Analysis on the Project Instruction Methodology in Three-Dimensional Animation Courses

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***Abstract*—Project Instructional Methodology (PIM) is an advanced category of educational approach which conducted by adopting actual projects or virtual projects. Through students' participation in the projects, their practical ability, teamwork ability, and problem-solving ability are cultivated. It aims to combine classroom learning with real-world application, so that students could face challenges and problems in practical situations and solve these problems through practice. Currently, due to the difficulty of actual instruction in three-dimensional animation courses, the advanced generation innovations and technologies have been updated rapidly, and both reflected the tasks of teaching and industry, and multiple issues exist in these teaching periods. The introduction and the enhancement of PIM for the current instruction of the animation curriculum can completely combine knowledge learning and project practicing, it could better cultivate three-dimensional animation high-quality applications and composite talents, and match the requirements of the development of the Chinese animation industry.**

***Keywords*—project instructional methodology, educational research, three-dimensional animation, undergraduates**

I. Introduction

The United States' research on computer digital virtualization originated in the 1960s. Three-dimensional animation began in the 1990s and sang unicorn by Pixar. At the beginning of the new century, the 3D animation market of Pixar and Dream Works has been divided into the 3D animation market. Since 2004, it has entered the heyday. 3D digital animation technology due to its accuracy authenticity and infinite operability, is currently widely utilized in multiple fields such as film and television animation, visual special effects, education, military, medicine, medicine, and other fields. A certain number of academic institutions, universities, and enterprises have participated in the ranks of research, development, and education.

In the 1990s, animation processing in China rose in the Pearl River Delta and Yangtze River Delta, which made people from Shanghai Fine Arts Film Studio, Beijing Oriental Film Studio, Beijing Science Film Studio, and animation departments under the Ministry of Water and Electricity, the only animation production departments in China, devote themselves to animation processing in animation companies such as Jade Animation, Pacific Animation, Cailing Animation, Shanghai Yilimei Animation, Shanghai Chaoyang Animation and Hangzhou Animation [1]. In 1990, there were about 50,000 animators in the world, while there were less than 3,000 animators in China. Around 2000, the government vigorously supported and promoted the domestic animation industry, which made the demand for animation products increase sharply in TV stations and children's animation channels all over the country, and animation companies were established like mushrooms after rain, and the demand for animation talents and animation practitioners increased sharply for a time. Animation education in China has ushered in an unprecedented period of prosperity, but it has also led to a serious homogenization of talent training in undergraduate, junior college, and higher vocational colleges. This lack of culture and the incompleteness of knowledge structure make it difficult for students to have deeper and higher development or innovative creativity, and it is also difficult for trained people to gain social or market recognition.

Currently, the cultivation methodology of animation talents in China is still lagging compared to developed countries such as the United States, Europe, Japan, etc., and the cultivation of animation talents in China is not comprehensive enough. It is often leveled with one side which ignores the practice from the viewpoint of the entire price. Some undergraduates frequently only master some common techniques and a certain long-accumulated experience in response.

The reason is that the animation majors for undergraduates are not allowed to the suitable position of the instruction and training of 3D animation. The characteristic of the trained student was a lack of experience of the project practice, and the expectations and requirements of the market for animation talents were seriously dislocated. For the antecedent reasons, this article proposes to research the PIM, select Autodesk Maya 3D software for instruction, and combine curriculum instruction with project practice to cultivate animation professionals that could better match the market and industry.

II. The Intention for PIM

3D animation is an animated art category that appears with the high-speed advancement of computer technology

Manuscript received July 26, 2023; revised September 27, 2023; accepted October 10, 2023.

and innovation. In 1980, at the Zagreb Animation Festival, the Association International du Film du Animation (ASIFA) gave an international unified name to the name of "animation" at the Croatian Capital Convention Center. So far, it has been written in the second paragraph of the association's articles of association: The art of animation is the creation of moving images through the manipulation of all variations of techniques apart from live action methods [2]. Animation is a dynamic image created artificially.

It is regarded as the 3D digital virtual atmosphere which created by the designer according to the computer techniques. In this virtual atmosphere, the creator establishes a certain of the principles, characters, and scenes according to the design requirements. According to the basic theories of animation, the computer software automatically records and generates the intermediate frame to make the role of the character.

The production of 3D animation is an essential course from the animation curriculum, and it is also the evaluation and summarization of the antecedent courses such as audiovisual language, character modeling, scene design, script and storyboard creation, original animation and movement principles, and 3D software foundation. The instruction unit must fully discuss before teaching to determine whether to introduce actual or virtual projects, and then organize 3–5 undergraduates according to the students' interests and professional abilities. Each group will eventually complete an independent animation project. In the previous courses, such as the animation script, character design, props and scenes design should be accomplished. In the animation production course, it is based on the creation of 3D digital models, material production, bone binding, and action regulating according to the conception design. The PIM is "the instruction activities conducted according to the complete project, and the intention is to organically combine theoretical instruction and practical cultivation in classroom teaching to exert the full disceptation of students' potential creative ability and improve the comprehensive ability of the undergraduates' to solve practical issues" [3].

The characteristic of the PIM for 3D animation course is to offer the independent "practical project" in the instruction under the guidance of the instructor, and give it to undergraduates. The students should collect the relevant information, design plans, and implementation plans, and complete the project. In the process of practical operation, the target undergraduates would be more familiar with the ability of the production for 3D animation, laying an excellent foundation for subsequential 3D animation design and creation. The conception of this instruction methodology is "Based on the Project, Guided by the Instructors, and Centered by the Students", which is different from the current instruction pattern of "Instructors Explain, Students Listen" for the traditional instruction system. For the undergraduates, PIM could entirely stimulate their curiosity and creativity, and activate their enthusiasm for active learning, independent creation, and exploration and innovation [4].

III. Process Description of 3D Animation

The production of 3D animation is a combination of digital technology and art design, so undergraduates must understand and familiarize the workflow of the entire 3D animation production. High-efficiency workflows can not only generate full play to the advantages and technical characteristics of digital animation, but also improve production efficiency.

(1) Conceptual design: Determine the theme, storyline, and role design of animation. At this stage, sketches, storyboards or conceptual art can be created.
(2) Modeling: Use professional Maya 3D modeling software to create 3D models of scenes and characters. The modeler makes geometry and surface details according to the conceptual design to make them realistic or meet the specific style requirements.
(3) Materials and textures: Add materials and textures to the model to make it have a practical appearance. By adjusting the properties of materials and adding texture mapping, the details and texture of the model are increased.
(4) Skeletal binding and animation setting: associate the bone system with the character model, add bones and controllers to the character, and then set key frame animation. Animators make animations according to the character design and storyline.
(5) Lighting setting and rendering: determine the lighting effects in the scene, set the lighting type, position and color, and other rendering parameters. When rendering, the computer will render the 3D scene frame by frame according to the camera's perspective, and generate the final image sequence.
(6) After effects or post-production: Import the rendered image sequence into post-production software (such as Adobe After Effects) for color correction, special effects, and video editing to improve the visual effect of animation.
(7) Audio design and soundtrack: add audio elements such as background music, sound effects, and dialogue recording. Through audio design, the animation is more vivid and rich.
(8) Export and release: output the final animation as a video file, select the appropriate format and resolution, and consider the appropriate compression settings. Publishing can include displaying on websites, sharing on social media or spreading on other media platforms.

The 3D animation creation process includes three sections: preliminary planning, mid-stage production, after effects and editing synthesis. The preliminary planning is primarily designed according to the script concept which includes the design of the character, senses, and props; and the storyboard design. For the mid-stage production, such as the procedure of the 3D storyboard (layout), model construction for the characters, scenes, props; materials and skeletal skin animation production; lamps setting, photography, layered rendering and synthesis in the later section. Eventually, construction of the complete

animation is synthesized by dubbing, soundtrack, and editing. 3D animation is based on computer digital techniques as the production instrument, comprehensive literature, art theory, dynamics theory, film art, and other disciplines; in the production process, teamwork requires cooperation, innovation, and hard work.

IV. Precudere of the PIM for 3D Animation

After determining the project for target undergraduates, students should be requested to formulate a detailed design schedule, because the production of the entire project cannot be completed within the teaching class. Students should use the design tasks of each stage.

A. Mid-Stage Production of 3D Animation

The mid-stage section primarily includes four components: 3D storyboard (layout); characters, scenes, props modeling; material and skeletal binding; and movement adjustment.

Initially, for the perceptive of the 3D storyboard (layout): which is utilizing the basic quality 3D model according to the script and the storyboard to construct the layout. These works include the motion of the camera machine position and arrangement, basic animation, lens content, and time customization in the 3D animation software. The storyboard determined the shots for the animation: a certain number of the shots constructed the plot snippet, the plot snippets constructed the scenes of the animation, and the scenes constructed the paragraph, eventually, the paragraphs constructed the entire animation. 3D storyboards provide guidance for the subsequent design and construction of the characters, scenes, and animations.

Furthermore, the creation of the 3D model is the basis for the production of 3D animation. There are three approaches of Maya software modeling, which include the NURBS, Subdivision Surface, and Polygon modeling. NURBS modeling is more convenient when making a smooth and curved object on the surface, such as vehicles, marine species, aircrafts, etc. Polygon modeling has strength in the objective of large planes, angles, and multiple details on the digital model surface. Such as characters, animals, monsters, mountains, planets, buildings, warships, etc. If the designers require the smooth quality of the 3D model, they should increase the number of faces, but it consumes the speed of resources. Subdivision Surface has a good modeling effect, but for there are too many levels, this category of methodology is not commonly used. When the actual modeling works in PIM, the approach for character, scenes, props, and other models, the NURBS and Polygon are frequently jointly utilized. The student should pay attention to the following points: first of all, the model is made strictly according to the original design; secondly, try to utilize the minimum lines to make reasonable wiring on the model, and employ the four sides surfaces to mobilize the animation. Finally, after the model is constructed, the undergraduates should delete the historical record of all objects to improve the operating speed of the computer.

Moreover, there are two methods to exert the materials to the 3D model. One approach is to give a variety of materials to the Polygon model in the material editor, which could be adjusted for the surface color, highlights, transparency, bump effect, and self-luminosity of the materials for the 3D model. Another methodology is to divide the complex Polygon model into the UV mapping, and then import it into the 2D graphic software such as Adobe Photoshop to generate the maps to form a sticker material.

Eventually for the movement of the character, to achieve vivid and realistic effects, the undergraduates should add skeletal binding to the 3D model, and then bind the surface skin. Only the skeletal binding technology could generate higher-level animation works. In addition, the students should create a dynamics system to locate and set the skeletal to locate and adjust the animation. Finally, a certain number of controllers handle the movement and rotation of the joints. When students bind the skin to the skeletal system, the skeletal can control the movement of the character 3D model and generate the animation, but the undergraduates also need to adjust the weight for the model surface of the skeletal system to make it correctly affect the corresponding model surface. When adjusting the animation, the animation key frame is primarily set, which is influenced by the controller. After the character 3D model is bound to the skeletal system and has set up the weight, all the modifications such as movement or rotation require students to control the controller. Therefore, when adjusting the 3D animation, students should perform animation adjustments that match the movement of motion and time according to the lens script settings, and the controller must be recorded at each key frame.

B. After Effects and Editing of 3D Animation

For the after effects and editing section of 3D animation, which are constructed by lighting setting, virtual photography, and layered rendering, as well as compositing works.

Initially, lighting is to provide a luminous effect for the 3D scene, and the tone and atmosphere of the current scene. The performance style and the characteristic of lighting in the animation could be divided into realistic style and cartoon style [5]. Realistic style is the light treatment method of lighting in the real-time effect in the actual shooting movie as much as possible in the character shape, texture performance, character movement, scene production, and lighting atmosphere treatment. The cartoon style originated from the expression of Japanese 2D animation or comics. The lighting pattern is relatively established, which emphasizes the coordination of the light itself and does not consider the direction of light. The lights are primarily set up as the main illuminant, auxiliary illuminant, and background illuminant. In the scene, the main illuminant source is frequently determined as the main lighting source. The student should place it initially, generally placed in three quarters position. The deepest and clearest shadows are often projected in the scene. Auxiliary illuminant is employed to fill the dark and shadow areas of the scene, and supplement the light of some corners which cannot be directly illuminated by the main illuminant source, which provides the scenes and

realistic effects for the scenes. Auxiliary illuminant could also be placed in the relative essential position to soften the shadow. Background illuminant is usually employed as the "edge light", and the target object is separated from the background through the illuminated edge of the object. The lighting setting in the 3D animation scene is quite different from the real-time shooting of the film. It requires spending more effort and resource on the rendering time. The more complicated the lighting settings, the more time it takes for the rendering, and the more difficult the light management will become [6].

In addition, traditional cameras include push, pull, shake, move, follow, rise, fall, etc. The virtual camera from the 3D software could entirely simulate the lens motion. In the production, the undergraduate could set key frame animations for the camera, or decide the camera as a path animation or multi-machine photography. It can also achieve the effects of depth of field, and blur of the movement.

Moreover, after the main construction for the 3D animation is completed, rendering output should be performed so that other software or media could participate and edit them. It could render the video files in AVI formats, and could also generate the output sequence frame. While making the animation, layered rendering is the category of rendering which is frequently used by undergraduates. On the one hand, it provides materials that are easier to control screen effects for later synthesis, such as weakening shadow, object cover, highlight special effects, etc. From another perspective, it also could enhance or speed up computer rendering and improve work efficiency. Students also could utilize the layered rendering settings to select different renderers in different objects of the animation scene, such as the Maya Software Render to generate the light and shadow of the character's hair. While the Mental Ray render could express the skin texture of the character's 3D material and the realistic texture of reflected refracted objects.

Eventually, the post-synthesis of animation is to combine and process various elements, including scenes, characters, special effects, audio, and so on, to achieve the final visual effect. Post-synthesis is usually done by using specific software tools. The first is image synthesis, in which elements of different layers are superimposed, masked, and the transparency is adjusted to blend them together and create realistic visual effects. This process is usually done by using image editing software (such as Adobe Photoshop) or composition software (such as Adobe After Effects). Then special effects are added. Various special effects, such as explosion, flame, and lightning, are added to the animation to enhance the visual impact and practical feeling of the animation. Special effects are usually created by special effects software (such as Adobe After Effects, Blender) and combined with animation scenes. Finally, audio synthesis synchronizes voice elements such as dubbing, background music, and sound effects with animated images, and mixes them to create more realistic audio effects. Audio synthesis is usually done by professional audio editing software (such as Adobe Audition and Logic Pro). In the post-synthesis of animation, we need to pay attention to the unified style, that is, when synthesizing each element, we must ensure that they are consistent in tone, light and shadow, effect, and so on, to ensure the overall visual quality and impression. Secondly, we should pay attention to the fluency of animation. For the actions of characters and objects, we should pay attention to adjusting the frame rate and in-between of the animation in the process of synthesis to make the animation look more fluent and natural. Third, we should pay attention to the realism of special effects. When adding special effects, we should pay attention to the realism of special effects and the degree of integration with the scene, so that it can be perfectly combined with the animation scene. Fourth, we should pay attention to audio collocation. In audio synthesis, we should pay attention to the clarity of dubbing, the quality of sound effects and the harmony of background music in order to create a good listening experience. In short, the post-synthesis of animation is to combine and process various elements to achieve the final visual effect. It needs to use professional software tools, and pay attention to unified style, animation fluency, special effects realism, and audio collocation.

V. The Significance of the PIM

The primary intention of PIM is to cultivate students' practical ability, teamwork ability, and problem-solving ability by participating in actual projects [7]. It aims to combine classroom learning with real-world application, make students face challenges and problems in practical situations, and solve these problems through practice, to promote the cultivation of students' comprehensive ability and professional quality. The following are the main purposes of the project teaching methodology.

A. Provide Practical Experience

In the actual employment of the PIM which provides a practical platform to encourage and let students personally participate in virtual projects or actual projects, so that students can apply their knowledge and skills in actual situations, understand and solve practical problems, and let them personally experience and apply what they have learned to actual situations. Through practice, students can better understand and master subject knowledge, thus increasing their practical experience.

B. Promote Independent Learning and Critical Thinking

Promoting autonomous learning and critical thinking: Students are required to think, solve problems, and make decisions actively, and students are encouraged to carry out autonomous learning and critical thinking. Students need to collect and analyze information, make decisions, and reflect on their work in the project. This can cultivate students' autonomous learning ability and critical thinking ability. Learn to think and evaluate the advantages and disadvantages of different schemes, to improve the problem-solving ability.

C. Develop Cooperation and Communication Ability

In the PIM, students need to cooperate with team members for effective communication and coordination. This helps to cultivate students' team spirit, leadership, and communication skills.

D. Cultivate Practical Application Ability

PIM focuses on cultivating students' practical application ability, enabling them to apply their knowledge and skills to practical problems through virtual projects or practical projects. By solving practical problems, students can understand the connection between knowledge and practice, improve their application ability and innovation ability, and master specific methods and skills to solve problems.

E. Develop Motivation and Interest in Learning

PIM could stimulate students' learning interest and initiative. Compared with the traditional teaching methods, the project-based teaching method enables students to participate in the learning process and practice more actively, and students will actively engage in learning and actively explore and learn new knowledge. Because they can feel the significance and influence of their work on the project.

F. Promoting the Integrated Capability

The PIM is usually carried out in groups of 3–5 undergraduate students, encouraging cooperation and collaboration among students. Students need to jointly set project objectives, work together, coordinate and communicate, and jointly solve various problems in the project. Emphasize the integration and comprehensive application of subject knowledge. Through the design and implementation of the project, students need to comprehensively use the knowledge and skills of multiple disciplines to cultivate problem-solving ability, innovative thinking, and teamwork ability.

To summarize, the purpose of PIM is to provide students with practical opportunities through practical projects, promote the development of comprehensive ability, cultivate learning motivation and interest, cultivate practical application ability, cultivate cooperation and communication ability, and promote autonomous learning and critical thinking [8]. Through the project teaching method, students can better cope with the challenges of practical work and future career development.

VI. Conclusion

The purpose of PIM is to cultivate students' practical ability, teamwork ability, and problem-solving ability by participating in practical projects. Through practical situations and practical activities, students can better understand and apply what they have learned, and cultivate critical thinking and innovative ability, so as to better adapt to future challenges and needs.

Each project team completes its own tasks in teaching, while after the end of each project stage, instructors should evaluate and summarize the work situation to estimate whether the phased requirements of the education have been matched. After each stage of the project is fully completed the additional stage could be produced. The intention is to put pressure on students to ensure the quality of work for the project under the PIM.

Through the PIM, the target undergraduate students could actively participate in the instruction, which can complete the competitive animation project, which not only improves students' learning interest and behavioral intention, but also guides students to master the industry knowledge and professional skills that are urgently required in the animation, and improve the employment competitiveness of the animation major students.

Conflict of Interest

The author declares no conflict of interest.

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