

Developing Digital Natural Laboratory Based on Edutourism for Environmental Geography

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Abstract - This study aimed to develop products and test the utility of the natural laboratory based on eco-spatial edutourism. This research was developed in three stages: 1) product development using five steps in the ADDIE model: Analysis, design, development, implementation, and evaluation, 2) conducting validation tests from learning experts, and 3) conducting limited trials in small groups. The research subjects were students of Geography Education study program, State University of Malang, in the environmental course in the academic year 2019/2020. The data were analyzed using the percentage table. The results showed: 1) the digital natural laboratory based on eco-spatial edutourism was valid by the expert validators, 2) the digital natural laboratory based on eco-spatial edutourism qualified for use in higher education learning.

Keywords - digital natural laboratory development, learning media, edutourism, eco-spatial approach.

1. Introduction

21st-century learning demands massive accessibility in using technology to improve learning quality. The use of technology has also been shown to improve learning outcomes [1], [2].

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The use of complex technology in the current generation [3] is massive, and the learning trend is increasing [3], [4] with digital activities will dominate on physical and manual activities [5], [6]. Therefore, learning in higher education is expected to lead to digital-based learning [7], [8], including learning related to nature and the environment [9], with instructional design learning on edutourism activities as educational tourism focused on technology tourism [10] and protect the tourism environment [11].

Edutourism as a learning activity aims to increase formal and informal knowledge and understanding for tourists. Edutourism is stated by [12] as tourism education for any program in which participants travel to a location as a group to engage in a learning experience directly. [13] provides the concept of edutourism as a tourism activity carried out for educational and learning purposes to primary or secondary activities.

Implementing edutourism has various forms. Edutourism can be ecotourism, heritage/cultural tourism, rural/agricultural tourism, or exchange program between universities students [14]. The activity can be study tours for adults or others, student trips between schools/universities, and student exchanges. Edutourism can be self-regulated or formal and can be conducted in natural or manufactured destinations. Edutourism is a major element of sustainable tourism and development concept.

Several studies on edutourism have shown a positive influence. According to [15], edutourism benefits the tourism industry and the surrounding community in accessing, managing, and utilizing existing natural resources. Developing edutourism can empower communities based on local wisdom and maintain food security [16]. In addition, [16] added that tourist sites used as edutourism will be visited by many tourists for educational activities, training, development programs, research, laboratory studies, and university programs. Therefore, edutourism in South Malang Coastal has the potential to be developed as a digital natural laboratory.

South Malang Coastal has natural tourism potentials that can be developed into a digital natural

laboratory. The Southern Cross Line (*Jalur Lintas Selatan*) impacts the development of new tourist sites [17]. Massive development has a negative impact on major environmental issues [18]. Hence, environmental sustainability becomes a major problem in the South Malang coastal [19], and risks the environmental stability in South Malang coastal that has high biodiversity and unique landscapes [20].

The geosphere phenomenon on the South Malang Coastal Coast can be used as a digital natural laboratory based on eco-spatial edutourism for university tourism and environmental courses. This natural laboratory will help achieve sustainable tourism, which requires maintaining the environment and culture [21]. Understanding the potential and sustainability of natural resources [22] raises human resources with environmental awareness in traveling [23].

Developing a digital natural laboratory is critical to achieve digital skills in the 21st century. According to [24] several 21st-century digital skills to consider: information, communication, collaboration, critical thinking, creativity, and problem-solver. The skills are essential in 21st-century education that is integrated with digital natural laboratories. Additionally, equality in using digital nature laboratories has the major potential to contribute to sustainable development. It is also aligned with the UNESCO concept of "The Decade for Sustainable Development in 2005-2014". The UNESCO concept recommends every educator: 1) to promote and improve the quality of education; 2) to redirect existing education to address sustainable development; 3) to build public understanding and awareness; and 4) to provide technical training [25]. Thus, education has an important role in supporting sustainable development or sustainable tourism.

Previous research results have shown the urgency of developing a digital nature laboratory. However, the development of a digital edutourism natural laboratory has not been widely discussed. The development of this digital edutourism nature laboratory can have a positive impact on learning [26], contributing to maintaining sustainable tourism [11] as a solution related to the empirical gap. Therefore, this research aimed: 1) to design the development of a digital natural laboratory based on eco-spatial edutourism, and 2) to measure the effectiveness of digital natural laboratory based on eco-spatial edutourism in the South Malang coastal area.

Based on previous study, this research has a new approach and perspective as a unique aspect of research. Contextual packaging of content is seen in potential locations for the development of edutourism destinations. It is hoped that the

packaging of material on such media can form a reflective and meaningful pattern of thinking, thereby a generating interest and motivation to learn. Furthermore, the potential for edutourism is packaged into learning media in the form of a digital natural laboratory at universities [27]. Determining a location that has potential as an edutourism destination will have a good impact on the surrounding community and existing local resources. In addition, new edutourism destinations can become meaningful digital natural laboratories for students through digital media packaging which is still limited with development referring to 21st century education and skills [28].

On the technical side, the development of a digital edutourism nature laboratory based on the Eco-Spatial Coastal area of South Malang has creativity. The basic elements of a digital natural laboratory refer to an artificial laboratory: 1) Collaborative Tools; 2) Information Management; 3) Simulation; and 4) Remote Operation. Then, digital nature laboratory products were found which are located on the basis of development with educational-based instructional designs (physical activity, knowledge, recreation-sports, and nature-sustainability) and the approach used as the basic design in development in the form of an Eco-Spatial approach.

2. Material and Methods

A. Research Design

The research design is research and development research aimed to determine the validity, implementation, and effectiveness of a digital natural laboratory using the ADDIE model. The ADDIE model is included in the development modelling framework that is most commonly used by many people in developing instructional design [29]. Based on the ADDIE development model, it consists of five stages of development, namely: 1) Analysis; Design; 3) Develop; 4) Implementation; and 5) Evaluation.

At the analysis stage, performance identification and needs analysis were carried out with the subject consisting of three segments, namely, students, lecturers, and coastal environmental conditions in South Malang; Environmental Geography learning; and learning media. The evaluation of the segment then becomes the basis for the development assumptions in the form of: 1) There is no clear and specific location for edutourism on the South Malang Coast; 2) Students and lecturers have a pattern of inclination and interest in non-interactive and simple learning media; and 3) The limitations of developing eco-spatial-based edutourism natural laboratories packaged in digital form.

Furthermore, the results of the analysis activities are used as the determination of steps at the design stage which consists of the preparation of learning video designs. Based on this need analysis, it is possible to develop an eco-spatial-based digital edutourism natural laboratory for Environmental Geography courses. Making prototypes that refer to the development framework on the storyboard. As for the storyboard, it contains the integration of scene and content. The scene is divided into two basic scenes in the digital natural laboratory, namely Terrestrial Scene and Aerial Scene. Meanwhile, the content contains material in the Environmental Geography course. In addition, at this stage expert validation is also carried out, both material expert validation and learning expert validation as a form of formative evaluation regarding the feasibility of the development product. The validation results can be used as a reference in implementing and evaluating related to digital natural laboratories. The development procedure is shown in the following figure 1.

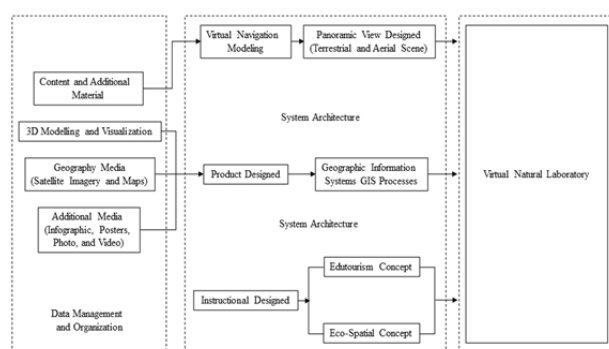


Figure 1. Flow chart of natural laboratories' digital development procedures

In general, the procedure for developing a digital natural laboratory consists of two development domains, namely: 1) Data Management and Organization and 2) System Architecture. In the Data Management and Organization domain as the domain of content packaging in the form of 3D modelling and visualization, Geography media, and other additional media (infographics, posters, photos and videos). Then, the material content is applied to the architectural system in the form of visual navigation modelling using panoramic views (terrestrial and aerial scenes), the Geographic Information System process on Geography referenced content, and instructional design of learning referring to the Edutourism and Eco-Spatial Concept.

Implementation was carried out with small group trials. At this stage it is also used to determine the feasibility of the developed product, especially in terms of (1) understanding the material; (2) Ability to identify problems, (3) Ability to solve problems.

Then, the results of the implementation of the digital nature laboratory are evaluated, namely formative evaluation (input from material and learning expert validators) and summative evaluation (user responses).

B. Research Subject

This research was conducted at the Geography Study Program at the State University of Malang, Indonesia in the 2021/2022 academic year. The subject of the trial was limited to using small groups of ten students with a sample of five students from class G and five students from class H using purposive sampling technique with the qualifications of students taking Environmental Geography (PGEO6017) courses in the third semester of the 2020 class. Purposive sampling technique by giving certain criteria to the subject, [30] through the consideration of researchers in adjusting to the research objectives [31]. Environmental Geography at the State University of Malang has standard learning outcomes for graduates to analyze the use of natural and environmental resources effectively and efficiently and make appropriate decisions according to the context, which consists of learning outcomes for subjects (CPMK): 1) Understanding the Geography approach in the study of Environmental Geography; 2) Applying environmental ethics; 3) Identifying environmental problems and implementing sustainable environmental management; 4) Understanding the application of environmental impact analysis (AMDAL); and 5) Designing innovative solutions through environmental projects. The characteristics of course outcomes which are dominated by field practice activities make digital natural laboratories relevant to use.

C. Instrument and Data Analysis Technique

The instruments in data collection in this research refer to the evaluation of the validation process, the assessment of trials, and the effectiveness of the use of digital natural laboratories in the Environmental Geography course. The design of the validation and trial assessment used a Likert's Scale, with each assessment being modified. Meanwhile, the effectiveness assessment refers to the mastery of competence and subject matter.

Analysis of the data used in this study using quantitative descriptive method. Descriptive analysis was carried out on formative evaluation by material and learning expert validators. Formative evaluation on expert validators is in the form of description questions with assessed competencies: 1) Ability to understand material related to edutourism and eco-

spatial; 2) Ability to identify environmental problems in the edutourism area; and 3) the ability to solve environmental problems in the edutourism area using five modified scale conversions [32]: 1) Invalid (0-49); 2) Less Valid (50-59); 3) Sufficiently Valid (60-69); 4) Valid (70-79); and 5) Very Valid (80-100). Meanwhile, the achievement of individual student success and classical completeness uses five modified scale conversions [33], namely: 1) Very Good (80-100); 2) Good (66-79.99); 3) Fairly Good (56-65.99); 4) Not Good (46-55.99); and 5) Very Poor (0-45.99). Data analysis is shown by the following formula.

$$\text{Percentage} = \frac{\sum \text{Score of each item}}{n \times \text{highest score} \times \text{number of respondents}} \times 100\%$$

3. Results

The development of a digital natural laboratory was validated by both material expert validators and learning expert validators. The evaluation instrument consists of two criteria and ten indicators. The instrument measured the validity of the digital natural laboratory. The validity results are shown in the following table 1.

The material validation was conducted by Geography lecturers of FIS UM with a score of 82 and very valid category. The result indicated that the digital natural laboratory based on eco-spatial edutourism is suitable for educational purposes.

Table 1. The results of material validation of digital natural laboratory

Criteria	Competency	Assessment	Score
Assessment of edutourism and eco-spatial elements	There is an element of edutourism	1	8
	There is an eco-spatial element	2	9
	The suitability of the elements of edutourism	3	8
	Compatibility of eco-spatial elements	4	8
Utility of the content of the material	Compatibility with learning outcomes	5	8
	There is an element of edutourism	6	7
	There is an eco-spatial element	7	9
	The suitability of the elements of edutourism	8	9
	Compatibility of eco-spatial elements	9	8
	There is an element of edutourism	10	8
	Total Score		82 (Very Valid)

Table 2. The results of learning validation of digital natural laboratory

Criteria	Competency	Assessment	Score
Assessment of edutourism and eco-spatial elements	There is an element of edutourism	1	8
	There is an eco-spatial element	2	9
	The suitability of the elements of edutourism	3	8
	Compatibility of eco-spatial elements	4	8
Utility of the content of the material	Clear information	5	8
	Increase learning motivation	6	7
	Encourage student activity	7	9
	Encourage critical thinking	8	9
	Encourages creative thinking	9	9
	Increase environmental awareness	10	9
Total Score		88 (Very Valid)	

Table 2 showed the validation process by learning validator in developing digital natural laboratory. The validation was conducted by Geography lecturers of FIS UM with a score of 88 and very valid category. The result indicated that the digital natural laboratory based on eco-spatial edutourism is suitable for educational purposes. Furthermore, the questionnaire results in the digital natural laboratory are shown in the following table 3.

Table 3. Student responses questionnaire

Indicator	Statement	Average Score
Giving motivation	1	7
Clarity of information	2	8
Using edutourism elements	3	8
Using eco-spatial elements	4	8
Using language clearly and concisely	5	8
Clarity of instructions in using digital natural laboratory	6	9
Video display and illustration design	7	9
Clarity of Exercise	8	7
Benefits for improving critical thinking	9	8
Benefits for increasing environmental awareness	10	9
Total Score		81 (Very Valid)

The questionnaire is conducted to 10 students of Environmental Geography courses in Geography Education program, consist of 5 students from class G and 5 students from class H. The results obtained an average score of 81 and very valid category. Moreover, the result indicated that the digital natural laboratory based on eco-spatial edutourism is suitable for educational purposes.

Table 4. Students responses on evaluation indicators

Respondent	Indicator 1: Ability to Understand Material	Indicator 2: Ability to Identify Environmental Problems	Indicator 3: Ability to Solve Environmental Problems
1	78	80	75
2	78	78	75
3	79	79	70
4	80	80	80
5	80	80	75
6	79	79	75
7	79	79	70
8	84	84	80
9	80	80	75
10	82	82	78
Average	79,9	80,1	75,3

Table 4 showed the results of evaluation indicators, consist of: 1) the average ability to understand the material is 79.9; 2) the average ability in identifying environmental problems in edutourism is 80.1; 3) the average ability in solving environmental problems in the edutourism is 75.3. The results concluded that the digital natural laboratory based on eco-spatial edutourism is valid to be used.

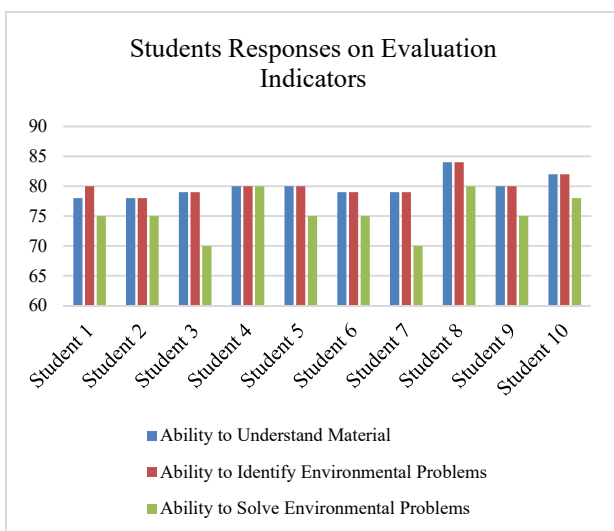


Figure 2. Students score in evaluation indicators

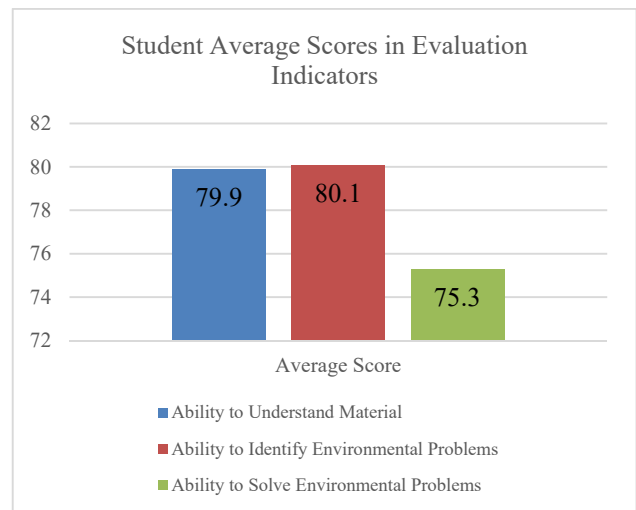


Figure 3. Student average scores in evaluation indicators

4. Discussions

The laboratory has a central role in supporting the learning process, especially to provide real experiences to students. Laboratory activities not only aim to improve theory [34], but students can improve their knowledge [35]. According to [36] laboratory activities are used to help students understand complex concepts and acquire knowledge through practical experience with processes or experiments [37]. Students can enhance their experiences and build knowledge of facts, concepts, and theories contained in the learning material by participating in laboratory activities.

Natural or field laboratories are popular, especially among academics interested in social sciences. Natural laboratory with multicultural-based tourism concept is needed to improve scientific literacy and natural science [38], mainly through applying theory [39], increasing processes [40], increasing problem-solving ability [41], and increasing student interest and attitudes towards learning [42]. Natural laboratory can be used as a learning medium, supports learning activities, and achieves three domains of educational goals: cognitive, affective, and psychomotor [34].

The existence of a laboratory is critical in science education, but it is frequently underused due to a lack of tools, materials, and risk factors for accidents. Efforts to overcome this problem have developed a virtual laboratory as a learning medium [43]. The development results demonstrate that the digital edutourism natural laboratory has a significant impact on student learning, especially related to material understanding, environmental problem identification, and solution.

Specifically, the digital nature laboratory contributes significantly to the field of education. Digital nature laboratories can optimally support the learning process with an in-depth understanding of the content. The digital edutourism nature laboratory can improve material understanding effectively [44] by visualizing abstract concepts [45]. Such conditions make the digital natural laboratory able to accommodate the formation of immersive experiences for students in learning [46], [47]. Integrating learning designs with digital laboratories through translation simulations enables more in-depth understanding of concepts [48], and affects students' ability to identify the environment.

The ability to identify the environment becomes a domain in reconstructing environmental understanding and awareness. Identifying the environment is an important issue in ecological knowledge [49], by gathering information to collect action in the cognition process [50]. Digital natural laboratory media can help simplify collecting comprehensive data and assist in the optimal diagnosis of environmental problems. Students can organize knowledge as a set of points of view in identifying environmental problems using digital natural laboratories. Diversification of material content that is designed in a complex manner in data management and organization helps accommodate student learning styles, both visually, audio and kinesthetically. This condition is used as a concrete research effort in overcoming the obstacles of distance learning that is oriented towards self-regulated learning.

The ability to solve environmental problems is then developed in students through access to digital natural laboratories. Digital nature laboratories affected the development of problem-solving skills by applying a theory [51]. Practical learning can help achieve a meaningful learning process [52], [53]. In a digital natural laboratory, students in the learning process are faced with integrated learning activities. Exploration of content in active learning, the cognitive domain accommodated by Geographic Information Systems (GIS), as well as the achievement of learning objectives through Edutourism and Eco-Spatial Concepts guide students to build new perceptions in reviewing a problem. Thus, learning technology media with conventional concepts will be effective while integrated with advanced technology.

Then, the digital nature laboratory shows effective solutions in overcoming the issues that are developing today. The online learning process with full boundaries of interaction between teachers, students, and the learning environment can be accommodated using a digital nature laboratory. Reconstruction of the real environment becomes virtual, by presenting objects in the student learning environment to effectively overcome obstacles during the covid-19 pandemic. Students' demands for active, independent and meaningful learning can be facilitated using a digital nature laboratory. Thus, the consequences of maintaining the quality of learning without neglecting the achievement of learning objectives and developing competence in students can be carried out.

The digital nature laboratory as a solution for field learning activities is actually very important in the learning process. The digital natural laboratory answers the limitations of the learning process related to the issues and challenges of learning during the covid-19 pandemic and its relation to the availability of high-cost practical tools and materials, the low students' accessibility reaching objects in the field, and preparing material tools and others. Some of the limitations of the laboratory limit teachers in carrying out practice-based learning [54]. Meanwhile, the demands of achieving competence and learning objectives in the study of social sciences and humanities have a great opportunity to contribute to the development of natural laboratories, and apply them to the learning process [55]. Therefore, the highest award in this research is related to digital natural laboratories that can contribute to the development of science, especially related to learning media innovation as a support for sustainable environmental learning processes in universities.

5. Conclusion

The results showed that: (1) digital natural laboratory based on eco-spatial edutourism was valid by the validators, 2) the trial results in small groups showed that digital natural laboratory based on eco-spatial edutourism was met the criteria. The digital natural laboratory based on eco-spatial edutourism is recommended to be applied in higher education, especially in supporting education about sustainable environment.

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