Enhancing Intrinsic Motivation of Librarian Students using Virtual Reality for Education in the Context of Culture Heritage Museums

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Abstract **– In this study the effects of intrinsic motivation and learning competency of virtual reality-based learning is compared to traditional text-based learning. In the study 28 students were involved from the second and third years of the library and information science faculty. The application of the fully immersive virtual 3D environment of Wieng Yong House was developed to support the virtual reality-based learning in the context of museums for culture heritage. To verify the hypothesis, the control group (traditional text-based learning), consisted of 14 students, used the course module of metadata for culture heritage in the museum whereas the experimental group (control group), consisted of 14 students, was provided virtual reality-based learning in the virtual museum. The tools of measurement were the pre-test/post-test quiz for learning competency and Intrinsic Motivation Inventory (IMI) with interview. The statistical model of paired sampled t-test assumptions was chosen for the statistical investigation for the hypothesis. The results suggest that constructing a virtual reality for learning in the context of a museum for cultural heritage might be a good way to enhance intrinsic motivation but cannot sufficiently and significantly improve the student's learning competency.**

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1. Introduction and Related Work

In the present, to preserve and express human knowledge resources, various fields have increasingly applied high speed internet and high performance computers to create or change their information and knowledge into digital forms. With the advances of technology, people can share, collect, and create various digital resources easily to others by converting the digital resources into a process on the computer. Most of these resources are important and significant information, so they should be preserved and protected for future generations. To maintain these important resources of humans, lots of cultural preservers have been applying technology to preserve cultural heritage into digital forms. According to [1], digital heritage can be made by computing process for maintaining significant meaning that should be preserved for future generations. Digital materials are more and more applied by persons, organizations, and societies to record and show valuable things and information for passing them on next generations. Digital materials consist of words, databases, motionless and movable pictures, software, sound, graphics, and websites. Learning to experience culture in the form of virtual reality is crucially important for current students and next generations. Virtual and combined realities offer a powerful, immersive context that is great for acquiring history and producing research with digital artefacts. Virtual reality is widely used as a groundwork and scholarly tool in the digital contexts of the scientific field of humanities. The whole extent can be reproduced giving a user to involve oneself in extents that do not occur anymore because of duration, historical situations, or unapproachability [2]. Virtual reality has been used in various fields of education, such as history, archaeology, sciences, and building design. The utility of virtual reality provides

students the chance to experience contents that would be hard to explain or narrate in traditional ways. Ability to interact via making a response to gestures, physical behaviors, and humans' actions, virtual reality is an excellent resource that can assist in teaching by offering a surrounding, allowing students to explore storylines and events [3].

However, there was a lack of research into Virtual Reality applications for librarians in the context of museums for education. Thus, the research focused on implementing a virtual reality learning concept for the digital preservation of cultural heritage, in order to improve the learning competence and motivation. This research is structured as follows: Some background on the virtual reality and Digital Preservation is presented in section 1 and section 2. Section 3 presents the research questions and hypotheses. Section 4 and 5 describes the research methodology and the overview of the development of visual museums. Section 6 and 7 shows the experiment result and discussion. Finally, section 8 contains the conclusion and future work.

2. Literature Review

2.1. Digital Preservation

Data preservation is a very significant matter in the culture of mankind, economy, the progress of civilization, and history. In the past, humans tended to record and write their information on rocks, ceramics, timber, and bamboo. However, with the progress of civilization, humans could find new ways to put the information in storage media through the use of technology, such as printing on paper or scribbling on silk. In the end, humans could successfully put information in photographic pictures on film and songs on record. The creation of electronic storage media, then appeared in the field of information keeping [4]. Digital preservation means to copy the digital data onto the latest media before the former media changes to be very outdated, which means that it is not possible to access the information anymore [5]. The information can be easily produced, operated, publicized, found, and collected by the use of digital technologies. It is a crucial part of digital information administration that provides a long-term accession to digitally kept data [6].

The CAMiLEON project [7], supported by the Joint Information Systems Committee (JISC) in the UK and the National Science Foundation (NSF) in the USA, focuses on the matters of application of technology assimilation to be a digital preservation procedure. The project acknowledges the capability of assimilation for the retaining of the functionality, the feature, and the sentiment of digital materials. Its aims are to expand equipment, instructions, and prices for assimilation. This project is operating a test among the users of many digital resources in their basic surroundings and in imitated surroundings.

The Computer Science and Telecommunications Board (CSTB) of the National Academies has sought the guidance for the Library of Congress on digital maintenance with the Information Technology Strategy. It is advised that the basic technology structure should be developed, especially in the area of networks, databases, as well as data technology safety. Preservation Policy 10 and The Digital Library SunSITE collection from the University of California, Berkeley, have been applied in this project supplying a variety of digital gathering levels as instruction [8].

a. The digital preservation of cultural heritage

Based on [9], the digital preservation of cultural heritage for the most part works with the context of digital technology. Also, the digital maintenance of cultural heritage is known as a section of applying technology that has been increasingly interested in the past few decades to preserve culture. The significant reasons are to make sure that the data of the object's form and appearance is not damaged or vanished by natural and accidental motives. Applying technology to preserve culture is also to present lots of audiences the distribution of digital media gathering by virtual museums as well as to build dummies. Besides, it is used to point out art forging and to approve the particular geometric collection or texture details when it is hard to get them from the real item [10]. Digital preservation allows cultural materials to be gathered, improved, preserved, and disseminated. Academics, community members, and next generations will be able to utilize and advance these cultural resources in the future [11].

The Digital Michelangelo project is created to explain the pipeline and the observation of 10 sculptures invented by Michelangelo, two construction interiors, and 1163 segments of an antique marble map in Italy. They used triangle-shaped laser scanners, and the duration of flight laser scanners. This work is a crucially important contribution as it is challenging to find solutions that can handle the huge statues and information, along with two billion polygons for the biggest simple dataset [12].

The Eternal Egypt project is an expansive historical program that has a goal to build a digital instruction and exhibit antique Egyptian artifacts in a virtual museum. The duration of flight range sensor and IBM research's pro 3000 digital picturing practice for fine standard color pictures are adopted in the project. To create the virtual accumulation, there are 16 3D, 2000 2D, and four controllable surroundings used in this project [13].

The Angkorian Temples project is a project that shows a vast domain of the reconstruction that has more than 100 historical constructions in Angkor, Cambodia by applying aerial pictures. The project is grounded on photogrammetric 3D sculpturing. Also, it presents outstanding consequences for the archaeological prospect documenting vast cultural heritage areas [14].

b. Virtual Reality Technology

Virtual reality (VR) is a technology that enables one to immerse oneself in an artificial environment; the world might be fully fictional or simply a replica of reality. The immersion is accomplished by the use of a virtual reality headset, which sets a stereoscopic 3D display system before the user's eyes. Some systems have sensors that detect head movement, allowing the user to see around. After that, the visuals are adjusted in real-time to match the position of the head or gaze [15]. VR has various special qualifications, such as perspective, and immersion. The user of VR application can select as well as switch between the viewpoints that present the virtual context. The first-person point of view (own point of view) is employed instead of the third-person point of view (outside point of view) in VR applications as the first-person point of view provides more direct interactions for the user with the context that generates immersion. Another special characteristic of VR is immersion. It refers to a mental condition induced by regulated sensory stimulation. The user senses immediate inputs or is immersed in the virtual surroundings. To make the user feel immersed, it relies on the actuality of the virtual sphere which the application of 3D graphics standards can precisely display in real or fictional surroundings [16].

Virtual reality has currently been used more and more in the virtual museums. Using VR in the virtual museums provides lots of essential advantages; it provides the lifelike depiction of exhibits and the surroundings, such as rooms in museums. It does not need time or travel to access the corresponding objects and it can be associated with exhibits [17]. Students are able to touch, choose, observe, and control the exhibits in the virtual museums. This context can allow students to learn and study the activities that consist of educational messages, motivating them to enthusiastically correspond to the exhibits [18].

c. Virtual Reality in Education

It is believed that Virtual Reality (VR) has a crucial role that promotes learning and teaching in higher studies. Students may be drawn in by the fact that it is new and that they will be immersed in a virtual environment [19]. In VR, students can experience the virtual context as if they are in the real world as they are able to turn and move as they wish as well as it can respond to students' gestures. Moreover, students can sense that their bodies are like in the real world, though they are in the virtual sphere because the special characteristic of immersive VR can support a vision of being there [20]. VR offer chances for students to feel instant in planned activities. While interacting with artifacts and being in interaction patterns in the virtual context, students are promoted to generate knowledge about those activities [21]. VR has two characteristics that may be used to support in educational fields in the future. The first one is the emotion of presence that need to be planned to support and not to overwhelm students. The second one is personification. Managing things in a three-dimensional area allows students to unexpectedly personally control over the learning environment [22]. According to [23], they found that the presence created by the three-dimensional technology can actually encourage the emotions and mind for studying because learners are able to control what they wish to see. Besides, they can decide how long they want to observe and can follow their attention and curiousness, thus offering them a sensibility of control and authorization over their own observation.

In engineering schools, they have used the three-dimensional models and VR technology to assist the professors and learners. VR and 3D models give learners the chance to envision the idea about engineering that they studied in their classrooms. Gibbon, in electrical engineering, operates labs consisting of the resonant circuit and the operational amplifiers that have been created in the three-dimensional modelling equipment. This way, students could easily understand the circuit problems that are taught in lectures [24]. In addition, children who require special schooling might benefit from virtual reality. According to [18], The Virtual Pink Dolphins Project brings together instructors and developers from Singapore, the Netherlands, and China to provide instructional content for children with Autism Spectrum Disorders (ASD). The goal of this research is to help children with ASD improve their social and communication skills by introducing them to dolphins. Nevertheless, actual dolphin treatment is too expensive; hence, virtual pink dolphins were created in Singapore and used in a special needs school.

2.2. Research Questions

Based on the scientific literature, virtual reality has been discussed and widely adopted successfully in the educational fields. In this research, we aim to investigate the virtual reality for learning competency in the field of digital preservation of muse-ums for librarian students in the bachelor degree program of the Library and Information Science Faculty. The term learning competency refers to applied skills, abili-ties and knowledge which students gain as a standard for the basic set of skills that specify the level of knowledge for librarians. To determine the effectiveness of using virtual reality compared to traditional teaching methods of text-based learning, we concluded the research hypotheses as shown below.

H1: The learning competency of librarian students during the use of virtual reality-based learning methodology will be relatively higher than students using traditional learning methods.

H2: Intrinsic motivation of the librarian students during the use of virtual reality-based learning methodology will be relatively higher than students using traditional learning methods.

3. Methodological Design

To verify our hypotheses, we used a mixed method design approach. The two major types of mixed method designs were proposed in this research. In the first segment we asked participants to gather quantitative information (H1) (pre-post test of the knowledge). The second segment focused on qualitative data by motivation questionnaire (H2) and an interview section with participants to summarize the experience of using virtual reality in the context of metadata for culture heritage. This mixed method design was adapted and modified from related research based on virtual reality for education [26], [27], and [28]. In terms of gathering data from virtual reality platforms, we developed the fully 3D virtual reality for the virtual museum which shows the case study of how to archive the ancient fabric in a digital collection by standard metadata.

3.1. Methodology Overview

Our studies focus on the Electronic and Digital Information Resources Management which is taught in the Library and Information Science major in the Faculty of Humanities, Chiang Mai University. However, in this study, we focused only on specific modules of metadata of the digital collection for the cultural heritage which can be quite difficult for students to understand clearly without any prior case studies for real objects of the archive in the museum for digital collection. In order to verify the hypotheses, we divided the students into two groups (control group and experimental group) for the experiment. The overview of our methodology is shown in Figure 1.

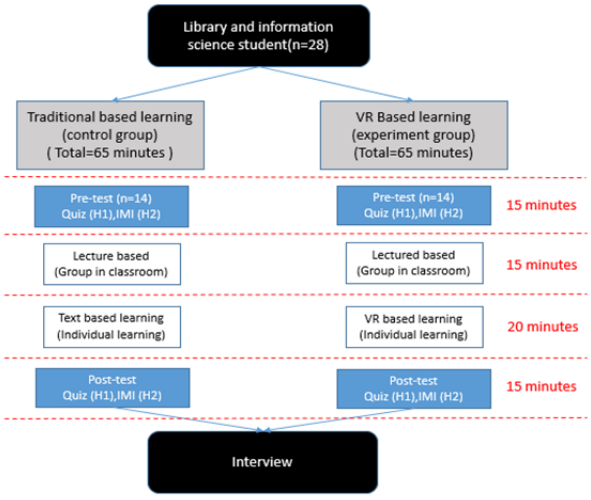

Figure 1. Overview of research Methodology

3.2. Participants

We recruited the participants among the students in the major of Library and Information Science with prior knowledge of basic metadata for information management but without any prior specific studies on cultural heritage. Twenty-eight students, aged between 19-21 years, were asked to participate in the research. Both control and experimental groups were divided into fourteen students, each group consisting of male and female students. Thus, both groups received pre-test and post-tests to perceive learning competency and answer the motivation questionnaire. Finally, ten from fourteen students of the experiment group were asked to get interviewed on their participation and learning experience. Please note that four students did not have to respond and take the interview regarding the results. The demographics of participants shown in Table 1.

Table 1. Demographics of participants

	Control (n=14)	**Experiment (n=14)**
Male/Female	8 / 6	7/7
Age (mean)	21.2	20.5
Degree program	Library and Information Science	
Study year	second year (n = 5) third year (n = 9)	second year (n = 6) third year (n = 8)
Do you have prior experience of virtual reality? (yes/no)	yes(n=1) no(n=13)	Yes (n=0) No (n=14)

3.3. Virtual Reality Construction and Instructor Setting

In order to measure the learning outcomes of our study, participants were asked to be divided into two groups which were taught by the same lecturer to describe the principle of metadata of culture heritage for fifteen minutes, the outline setting is shown in Figure.1. Both groups started with a pre-test, lecture-based learning, then the control group was assigned to read the text-based learning material, then to do the post-test, and give feedback. In terms of the experiment group, the participants were asked to learn the case study of metadata for culture heritage by virtual reality, then do the post-test, and give feedback on the learning experience.

▪ Material of the lecture-based learning (Group in the classroom) – For this research, learning materials were used to teach the bachelor degree students of Library and Information Science. The main subject of the material of the teaching and learning is a PowerPoint slide which consists of the outline of the learning objective, principles, standard metadata and the process of the digital archive from the physical object to the digital object described by a lecturer based on the Electronic and Digital Information Resources Management course corresponding to the book of Metadata for digital collections [25]. After learning the course, students gain knowledge on managing the electronic and digital information with specific knowledge of digital collection management. However, in this study we focused on the module for the concept of metadata and its functions for the digital archive of cultural heritage in the context of the Museum.

▪ Material of the traditional lecture-based learning group and VR-based learning group – The session of the lecture-based learning provides only the principle of metadata for culture heritage. However, for more understanding for students, the material of traditional lecture-based learning by text showed the case study of an ancient fabric in the museum shown in Figure 2. The Museum of Huan Yong Ancient Fabric consists of numerous ancient woven cloths that are preserved and conserved because they are a precious cultural legacy of Lamphun and not easily seen. Nonetheless, the museum is not renowned among people nowadays and only known to people who are fascinated with cloth. Itemizing and registry are the essential data for museum managers, to be aware of the quantity, sources, and the lifespan of materials. Audiences, also, are able to learn the significant information so that they realize and are proud of Thai folk intelligence, including cloths' history, the lifespan of woven cloths, designs, genres of cloths, weaving methods, etc. In both text-based and VR-based materials it was described how to use metadata for categorizing the ancient fabric into digital objects.

▪ The construction of Virtual Reality – To develop the virtual reality for learning, we constructed the content of the museum of Huan Yong as we mentioned previously. The process of the development of the virtual museum by virtual reality includes three distinguishable stages: 1) Collection of the photographic material in the Museum of Wieng Yong House; 2) Digitization of the ancient fabric in the museum; 3) Development of the virtual museum and the integration with a virtual reality Head-mounted display device. We provided the details of construction step by step.

1) Collection of the photographic material in the Museum of Wieng Yong House. In this step, collecting the information and photography were the most time consuming regarding the tasks to be completed. Every environment of the museum for photographs were taken to estimate the perspective for the virtual museum. Before observing the museum, we asked the permission of authorities granted for the team to visit the museum for eight times. The main objective of this step was to collect the texture of the wall, floors and other material environment around the museum. However, no special equipment was used, except the twelve million pixels from the smartphone of iPhone 11 pro max. The photographs of the museum are shown in Figure 2.

Figure 2. Compare between Real place of Museum (left) and Virtual Museum(right)

2) Digitization of the ancient fabric in the museum- The process of digitization of the ancient fabric in the Museum employed the method of digitization of Cultural Heritage [29]. In short, Digitization is the transformation of a physical object into digital objects which consists of software, hardware, standards, policies and procedures. The first step of the digitization process is preparing physical cultural objects. The second step is to use an appropriate hardware to collect data and transform the objects to digital objects. Then, the result is a digital object representation or more specifically a standard format for each cultural object. Finally, provided metadata is essential to preserving information about the digital object, and displaying it correctly which can easily provide access to the content, including a searching tool, learning environment, and exhibition. In order to digitize the

objects in the museum, the equipment of Fujisu Image scanner scansnap SV600 and Cannon EOS600D kit 18-55 IS were used for the texture of fabric. Note that we asked the help of professional librarians who are specialists in the preservation of fabric because each ancient fabric was more than fifty years old and can easily be damaged or torn. In order to be easily retrieved, we selected the VRA core metadata [30] to describe the fabric. The process of digitization of the fabric is shown in Figure 3.

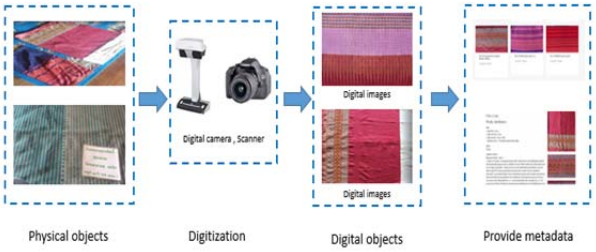

Figure 3. Process of digitization of ancient fabric in the museum

3) Developing a virtual museum and integrating it with virtual reality Head-Mounted Display- In this step, the virtual museum was developed by Game development software of Unity version 2020.1.7 and 3d modeling of environments in the museum by the 3D visual effect software of Autodesk Maya studio. According to the literature review [31] virtual reality can provide an immersive experience for users. However, it is not easy to develop a virtual museum without the experts of the specific fields. Thus, the virtual museum has been created by the cooperation of lecturers and researchers of the College of Art Media and Technology, Chiang Mai University who are experts in the fields of digital media, game development and virtual reality in order to provide immersion and realistic content. On the other hand, the lecturers of the Faculty of Humanities department of the Library and Information Science, who are experts in the field of the librarian profession, were responsible to verify the accuracy of the content. Thus, in this step, we spent three months to develop realistic fabrics and combine them with virtually-created artefacts and real environment scenes. The result of the virtual museum is shown in Figure 4.

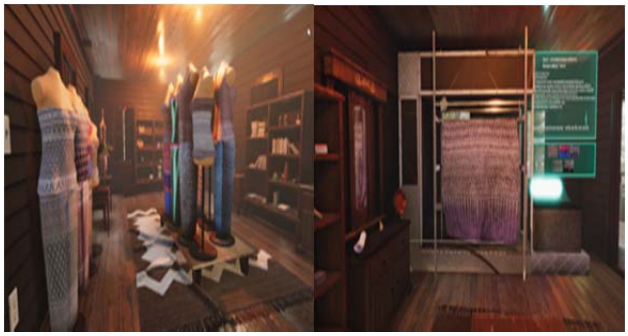

Figure 4. Presenting the virtual museum environment by virtual reality

4. Research

4.1. Tool for the Evaluation of Quantitative Data (H1)

Pre-test/Post-test quiz: This tool was used for the evaluation of learning competency for both groups. The questions of the Pre-test/Post-test were employed and modified from the book of Metadata for digital collections [25] which consists of twenty quiz questions. In addition, here we provide a few question examples: "What is the meaning of the element of "stylePeriod" in VRA core?", "Could you give an example for the element of measurements in VRA core?"; "VRA Core is built around three record types, work, image, and collection. What is the difference between each type? The students of both groups were asked to do it in the classroom before/after the end of the research.

4.2. Tool for the evaluation of qualitative data (H2)

Pre-test/Post-test intrinsic motivation questionnaire: This tool employed the questionnaire of the short version of the Intrinsic Motivation Inventory (IMI) [32], [34] based on the original version [33] to evaluate the motivation of students shown in Appendix 1. However, the original version was used to measure effect of the material of learning as a game on student motivation. Thus, in this research we modified the questionnaire using virtual reality instead of game to measure the motivation. The questionnaire was measured by a selection of 14 items which were given on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The three subscales were covered from intrinsic motivation; 'interest', 'perceived competence', and 'effort'.

Interview: The objective of the interview was to collect students' virtual experiences identifying both advantages and disadvantages while using virtual reality. Please note that we interviewed only the virtual reality group after using the virtual reality.

4.3. Research Process Steps

Both groups followed the steps of the research process the course of one-day setting. The following steps were taken:

1. Instructor's part to explain the steps of the research process for both groups;
2. Both groups take the pre-test quiz and pre-test intrinsic motivation questionnaire before the lecture session starts;
3. Both groups join the lecture in the classroom based on Chapter 8 of the book Metadata for digital collections [25] which explain VRA Core: The Visual Resource Association Core Categories for fifteen minutes;

4. Each group was asked to execute the experiment separately as follows:

4.1. Traditional text-based learning group

For this experiment, the instructor provided a briefing of the research procedure in a traditional way. Then, the students were given the material of the PowerPoint slides of the case study using VRA core metadata for the ancient fabric in the Museum context to learning by itself for twenty minutes. As this was the traditional way of learning, students could easily understand the procedure. The text and image as the content of the PowerPoint slides was similar to that of the virtual reality the material of learning shown in Figure 5.

4.2. Virtual reality-based learning group

In the virtual reality-based learning group, most of the students were unfamiliar with the virtual reality head-mounted display hardware of oculus quest 2. However, as this is not a conventional way of learning, each student started with an initial session to become familiar with virtual reality for five-ten minutes. In the introductory session of learning in virtual reality, the students were asked to start the application of learning ancient fabric in the Museum for twenty minutes. The students can observe the museum and select the ancient fabric including VRA core metadata to describe the detail of fabric as shown in Figure 6. The content of virtual reality was similar to that of the text-based learning but in virtual reality students could make observations by walking and interacting with the environment around the virtual museum to see the detail of each fabric.

Figure 5. Comparison of the learning materials used by the VR group and the Text-based group (PowerPoint)

5. Taking the post-test quiz and post-test intrinsic motivation in the end of the research for both groups.
6. nterview with the VR-based learning group to collect qualitative data of learning experiences.

5. Results

5.1. Pre-Post quiz (H1)

We collected data from both groups at the start/end of the research experiment as shown in Table 2. In order to verify the hypothesis (H1), we consider to use the t-test verification hypothesis with unpaired samples. Table 3 shows the p-value of 0.609, there was no statistical evidence of significant difference to support the learning competency between the control group (traditional text-based learning) and the experimental group (virtual reality-based learning) at the significance level of 0.05. In addition, using virtual reality-based learning by librarian students cannot contribute to better results as regards to learning competency compared to traditional text-based learning.

Table 2. Data collection of pre-post quiz

Group	Pre-test	Post-test	SD
Control group (Non-VR)	1.35	5.92	1.08
Experiment group (VR)	1.28	6.07	1.25

Table 3. Verification of t-test assumptions of learning competency

	Control group (Non-VR)	Experiment group (VR)	T-value	P-value
Pre-Post (Mean difference)	4.57	4.78	-0.52	0.609

5.2. Pre-test/Post-test Intrinsic Motivation Inventory (H2)

Similarly to the previous session, both groups were asked to fill the intrinsic motivation questionnaire at the start/end of the research experiment. The data of the pre-test and post-test are shown in Table 4. The Intrinsic Motivation Inventory separated data into competency, interest and effort. We also verified the t-test hypothesis with unpaired samples. Table 5 on competency shows that the T-value is 10.085 with a P-value of 0.000 which is less than 0.05. Thus, the competency of the VR group is significantly different from the Non-VR group. As regards interest, the data shows that the T-value is 9.030 and P-value is 0.000 which is less than 0.05, which means that the interest level of the VR group also is significantly different from that of the Non-VR group. Finally, the data of effort shows that the T-value is 7.318 with a P-value of 0.000 which is less than 0.05. The intrinsic motivation of the VR group has been shown to be significantly different from the Non-VR group on all three subscales.

Table 4. Pre-test/Post-test and SD of intrinsic motivation of the control and experiment groups

Group	intrinsic motivation	N	Pre-test	Post-test	SD
Non-VR	competency	14	3.21	3.25	.01
	interest	14	3.16	3.42	.10
	effort	14	3.15	3.26	.10
VR	competency	14	3.17	3.61	.15
	interest	14	3.25	4.16	.21
	effort	14	3.15	3.72	.23

Table 5. Verification of t-test assumptions of motivation

	Intrinsic motivation	Control group (Non-VR)	Experiment group (VR)	T-value	P-value
Pre-Post (Mean difference)	competency	0.04	0.44	10.085	.000
	interest	0.26	0.91	9.030	.000
	effort	0.11	0.57	7.318	.000

Figure 6. Participants of the Virtual reality-based learning group learning the content

5.3. Interview with Students

In this section, the semi-structured interviews were carried out with our participants after the post-test section in the virtual reality-based learning group. Two major themes were used to gather the qualitative data in order to find the learning outcome, experience and get feedback to improve the virtual museums in terms of content (theme1) and usability (them2). The outline of the semi-structured interviews shown in table 6.

Table 6. Outline of the semi-structured interviews

Construction	Open-ended Questions
The participants perceived some benefits or advantages with the virtual reality applying the content for librarians (content)	1. What is your opinion about using virtual reality as a virtual museum? 2. What is your opinion about using virtual reality for learning compared to traditional ways of learning?
The participants perceived some disadvantages or difficulties regarding virtual reality (usability)	1. How do you feel using the virtual reality with the Head-Mounted Display device? 2. How do you feel about controlling the virtual reality for learning?

Theme 1: The participants perceived some benefit or advantages with the virtual reality applying the content for librarians**.** Almost all of the students appreciated the fully 3D virtual museum with Oculus quest 2 presented. For example, some students who had never been to a fabric museum before, noted that "using virtual reality was very interesting for learning about these museums and related to the course of metadata, observing that one could describe a fabric in more details and also the environment of the museum". Another opinion of students who have experienced the 360-degree panorama images was that "this virtual museum is extraordinary, I have never used it before, it was different from the content in the classroom. It is something fully immersive, it feels like it physically puts you in that position". In terms of the content for librarians, some participants indicated that virtual reality tools can provide enjoyable and engaging courses for librarians which they feel are very boring otherwise. They mentioned features such as the simulation of categorizing books in a library and digital preservation which is required in the real museum for the deep details of objects of cultural heritage.

Theme 2: The participants perceived some disadvantages or difficulties with virtual reality. Surprisingly, after observing several participants, we found several disadvantages of learning through virtual reality. First, technical difficulties persisted with virtual reality devices: one of the students did not enjoy virtual reality when setting up the device: "I struggled with setting up the device. It did not fit for my head and felt uncomfortable while using virtual reality" and in another case a student who wear glasses also found the same problem. Second, some of the students did not follow the proposed learning objective: we found that some of the

students spent most of the time immersively walking around and surveying the object and environment around the virtual museum. "I felt I was distracted a lot of times during using virtual reality, and I forgot to pay attention to the learning objective that the lecturer wanted me to learn". In these situations, using virtual reality uncontrolled and without guidance would be more frustrating for students compared to learning through PowerPoint and text-based learning in the classroom.

6. Discussion

The result of intrinsic motivation with IMI questionnaire showed significant enhancement in the pre-test and post-test from the control group (Non VR) and the experimental group (VR). Our hypothesis (H2) that the intrinsic motivation when using virtual reality learning materials is higher than in the case of traditional text-based learning was confirmed. Especially in terms of interest, the statistical data showed that students are more curious and more interested in the realistic ancient fabric than in text and image. However, for perceived competence, students also feel that virtual reality could improve the knowledge and skill as well as the effort more than traditional text-based materials. The result is aligned with [36] in the context of librarian in public library and also consistent with the research findings of [34], [35] to improve intrinsic motivation for training nurse and medical students.

As for learning competency (H1), unfortunately the results of learning competency showed no significant improvement in the pre-test and post-test between the control group (Non VR) and experimental group (VR). Thus, we can state that applying virtual reality for enhancing learning competency was not effective in the context of a librarian course in a museum. As far as related literature is concerned, it was a lack of research of learning competency in the context of librarians. However, in other contexts the research findings are inconsistent with [34], [35] of the context of healthcare and [37] of the engineering environment. Based on the results, we realize that virtual reality cannot improve the learning competency in our research because the content of metadata of cultural heritage in museums may not be as complicated as in healthcare and engineering which needs specific knowledge skill and facilitate complex knowledge learning. Consequently, virtual reality not only implicitly boosted learning competency but also explicitly improved the students' intrinsic motivation which showed an ability to help students learn by self-directed learning and positive attitude.

7. Conclusion and Future Work

This research aimed to investigate the effect of virtual reality in terms of learning competency and motivation in the context of Library and Information Science among undergraduate students who had never been taught the content of digital preservation in museums. The proposed virtual reality application of ancient fabric in the Museum of Wieng Yong House can enhance the intrinsic motivation but it cannot improve the learning competency. However, virtual reality provides the immersive experience and improves the engagement of students in the classroom and provides virtual reality as a material to support learning.

For future work, first we plan to develop more content of virtual reality which relates to the courses in the context of Library and Information Science in museums. Second, we plan to perform new tests with a more significant number of participants to verify the stability of the results. For our work, we believe this could be an area for future research of Library and Information Science that will help to serve as a guideline for academic research to develop a virtual reality application for librarians in the context of museums for education.

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Appendix 1

Intrinsic Motivation Inventory questionnaire (five-points Likert scale ranging from 'strongly disagree' to 'strongly agree')

Pre-test	Post-test
Competence	
I think I am good at the course	I think I was good at learning through virtual reality/text-based
I think I do pretty well in the course, compared to others	I think I did pretty well in learning through virtual reality/text-based, compared to others
I am satisfied with my performance at the course	I am satisfied with my performance while learning through the virtual reality/text-based
I am pretty skilled at the course	I was pretty skilled at learning through virtual reality/text-based
I think I am pretty good at the course	I think I was pretty good at learning through virtual reality/text-based
Interest	
I think the course is quite enjoyable	I think learning through virtual reality/text-based was quite enjoyable
I think the course is very interesting	I think learning through virtual reality/text-based was interesting
I think the course is fun	I think learning through virtual reality/text-based was fun
At the course I often think about how much I enjoy it	While I was learning through the virtual reality/text-based, I often thought about how much I enjoyed it
I think the course is boring	I think learning through virtual reality/text-based was boring
Effort	
I do my best at the course	I did my best while I was learning through the virtual reality/text-based
I try very hard to do well at the course	I tried very hard to do well in learning through virtual reality/text-based
It is important to me to do well at the course	It was important to me to do well in learning through virtual reality/text-based
I put a lot of effort in the course	I put a lot of effort in making this virtual reality/text-based