Students' Perceptions of Learning Object for 3D Character Modelling Lesson

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Abstract— Lecturers have to spend a lot of time to teach their students on the proper techniques of designing and modelling of 3D characters. It is almost impossible for lecturers to cover everything in the class due to the complexities and time-consuming of the procedures and steps. Thus, students have to continue and complete the tasks on their own outside class hours without lecturer's supervision. Outside the class, students still require some form of instructions that are able to provide them step-by-step procedures of designing and modelling of 3D characters. The instructions must be easy to follow, step-by-step, readily accessible anywhere and anytime. Learning object (LO) is any entity that may be used for learning, education and training. It leads education with the instructional technology towards more effective instructional design, development and delivery of learning content. It provides a new paradigm in the way people teach and learn. In this study, LO has been used for developing students' 3D design and modelling skills. This paper reports on a perception study among a class of digital arts students of Tuanku Syed Sirajuddin Polytechnic in Perlis, towards the use of LO in 3D Character Modelling lesson. The purpose of this LO is to help students by providing guidance for them to do their assignments and also to enhance and improve their 3D design and modelling skills. An evaluation on the use of the 3D Character Modelling LO was conducted among 30 students. The results indicate that the students agreed on the Learnablity, Usefulness, Ease of Use, Functionality and Effectiveness, Satisfaction and Outcome/Future Use of the LO. The potential use of 3D Character Modelling LO for teaching and learning is discussed at the end of this paper.

Index Terms— Learning object, 3D character modelling, usability, user acceptance, learnability.

1 INTRODUCTION

NOWADAYS, the process of teaching and learning has grown rapidly together due to technological improvement. Educators need to adapt with the existing modern technology and computer science curriculum to support 21st century learning. Modern students learn differently from those in the past and aware of the growth of technology in their daily life. When student learning styles are matched with instructional strategies, student achievement is maximized [1][2][3].

Learning object (LO) can be one of the support tools in enhancing and also maximizing the learning process of students. A LO is a small and reusable digital component that can be selectively applied alone or in combination by computer software, learning facilitators or learners themselves to meet individual needs for learning or performance support [4]. The IEEE Learning Technology Standard Committee defines a LO as "any entity, digital or non digital, that may be used for learning, education and training" [5]. According to McGreal [6], a LO ranges from anything to everything, through anything digital, to only objects that have an apparent learning purpose, to those that support learning only in particular specific context as shown in Fig. 1.

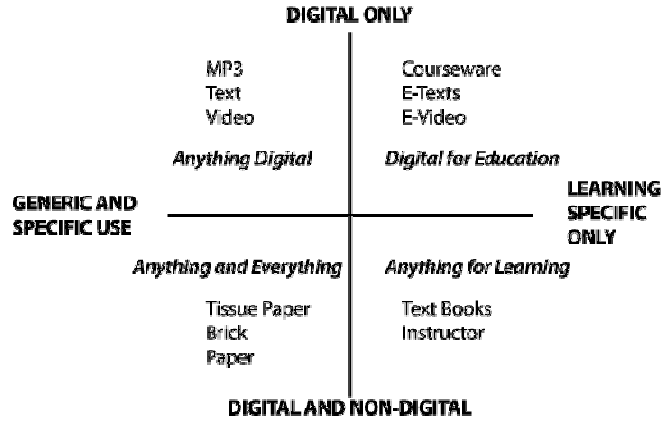

Fig. 1. Views of Learning Object [6].

In this study, LO is used for developing students' problem solving skills and modelling skills in 3D lesson. Students need a lot of time to practice in order to develop models on 3D characters including practice outside class

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hours without the supervision of lecturers. Effectiveness of using this LO depends on the LO design and implementation itself. In this context, the proper specification of LO during the design stage leads to the most significant impact on the potential interaction [7].

Unlike paper tutorial or textbook, each LO represents small chunk of essential components of an effective learning experiences [8]. With this design, LO can be reused and shared among courses.

This paper is structured as follows. In Section II we present the Background, reporting on the Concept and Definition of Learning Object, Learning Objects Design, Learning Object Tools, Technology Integration in Education, The Instructional Relationship, and The Advantages of Implementing Learning Objects in Educational Application. The Research Methodology applied in this study is presented in Section III. In Section IV, we show the results. We discussed the results in Section V and finally in Section VI, overall conclusions are taken and future work is presented.

2 BACKGROUND

2.1 Concept and Definition of Learning Object

When teachers first gain access to instructional materials, they often break the materials down into their constituent parts and then reassemble these parts in ways that support their instructional goals [9]. [58] defines LOs as any reusable resource, digital or non-digital that can be used to support learning activities. As long as an object is addressable, such as web pages, applications, textbooks, calculators, and microscopes, it can be used as an LO.

According to [10], the term LO generally applies to educational materials designed and created in small chunks for the purpose of maximizing the number of learning situations in which the resource can be reuse. [59] emphasize the intent of the object more than the structure. According to them, a LO is "a digital file (image, movie, etc.) intended to be used for pedagogical purposes, which includes, either internally or via association, suggestions on the appropriate context within which to utilize the object." They claim that a newspaper article would not be considered to be an LO simply because it could be used for learning. It must be linked to "pedagogical purposes". [60], using Peirce's theory of signs, defines a LO as "a form of organized knowledge content involving learning purpose and reusable value."

Thus, according to these authors, it could be summarized, an information object becomes an LO when it is designed to be used by itself or in combination with other media objects to facilitate or promote learning. Any entity, digital or non-digital, that may be used for learning, education and training can be defined as LO [5]. LO may be text, presentations, quizzes, simulations, video clips, tutorials, animation, photographs, maps or assessments [11]. This learning should be demonstrable and testable through assessment and observation. To be an LO it must be packaged and made available for distribution as a lesson of some kind.

According to Mason, Pegler, and Weller [12], they found the following comments by learners who already used LO are typical:

"I liked learning in small chunks and making a choice at the beginning of the week as to which learning object to work on."

"I found learning objects instructive and stimulating. I felt that it offered me greater flexibility in how I approached my studies and what I studied."

LO can help the learners become self-directed learners who take responsibility for their own academic performance [13].

2.2 Learning Objects Design

In order to meet learner needs, the LOs design need to be effective, to reflect the needed qualities of educational integrity, reusability, accessibility and interoperability [14] as shown in Figure 2.

According to [14], some questions should be answered before developing the LOs. The questions are:

1. Do you have a specific learning objective to support developing of LOs? What skills and knowledge do you anticipate learners to gain from the LO?
2. Is developing a LO more effective than using other existing or readily available resources to meet your educational objective?
3. Who are the learners who will be using the LO? What if their approximate age, technical skill level and motivation?
4. How will the LO be used? How will learners use your LO to meet the educational objective? How will the content be presented? How will the LO relate to other resources being used? Build on a learner's existing knowledge and try to use real life, concrete examples where possible to help learners understand a concept more easily.
5. Are you using different media in your LO, such as combination of text, graphics and audio? Designing LO using variety media will help learners, promote interactivity and reinforce concepts.
6. What right issues might there be? Do you have right permission to use an image or a piece of text? Are you creating original content or adapting from a third party source?
7. What resources are available for development, such as access to expert course designers, multimedia personnel and financial support?
8. How will learners evaluate their progress? It can be survey questionnaire.

Answering these questions is very important because the designed LO should reflect the educational objectives. Moreover, a LO should be self-contained with specifically designed activity and assessment methods to make it effective.

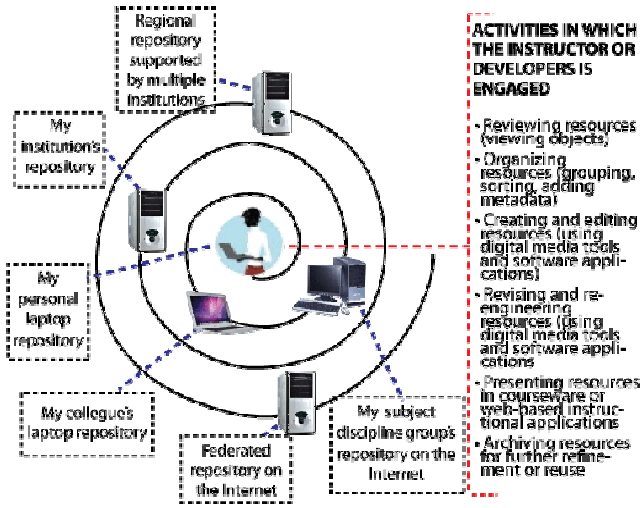


Fig. 2. Basic Instructional Design Principles in Designing Effective LOs.

2.3 Learning Object Tools

A screencast is a digital video recording of what happens on the presenter's computer screen and accompanying by audio narration. This is also known as video screen capture. The term screencast was coined and popularized by Jon Udell (father of screencast) in November 2004 [15]. Screencast is a digital movie in which the setting is partly or wholly a computer screen in which audio narration describe the on-screen action [16].

Screencasting is rapidly becoming a popular method of presenting content for instruction [17]. According to [18] students can use screencast for revision because of their flexibility. Screencast will make student have time-flexible to learning the entire software lesson, anytime and anywhere which suitable for them. Screencast also support some student in circumstances beyond their control, students could not attend a particular lesson.

In conventional approach normally lecturer will use lecture notes or slides as supporting materials in learning process. However, by using screencast it enhance the learning process with additional of screencast elements. The previous research also shows that by using screencast the feedback from student are 100% positive. 100% agreed that lecturer's demonstration supported by screencast is better teaching approach [19]. Screencast can be used to supplement teaching material [20].

Another benefit of screencasts as capture system is not only just for teacher-student interaction; they can also be used to support teacher-to-teacher communication. This capture system is not only available on campus and among colleagues; it can be shared to outsiders. They can share their lesson plans, scheme of work, notes and tutorial and approaches to assessment between them and share different teaching methods also. Communication then can take place through screencasts where they can exchange ideas, comment on student progress, showcase approaches to teaching and generally do the things that would normally require them to be present in a given location and a given time [21]. The following review some examples of screencasting software, grouped into freeware and commercial software.

1.0 Freeware

- AviScreen - Records the video into AVI files, but can also do BMP photos. It is Windows only and does not record audio.
- CamStudio.org - An open source program for capturing on-screen video and audio as AVI files. Operates on Windows only.
- Copernicus - Focuses heavily on making quick and speedy films by recording the video to the RAM for quicker access. Does not include any support for audio. Operates on Macintosh.
- JingProject.com – Records video, take a picture of any portion of user's desktop, draw on it, add a message, and immediately upload created media to a free hosting account. Works with Macintosh and Windows machines.
- Screencast-O-Matic.com - A Java-based screencasting tool that requires no downloads and will allow user to automatically upload to hosting. According to their site it works well with Macintosh and Windows machines, but does have some issues with Linux.
- Wink - Screencasting software that focuses on making tutorials with audio and text annotation abilities. Outputs to Flash, PDF, HTML, EXE files and more.

2.0 Commercial Software

- Camtasia – Capture whole video, does screen capture, robust options such as adding text and callouts, captioning, hotspots and basic interactivity, SCORM compliant with some quizzes, integrates an "add in" into PowerPoint. Runs on both Windows and Macintosh.
- AllCapture - Capture in real time, add audio during recording or after completion. Can output to Flash, EXE, ASF, DVD, SVCD and VCD. Runs on Windows only.
- HyperCam – Records screen activity to AVI files along with system audio. Operates in Windows only.
- iShowU - Offers a wide-range of pre-sets that allows users to record directly into QuickTime and up to 1080P in both NTSC and PAL formats. Also does audio and the file is ready to be published as soon as hit stop. Operates on Macintosh only.
- ScreenMimic - Software for the Macintosh that offers transitions, audio dubbing, can output to HTML, Quicktime and Flash.
- ScreenRecord - Outputs to QuickTime directly

and can record user's clicks and all on-screen activities.

2.4 Technology Integration in Education

In this globalization era, the explosion of technologies is impacting the world in more ways than what can be imagined. Most educators agree that education needs to reflect technological and social changes in our society [22][23][24]. Colleges and universities are making sizable investments in computer-related technologies to support and enhance instruction [25].

Many teachers who use technologies found that technologies can help them to improve learners' learning and motivation, address learners with different learning styles or special needs, expose learners to a wider world of information and experts, and implement new teaching techniques [26]. In cases where technology is used, positive results appeared. Previous studies, for example [27] and [28], found that technology drives a change. Similarly, by conducting four experiments, it is found that the effect of educational technology on promoting meaningful learning in multimedia lessons was common [29]. Despite many benefits gain and positive evidences reported, many faculties are not using technology in their courses [30]. Many technology integration literature describes faculty in higher education are comfortable using technologies such as word processing, email, and web searching [31][32][33], but ironically, not comfortable integrating technology into their classroom practices for meaningful learning [34][35][36].

In the literature, one important area of study examines barriers or obstacles inhibiting the integration of technology into education. Based on the literature and practitioner experience, [31] identify five categories of barriers to technology integration: time, expertise, access, resources, and support.

Of the five factors, time seems to be the most crucial constraints among the teachers. To apply educational technology in their teachings, teachers have to spend time to make plans, collaborate, prepare and use technology in the classroom [37][38][39][40]. Besides that, to upgrade their knowledge on new software and learning technologies, teachers have to spend time to attend technology-training activities [38][40]. With the update of software versions and advancement of new gadgets, teachers need to spend time to personally explore, digest and experiment with technology as well as time to maintain skill [39]. The second critical factor is expertise. To create an expert in technology teaching, teachers need to be sent for training. The type of technology training should be hands-on, systematic, developmental and on-going in nature [38][40][41]. Third critical factor is access. The interpretation of access to technology may include access to computers, the computer labs and the internet. [37] stated that without access, technology implementation will not occur in the classroom despite of all the time, expertise and resources a teacher has.

Resources are the fourth critical factor. The institution needs to provide enough financial resources to staff development, training and technical support. Institution that wishes to adopt technology in the teaching and learning needs to be aware that gadgets, software and hardware are prone to become obsolete. Therefore, budgets need to be prepared to fund the purchase, maintenance and upgrade hardware and software [39] and [41]. The fifth critical factor is support. This encompasses both administrative and technical support. Administrative leadership can best support technology implementation by articulating a vision for the implementation, and providing a role model of adoption and utilization [41]. Technical supports include the identification of personnel who are competent and knowledge in hardware, software and equipment maintenance who are also available to work directly with the lecturer [38][41][42].

2.5 The Instructional Relationship

The phenomenon of instructional designers creating LOs is increasingly popular [6][49][50]. LOs design currently leads the instructional technologists towards more effective instructional design, development and delivery of learning content [45].

Krauss and Ally [46] conducted a case study to examine the challenges and issues instructional designers face when developing a LO for healthcare related subject. Their study examined theories of learning and cognition that may influence the design of LOs by using an available instrument and methodology for assessing the LO quality. The authors concluded that it is important to inform instructional design decisions about the scope of a LO and the sequence of instruction from users as well as theories of learning and cognition. The authors concluded that more time should be devoted to exchanging best practices for designing and applying LOs to instructional contexts than on developing the content itself.

In contrast, [47] conducted a study to determine how instructors and course designers typically use LOs. Study participants designed post-secondary course content using as many publicly available LOs as possible. The study followed a development research design and presented three case studies from different academic subject areas. The three course development teams were able to ultimately produce full courses or revisions using the approach, despite encountering many problems attempting to create full courses from LOs. There were varying levels of satisfaction with the approach to course design among the development teams.

Elliott and Sweeney [48] conducted a case study to examine the efficiencies gained through the use of existing LOs to support a healthcare course in contrast with having to develop new LOs. They found that the approach whereby they focused on using existing materials promoted a threefold advantage in development time and a reduced cost. Additionally, they reported that gaining permission to use materials was not found to be a significant problem and some difficulties.

Past study focuses on a group of instructional designers who have developed LOs and have been through an equivalent training experience relating to the creation of LOs. Our study, on the other hand, focuses on

students' evaluation on the use of LO for specific lesson.

2.6 The Advantages of Implementing Learning Objects in Educational Application

Educational organisations that implement a LO approach often come up with internal definitions that link various LOs into a cohesive learning experience [14]. For example, Cornell University in the United States uses Ulises A. Mejias "learning molecules model" for categorising LOs by their instructional uses (a) scenario (e.g, a question, a problem or a case-study), (b) resources (e.g, an article or an image), (c) utility (e.g, a simulation or a calculator, (d) collaboration (e.g, discussion board or an email) and (e) evaluation (e.g, a test, an activity or an exercise)

Kulik et al. [49] found one study that listed an 88% savings in learning time with computerized instructions (90 minutes) while classroom instructions (745 minutes). He found also another study that listed a 39% savings in learning time-computerised instruction (135 minutes) while (220 minutes) for classroom instruction. Both study included computer instruction in education.

LO is considered unique because it provides a customized, individualized and flexible learning environment. The required approach can be grounded in constructive principles of learner-centred and learner-controlled learning environments. Collis [50] noted that the LO design makes a pedagogical shift from the emphasis of learning as participating and contributing to the learning experience. Learners construct their own understanding from experiencing objects, activities and processes by organizing, analysing, synthesizing and evaluating knowledge in self-directed and collaborative fashions rather than in predetermined structure [45].

3 SECTIONS

3.1 Awareness of Problem

The awareness of problem came from the experience in teaching and learning process for 3D Character Modeling subject where students were having difficulties to follow the instruction during class hours and cannot understand the given notes.

3.2 Suggestion

In this phase, students' feedback on using LOs for learning 3D Character Modelling is collected to improve teaching and learning process. The character modelling process from head to toe in a step-by-step format is designed and developed as the content of the learning object. At the end of this phase, additional elements gathered from students for Character Modelling course were put to tentative design and used as guidance to develop the LOs.

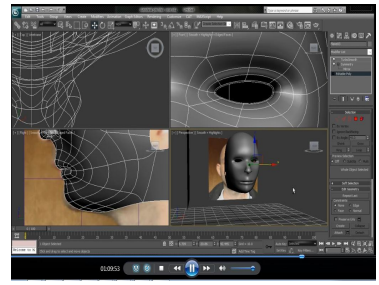
3.3 Development

During this phase, the designs of the prototype application including picture illustrations are developed. The LO application prototype is based on the concept of video and screencast capture. Each capture explains the different sub-lesson in modelling of the 3D Character. This application runs on Window Media Player platform. There are six chapters developed for the prototype and are as follows:

- Chapter 1: Head modelling which covers on how to model 3D head. This chapter explains how to imitate human anatomy by getting the right topology.
- Chapter 2: Eye modelling.
- Chapter 3: Torso or clothes modelling for the character.
- Chapter 4: Leg modelling.
- Chapter 5: Shoe modelling.
- Chapter 6: Hand modelling.

Once all the chapters have been covered, the student will be able to build a character with a good basic proportion and visual appeal. Table 1 shows the storyboard for Chapter 1 with its interface design. The storyboard describes the required components that must be included in the interface for Chapter 1 LO. These include LO title, video size, display format, duration and all the required buttons.

TABLE 1. THE STORYBOARD OF CHAPTER 1 – HEAD MODELING.

Chapter 1: Head	Standard Page
	Size : 800 x 600 View : Full Screen Duration : 01:35:42 (Chapter with the longest duration)

Object ID	Type	Event	Action Triggered/Description
T1	Text	Title of LO	Presenting the name of chapter
V1	Video	On the screen	Presenting step-by-step lesson
B1	Button	Stop	To stop the lesson and exit
B2	Button	Previous/next	To go to the previous scenes or next scene. Can control to make the move previous or next faster.
B3	Button	Play / pause	To play or to pause the lesson
B4	Button	Volume Control	To control the volume either to loud, slow or mute.

The development of LOs in 3D Character Modelling lesson uses existing techniques such as computer graphics, hardware, software and content. The software used to design and develop the LOs includes 3DS Max 2010, CAMTASIA Studio 6, Adobe Premier Pro CS4 and Adobe Soundbooth CS4. After the development phase, questionnaires were distributed among students in order to determine their responses in terms of usability after using the LOs.

3.4 Evaluation of Learning Object

Evaluation was conducted among students to measure their perception in terms of Learnability [52], Usefulness [53], Ease of Use [55], Functionality and Effectiveness [54], Satisfaction [56] and Outcome/Future Work [52] as depicted in Fig. 3.

Learnability is the degree to which a person believes that using this application would be easy to improve their learning ability [52][57]. Usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance [53]. Ease of Use is the degree to which a person believes that using this application would be free of effort [55]. Functionality and Effectiveness are used to measure students' perception on the function and effectiveness of the learning object [54]. Satisfaction is the degree of students' satisfaction with the overall application and contents [56]. Finally, Outcome/ Future Work is the degree to which a person is willing to use this application [52].

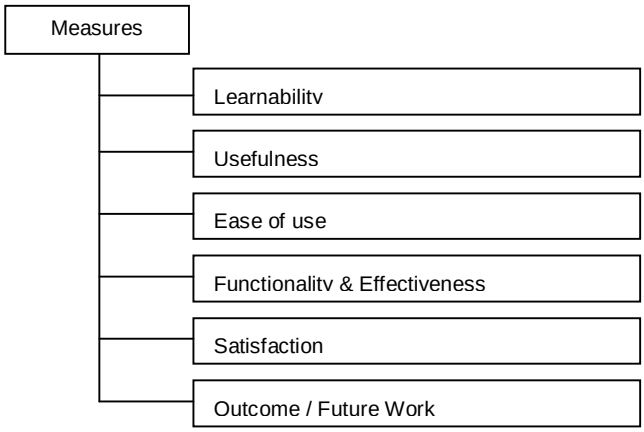


Fig. 3. Evaluation Components.

3.5 Conclusion

The outcome of the evaluation of this research is discussed to ensure that it can be used as guidelines for further research.

4 RESULTS

The questionnaire was divided into four parts; demographic, computer experience, knowledge in 3D and user requirements.

The study used SPSS version 15.0 to perform the descriptive statistic for collected data. Each descriptive analysis reduces redundant data hence contributes to a smaller and simple summary.

Data summary from data collection of respondents' general information has been showed in Table 2. Descriptive statistic on the frequency was used to collect data of this dimension. Table 3 shows descriptive statistics for the entire items.

TABLE 2. DEMOGRAPHIC PROFILE OF RESPONDENTS.

Profile	Classifications	Frequency (%)
Gender	Male	15 (50)
	Female	15 (50)
Race	Malay	28 (93)
	Chinese	2 (7)
Computer Experience	1-5 years	17 (57)
	6-10 years	13 (43)
3D Basic Skills	Yes	0 (0)
	No	30 (100)

TABLE 3. DESCRIPTIVE STATISTICS FOR INDIVIDUAL ITEMS.

Item	Measurement	Mean (Standard Deviation)
	Learnability	
1	It was easy to learn to use the application	4.70(0.466)
2	The information provided by application was easy to understand	4.43(0.774)
3	The information provided helped me in learning of 3D Character Modelling	4.57(0.504)
4	It provides clarity of 3D Character Modelling	4.47(0.571)
5	Using the application is reasonable for the learning	4.63(0.490)
	Usefulness	
6	Using the application would enable me to accomplish tasks more quickly	4.23(0.817)
7	Using the application would improve my job performance	4.23(0.626)
8	Using the application in my job would increase my productivity	4.10(0.607)
9	Using the application would enhance my effectiveness on the job	4.03(0.615)
10	Using the application would make it easier to do my tasks	4.43(0.679)
11	I enjoyed working with the application	4.33(0.606)
	Ease of use	
12	Learning to use this application would be easy for me	4.73(0.521)
13	I would find it easy to get the application to do what I want it to do	3.23(1.135)
14	It is easy for me to becomes skilful when i use the application	4.07(0.828)
15	I would find the application to be flexible to interact with	4.17(0.648)
16	I would find the application is easy to use	4.47(0.571)
17	I found it easy to work in 3D	4.53(0.571)
	Functionality & Effectiveness	
18	Information was presented in a meaningful way	4.10(0.607)
19	I could achieve what I wanted in the application	3.43(0.898)
20	I found it easy to access all the functionality (control) of the application	3.80(0.664)
21	The application is easy to use	4.53(0.681)
22	The application show the information step by step	4.50(0.572)
23	The application presented in useful format	4.23(0.568)

5 DISCUSSION

As shown in Table 2, both male and female respondents were equal (15, 50%). Majority of the respondents were Malay (28, 93%) and more than half have computer experience in one (1) to five (5) years. All respondents did not have 3D basic skills.

33 items were evaluated. It shows that overall, measurements on using LO in 3D Character Modeling lesson has high mean scores. It is found that Item 13 (Mean=3.23, SD=1.135) and 19 (Mean=3.43, SD=0.898) has the lowest mean values among others. This is due to less function and interactivity as the application is in a multimedia and video format.

For learnability, the highest mean score is the item "it was easy to learn to use the application". It is anticipated that respondents have been familiar with the interface since the learning object consists only multimedia and video format. Students agree that the use of the application is reasonable for learning.

Students agree that the application might allow them to accomplish tasks more quickly and therefore improve their job performance. Students agree that using the application would enhance their effectiveness and increase their productivity.

Table 4 represents the descriptive statistics for all dimensions in overall mean scores. From the table, we can see all the items with mean values more than 4 frequently, which indicates that most of students agreed on these items and only three items neutral. The results suggest that all students agreed and satisfied in using this prototype application for 3D Character Modeling lesson. The measures on learnability is the highest than the rest with the mean value is 4.57. This suggests that the LO for 3D Character Modeling are useful and helping the students in learning 3D Modeling process.

However, the measurement of functionality and effectiveness is the lowest with mean 4.17. This probably happened because the application is more on video based learning, so it has less function.

TABLE 4. DESCRIPTIVE STATISTICS FOR ALL ITEMS.

Item	Measurement	Mean
1	Learnability	4.57
2	Usefulness	4.23
3	Ease of use	4.32
4	Functionality & Effectiveness	4.17
5	Satisfaction	4.40
6	Outcome/Future work	4.30

6 CONCLUSION AND FUTURE WORK

This article has presented the students' perception on using LO application for 3D Character Modeling lesson. The application was developed to help student improve and enhance their 3D modeling skill and to assist student to finish their assignment task. The application was evaluated and the results confirm that it is learnable and useful for students and it is capable to help them in their job assignment.

The scope of this research is only for digital arts student in 3D Modelling Character lesson. Thus, further developments have to be made to cover other courses and lesson.

The prototype focused in developing 3D Character modelling to help students enhance and improve their 3D skill to do the assignment. Thus, in the next step is to help student to develop a real 3D Character with skin and bones and can animate the character.

For this study, the evaluation is focused on students after experiencing the LO to do the assignment task. In future, an evaluation on lecturers or teachers who use it to teaching and learning process in class may be of interest.

Overall, the use of LO in 3D Character Modelling lesson has gained promising results among the students. The existing of this LO has helped them to enhance and improve their 3D skill as well as assist them to finish the assignment task on time.

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