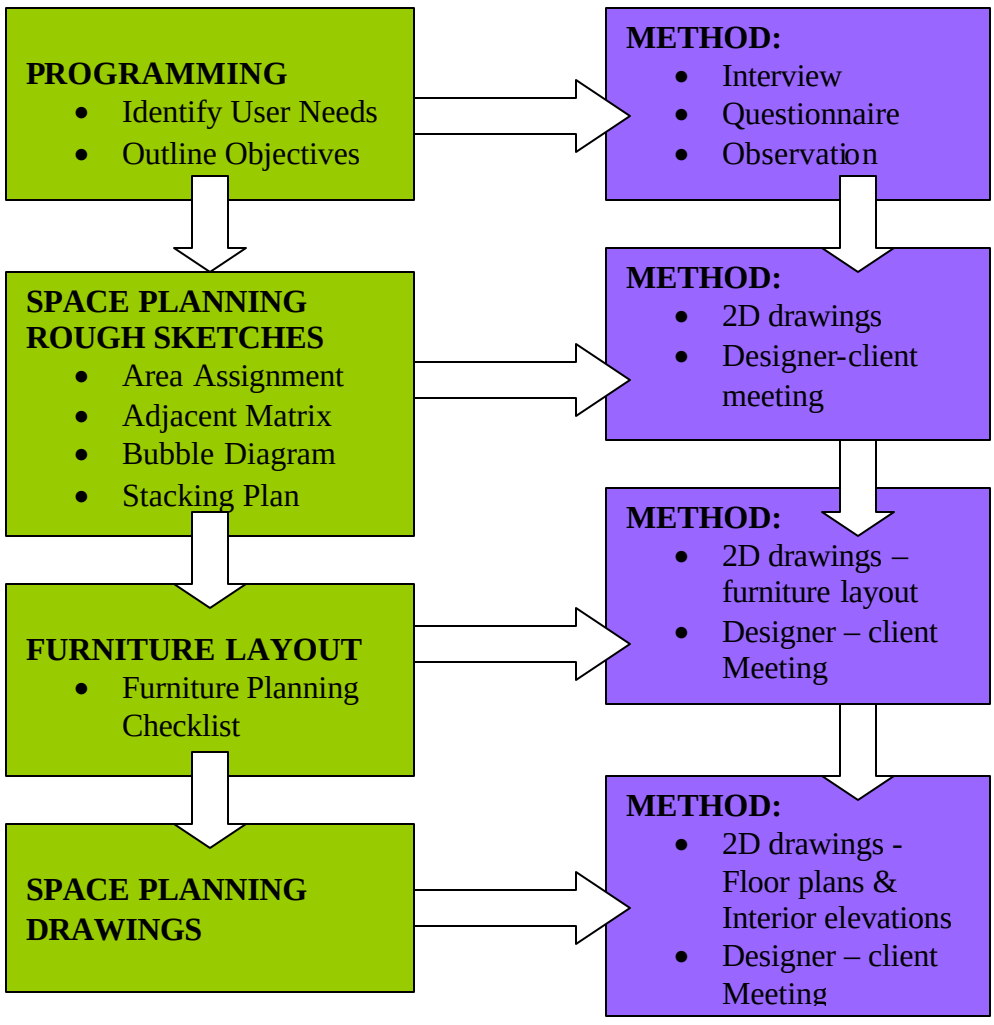

Figure 1: Traditional Space Planning Method and Process

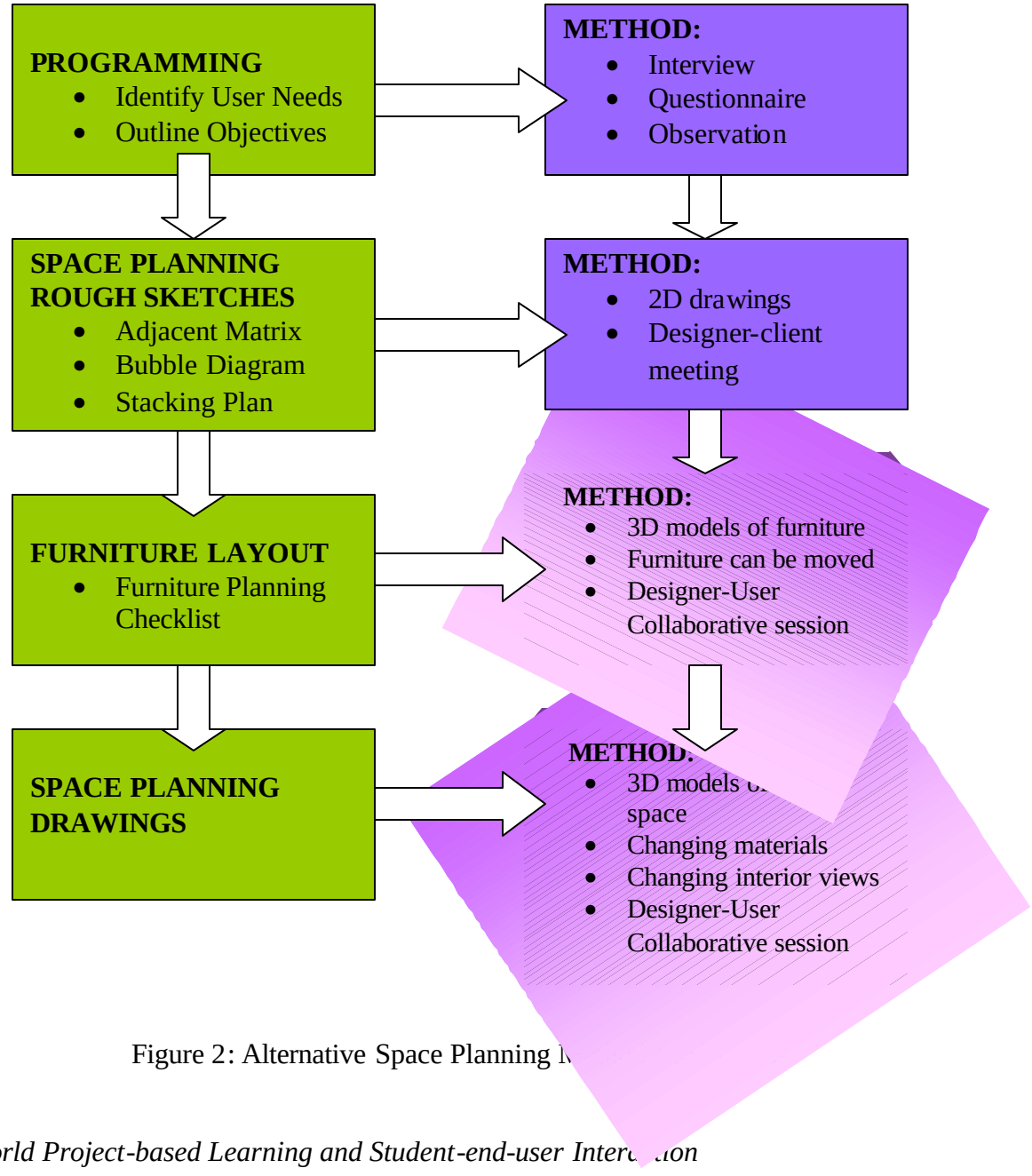

Figure 2: Alternative Space Planning

2.3 Real World Project-based Learning and Student-end-user Interaction

Real world Project-based Learning (PBL) is a model for classroom activity that shifts away from the classroom practice of isolated and teacher-centered lessons. It emphasizes learning activities that are more practical and comprehensive, student-centered, and integrated with real world projects and practices. PBL also provides opportunities for a real world interaction. Students

apply and integrate the content of subject matters at authentic moments instead of in an artificial setting. PBL also helps make learning useful to students by establishing connections to life outside the classroom, addressing real world concerns, and developing real world skills. A real world project-based learning provides students enormous advantages not available from traditional instruction (San Mateo County Office of Education, 2000). Many of the skills learned through project-based learning are more practical skills, which students can not learn from the class. These skills include the ability to communicate well with others, make right decisions by using the knowledge learned from the class and solve complex problems. In the classroom, PBL provides many unique opportunities for instructors to build relationships with students. Instructors may fill different roles, such as coach, facilitator, and co-learner when both instructor and student engage in a real world project-based learning.

Research indicates that successful learning process involves an interaction of students, instructors, and others such as communities. A real world project-based learning requires effective communication and interaction. Furthermore, involving students in real-world projects and linking new information to prior knowledge requires effective communication and collaboration among instructors, students, and others (Tinzmann, et al., 1990). Student-instructor collaboration is not the only one component; instead there are other collaboration in the classroom such as student and end-user collaboration. Therefore, to integrate a real world project-based learning component in this AutoCAD course needs an effective communication method that can ensure successful interactions between students and users. It is obvious that computer generated 3D models will be one of key tools for the success of collaboration.

3. COURSE DESIGN AND PROJECT REQUIREMENT

3.1 Course Design

The course is for second year interior design students. In this course, students will learn advanced AutoCAD skills. The first objective of this course is for students to learn how to use AutoCAD software and build 3D models. The second objective of this course is to let students experience a real space planning process and interact with end-users. It will solve the communication problems in the design process when interact with end-users through computer generated three dimensional models. Another aspect of successful learning process is to assess different perspectives that students become knowledgeable and capable through dialogue and interaction. Therefore, a real world project-based learning component has been integrated into this course. One of the learning outcomes for this course is that students will be able to create 3D models of their design concepts. In order to assess this learning outcome and application of the knowledge and skills students learned from this course, a comprehensive final project is required for this course. The final project is to redesign a real conference room which is plain and without many decorations (Figure 3 and Figure 4). Students need to go through a real space planning process and get feedbacks from end users. The final project process can be described as:

- Step 1: Project assignment - The project descriptions and requirements as well as existing conditions are given to students, such as dimensioned floor plan and section.
- Step 2: Field measurement and visit – Students were taken to the existing conference room to see the existing conditions and taking photos or doing measurements as necessary.
- Step 3: Studio Time – Students will spend two and half weeks in class to build the 3D models for furniture and the interior space, as well as lighting design. The author as the instructor will provide helps and advices to students. During this period, instructor's role shifted to varied roles, such as co-designer and coach.
- Step 4: User feedback session – End users are invited to the class. Students presented their design solutions with different perspectives and get feedbacks from end users.

3.2 Project Requirement

The requirement for this project is to create an attractive and appealing interior space which furnished by a tele-conference screen; a refreshment counter; a display case for trophies; a conference table with at least six chairs. Student's creativities were stimulated by the instructor. Possible architectural components such as coffer ceiling, coved ceiling or dome ceiling with different lighting designs were shown to students. Students were required to apply different finishes to the interiors and be able to move the furniture around when present their design concepts to users. The following photos show the existing conditions of the conference room. There is no display case in the existing conference. All trophies and certifications are displayed on a simple shelve. The ceiling is ordinary acoustical ceiling tiles. The interior lighting and wall paint were very plain. The color tone in the conference room is cool gray.
The design requirements for this conference room are:

1. Need a conference table with at least six chairs
2. Need a countertop for serving refreshment and drinks
3. Need a display case (glass window / display window)
4. Need a screen for Tele-conference
5. Ceiling could be a dome, curved ceiling; coffer ceiling; floating ceiling or any other type of ceilings.
6. Use 3D AutoCAD to create a 3D rendering for this space with different perspectives.
7. You may choose appropriate finishes for this interior space. Design lighting for this room also.
8. Refer to attached plan for dimensions.

4. DESIGNER - USER INTERACTION SESSION

The end users were invited to the class. Each student is required to present the design solutions to users. Students have to present different perspective views and explain their design intent. The 3D models provided dynamic visual images to users. Users asked questions and made suggestions to students. Feed backs are very positive. Users are very pleased with the design

solutions. Users stated that student's design had exceeded their expectations. They enjoyed the interaction session with 3D models. The final 3D models of the conference room not only allow designers to change materials for furniture and interior finishes, but also allow designers to move the furniture around. It really provides lots of flexibilities for designers in the design process. In the meantime, it solves the communication problems that may exist between designers and users. Students learned a great deal from this designer-user interaction learning process. They really experienced a real space planning process with 3D models. Students stated in their course evaluations "I enjoyed making 3D models and I feel so proud of myself and be able to present design concept to users…." Figure5 and Figure 6 show a sample of student work from this class. This sample design provides a warm color tone in the conference room. A glass display case adds the senesce of sophistication to the space. Coffered ceiling adds more visual interests. A refreshment counter is provided. Lighting design and art accessories help to achieve the goal of an attractive and appealing space.

Figure 3: Photo of Existing Conference Room

Figure 4: Photo of Existing Conference Room

Figure 5: Sample of Student Work - 3D Model Of Redesigned Conference Room

Figure 6: Sample of Student Work – 3D model of Redesigned Conference Room

5. SUMMARY

This alternative space planning process through 3-D visualization really gets users to be involved in the design process. The significance of this process is that users have a say in the process and are able to act as a decision maker. Because of this real world project-based learning component, students not only learned 3D AutoCAD, but also went through an innovated space planning process which is interaction with end-user through 3D models. As a result students have better understandings of the space planning and interaction with users. The limitation of this approach is the limited furniture 3D models and caseworks. The future study direction could be the creation of furniture library in order to provide more choices for users. Project-based learning may connect to the real world because it addresses real world issues that are relevant to students' lives or communities. The recommendations for future course improvement are:

- Keep real world project-based learning component in course design
- Establishing an assessment process and allowing students to participate in creating their own assessment standards because it is an important component of project-based learning.
- The real world project-based learning can take on many forms, such as service, design, consulting, depending on the goal of the project.
- Design reviews are short structured events, in which a group of people discusses the work they have done so far, and their plans to complete the project. Design reviews throughout the project give students the chance to learn from each other and learn how to critique constructively. Allow peers to critique the plan and offer suggestions. Students can learn a lot from each other.
- Add more designer-user interaction sessions throughout the semester so that students may get feedbacks from users during the early design process.
- Effective communication and collaboration are essential to achieve a successful learning process. The professor needs to change the role as a facilitator or helper instead of an instructor when students interact with end-users.

In conclusion, this real world project-based learning is a successful learning process to students. The student- end-user interaction session is an important component in PBL. Students gained more experience which they won't learn from a more traditional class. It will benefit students for their future professional practice.

References

Pile, John (2003). Interior Design. Prentice Hall, New Jersey

San Mateo County Office of Education. (2000). Project-Based Learning with Multimedia. http://pblmm.k12.ca.us/PBLGuide/WhyPBL.html

M.B. Tinzmann, B.F. Jones, T.F. Fennimore, J.Bakker, C. Fine, and J. Pierce (1990). What is the Collaborative Classroom?, NCREL, Oak Book.
http://www.ncrel.org/sdrs/areas/rpl_esys/collab.htm