Developing an Effective Format for Introducing 3D Computer Animation to Adult Learners

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Abstract

By 2030, the workforce in Singapore will be required to transition towards Industry 4.0 which will necessitate the presence of individuals within the force with proficiency in 3D modeling as one of the critical skills to acquire due to its highly transferable nature, applicable across a wide range of sectors (SkillsFuture, 2022). The purpose of this research is to develop a format for teaching basic and intermediate 3D modeling skills within the 3D computer animation context. The research will consider the unique challenges faced by adult learners in this field, such as spanning a broad range of experience or technical knowledge. The SkillsFuture learning platform will be used to deliver this course as it provides accessible learning to Singaporean residents, subsidized for citizens and PR. In addition, the software Blender will be utilized to teach high-end computer animation, a powerful 3D creation software that is free and open source, making it an effective tool for adult learners. The development of three SkillsFuture courses for high-end computer animation was completed and released during the 2021/2022 period, and a total of 11 runs were conducted. The format used was in-person and small size classes which allowed personalized support and to alter the pace of the class according to the learners needs. Furthermore, microlearning (Boring & Tomei, 2022), project-based learning (Pusztai, 2021), and storytelling (Bonds, 2016) andragogy were implemented. The courses were well-received by adult learners spanning a broad range of ages and professional backgrounds and the feedback collected was overwhelmingly positive, confirming they were able to absorb and apply the knowledge imparted. The success of the courses suggests that this format can be used effectively to teach adult learners 3D modelling within the broader context of 3D computer animation. This could lead to the development of more specialized courses for learners who have already completed the introductory courses, providing them with advanced knowledge in the field.

Keywords: *Andragogy, Industry 4.0, 3D Computer Animation, Microlearning, Project-Based, Storytelling.*

Introduction

The Fourth Industrial Revolution (4IR), also known as Industry 4.0, is one of the major drivers of change today. Many believe that it will have a greater impact on the globe than the first industrial revolution did (Donzelli, 2019). According to Temasek Holdings Limited, (2017), up to 375 million individuals worldwide will have to start new occupations by 2030 because automation will threaten 51% of all jobs. Consequently, Singapore wants to adopt Industry 4.0 to weather these shifting global trends requiring the acquisition of critical, in growing demand, and transferable skills, including that of 3D modelling. As a result, there is a need to create effective methods for instructing adult learners in 3D modelling. To address the difficulties experienced by adult learners, this study provides a format for teaching basic and intermediate 3D modeling abilities within the context of 3D computer animation.

Theoretical Framework

The fourth industrial revolution, known as Industry 4.0, is defined by the integration of cutting-edge technology like artificial intelligence, robotics, and the Internet of Things into industrial processes. This study explores the significance of 3D modeling abilities in this context, as it is seen as a critical skill that, due to its growing demand and transferability across sectors, can help workers adapt to the changing demands of the workforce and remain relevant in their fields (SkillsFuture, 2022).

3D modeling is the process of employing specialist software to produce a three-dimensional representation of a real-world item (Chong, 2019). In order to properly teach 3D modeling, it's critical to comprehend a number of related theoretical ideas. Polygonal modeling is a key component of 3D modelling. This entails building a collection of linked polygons to produce a surface that symbolizes the item being represented in 3D (Villar, 2020). Polygonal modeling is the act of manipulating vertices, edges, and faces to produce a model that precisely captures the form and dimensions of the item being represented (Chong, 2019). According to Siemens (2009) another 3D modeling technique used to produce intricate geometrical patterns and forms is procedural modeling.

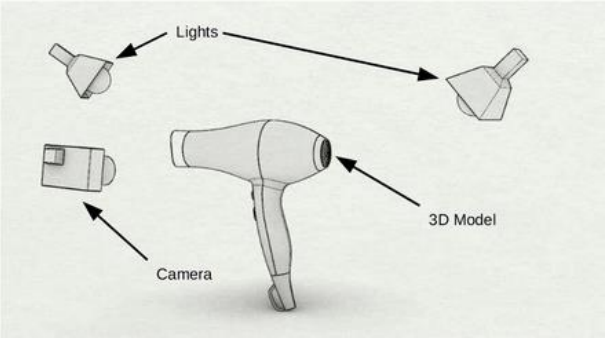

Figure 1: Elements for 3D models. *Note. Chong, S. P. (2019). Blender 3D Modelling: A Concise Guide to Version 3.0. Amazon KDP.*

This entails the use of algorithms to produce 3D models in accordance with a set of guidelines or specifications. The production of natural surroundings, including trees, rocks, and landscapes, frequently uses procedural modeling. Additionally, the employment of several software tools and methods, such as texture mapping, shading, and lighting, is common in 3D modeling. In order to give detail and realism to a 3D model, texture mapping involves applying a two-dimensional picture, or texture. To give the appearance of depth and volume in a 3D model, shading implicates applying colour and shading. Lighting entails replicating the effects of light sources on a 3D model to produce a lifelike depiction of the thing being represented. Generally, for teaching 3D modeling effectively, it is crucial to comprehend these theoretical ideas (Villar, 2020). Learners can acquire the abilities required to produce precise and realistic 3D models that can be used in a variety of sectors and applications by giving them a firm understanding of these principles.

The pool of students came from different backgrounds such as those who work in digital media, beginners who are new to the animation field, and professionals from other industries. These comprised different age groups, from young workers to seniors, and included citizens, permanent residents, foreigners, and employees sponsored by their company. The participants also had different levels of computer skills, ranging from experts to those having limited exposure. Due to this diversity, the needs, and dynamics they brought to the class were multifaceted. Therefore, the format and andragogy utilized in the courses were carefully chosen to ensure that they amplify the adult learners' potential. As indicated by Greenberg (2009), in a physical setting, stimuli including perception, intake, time, and mobility have an impact on adult learners. The processing of information by students involves a variety of senses, including the auditory, visual, and tactile. Each learner's preferred sense can be determined by the instructor, who can then best support that learning style. As a result, physical classes were chosen over other online learning formats. Additionally, small-size classes were arranged as research shows that, due to changes in the learning environment, increase in class size has a detrimental influence on learner's performance, particularly for learners from disadvantaged backgrounds. Instructors respond to increasing class numbers by expecting students to take more responsibility for their own learning, which results in reduced pupil-teacher engagement (Fredriksson et al., 2014). The length of each course was decided to be 7 hours only to make them less daunting to the learners, but still providing enough time for learners' acquisition of knowledge and skills. Each course was delivered over two consecutive evenings, from 7 to 10:30 pm at the Nanyang Polytechnic campus computer laboratory, which provided all equipment and software needed for learning. Additionally, this time frame proved to be popular among working adults who would not have been able to attend daytime classes. For andragogy, microlearning (Boring & Tomei, 2022) was incorporated to provide short, focused bursts of of bite-size learning that can be quickly consumed by adult learners. Each 3.5-hour lesson was broken down into smaller segments with short breaks in between for the learners to review the material and ask questions. Project-based learning (Pusztai, 2021) was used to help adult learners apply their understanding in real-world scenarios. Multiple small projects were given throughout the delivery of the lessons, to provide tangible milestones to practice the newly acquired knowledge. Learners were assigned a series of projects that were progressively challenging them to develop their 3d modeling and animation skills. Lastly, storytelling (Bonds, 2016) was implemented to make their learning experience more engaging and memorable. Each practical activity included a narrative to offer context and scope while also ensuring that learners had fun during the process.

Table 1: Course format key aspects

In-person setting	• engaging all senses • individualized support of preferred learning style
Small size class	• increased pupil-teacher engagement time • personalized feedback
Short duration	• less daunting • enough time for acquisition of knowledge and skills
Microlearning	• bite-sized information • quicker to consume by adult learners
Project-based	• application of skills in real world scenario • tangible milestones
Storytelling	• engaging and memorable experience

Methodology

The SkillsFuture platform was chosen as a method of reaching a wider audience. The platform is part of a national drive to help Singapore's residents reach their full potential, regardless of their socioeconomic status. SkillsFuture is a comprehensive high-quality system of education and training that can adapt to society's ever-changing needs ("About SkillsFuture", n.d.). The portal is accessible to all residents of Singapore, however there are certain advantages exclusively available to citizens and permanent residents, such as subsidized course fees and the latter also receive credits to offset the fees. Additionally, upon successful completion of each course, the participants will receive a Certificate of Completion (COC) signed by the directors of Centre of Industry & Lifelong Learning and School of Design & Media of the Nanyang Polytechnic, which adds recognition to their learning.

Blender, a popular open-source program for producing 3D models and animations, was selected as a tool for teaching 3D modeling in the SkillsFuture courses. Its features and functionalities were taught in the courses to assist students understand the common tools and techniques utilized in 3D modeling. Furthermore, Blender's accessibility makes it an excellent choice for adult learners. The GNU General Public License (GPL) allows for free usage of Blender for any purpose, and its simple installation process makes it a viable choice for students who may not have access to expensive software or have minimal technical knowledge.

Three 7 hours long courses were created, where the first course, "Blender for Beginners," served as a broad introduction to Blender and covered procedural modeling, texturing, lighting, and rendering techniques in addition to key 3D modeling methods. The goal of the course was to provide students a strong foundation in the program and equip them to make simple 3D models. A sample of how the first course was structured to fit within the 7 hours timeframe is presented in Table 2. The second course, "Digital Sculpting with Blender," went into further detail into a specific modeling method known as sculpting. This approach enables the user to freely form shapes simulating traditional clay sculpting. The course was created to assist students in mastering the sculpting approach and using it to generate complicated 3D models. "Grease Pencil in Blender," the third and final course, focuses on creative concept generation approaches that may be utilized to swiftly produce ideas for 3D models. It also teach students how to showcase models in a cartoon form, which is becoming increasingly popular in the creative industry. The course was created to assist students in developing their 3D computer animation skills and applying it to the creation of attractive 3D models. An essential component of the classes was providing learners with thorough lesson notes at the conclusion of each course. These notes were a useful tool for students to review and solidify their comprehension of the course material. Along with instructions and screenshots to lead students through the creation of 3D models, the lesson notes included a summary of the major ideas and methods covered in the course. Links to additional resources and tutorials were also included in the lesson notes to help learners continue to learn and advance.

The evaluation techniques used in the Blender courses were created to measure course effectiveness by assessing participants' practical skills and understanding of the course content. The courses were practice-oriented, with various small-sized exercises delivered in each 3.5-hour class over two days. These tasks were created to assess learners' understanding and skill gain in 3D Modelling and Computer Animation. At the end of each course, the instructor gathered the completed tasks to check the learners' comprehension and application of the course contents.

Table 2: Blender for Beginners class, first course schedule breakdown

Day 1

19:00-20:45hrs	• Introduction • User Interface • Navigation • Object Level interaction • Modelling
20:45-21:00hrs	Break Time
21:00-22:30hrs	• UVs • Texturing • Shading

Day 2

19:00-20:45hrs	• Lighting • Eevee Rendering • Cycles Rendering (part1)
20:45-21:00hrs	Break Time
21:00-22:30hrs	• Cycles Rendering (part2) • Compositing • Grease Pencil

Results and Discussion

At the end of each course the learners were given a feedback form to complete which contained a set of questions/statements to be rated from 5 or strongly agree (excellent), to 1 as in strongly disagree (very poor).
A sample of questions asked is the following:

1. The general environment (e.g. training room, equipment, seating) was conducive to learning.
2. The concepts and skills taught are useful for my work.
3. The duration of the course is appropriate.
4. The course has met its stated objectives.
5. My overall rating of the course.

The courses' overall average response to all questions is 4.5. The training space, furnishings, and equipment were deemed appropriate and conducive to learning by the

students. These are essential elements of the in-person setting, as they helped the learners to remain engaged and focused throughout the course delivery. In addition, the attendees were also pleased with the staff, who were described as pleasant, prepared and helpful in guiding them in the physical class setting. This is another relevant factor in the in-person component of the course format as it contributed to the participants' favourable learning experience.The learners had a positive overall experience with the courses, having the majority of them saying that it met its purposes. Furthermore, several of them gave the course high marks, suggesting that they were pleased with the instruction they received. This is solid indication that the course format was effective in providing learners with the skills and knowledge they needed to improve their expertise in 3D modeling and computer animation with Blender. In addition, the feedback form included a combination of yes/no and open-ended questions to gather additional information. The questions are as follows:

1. Will you recommend your colleagues/friends to attend this course?
2. Other comments about this course?
3. What other course/training areas would you be interested in?

90% of the learners reported they would recommend the course to colleagues and friends displaying a high satisfaction level. The open-ended comments given were overwhelmingly positive, as per samples below:

1. The 2-days course was definitely a big help in starting my journey to learning more of the Blender programs. It provided sufficient info to transit my current knowledge of other 3D software into this one. If there was an advance course, I will consider taking it.
2. Easy, clear and concise. Materials supplemented were efficient and hands on, making it easy to grasp.
3. Glad that NYP conduct these courses and have learned good pointers from the trainer. Looking forward to the next blender course.

The remarks highlight strengths in the chosen format, like ease of understanding achieved via project-based and storytelling andragogy.

Nonetheless, an area of improvement mentioned by participants was the courses' duration which was deemed insufficient by some and that few more hours should have been allocated to deliver them. This feedback suggests that some adult learners might need more time to comprehend complicated information and put new skills into practice. In order to ensure that the material is sufficiently covered, and the students have enough time to practice and reinforce their new knowledge, it may be advantageous to consider adjusting the course duration for subsequent courses. Additionally, offering extra resources like online tutorials and reference materials could be beneficial in assisting students' ongoing practice and development outside of the classroom.

Conclusions

The majority of adult learners gave the courses positive ratings, with a 90% high rate for several questions on the evaluation form, according to an analysis of the data collected. This indicates that the chosen format of teaching 3D modeling skills to adult learners through the courses was deemed successful. The use of Blender as a tool for imparting knowledge of 3D modeling was another strength. Blender is a great option for adult learners who might not have access to expensive software or have little technical expertise because of its accessibility and affordability. The structured teaching of specific Blender features and functions in the courses helped students comprehend the tools and methods needed to produce 3D models. One of the weaknesses of this study was the limited sample size of adult learners who took the courses where a bigger sample size would have resulted in more precise findings and improved the data's generalizability. Additionally, the evaluation forms only provided limited feedback and did not include in-depth interviews or observations of the learners in action. In conclusion, the format discussed in this paper has proven to be successful at teaching adult learners the fundamentals of 3D modeling. It has been found that in person and small size classes are effective methods for increase students' engagement and personalized learning. In addition, the use of microlearning, project-based learning and storytelling was found to be an effective andragogy enabling the learners to acquire the desired knowledge. Overall, the course format has been proven to be promising, with some reservation on the length of each run which might need to be extended in future iterations. Future studies can investigate how well these courses work in various situations and with various populations, as well as how well they work when different andragogies and teaching techniques are used. The three introductory courses for adult learners' success in teaching 3D modeling skills illustrates the potential for further growth in this field. Based on the study's positive findings, it is suggested that additional courses be created for learners who have already finished the basic courses. These courses may provide learners with further specialized knowledge and skills expanding their understanding of 3D modeling.

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