

# SHELI: Augmented Reality-based Instructional Multimedia about Endangered Species for Elementary Students

Ria Anggraeni

Computer Science Education Department, UPI  
Bandung, Indonesia  
ria.anggraeni@upi.edu

Enjun Junaeti

Computer Science Education Department, UPI  
Bandung, Indonesia  
enjun@upi.edu

**Abstract**— as a popular destination for tourists, Indonesia has an amazing nature. It is a home for 12% mammals, 16% reptiles and amphibian, 17% birds, 10% flowering plants and 25% fish species. Indonesia has the greatest biological diversity in Asia. However, about 23% mammals and 12% birds in Indonesia are endangered. Southeast Asia, which includes Indonesia, has the highest relative rate of any major tropical region, and could lose three quarters of its original forest by 2100 and up to 42% of its biodiversity. Indonesia has lost 26% of its primary forest since the 1990s. The destruction of Indonesian nature could also have a significant impact on whole world's environment. Any realistic solution will need to involve a multidisciplinary strategy, including political, socioeconomic and scientific input, in which all major stakeholders (government, non-government, national and international organization) must participate. By applying science and technology, this study's aim is to build an instructional multimedia for elementary students named SHELI (Selamatkan Hewan Langka Indonesia) about endangered species. SHELI is an Augmented Reality-based Application. Its aims are to introduce endangered species, boost students' motivation, and increase students' sense of awareness of the importance of endangered species' conservation. SHELI will be developed by using Design Based Research. The result of the study are design of SHELI and lesson plan to implement it in learning activity.

**Keywords**— *Endangered Species, Indonesia, SHELI, Augmented Reality-based Instructional Multimedia, Design Based Research*

## I. INTRODUCTION

As popular destination for tourists, Indonesia has an amazing nature. A vast mosaic about 13,667 islands, Indonesia connects two biogeography regions known as the Sunda sub region, an area stretching from southern Burma and Thailand south to northern Indonesia and Borneo, with Oceania to the south and east. [1] It is a home for 12% mammals, 16% reptiles and amphibian, 17% birds, 10% flowering plants and 25% fish species. Indonesia has the greatest biological diversity in Asia. [2] However, about 23% mammals and 12% birds in Indonesia are endangered. [1]

Southeast Asia, which includes Indonesia, has the highest relative rate of any major tropical region, and could lose three quarters of its original forest by 2100 and up to 42% of its biodiversity. Indonesia has lost 26% of its primary forest since the 1990s. [1] The destruction of Indonesian nature could also have a significant impact on whole world's environment. [2]

Here are some endangered species in Indonesia: Javanese Rhinoceros; Gibbons; Orangutan; and Asian Golden Cat. [1][2] Any realistic solution will need to involve a multidisciplinary strategy, including political, socioeconomic and scientific input, in which all major stakeholders (government, non-government, national and international organization) must participate. [1]

As an academic member, through education, to protect the nature and endangered species, the solution that we can offer is developing a media that able to deliver messages to the students (society) about the importance of endangered species' conservation. The media is digital instructional multimedia for elementary students named SHELI (Selamatkan Hewan Langka Indonesia). Studies have shown that immersion in a digital environment can enhance education in at least three ways: by allowing multi perspectives, situated learning, and transfer. [5]

SHELI is an Augmented Reality-based Instructional Multimedia. Augmented reality (AR) is a growing phenomenon on mobile device. [3][4] Smart phones and tablets currently have processing capabilities that makes it possible the use of AR application in these mobile devices. [4] AR is now becoming more main stream with real opportunities for it to be used for educational purposes. There are two form of AR: 1) geo-based (location aware) and 2) vision-based. The deployment of AR is the substantial change in teaching activities by allowing the addition of supplementary information which is seen on mobile device. Mobile AR allow us to fuse real-world experience and meaning within specific physical context. In addition, it brings in new aspects: most importantly, it fosters the movement of user; their geographical position; the physical place where learning can occur; and enable formal learning to connect with informal learning. [3][5]

This paper examines the current state of AR technologies, AR's implementation in education for learning and teaching, and the steps and design of developing SHELI that is computer vision-based and geo-based.

## II. LITERATURE STUDY

### A. Augmented Reality (AR)

Augmented Reality is defined as combination of 3-D virtual objects, 3-D real environment in real time and a system that align both virtual and real object that runs interactively in real

time. [3][4] Milgram *et al* provide useful visualization to describe how reality and virtual are connected. It points out a continuum which encompasses all real and virtual objects and environments (see Figure 1). Mixed reality is an area in the middle, where the extreme meet, and is considered a blend of both virtual and real: [3]

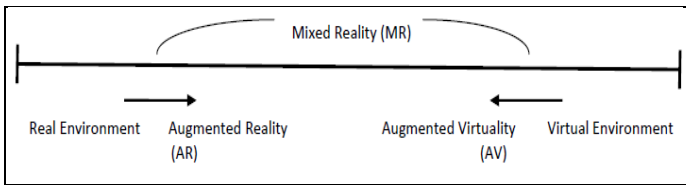


Figure: 1. Representation of the Reality-Virtual (RV) continuum – Milgram [3]

There are two types of AR: 1) computer vision-based and 2) location-aware (geo based). [3][4][5] Geo-based (location aware) application use GPS, accelerometer, gyroscope, and other technology to determine the location, heading, and direction of the mobile device. Vision-based application use image recognition capabilities to recognize images and overlay information on top of this image. These can be based on markers or marker less that recognizes an image that triggers the overlay data. [3]

Nowadays, mobile technologies such as smart phones and tablets have processing capabilities that makes it possible the use of AR. [4] Mobile AR enables us to integrate real-world experience and meaning within specific physical contexts (see Figure 2). Mobile AR can be classified based on: device or technology; mode of interaction; method of sensory feedback to the user; portability; and learning activity. [3]



Figure: 2. Mobile AR

### B. Augmented Reality in Education

Studies have shown that immersion in a digital environment can enhance education in at least three ways: by allowing multiple perspectives, situated learning, and transfer. AR as an instructional tool has potential ability to enable students to see the environment in new ways and engage with realistic issues in context with which the students are already connected. [5] AR-based instructional multimedia as tool facilitates contact between students with environment. This

tool produce quantitative improvements in terms of the speed and efficiency of human development; it also produce qualitative transformation because mediated contact with the world. Through an exploratory interaction with the world and experience develop child's development. [3] The use of AR in mobile device changes the learning activities significantly. [4]

Two form of AR that available for students and educators are vision-based and geo-based. Geo-based AR presents digital media to learners as they move through a physical area with a GPS-enabled mobile device such as smart phone. The media augment the physical environment with narrative, navigation, and/ or academic information relevant to the location. While vision-based AR present digital media to learners after they point the camera in their mobile device at an object (e.g.: QR code, 2D target). [5]

The theories assert AR could provide enhanced learning are: 1) situated learning theory and 2) constructivist learning theory. Situated learning theory propounds that all learning occur within a particular context and the quality of the learning is an outcome of interaction among the students, places, objects, processes, and culture within and relative to that given context. It builds upon and extends other learning theories such as social learning theory and social development theory, which propound that the degree of learning is dependent upon the quality of the social interaction within the learning context. Constructivist learning theory assumes that meaning is imposed by the individual rather than existing in the world independently. People construct new knowledge and understandings based on their prior experience, what they already know and believe which is shaped by their developmental level, and their socio cultural background and context. Learners build personal interpretation of reality based on experience and interaction with others. Constructivist Instructional design includes anchored instruction, case-based learning, collaborative learning, micro world and simulations, and situated learning in communication. Five conditions most likely to enhance learning in Constructivist learning theory: 1) embed learning within relevant environment; 2) make social negotiation integral to the learning experience; 3) provide multiple perspective and multiple modes of representation; 4) provide self-directed and active learning opportunities; and 5) support and facilitate metacognitive strategies within the experience. AR align wells with situation and constructivist learning. [5]

### C. Advantages of Augmented Reality

The advantages of AR: 1) the ability to present to a group of learners multiple incomplete, yet complementary perspectives on problem situated within a physical space; 2) affords educator the ability to leverage physical space as an additional layer of content for students to observe, manipulate, and analyze; 3) ability to access outside resources (i.e., internet) and additional software on the devices to solve the given problem more effectively; 4) boost up motivation. [5]

*D. Challenges of AR and its implementaton*

The limitation of AR in its current state of development is student cognitive overload. Student overwhelmed with the complexity of the activities, the scientific inquiry process and navigation, or making decision as a team. Managing the level of complexity is a key to decrease the cognitive load by: 1) simplifying the experience structure and increasing the complexity as the experience progresses; 2) scaffolding each experience explicitly at every step to achieve the desired experience/ learning behavior; 3) limiting character and items encountered by student to ~ 6 per hour; 4) replacing text with subtitle audio.

In addition, there are limitations within current state of the art in location aware and mobile technologies (i.e. network, battery life, and high cost [3]). Geo-based AR has major problem that is imprecise location. [3][5] Another criticism of AR is the concern that learning may not be driven by the pedagogy but more by the AR tools' strengths and weaknesses. [3]

**III. RESEARCH METHODOLOGY**

This study uses Design Based Research to conduct the research as follows:

*1) Identification of Problems and Objectives*

At this stage, preliminary analyzes are done to recognize the needs of the study by investigate the state of endangered species and identify the problem. The purposes, benefits and limitation are also defined.

*2) Literature Study*

At this stage, relevant information; theories; and researches about endangered species, mobile augmented reality and its implementation in education are determined.

*3) Instructional Multimedia Game Design and Learning Activities Design*

Prototype and learning design will be made at this stage. Flash will be used to make the mock-up. The result of the learning design is lesson plan for elementary student in science course.

*4) Development*

At this stage, SHELI's design will be developed into instructional multimedia games for learning activities.

*5) Implementation*

SHELI and lesson plan will be implemented in learning activities in science course at elementary school.

*6) Evaluation*

After the implementation, a test will be conducted to evaluate the effectiveness of the instructional multimedia game and lesson plan, student's motivation, and the learning result.

*7) Revision*

The result of evaluation will be reviewed and followed up.

*8) Publication*

The result of this study will be published in seminar or journal.

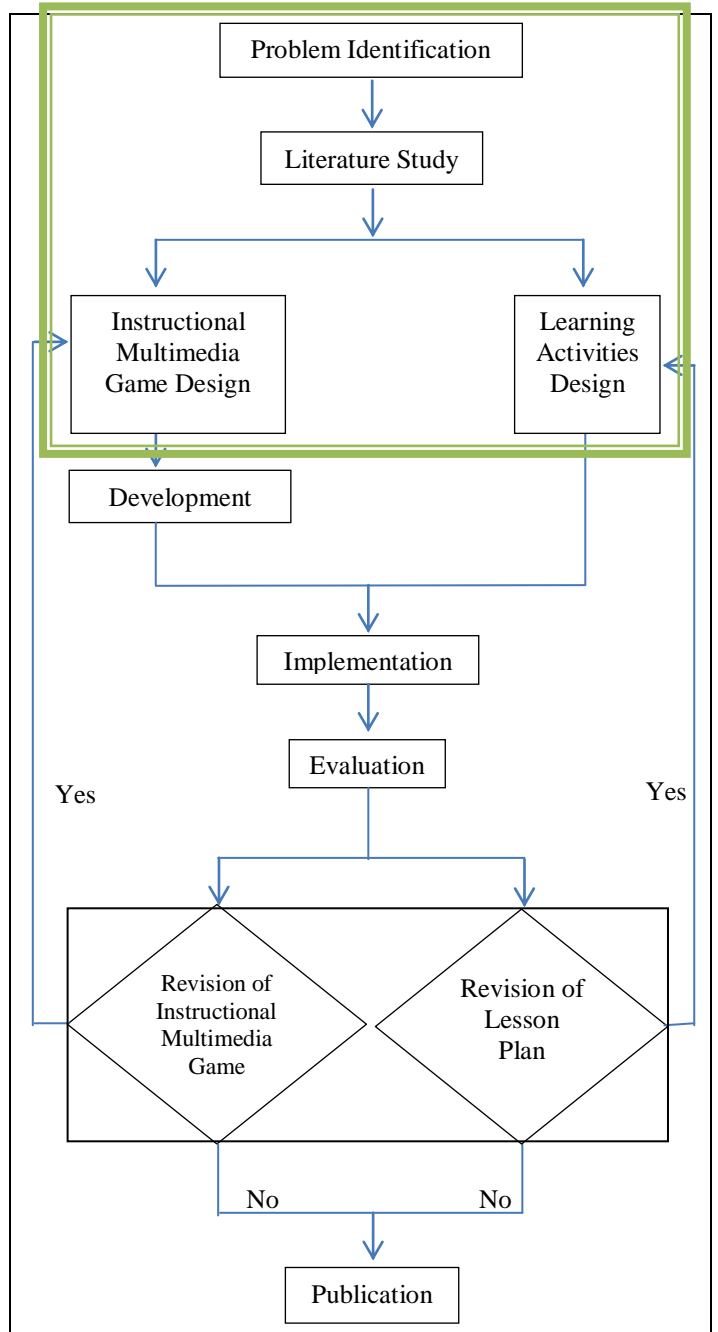


Figure: 3. Research Method

**IV. RESEARCH RESULT**

There are eight stages in this study; however we only conduct the study until 3<sup>rd</sup> stage.

*A. Design of SHELI's Mock-up (User Interface)*

SHELI is an Augmented Reality-based instructional tool to deliver material in Science class about Endangered Species. SHELI is designed into an edutainment game, so it could boost

students' motivation in learning. Flash is used to design SHELI's Mock-up. Here is SHELI's mock-up:

1. Welcome Screen (see Figure 4)
2. Encyclopedia: it contains information about endangered species such as Javanese Rhinoceros, Gibbons, Orangutan, Cendrawasih, Komodo and Sumatran Tiger. This feature is equipped by AR-book that has marker to describe state, habitat and anatomy of endangered species (see Figure 5)
3. Pet Game: it allows student to preserve the endangered species by feeding and taking care of them (see Figure 7)
4. Adventure: it allows student to travel around zoo or wildlife reserve to see endangered species in real life directly. This feature uses GPS and Google Map to determine the location, heading, and direction of the mobile device (see Figure 6)
5. Mini Games: it allows student to relieve their boredom in learning activity by playing games (see Figure 8)
6. Shop: it allows students to buy food for feeding endangered species (see Figure 9)

Figure: 5. Encyclopaedia of SHELI

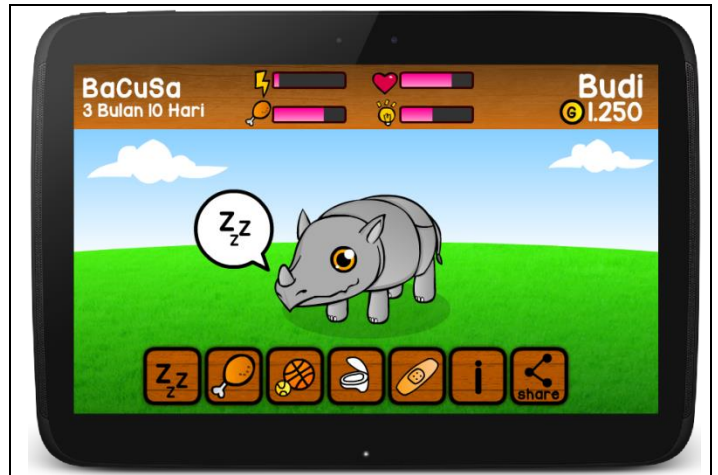


Figure: 6. Pet Game



Figure: 7. Adventure Games



Figure: 4. Welcome Screen of SHELI



Figure: 8. Mini Games





Figure: 9. Shop

### B. Design of Learning Activity (Lesson Plan)

Here is the lesson plan to implement SHELI:

1. Apperception  
In this section students will be introduced about endangered species and explained about SHELI's user manuals.
2. Main Activity  
In main activity, it will be divided into several stages:
  - a) Students will be divided into groups to learn about endangered species using encyclopaedia in SHELI which uses AR technology.
  - b) Each of group will experience how to preserve endangered species through pet games in SHELI.
  - c) Finally, they will go to Zoo to observe the endangered species directly. They can utilize feature Adventure in SHELI which use GPS and Google Map.

### 3. Evaluation

At this stage, students will be asked to make a report or review about endangered species. Furthermore, their knowledge will be tested by using some instrument. Lastly, they need to fulfil the questioner about SHELI.

### V. CONCLUSION

Study conclusions as follows:

1. The current state of Mobile AR and its implementation are presented.
2. The design of SHELI's mock-up's made.
3. The design of learning activity to implement SHELI's made.

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### REFERENCES

- [1] Josip, "Endangered Species in Indonesia" (2011). Australian Science. <http://australianscience.com.au/enviromental-science/endangered-species-in-indonesia/>
- [2] WWW Indonesia. "Spesies" (2015). WWF Indonesia. <http://www.wwf.or.id/program/spesies/>
- [3] FitzGerald, Elizabeth *et al.* "Augmented Reality and Mobile Learning: The State of the Art" (2013). International Journal of Mobile and Blended Learning, Volume 5 Issue 4, October 2013 Pages 43-58.
- [4] Figueiredo *et al.* "Augmented Reality tools for Teaching and Learning" (2014). International Journal on Advances in Education Research, March 2014.
- [5] Dunleavy, M., & Dede C. (in press). "Augmented Reality Teaching and Learning". In J.M. Spector, M.D Merrill, J. Elen, & M.J. Bishop (Eds.) The Handbook of Research for Educational Communications and Technology (4th ed.). New York. Springer. <http://isites.harvard.edu/fs/docs/icb.topic1116077.files/DunleavyDedeARfinal.pdf>