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A Study on Basic Level 3D MAYA Animation Instruction in College:

an Action Research Approach

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Abstract

Digital content is currently one of the most critical and leading industries in developed countries all over the world. Game, animation, and digital arts creation are the three major areas of digital content industry. MAYA 3D is a very important software for designing game, animation and digital arts. However, it is still difficult to implement MAYA instruction in the university setting in Taiwan due to the following limitations: English only interface; numerous and complicated commands; imbalance between creativity and techniques; expensive hardware, software, and tuition; insufficient teaching materials and resources; passivity of students; shortage of faculty specialized in this domain in higher education; and immature cross-disciplinary cooperation mechanisms. To explore ways for improving MAYA instruction, in this study I adopted an action research approach to collect research data, analyze and reflect on the teaching processes and results, and present results for insemination.

The purpose of this study is to explore the characteristics, functions and instructional limitations of MAYA, demonstrate the basic teaching procedures, compare and analyze students' final works, reflect on issues and problems in the instructional program, and finally

make suggestions for improvement. In this paper, I introduce functions and teaching materials of MAYA software first. Then, I analyze teaching hardware and materials, and adopt integrated teaching methods to demonstrate a work from start to completion step by step. Next, I compare and analyze the merits and weaknesses of students' final works, and discuss the effectiveness of teaching. Finally, conclusions and pedagogical suggestions are made, which include the following: 1) It's necessary to promote students' positive learning attitude, and to cultivate their aesthetic sensibility and creativity. 2) Qualified and experienced university faculty specialized in MAYA and its applications are urgently needed. 3) An integrated approach to teach MAYA step by step has been shown to be effective. 4) It is necessary to develop a MAYA training course which is adequate and complete. I hope that these suggestions are useful to other teachers and researchers involved in MAYA instruction, are helpful for training game and animation designers, and are valuable for promoting the quality and quantity of domestic digital content creation.

Keywords: MAYA software, 3D animation, action research, digital content

Background and Motivation

The fast development in computer technology has brought the information revolution into every aspect of modern life (Gere, 2002). The field of creative arts has also been caught up in this trend of digitalization (Paul, 203; Yeh, 2005), which has added a new and powerful tool to the artist's toolkit. Digital art has been included, along with game, animation, digital video, mobile communication, software, and network service, in the 2-trillion Twin-Star digital content project (Ministry of Economic Affairs, 2004) of the 2008 national development plan of Taiwan, the Republic of China (Council for Economic Planning and Development of the Executive Yuan, 2006). The importance of digital art cannot be over-emphasized.

In 2002, in response to the national development plan mentioned above, the Ministry of Education (MOE), Taiwan, ROC,

selected five universities to set up educational resources centers around the island for providing digital art training to college students majoring in art and designing. As a partner of the Digital Media Center of National Yulin University of Science and Technology, which was selected by MOE as one of the five resources centers, the Department of Fine Art of National Chiayi University has been funded by the project since 2002, and, with the money, has been able to hire professional animation designers to offer MAYA 3D animation courses to students in the department. Ever since then, digital art education has been a focus of the curriculum, and, as one of the faculty members initiating the 3D animation instruction, I have been involved in the teaching and promotion of MAYA 3D animation. In this paper, I report the experiences, processes, and results of the action research study on my own teaching of the basic level MAYA 3D animation courses in the past four years. It is hoped that my report and sharing would be interesting and helpful to those who are interested in and/or involved in MAYA 3D animation instruction and production, and, as a result, would enhance the effectiveness of MOE's digital art training program.

Purpose and Method

The purpose of this study is four-fold: 1) to explore the functions and characteristics of MAYA; 2) to demonstrate the instructional processes of a basic level MAYA course; 3) to analyze students' works from term projects and discuss their strengths and weaknesses; and 4) to reflect on the instructional processes and present pedagogical suggestions.

An action research approach was adopted in this study. According to McNiff, Lomax, and Whitehead (2001), action research refers to research conducted by practitioners for improving professionalism and practices in various work settings, which may lead to the following four benefits: 1) improving one's own professional development; 2) better practices in the profession; 3) improved working conditions, and 4) improved social order and conditions.

As such, the purpose of action research is to improve the status quo and increase knowledge. Tsai (2004) suggests that there are three types of action inquiries: scientific-techno, practical, and critical. As an

instructor of digital art and design in college, I was constantly engaged in overcoming obstacles in teaching and elevating the quality and effectiveness of instruction; thus, the practical action research seemed rather natural for me, which I conceived as an important strategy to improve MAYA 3D animation instruction and to increase knowledge relevant to teaching digital art. Following Tsai's (2004) procedures of curriculum development action research, this study had five interrelated components: 1) focusing on the problem; 2) planning the program; 3) seeking for partners; 4) implementing the program and constantly reflecting on the execution; 5) evaluating the feedback; and 6) reporting results from the action research on the curricular development project.

MAYA is a very complex system for creating 3D animation and it would be easier for both the instructor and the students if they progress step by step from the basic level to the intermediate level and to the advanced level. With the funding from Ministry of Education, the present researcher invited Mr. Lin Yue-han, a professional animator, to help with the technical part of the action research project, which started from September 2005 and lasted till January 2006 (i.e., the fall semester of 2005).

To collect data, the teacher researcher kept a researcher's journal, collected teaching materials, collected student works, and interviewed students. The subjects were the senior students in a two-year college program of a local technology institute. Most students already had some basic computer literacy, but given the highly complex nature of MAYA 3D animation system, which is far more complicated than ordinary software for creating and editing 2D images, most students would find MAYA 3D to be rather challenging for them.

Literature Review

In Taiwan, research in computer-assisted art instruction has focused mostly on 2D art (for example, Tien-chun Chang, Chen-feng Kao, Ting-ming Wang, Chien-ping Lee, and Chuan-cheng Chang). Pei-chun Lin and her graduate students have done some research in 3D animation, but in comparison with 2D art, 3D animation is scarce. MAYA 3D animation training has been rare due to expensive tuitions,

insufficient teaching materials, and very limited research report. To promote domestic research in digital content and application, it is clearly necessary that more research on MAYA 3D instruction is conducted and reported.

Functions and Characteristics of MAYA

My specialty is in art education and has quite some experience in traditional arts and art theories. After some initial exploration in MAYA, I realized that it is a very important tool for artistic creation and application in the digital age, a very powerful but challenging tool which is much more expansive and complicated than traditional tools in art. It required not only artistic competence, in its traditional sense, but also basic competence in music, drama, literature, movies, information technology, and computer programming. Such demand of interdisciplinary knowledge and skills is very challenging for an individual. Thus, collaboration among people from different fields may seem a good strategy for producing excellent 3D art works.

To the best of my knowledge, MAYA 3D software is gaining popularity not only in the field of art and design but also in architecture, medicine, engineering, and aeronautic and space science, etc. Another application of MAYA is found in simulation of building. Tseng (2003) comments, "In Columbia University, students specializing in digital design are trained to use MAYA, which is more frequently used by Hollywood movie makers, or Softimage to execute building tasks. The purpose is not to create special effects but to realize and visualize concepts and ideas in architecture through the powerful software" (p.143). Therefore, art students with traditional aesthetic competence and hand drawing abilities would be able to find a job in many other fields if they are trained in MAYA 3D software.

MAYA has many utilities, including digital art creation, special visual effects in movies, virtual reality, computer animation, game production, architectural design, medication, and electronic commerce (Chien, 2004). Furthermore, MAYA has been judged to be a top 3D animation software. According to the white paper report on Taiwan's digital content industry prepared by Industrial Development Bureau of Ministry of Economic Affairs, digital content can be applied in the following domains: 1) entertainment (movie, game, network

broadcasting, etc.); 2) industries (architecture, industrial design, etc.); and 3) miscellaneous applications such as in medicine, science, the military, education, etc. Animation can also be classified according to its target, such as network animation, game animation, advertisement animation, television animation, movie animation, and movie special effect animation (see Figure 1)(Ministry of Economic Affairs, 2004).

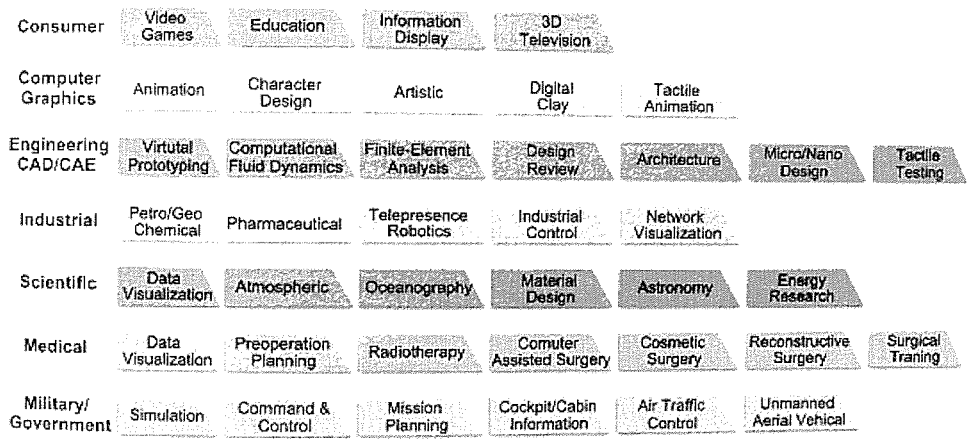

Figure 1. The application of 3D animation

From the above listing, we can see that 3D animation has very wide applications and that MAYA is recognized to be a top application for creating 3D animation. The value and potential of MAYA is unmistakable. Art students who are well trained in MAYA will be able to work in many more fields than in the traditional art education field (Chien, 2006).

Teaching Resources for MAYA

When MAYA became commercially available in 2000, teaching resources for MAYA were very limited, making both teaching and learning MAYA very challenging to the teacher and the students. To learn about the software or the commands, the user had to refer to the English manuals, which consist of more than a dozen volumes (Alias/Wavefront, 2000), or to pay a dear sum of tuition to attend MAYA classes offered by private institutions. For instance, I registered in a 9-day intensive MAYA workshop in Taipei in the summer 2001 to study

advanced MAYA. The tuition was NT$56,000 (about $1700), an amount equivalent to the monthly salary of a beginning assistant professor in college. But given the brief period of time and highly compressed program and high level of stress, the workshop was not as effective as had been expected and was, frankly speaking, not worth the money. That kind of workshop wouldn't be affordable for college students. With this experience, I started to conceive the idea of offering MAYA 3D instruction to college students.

Later, a Chinese translation of the original MAYA 3.0 manual set was published by *Dragon Code Studio* (2001) of Mainland China, which was also in Taiwan. The Chinese version was an important resource for MAYA users at that time. Most importantly, MAYA was widely used in many popular animation-based movies produced by Disney, such as *"A Bug's Life"*, *"Toy Story"*, and *"Finding Nemo"*, among which, Finding Nemo won the 2003 Oscar Award in the best animated film category. The great success of the movies brought MAYA to spotlight, and more and more resource books on MAYA have been published since then. The official website of MAYA (http://www.cradle.com.tw/maya1, 2006/5/28) states, "MAYA has been widely used in producing special effects in movies. Block busters such as *'A Bug's Life'*, *'MIB'*, *'The Truman Show'*, *'Titanic'*, *'Old Master Q'*, *'Ice Age'*, *'Lord of the Ring'*, *'Shrek'*, *'Harry Potter'*, and so on all depended on the powerful MAYA to produce the animation in them."

However, the early manuals were mostly written by practitioners who tended to focus on demonstrating the commands; and many of the manuals were either ill-organized, disconnected, or full of typos. There were few integrated and extended examples in these manuals, which cost beginners a lot of time and frustration. Later manuals were more carefully written. For example, Ching Ho Publishing Co. of Taiwan published a progressive series of MAYA manuals (Yeh, 2005), and Po Shuo Publishing, reprinting sources from Mainland's Universal Digital Media Training Center, published another series of MAYA manuals (Chen & Hsu, 2005). The latter one was especially helpful because it provided many practical experiences shared by Mainland's animators and also much information about the background and techniques in animation.

In addition to print-based manuals, VCD's of step by step MAYA instruction have become increasingly available, which are either

produced in Taiwan or imported from abroad. The demonstration VCD' s published by Alias/Wavefront, Gommon, and Digital Tutor are generally pricy. Locally published VCD' s, such as those online videos produced by Ching Ho Publishing Co. are much more affordable and are very helpful in promoting learning of MAYA. The Department of Fine Arts of National Chiayi University, where I work, also provides a website designated to 3D animation learning (http://140.130.49.109), which includes course information and recording of classroom instruction.

Availability of teaching resources is certainly the first important thing in MAYA training; however, effective teaching methods and timely solution of problems are also essential (Interview 04–23–2006). It is very difficult for inexperienced learners to learn MAYA by themselves. Private classes, even with government subsidies, are still very expensive. Offering MAYA courses seems a good strategy, but there is still a long way to go as higher education institutes in Taiwan still lack qualified and experienced teachers, equipments and software to implement MAYA instructional programs.

Challenges in Teaching MAYA

In my experience, a very intriguing phenomenon in MAYA instruction was that many students were interested in learning MAYA but very few could endure the hardship of it. For instance, over the past years, some thirty students would usually sign up the MAYA course I taught at the beginning. After a semester' s hard work, some 20 students might remain, but only about 10 really interested students would make it to the very end of the second semester. Difficulties that daunted the students included the following: English only interface; numerous and complicated commands; imbalance between creativity and techniques; expensive hardware, software, and tuition; insufficient teaching materials and resources; passivity of students; shortage of faculty specialized in this domain in higher education; and immature cross–disciplinary cooperation mechanisms (Chien & Chang, 2004).

In my observation, the college students enrolled in the program were curious about computer animation, but they generally lacked a proper goal, perseverance, and endurance, which led, at least partially, to ineffective learning. In contrast, a world class game designer who was asked to provide advice for game designers made it clear that

more time and more hard work in front of the computer screen was all that was needed for an outstanding game artist (McKinley, 2005). Another game designer also suggested, "You have to work very hard to completely master the techniques, willing to spend a tremendous amount of time on the software, the models, and special effects, and the roles" (McKinley, 2005, p.6). From the masters' advice, we know that constant and continuous hard work is definitely needed for great achievement in animation works. But this seems to be what our students do not have nowadays.

To sum up, MAYA instruction in higher education setting may still have a long way to go. In this study, an action research approach is taken to solve the problems mentioned above, so that the powerful software MAYA would be learned by more art and design students and applied in more fields, which would eventually reduce unemployment and increase more economic value of the country (Chien, 2005).

Instructional Program

This action research project started from September 2005 and ended in January 2006. The basic level MAYA course was offered to art students in a local institute of technology. The instructor and the students met in the evening for three hours every week. The program is described as follows.

Equipment and Facilities

MAYA used to be operational only on expensive SGI workstations, but thanks to the fast development of computer technology MAYA can now be run on personal computers or even notebook computers. However, to ensure smooth running, it's better not to rely on the built-in graphic chip but to use an independent graphic card with at least 1GB RAM. Dual CPU or dual Xeon mainboards will certainly increase the speed of MAYA.

MAYA demands a lot of CPU speed and RAM. In addition, ever newer versions with ever higher demands on the hardware have been issued by the publisher over the years, constituting a heavy financial burden on the individual student and/or the school. Fortunately, the

fast advancement in computer technology has enabled computer manufacturers to produce high performance computers at much lower and affordable prices. Learning MAYA is becoming more common among students.

As for the software, the price of MAYA has been lowered many times and there are educational editions available too[1].MAYA even provides a free personal learning edition for beginners, which offers all the similar functions except for screen images and watermark after image calibration[2].In this study, Pentium IV computers were used, which ran at a reasonable speed for the basic level MAYA.

Teaching Materials

As mentioned in the literature, there are some quality Chinese manuals available in Taiwan now. For the beginning MAYA learners in this study, the MAYA Evolution Series, I (Yeh, 2005) were adopted. The book provided useful chapters for students to study and also provided a structure to schedule students' learning. It was also a useful reference book which students could consult when they needed to solve problems immediately. Moreover, the researcher added other materials, some of which were teacher-developed, to the curriculum according to students' levels and needs. Students were encouraged to create their own MAYA products to be used in class.

The researcher also produced instructional VCD's and distributed them to students. The VCD contained outstanding works by former students, animation demonstrations, local and foreign instructional videos on MAYA, and MAYA resources websites. The students were encouraged to visit the MAYA 3D website constructed by the researcher and his colleagues and students in a previous MOE-funded project[3] .

Instructional Methods

Different from the traditional teaching method which usually starts with an introduction to the commands of the software, I started the course with an exploration of the basic operations of MAYA and the interfaces. This was intended to give students a holistic picture of MAYA so

1 MAYA 7.01 Unlimited Educational Edition cost around $1700 in April 2006.

2 Free download URL: http://usa.autodesk.com/adsk/servlet/index?id=6902573&siteID=123112

that they wouldn' t get lost when they ran into trouble in doing MAYA exercises. From the second class and on, students were instructed to apply simple NURBS to build models of fruit (starfruit, apple, orange), fruit plate, teapot, and tea cup, and then applied the polygon model building function to construct a tea table to set the fruit plate and the tea utensils. After the model was completed, students were instructed to add some simple texture to the model to increase its aesthetic value and integrity. Finally, the objects were grouped, and the history was deleted, and then it was ready for the next step, as shown in the picture below:

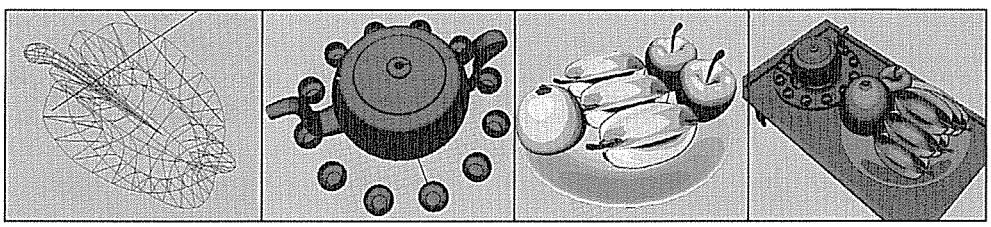

Figure 2. A Basic MAYA Model Building

In the next step, Polygon Model Building function was applied to build a house whose height was adjusted to the same level of the reference grid. The previously constructed fruit plate, tea utensils, and tea table were then put into the house, with their sizes adjusted accordingly. Then, by generously using the NURBS and Polygon model building functions, more objects┌beds, end tables, pillows, desks, desk lamps, televisions, sofa, for example┌were added into the house (see Figure 3 below), so as to familiarize the students with the model building process on the one hand and to further furnish the rooms on the other.

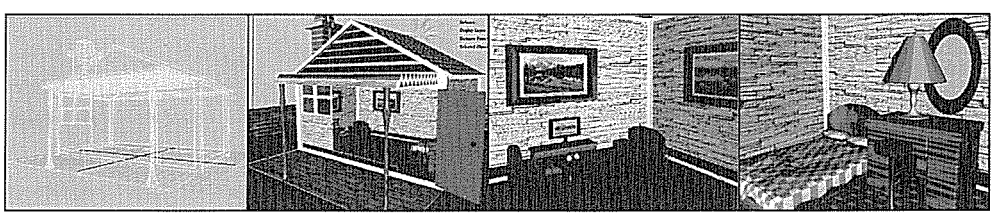

Figure 3. Model Building Exercise for Basic MAYA

3 http://140.130.49.109

After furnishing the rooms with appropriate objects, outdoor items (for example, fence, garden, street, trees along the street, and background) were then constructed and added to the house model after modifying the sizes. Grass and trees could be created with graphic tool such as Paint Effect. One important point to remember at this time was the necessity to appropriately adjust the default value in the Attribute Editor so as to avoid system freezing or lagging. Figure 4 is an example of basic level outdoor model building using MAYA.

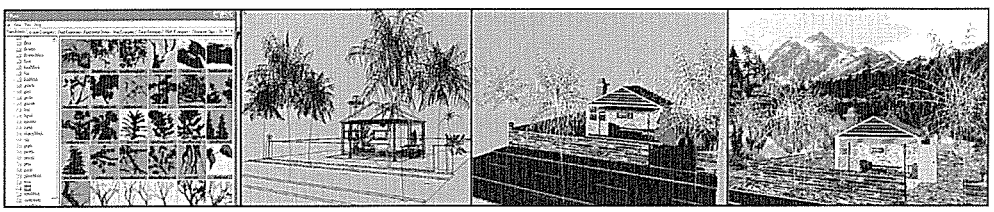

Figure 4. An Example of Basic Level Outdoor Model Building Using MAYA

With the indoor and outdoor objects completed, students were recommended to adjust the size, location, texture, and mapping of each object. They were suggested to collect maps and even modify and refine the mapping pictures with photo editing software such as Photoshop. This would enrich the texture and the mapping and would improve the aesthetic value of the work.

Then, students pressed the 7 key to bring out the Lighting mode. In this mode, MAYA allowed the students to adjust the main light, the secondary light, and the supplementary light according to the time frame (i.e., morning, noon, evening, night). The lighting mode was adjustable too, based on the characteristics of the lighting device. For instance, Direction Light was recommended for outdoor lighting, and reflection light should be dimmed according to its direction and distance. Instant IPR could be applied to calculate the brightness level of each lighting device, as shown in Figure 5. The process of light control is similar to drawing, a basic skill for all art majors. It is therefore claimed that art majors engaging in 3D animation work may be able to produce superior works because they have better aesthetic sensibility in shape and color and are more sensitive to subtle differences in shade and light. Technology majored students may excel

in techniques, but they are generally weaker in aesthetic development, which is needed for creating works of perfection and beauty.

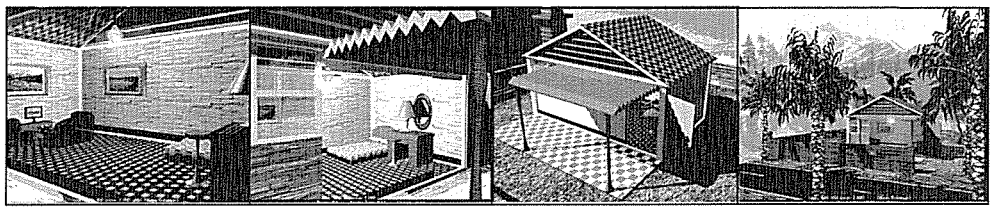

Figure 5. Lighting Exercise in Basic Level MAYA

With model building, texture modification, and lighting completed, the next step was to make some simple arrangement of the lenses for the animation. Students in my class were instructed to set the lens to Resolution Gate mode for choosing different lenses, setting distances, and creating motion. Students could also set up several lenses simultaneously, each of which was given a different motion. In addition to the lens in motion, the background and the objects in the setting could also be set to change their locations, directions, sizes and colors, which would result in very rich and dynamic animation.

The final step was image calculation. MAYA could calculate individual still images or continuous motion pictures. At the beginning, students were recommended to set the picture at lower resolution level so the result of calculation could be quickly obtained. If the result was as expected, then the pictures could be set to the actual size and the production quality. The size of single images for exhibit could be set at 4K square. If the output was to be made into movie with some moviemaking software, then Avi format or continuous single image in Targa format was proper. Students were strongly suggested to use post production software to modify the images—increasing the resolution, adding opening and ending and transition, changing the speed, and adding subtitles and music or sound effect—to improve the quality of the work.

Summing up, the steps illustrated above would help a beginning MAYA learner to complete the basic processes of model construction, model combination, texture modification, lighting, animation, and image calculation to create an animation work quickly.

Analysis of Students' Works from Term Projects

At the end of the semester, students all used the computer to create 3D animation works using their newly acquired MAYA knowledge and skills, however basic that might be. To analyze and evaluate students' works, I adopted the evaluation model for art students developed by Clark and Zimmerman (2004). In the evaluation rubric, the quality of students' 3D animation works was graded according to a five-point scale on three criteria: 1) model construction, 2) the relationship between the construction and the environment, and 3) the use of light.

Some students' works are collected in Figure 6. As readers may see, the construction of the first picture in the first row (the criterion of model construction) is very simplistic and the color of it is monotonous; it lacks subtlety in construction, texture, and lighting. The second picture in the same row still has some weaknesses but shows a lot of improvement already. The fifth picture is close to ideal.

In the second row (the criterion of construction-environment relationship), the first picture is still very rudimentary, as the details have not been worked out, making it look like an unfinished work. The background has not been extended to fit the picture size so that there is a black frame in the upper part of the picture. The background has not been put in the distance and is blocking the trees in the left side. In contrast, the last picture in the same row is much better: the fog in the environment, the lighting from above, and the shades of trees create a consistent and harmonious relationship between the construction and the environment.

In the third row (the criterion of use of light), the first picture has a background that is too bright. The second picture is totally darkened. The third one has an interesting atmosphere but it is lean in objects. The fourth picture has a well-calculated angle and represents a clear perspective.

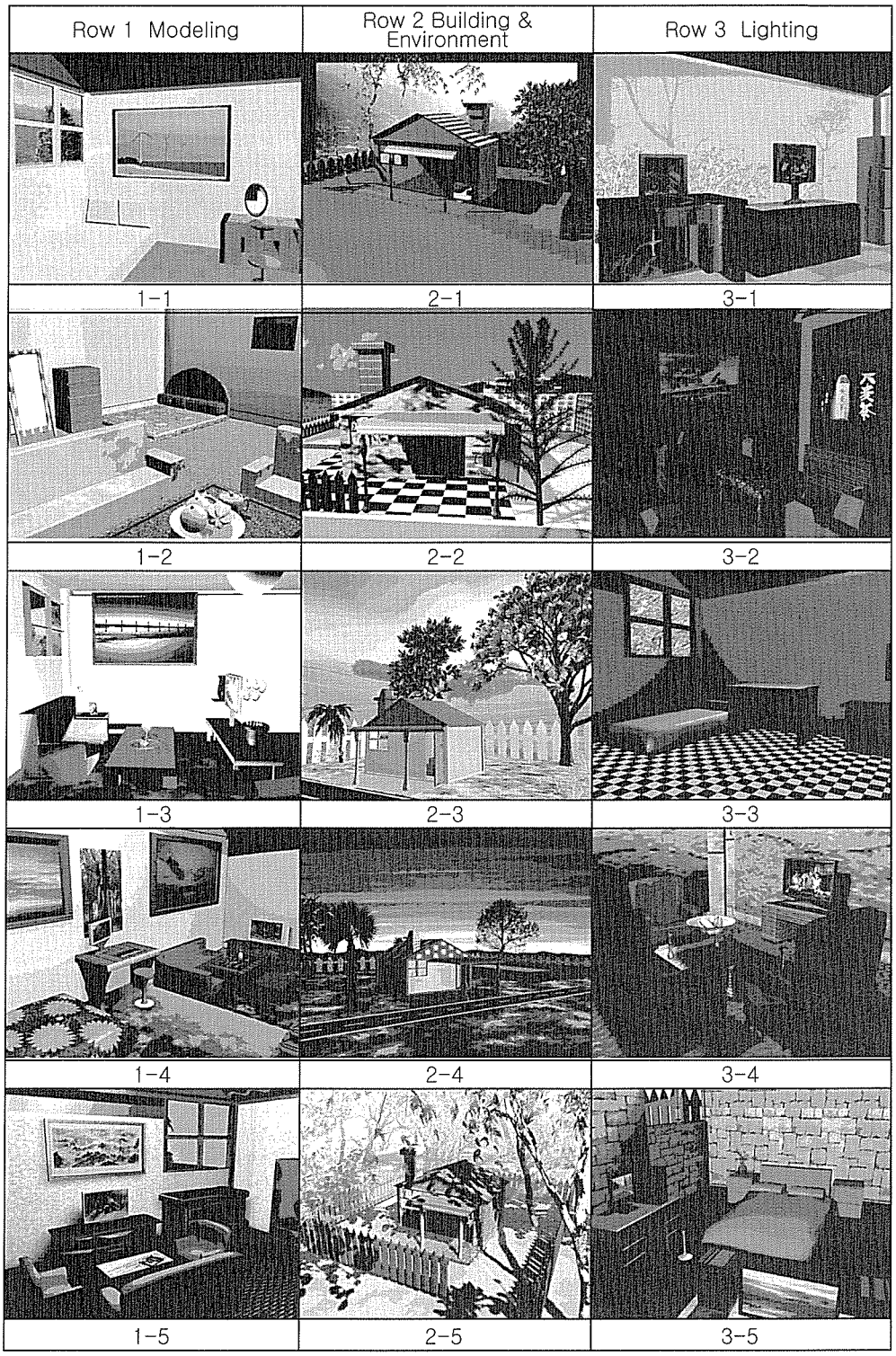

Figure 6. Comparing Student Works from the Basic Level MAYA Course

I was quite appreciative of the performance of the students in this course, who studied MAYA, with their limited English proficiency, for only a semester during which they met with me only one evening a week. Compared with a class that I had taught before which produced only 6 presentable pictures, this class created 26 still pictures that I felt was presentable and 8 motion pictures files that were published on the website[4] .As can be seen in the works shown in Figure 7 and Figure 8, the works of this class outperformed their earlier counterparts in both quantity and quality. A very important reason, I believe, was the constant monitoring and control of students' learning and problems. Another reason was this class had three full weeks to revise and refine their animation works, a lesson that I learned from previous teaching experiences.

Figure 7. 6 Presentable Still Images Created by Information Management Students of Wufeng College in June 2005

4 Please compare the Jan. 2006 works with June 2005 works in http://140.130.49.109 under "Students Works," then "Wufeng Information Management 2006," and then click on "Recommendable Works."

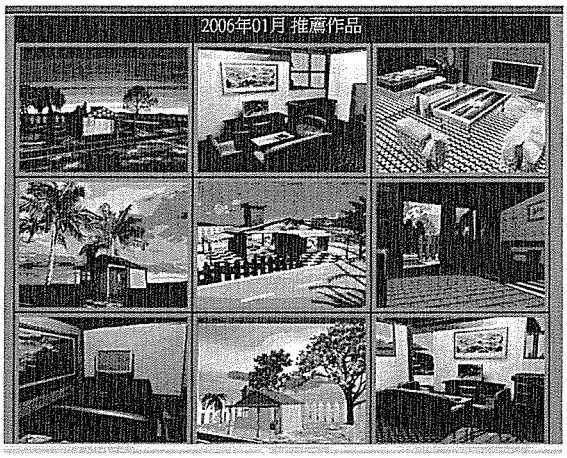

Figure 8. 26 Presentable Still Images Created by Information Management Students of Wufeng College in February 2006 (including 8 motion pictures files available on the web)

Discussion

In this section, I will further discuss some issues in teaching MAYA 3d animation. I will focus on three areas: equipment and facilities, teaching materials, and teaching methods.

Equipment and Facilities

Pentium IV desktop personal computers were used in this course. The two-year old computers, though a little old, still performed quite well when running the basic level MAYA commands. However, it was advisable for the class to meet in a computer lab with some extra computers in reserve, as computers often had problems and in such cases there would still be computers available. Furthermore, students without computers at home often requested the department to open the computer labs to students during non-working hours so that they could do MAYA exercises (Teaching Log 11-03-2005). Such an arrangement was a great help to those students, as doing MAYA homework was very time consuming and the three hours in class were definitely insufficient. Finally, it was advisable to use the same edition of software across different classes so that files created by students in different classes would still be compatible with the system. For students with limited proficiency, MAYA edition with a Chinese patch was a solution.

Teaching Materials

Textbooks, supplementary handouts, and MAYA resources websites were all essential to effective learning. However, textbooks could be expensive and not affordable for every student. It would be very nice if the teacher or department could leave a few copies in the lab for students to use. Furthermore, it would also be helpful to digitally record the instructional procedures and the screens of the instructor and then post them on the web so students wouldn't have to take notes in class and they could review any time they wanted. For students who had not been able to attend the class, the recordings were an important resources for their self-study.

Instructional Methods

Generally speaking, I would start a class by sharing with students animation works from previous classes while analyzing the strengths and flaws of each work. I would sometimes show them exemplary works and analyze their model construction, texture, lighting, and lens use. I found such method to be effective in facilitating students' conceptualization of successful 3D animation works and the procedures to achieve to that level.

In teaching MAYA, it was helpful to increase the frequency of demonstration and practice while avoiding lengthy demonstrations. If students encountered any troubles, immediate troubleshooting was necessary. This was because MAYA commands were very complicated and lengthy demonstrations were difficult for students to follow step by step. If students got lost in the middle, they might be force to give up.

Furthermore, it was important to design gradual sequences of steps leading to the completion of a work. Commands could be explained in the process of creating an actual work. For example, students could be instructed to construct a simple fruit model, then indoor objects, and then outdoor objects. After students had learned a couple of basic commands and functions, they should be encouraged to use what they had learned to create some small but different things. Gradually their concepts and skills would build up, so was their confidence and creativity. Eventually they would be able to attain to the professional level.

Conclusion and Implications

Based on the results and experiences of the action research study on MAYA 3D animation course, this paper presents the following conclusions and implications.

Conclusion

1. MAYA is a powerful but complicated tool for creating 3D animation, and there have been more and more teaching resources for this new tool.

From my own experiences in using and teaching it and by the recommendations of many users, we can safely say that MAYA is a very powerful tool for creating 3D animation and has very wide applications, including television, games, animation, webcasting, architecture, industrial design, commercial design, medicine, natural sciences, and military and educational purposes. Its value and importance has been clearly recognized by the government and private sectors. However, promoting MAYA is impeded by a variety of difficulties: the English only interface of the software, complex commands, lack of students who are competent in both art and technology, expensive hardware, software and tuitions, insufficient resources, lack of perseverance in students, lack of MAYA specialists in higher education, and lack of mechanisms for interdisciplinary collaboration. The fortunate part of it is more and more quality resources are becoming available, which makes teaching and learning MAYA less formidable now.

2. At the beginning stage, instruction that focuses on completing 3D animation works might be more effective than teaching the commands only.

Basic level MAYA instruction includes model building, texture, lighting, animation, and image calculation. Intermediate level MAYA instruction includes model building of humans, binding of framework, and adjustment of motions. In my basic MAYA class, I adopted an approach that integrated command instruction and work completion—that is, students learned about the commands while creating some simple 3D constructions, which, after adjusting their sizes, locations, texture, lighting and aesthetic qualities, accumulate to a larger piece of work. This approach avoided the intensive, and often frustrating,

drills on commands at the beginning. Working toward a completed 3D work had the advantage of offering the opportunity to think about the meaning and aesthetics of the work right from the beginning.

3. The action research project resulted in many quality works by students.

The students in this course were able to produce many quality animation works, outperforming students in earlier courses. The researcher adopted Clark and Zimmerman's criteria (2004) and ranked student works into five levels. The evaluative scheme enabled the students to identify the strengths and flaws in their works, and thus helped to improve their 3D animation works.

4. Constant monitoring of students' learning processes and immediate solutions to students' problems ensured good teaching qualities in the project.

In this action research project, the teacher researcher paid constant attention to students' learning processes and tried to solve students' problem immediately. Such constant monitoring of and reflection on the learning and teaching processes were believed to be beneficial in students' acquisition of MAYA knowledge and skills. Specific instructional strategies included 1) the use of the same edition of MAYA; 2) opening the computer lab to students prior to and after class; 3) shortening demonstrations in class; 4) simultaneous recording of instruction to provide more learning materials for students; 5) implementing peer evaluation toward the end of the semester so that students had the opportunity to see each other's merits and weaknesses; 6) requiring students to beautify their still images and videos with post-production software; and 7) publishing students' works on the web to stimulate their motivation and ambition.

Implications

I offer the following suggestions for teachers interesting in MAYA to consider:

1. Developing positive learning attitude and perseverance in students.

Due to the complexity and massiveness in the MAYA software, a strong motivation is an essential element in successful learning of the software. However, many college students lack the kind of

determination and perseverance needed for going through the daunting task of studying MAYA. Instilling a strong desire in students toward learning such a powerful and useful 3D animation creation tool as MAYA is the first task of all MAYA instructors in college.

2. Developing aesthetic sensibility and creativity in students in their daily life.

Creating animation requires not merely technical prowess; aesthetic sensibility and creativity are equally essential for masterpieces in animation. Unfortunately, aesthetic sensibility and imaginative powers cannot be acquired overnight. Therefore, it is important to cultivate students' competence in liberal arts through general education courses so they will be more equipped to study the art of 3D animation.

3. Recruiting and training 3D animation faculty in higher education.

High quality instruction comes from high quality teachers. At present, there are very few university faculty specialized in 3D animation. In the industry, there are talented 3D animation professionals but there are usually without a terminal degree, whereas in higher education institutes there are faculty with terminal degrees but very few are specialized in 3D animation, especially in MAYA, as it is still a very new application. Thus, it is certainly urgent for universities to rapidly recruit or train faculty in this specialization. It may also help if higher education institute can be more flexible about the requirement of doctorates in the hiring process, as it is the case in other developed countries.

4. Implementing integrated, step by step 3D animation instructional procedures.

To avoid the limitation of concentrating on command instruction in many MAYA manuals, it is important to incorporate command instruction into a gradual process of model building which naturally culminates into an integrated work of animation art. In this study, students were instructed to build simpler models such as cups and plates at the beginning, then indoor furniture, then outdoor environment, and finally these were integrated into a more complicated construction. Such a gradual development into a completed work not only familiarized students with the commands of the software but also provided them with the opportunity to think over, and hopefully solve,

the problems of ratio, background arrangement, file management, application of aesthetic principles, and use of imagination. Such an approach would also prevent the possibility of producing many but disconnected models or works of a craftsman but not an artist.

5. Providing adequate and comprehensive training programs.

Designing 3D animation and games is an art that requires a wide variety of specialized knowledge and skills. This study presents a basic level MAYA instructional program. However, a complete training program in MAYA will include instruction in story formation, role arrangement, lens splitting, and many other complicated procedures, such as 2D animation, videotaping, post production, 3D animation, virtual reality and interactive games, model building, and on and on. All these require careful design of training courses; sporadic glimpses on ill-organized topics and skills would only lead to fruitless and frustrating learning experiences.

In all, MAYA 3D software is a powerful tool that is difficult to teach and difficult to learn. Both the teacher and the learner need to be very patient and persisting in order to overcome the difficulties in MAYA instruction and learning. It was with such an understanding and a strong determination that the researcher of this present study chose to work with a professional animator in offering a MAYA 3D animation course in college and at the same time conduct an action research study to explore the issues, problems and strategies of such a course. At the completion of the project, I am here reporting the results from that project. Suggestions for improvement are certainly welcome. It is hoped that such a project will bring out more similar projects in colleges, or even high schools and middle schools, and in departments of educational technology, information engineering, and fine arts.

While this report is being written, the present researcher is engaging in another action research project on an intermediate level MAYA course (character design, e.g.). Following the suggestion of Professor Clark and Professor Zimmerman, who visited my department in 2005, I intend to connect my teaching with research; and through continuous sharing of research results I hope to improve the quality of teaching and to solve the problems of teaching MAYA 3D in college. It would be an unfortunate mistake if some institute or instructor should

would be an unfortunate mistake if some institute or instructor should take research in 3D animation instruction as a business secret. In such a case, similar mistakes would be repeated and all would have to double their effort for reduced benefit.

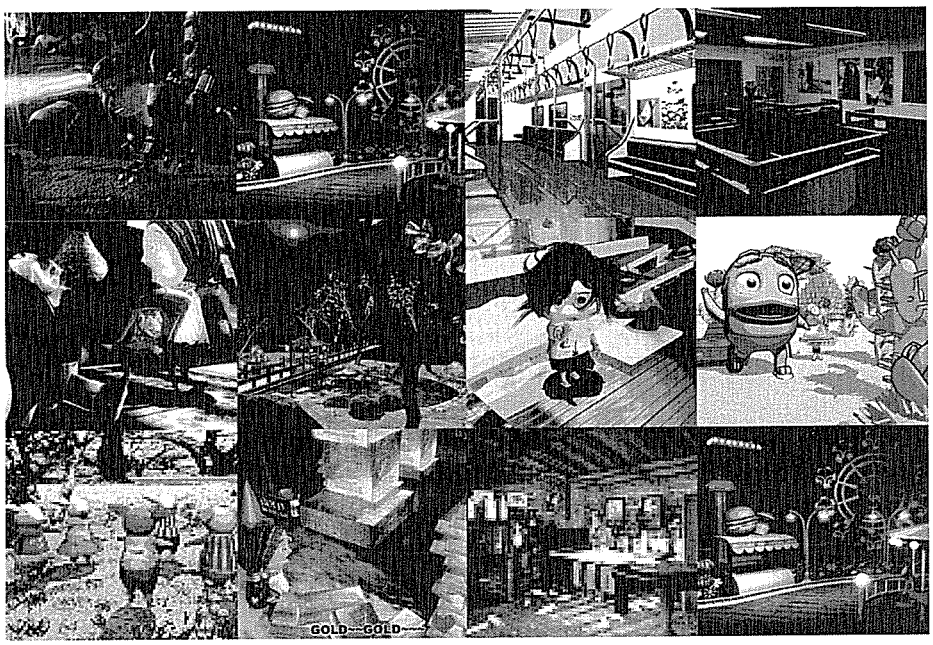

Figure 9. Work by Student in an ongoing Intermediate Level MAYA Course

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