Scuba Diving Virtual Reality Media Design as Underwater Tourism Preparation

Dian Novian[1*], Moch Bruri Triyono[2], Pardjono Pardjono[1], Ratna Wardani[1]

[1] *Department of Informatics Engineering, Gorontalo State University, Indonesia*
[2]*Postgraduate Program in Technology and Vocational Education, Universitas Negeri Yogyakarta, Indonesia*
Email: *aadian@ung.ac.id*

ABSTRACT

Maritime tourism is a priority foreign exchange earner for the Indonesian economy. According to marine protected area (KKP) data, Indonesian seas have the potential for educational tourism, underwater/diving tourism, conservation tourism, and scientific diving. However, developing marine tourism, especially underwater through diving activities, has various problems, one of which is a lack of understanding of the underwater beauty of Indonesia, and a lack of publicity and socialization related to diving activities, this makes tourists think diving is difficult to learn. Based on these conditions, this study aims to design 3D assets that can help provide an introduction, knowledge, and understanding of diving, These 3D assets can be used in making scuba diving virtual reality (VR) media applications that are useful for tourists to avoid high risks. The object of this research is diving training lessons from the Indonesian Diving Association (POSSI). The research method uses the R&D method with the ADDIE (Analysis Design Development Implementation and Evaluation) development model. The results of the study show that the design of virtual reality scuba diving media can be used as a basis for making VR scuba diving media applications as a preparation for underwater tourism.

Keywords: Virtual Reality, 3D, Scuba Diving, ADDIE, Underwater tourism.

1. INTRODUCTION

Indonesia is the largest archipelagic country in the world and has a long tropical season. This condition is very favourable so Indonesia has a large diversity of underwater biological natural resources. Therefore, marine tourism is one of the leading tourism potentials. Indonesian marine tourism, particularly scuba diving, has grown rapidly in the last 5 years. According to the Ministry of Tourism, the recreational diving business has the potential to reach 35% of the total domestic marine tourism potential which is estimated at US$4 billion [1]. This shows that scuba diving tourism is one of the tourism industry potentials that need to be developed in Indonesia.

Marine Protected Area (KKP) data shows that Indonesia's sea area is 3.257 million km^2 with a coastline length of 99.093 km, occupying the second largest position in the world after Canada. The area of the Coastal MPA and small islands is 20.87 million ha, has 590 species of coral, 2.057 species of reef fish, 12 species of seagrass, 34 species of mangrove, 1.512 species of crustaceans 6 species of turtles 850 species

of sponge, 24 species of marine mammals and 463 points the ship sank [2]. This potential makes the Indonesian seas very suitable for educational tours, underwater/scuba diving tours, conservation tours, and scientific diving. With the wealth and beauty of the Indonesian seas, scuba diving is one of the marine tourism potentials that need to be developed.

The Indonesian marine tourism industry has a very large global market segment. Indonesia has more than 700 scuba diving and snorkelling spots which already have prestige for underwater tourism. Data for 2014 show that of the 9 million foreign tourists who come to Indonesia, 70% of them choose sea tourism. This is different from domestic tourists, who still have a very small percentage of choosing water sports and marine tourism as tourism activities [3]. The development of underwater tourism through scuba diving activities is a challenge for the development of marine tourism potential. The low interest of domestic tourists in underwater tourism can be caused by various factors. Lack of knowledge about the underwater beauty of Indonesia, lack of promotion and socialization related to

scuba diving tourism, and high costs to the notion that scuba diving activities are difficult to learn. Not many people know that scuba diving can improve critical thinking and problem-solving skills through real-world experiences [4]. Scuba diving can also increase the feeling of happiness as conveyed by Ho [5], the study attempted to examine the relationship between leisure involvement, social support, and happiness. This study further confirms that the mediating effect of leisure involvement positively affects happiness. Furthermore, social support positively leads to leisure involvement (eg, scuba diving) and can also directly influence happiness with positive relationships. Consequently, this study provides managerial implications for scuba diving service providers. This is reinforced by Baek and Choi [6] who states that experience (experiential) economic theory can be applied to identify pleasure. These findings can be interpreted that diving affects self-realization through the perception of pleasure through physical education activities, such as having fun through scuba diving experiences, meeting new people, increasing knowledge, and receiving support from one's abilities. Scuba diving is a high-risk activity because it is carried out in extreme situations. Therefore, the people who carry out these activities must have good skills and are sufficiently trained in critical thinking and quick decision-making.

Scuba Diving is an activity that has a high safety risk, requires special equipment, and is expensive because it involves activities in extreme situations. Naturally, not many people and tourists have an interest in diving as a tourist option. On the other hand, the number of human resources involved in the underwater tourism industry is still limited. This is one of the obstacles to the development of the marine tourism industry. This obstacle can be overcome by increasing interest in scuba diving activities through the introduction and experience of scuba diving. The introduction and experience of diving are not always done directly, but with the use of technology.

In the learning context, technology is designed and developed to facilitate access to information sources. Before the technology existed, one of the sources of information used in learning was books. With the development of technology, books are transformed into digital books or e-books. Search engines like Google also make it easier to surf information sources located around the world [7]. It is very possible to improve the quality of the learning process in the digital era through the use of technology. Virtual Reality (VR) as a technology shows a significant development towards educational evolution. VR technology can be developed as a learning medium, one of the uses of this technology is to introduce and increase interest in the marine tourism sector, especially scuba diving.

VR technology functions as a practice tool to protect from the risks of physical activity, and trains high-level critical thinking regarding the procedures to be carried out [8]. VR technology also provides great benefits for training in high-risk environments involving safety and security [9]. In the context of introducing scuba diving activities, media developed based on VR can bridge the gap between the desire of someone who wants to try diving activities and worries or even fear of risks and expensive costs. Although to acquire real diving abilities and skills one has to do it directly. But at least through the simulation experience, someone will know about diving activities and it is hoped that this experience can be a trigger to learn directly.

To be able to understand diving activities, one needs to connect diving knowledge with actual diving activities. By connecting one's knowledge with the real world, one can get a more meaningful learning experience [10]-[11]. The integration between knowledge and the real world is called authentic learning [11]. With an authentic learning approach, someone will feel that their knowledge is relevant to everyday life [12]. Authentic learning can motivate a person to continue learning to solve more everyday problems [13]. In this study, the author will apply an authentic context to the system because it is proven that the application of an authentic context in learning can encourage one's cognitive, operative, affective engagement [14].

2. LITERATURE REVIEW

2.1 Virtual Reality

In July 1997 the Centre for Advanced Investigation into the Interactive Arts (CAiiA), at the University of Wales, held its first "Awareness Reframed" conference. No one can define a definitive definition, but the term provides a great stimulus for exploring ideas about consciousness: from the neuro-physiology of artificial intelligence, from extrasensory perception, from the Internet to VR installations, and from constructed vision to the role of geometry in painting. Roy Ascott, chairman of the CAiiA, says "technogenic terms" are key. It refers to our use of technology in the production of culture, and it also refers to abstractions, or how we understand the world and the processes of our existence. It shows an exploration of how technology is changing our perception of the world [15].

While Metzinger states VR is an activity exploring promising points of contact between philosophy and the growing field of virtual reality research aimed at an interdisciplinary audience, proposes a new set of research targets by presenting various concrete examples characterized by high theoretical relevance and heuristic fecundity for future interactions. which is

more intensive and marks some potential new directions for research [16]-[17].

Meanwhile, there is no universally accepted definition of virtual reality and that the concept exhibits some ambiguity and flexibility [17]. He also said that the virtual reality environment is computer-generated and interactive. In effect, computer-generated environments make these environments virtual and immersive, and interactive making our experience of them at least akin to ordinary reality. Understanding of the electronically simulated environment and the "goggles and gloves" system as a means of accessing this environment. The application of this definition is thus limited to technology, the unit of analysis and its potential variants are not specified. However, it is possible to define virtual reality without reference to specific hardware [18]-[20]. Its application can be used in various fields, for example, Education [21]-[25] underwater tourism [26]-[29], medical [30], design [31] and sports [32]-[34]. Learning to use Virtual Reality media is very simple and can be accessed easily through many platforms, "Since websites can be placed within the environment and videos, from platforms such as YouTube, can be streamed, instructors can easily customize an environment to have the concepts, information, web, and video resources that they might want to have continuously available in their actual or virtual learning environment [35].

2.2 Marine Tourism

In simple terms, to define marine tourism, the first thing that needs to be understood is to describe and interpret the definition of "tourism" and the definition of "maritime". From a tourism perspective, there are several other definitions of tourism, when viewed from the perspective of the industry and economic activity, tourism is one of the newer industries, capable of providing rapid economic growth in terms of employment opportunities, income, the standard of living, and in activating other production sectors. within the receiving country [36].

Tourism is the processes, activities, and outcomes arising from the relationships and interactions between tourists, tourism suppliers, host governments, host communities, and the surrounding environment involved in attracting and hosting visitors [37]. Here are some definitions of marine tourism from several experts.

1. Marine tourism includes recreational activities that involve traveling far from where one lives and that have a host or focus on the marine environment, where the marine environment is defined as waters that have salinity (salt content) and are affected by tides [38].
2. Marine tourism is a form of tourism that uses or exploits the potential of the coastal and marine

environment as the main attraction. The concept of marine tourism is based on the view, of the uniqueness of nature, the characteristics of the ecosystem, the uniqueness of art and culture, and the characteristics of the community as its basic strength.[39].

Based on several existing definitions, it can be concluded that marine tourism is a travel activity carried out by a person or group of people to the coastal and marine environment, carrying out activities in seascapes and or landscapes with the aim of recreation, fun, self-development, and interact with local culture in a temporary period. All activities in seascapes and landscapes as long as they involve elements of travel, temporary, and tourism activities in the marine coastal environment/ecosystem are included in marine tourism [40].

2.3 Underwater World

The underwater environment is different from the conditions on the ground, what you feel will change, you will experience a sensation of weightlessness, objects will look bigger and sounds will feel louder, movements will be strongly influenced by the surrounding water, and the sensations you feel can be enjoyed as part of from diving, it is important to understand the causes of the changes that occur.

Adaptation to the underwater environment needs to be done because the human body is not created for underwater conditions, underwater objects will appear 25% larger than their actual size, diving is not a silent sport, we can listen to every breath in and out loudly because water 800 times denser than air, water is an effective conductor of sound, sound travels 4 times faster than air, this makes it difficult to determine where the sound is coming from. Water conducts heat away from the body about 25 times faster than air. That's why a water temperature of 22 degrees Celsius/72 degrees Fahrenheit feels cold but the same temperature in the air feels comfortable [41].

3. METHOD

This study uses a research and development methodology using the ADDIE model. Application of the ADDIE model to develop training with varying complexity in the form of intra- and inter-context interactions [42]. The ADDIE model stands for (a) analysis, (b) design, (c) development, (d) implementation, and (e) evaluation. The process of developing the ADDIE model learning system is shown in Figure 1.

The research stages start from the first stage of the ADDIE model, namely:
a. Analysis

This section is an information dig. Preliminary research is used to see the profile of the implementation of scuba diving learning. This profile is explored through documentation, interviews, and observations. In the ADDIE model, the analysis must be carried out correctly and completely so that the design stage is only one way.

At the analysis stage, what needs to be explored is a needs analysis, which comes after seeing how big the gap is between reality and expectations or the expertise and skills one has. After the gap is found, what needs will arise to overcome the gap? In the needs analysis phase, the role of the dive trainer or dive instructor is very large, because many people know about the activities that take place. In addition, at the needs analysis stage, information gathering can be done for tourists, students who will take part in diving education, scuba diving instructors or assistant instructors (Dive Masters), and the tourism office.

b. Product Design Phase
Product design must match the learning objectives, research tools, types of exercises, topics, lesson plans, and media choices. The design phase must be systematic and specific, and the development and evaluation of plans refer to the objectives of the plan.

c. Development Phase
The main work in this development stage is prototyping, material development, and field testing. Prototype development varies in size and complexity. The development of this prototype is easy to observe. In this case, scuba diving VR media design.

d. Implementation Phase
This phase is a continuation of the development phase. After the development phase is complete, implementation continues to the intended sample.

e. Evaluation Phase
The main goal of this assessment phase is to understand how well the 3D models media design goals have been achieved for VR scuba diving.
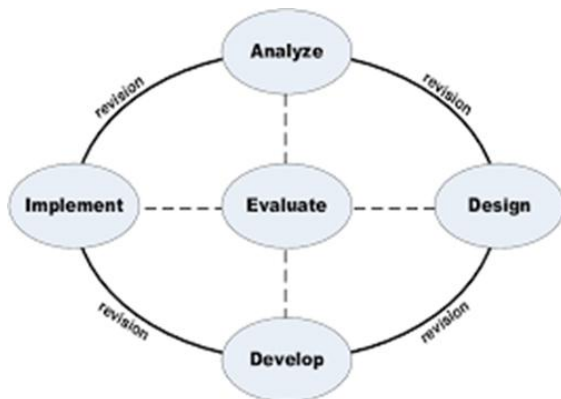

Figure 1 ADDIE Development Model [42].

4. RESULT AND DISCUSSION

4.1 Result

After going through the stages of analysis obtained from tourists, prospective students who will take part in diving education, scuba diving instructors and dive masters as well as from the tourism office, the next stage is to design VR scuba diving media at this stage, 3D modelling is made so that assets can interact when used [43], the software used is a blender, the modelling is divided into two parts, namely: 3D model of diving equipment. At this stage, the researcher modelled the diving equipment as shown in Figure 2.
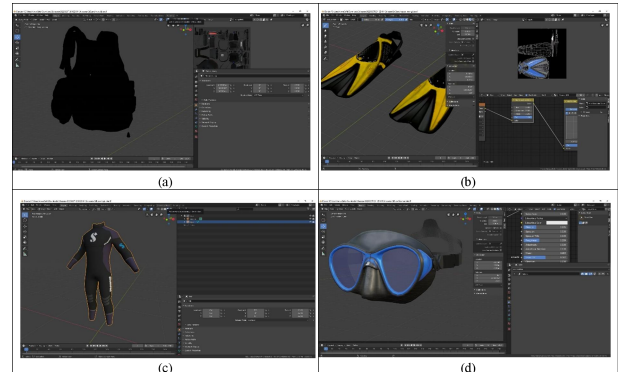

(a)   (b)
(c)   (d)

Figure 2 3D model of diving equipment.

Figure 3 3D model of complete diving equipment.

Figure 3 is an overview of the complete 3D model of the diving equipment that is made and ready to proceed to the next stage. 3D model of the sea environment. At this stage, the researchers carried out modelling related to the marine environment that would be used during diving simulations as shown in Figure 4.

After the 3D model of both the diving equipment and the marine environment has been completed, the next step is to do the coding, the tools used in making the program are unity and the XR Interaction toolkit. Figure 5 is the process of working on VR scuba diving using Unity.
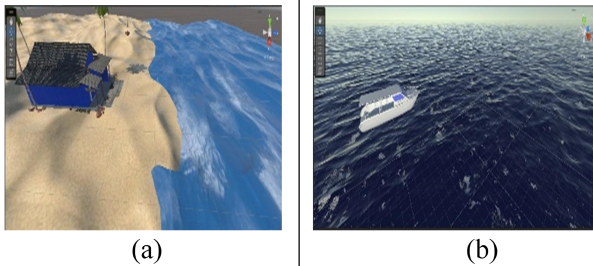
<div align="center">(a)   (b)</div>

Figure 4 3D model of the marine environment.

<div align="center">(a)   (b)</div>
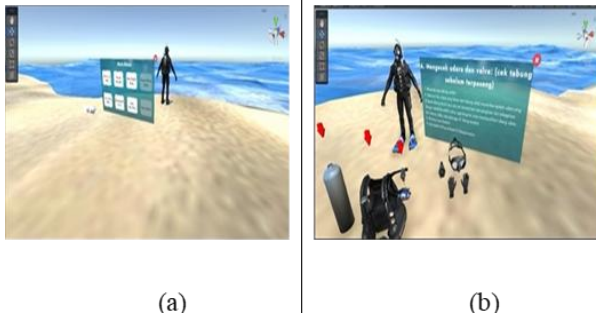
Figure 5 VR Media Scene.

The Head Mounted Display used in this study uses a device from the Oculus Rift S. Figure 6 Below is a snippet of the VR media program script to control the X and Y buttons on the controller which are enabled to go up and down during the diving process.

```
1   using System.Collections.Generic;
2   using UnityEngine;
3   using UnityEngine.Events;
4   using UnityEngine.XR;
5
6   [System.Serializable]
    2 references
7   public class PrimaryButtonEvent : UnityEvent<bool> { }
8
    Unity Script (1 asset reference) | 0 references
9   public class PrimaryButtonWatcher : MonoBehaviour
10  {
11      public PrimaryButtonEvent primaryButtonPress;
12
13      private bool lastButtonState = false;
14      private List<InputDevice> devicesWithPrimaryButton;
15
        Unity Message | 0 references
16      private void Awake()
17      {
18          if (primaryButtonPress == null)
19          {
20              primaryButtonPress = new PrimaryButtonEvent();
21          }
22
23          devicesWithPrimaryButton = new List<InputDevice>();
24      }
25
```

Figure 6 Script to the X and Y buttons on the controller.

A prototype VR scuba diving media was created to test how far the 3D assets of diving equipment and underwater 3D environment assets can match what is desired. In Figure 7 you can see the 3D assets that have been made which can be done for simulating the installation of diving equipment. Previously, the user will be given knowledge about the diving equipment and the functions of the diving equipment and strengthened with material that contains steps or instructions on how to install the diving equipment. the

material source is taken from POSSI at the first level of the 7th level.

Figure 7 Diving Equipment Installation Menu.

4.2 Discussion

The development of 3D Design Media is one of the steps in building VR-based applications to introduce underwater tourism to tourists. The design of 3D VR Scuba diving media can be used in making VR Scuba Diving applications which function as a training tool, protect against the risks of physical activity, and train high-level critical thinking about procedures to be carried out so that later a VR Scuba diving application can be created that can bridge the gap between the desire of someone who wants to try diving activities with worries or even fear of high risks and costs. Although to acquire true diving abilities and skills, one has to do it in person.

Based on the research conducted, the development of 3D models of diving equipment can be implemented in designing VR applications that can be used for VR-based scuba diving learning.

5. CONCLUSION

The design of this 3D media is suitable for making VR applications related to SCUBA Diving learning where all aspects have been adapted to the learning that will be delivered starting from the introduction of diving equipment to learning materials adapted to what is usually done by the Indonesian Diving Sports Association (POSSI) in terms of diving education learning/training material.

This research can also be used for non-formal learning. Because until now in Indonesia there is only one tertiary institution that has an underwater tourism study program (Bachelor), namely the Manado Polytechnic.

AUTHORS' CONTRIBUTIONS

DN., MBT., P, RW. conceived and planned the experiments. DN., carried out the experiments, planned

and carried out the simulations.   DN., MBT., P., contributed to sample preparation.

MBT., P, RW., took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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