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Digital Energy Literacy : The Need for Android-Geofinder Application Based on Geographic Information System (GIS) to Enhance Student's Geothermal Energy Literacy In Indonesia

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***Abstract*—Currently, in this industrial revolution 4.0 era, Digital Energy Literacy has an important role as a solution to face the threat of energy crisis and climate change problem. This study aims to analyze the need for an android geofinder application based on the Geographic Information System (GIS) as interactive and informative multimedia to improve geothermal energy literacy. it was conducted on undergraduate students in the city of Surakarta. Questionnaires and interviews were used as data collection instruments. 94 students filled out a questionnaire through online google-form. The data analysis used the triangulation-method by Miles and Huberman which consists of data reduction, data presentation, and drawing conclusions obtained data. The results showed that smartphone was quite familiar among students and had the wide opportunity became relevant informative multimedia in the field of geothermal energy. Android geofinder applications are expected to be a reference for researchers in using Android-based multimedia, to improve students' learning motivation and understanding, and also to enhance student's energy literacy. The detailed data analysis is described in the main section of the below article.**

Keywords— digital energy literacy, geothermal energy, climate change, android-geofinder application, geographic information system (GIS)

I. INTRODUCTION

The mastery of digital technology has become a fierce competition around the world [1]. The ability of a country in managing technology becomes a big capital in controlling a certain field, such as Japan with its automotive industry, Taiwan with its agriculture, America with its management business, or Finland as a reference for education in various countries [2-4]. Technology has become one of the major factors affecting education in the world. The era of the industrial revolution 4.0 demands education to enter a new phase. There have been adjustments in various fields, such as changes in the existing curriculum, cooperation between countries is wide open [5], changing student learning patterns [6–9], teaching methods, ways of measuring one's skills, to determining future careers [10]. Likewise, the development of digital media technology in supporting energy literacy in the world

The establishment of energy literacy has become a challenge [11,12] and a great opportunity [13,14] for the preparation of

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energy readiness [15,16] in the future. Regardless of the issue of the energy crisis in the future, renewable energy has become a household task that needs to be prioritized for the sake of balancing nature and human health. Therefore, both parents and future generations need to have sufficient energy literacy skills. Increasing energy literacy is necessary for a quality and environmentally friendly energy future

Energy literacy today, has an essential [17] and sensitive [18] role. Society has a large dependence on energy, this makes energy consumption habits bad. Existing policies often overlap, causing people to hesitate to make the right decision. Talking about energy, you cannot go in between, policies must be clear with consequences that can be understood by all parties. The description of the interests of energy literacy affects various areas of the field, such as: industry, telecommunications, lighting, transportation, and even socio-cultural involvement.

Cognitive ability is not the only factor needed to determine the quality of energy literacy [19]. Affective and psychomorphic have a close relationship with the success of energy literacy [20]. This creates a basic understanding of the target population and determinants of energy-saving behavior [21]. Chen [22], explained that in order to improve understanding of energy literacy, the effectiveness of education as a whole is needed. One of them is the right supporting media is needed.

There are still few digital media to support energy literacy in Indonesia [23,24]. Interactive digital technology media, including: smartphones, tablets, television, computers, radio, projectors and VCD players [25]. There are many types of learning media, including: audio-based, visual-based, and audio-visual-based or so-called multimedia. Smartphones are the most popular and familiar digital media among students. However, it is necessary to control the use so that it can be used optimally. Tools with the Android operating system are equipped with internet features that can be used to access various kinds of data or information access via the website. Along with the proliferation of smart phone users, website access via Android is increasing and it is predicted that it will surpass website users via desktop computers. The analyst site http://gs.statcounter.com explains that internet access via Android from September 2014 to September 2019 increased from 29.36% to 51.78%. This proves that internet access via Android in the world is in great demand every year and will continue to grow in the future. The Internet has a geographic spatial technology system or geographic information system (GIS) [26], which is specially designed for spatially referenced data analysis and reading the geographic coordinates of the earth. This capability is very supportive for determining the geographical location and topology of geothermal energy

Spatial geographic technology plays an important role in the development of geothermal energy technology [26–32], but currently it is not widely known or used optimally. Related research, Trump [33] explained that a web-based-oriented framework of geothermal energy production databases in the world is capable of being a business intelligence platform for distribution and even broad data analysis. Not to mention other renewable energies such as: solar panel energy [34], wind energy [35,36], water energy [37], biomass energy [38-40] and other renewable new energies. The disadvantage of a web-based platform is that it is very dependent on an internet connection, so that the level of feasibility is limited. In response to this, an application called geofinder was developed with an Android-based GIS system. Geofinder is a geothermal energy potential data information system application. This application offers application efficiency (database business intelligence platform), simplified platform access, expanded administrative features, and easy access to geothermal database updates. This application was created as a form of web-based development towards android-based, so that it is more familiar to students today. This study seeks to describe the analysis of the need for application of GIS-based geofinder android application innovation media to improve the quality of geothermal energy literacy, as well as a reference material for other researchers in the development of related topics in the future.

II. METHOD

A person's readiness in understanding knowledge is highly dependent on scientific intake and the ability to think in reasoning an event. It will be difficult if the research is taken from one point of view. An exploratory approach was taken to meet various responses. This article is written in a design-descriptive line [41], trying to describe the unusual phenomenon of respondents. We summarize the interesting data, link it with previous research, and draw conclusions. This investigation creates a different pattern from previous experiences, which are detailed in the main part of this article.

University level is the right level to talk about energy literacy, especially renewable energy. 94 students of Mechanical Engineering Education, Sebelas Maret University Surakarta, were selected as relevant samples as limited scale respondents. Distribution of data using purposive-sampling technique. This study used two types of instruments, namely: interview and

questionnaire. Questionnaires are used to measure the analysis of basic abilities and analysis of student needs. Observation through interviews seeks to confirm students' needs in accordance with what they expect in the field. The collected data is followed up with interactive analysis according to Miles Huberman's line [42] which consists of data collection, data reduction, data presentation, and conclusion drawing.

III. Result & Discussion

As previously explained, this study used two categories of data collection methods, namely using a questionnaire and an interview. When recording the questionnaire data, the researcher simultaneously conducted face-to-face interview data to obtain depth of data. The data is then processed according to procedural terms, to determine sentences with the same pattern, so that conclusions can be drawn according to the respondent's response. To find out the initial needs analysis, a measurement of students' basic literacy skills towards renewable energy has been carried out. The familiar level of renewable energy among students is shown in Figure 1.

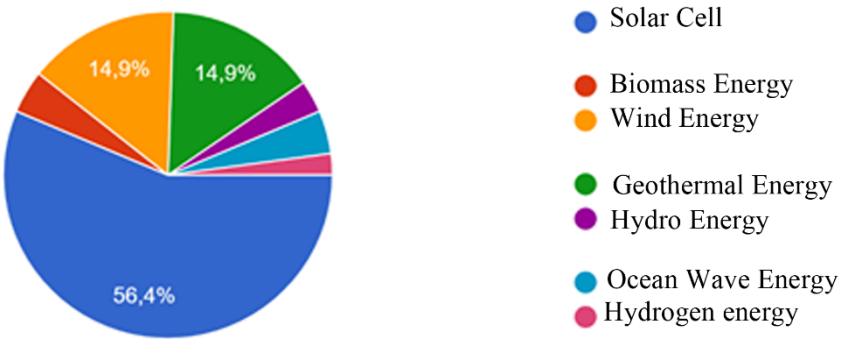

Fig. 1. Basic literacy skills for students on renewable energy

Referring to Figure 1, it shows that Sollar Cell is the most familiar type of energy among students, where 56.4% of them know this type of energy. Meanwhile, geothermal energy gets 14.9% of votes, equivalent to wind energy. With this difference in numbers, it is enough to prove that geothermal energy is not popular enough among students. When viewed from current geothermal data, Indonesia has a potential of 96000 Gwe / year [43]. Even geothremal energy is a renewable energy source with the greatest potential compared to other types of energy. Increasing geothermal energy literacy needs to be done to encourage and support the government to optimize all existing potential.

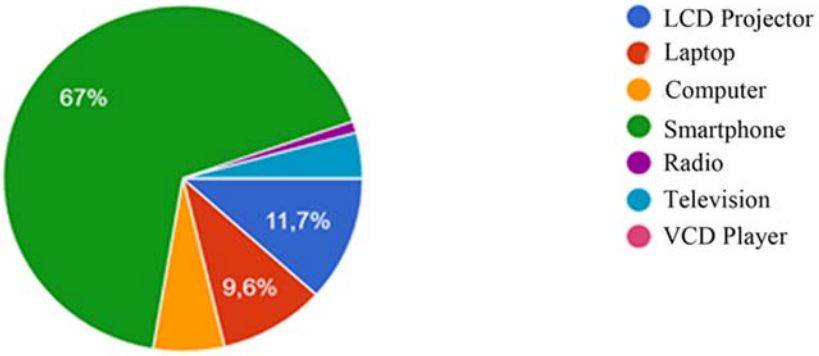

Fig. 2. Electronic media that is familiar among students

It can be clearly read that Figure 2 shows that smartphone electronic media is the most popular media among students (67%). In addition, in conditions that are entering the era of a pandemic, smartphone media has a great opportunity as the educational media of choice for students. Using media that is close to students, learning will be more precise and easier to convey. The era of the industrial revolution 4.0 is at the same time a trigger, that it is necessary to keep thinking about following technological developments towards easier access to learning. There is also a tendency for students to say that they are more familiar with renewable energy issues through the school environment, not from outside the school environment. In addition, the data shown in

Figure 3 provides great information that schools are still the center of student scholarship.

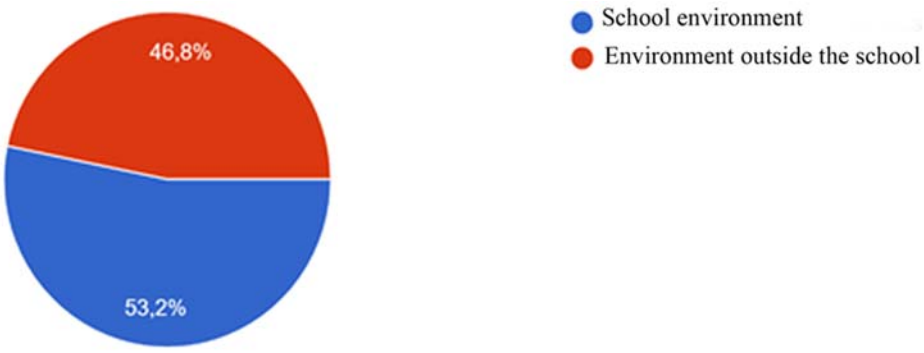

Fig. 3. Environmental learning resources related to renewable energy

Table 1 is the result of a quantitative survey of respondents' opinions. All data are recorded without any coercion or tendency from anywhere. Respondents did not get specific material before filling out the questionnaire. Data retrieval is carried out directly and suddenly. This is to ensure that the respondent's answers come from personal knowledge they previously acquired. General and random student knowledge is very important as a benchmark for analyzing the needs of a product's development. It can be ascertained that the need comes from the respondent's personal experience and knowledge, not from the demands or tendencies of other requests. This needs analysis is divided into 4 aspects, namely: the respondent's initial energy literacy ability, energy literacy assessment in schools, multimedia needs, and the importance of andoid-based applications. The answers to all aspects can be seen in detail in Table 1.

Table 1 also provides information that the learning process in Indonesia has not been optimal in providing information about renewable energy, especially in applying innovative media as educational media. Currently, the existence of renewable energy is familiar to students. 74.4% of students said they knew renewable energy. However, in a specific context geothermal energy only reached 56.45%. This figure is considered not familiar enough among students. Even though Indonesia is surrounded by many volcanoes, as a characteristic of the potential for geothermal energy [44]. The existence of geothermal energy in Indonesia is observed to be still limited, and its location is difficult to reach where the power plant is in the location of the resource. It would be natural for students in big cities not to be familiar. In contrast to solar panel energy, almost every street corner and roof of an urban home has this technology. It is not surprising that many students are more familiar with this source of solar thermal energy (see figure 1). Seeing these data, knowledge is a basic thing that needs to be pursued, even the family plays an important role in fostering conservative behavior towards renewable energy [45]. This phenomenon shows that there is a need for strong encouragement and more attention so that energy knowledge is slowly increasing and having quality.

Tabel 1. Results of the student needs analysis questionnaire

Aspect	Question	Answer (%)	
		Yes	No
Level of Student's energy literacy	1. Do you know about renewable energy?	73.9	26.1
	2. Are you familiar with the geothermal energy?	56.5	43.5
Assesetment of energy litercy at school	3. Does school / university facilitate you to learn related to renewable energy?	60.9	39.1
	4. Do the teachers at your school / university provide learning / information / knowledge / understanding about renewable energy?	73.9	26.1
	5. Have teachers at your school / university ever used electronic media to introduce renewable energy?	66.3	33.7
	6. Do you have a mobile / smartphone, and can use it?	97.8	02.2

Aspect	Question	Answer (%)	
		Yes	No
The need for interactive multimedia in the form of android based	7. Do you know about interactive multimedia?	66.3	33.7
	8. Do you know about interactive digital multimedia education based on android applications?	67.4	32.6
	9. Do teachers at your school / university use interactive digital multimedia education based on android applications to introduce renewable energy?	63.0	37.0
	10. Do you need interactive digital multimedia education based on android applications for learning renewable energy?	78.3	21.7
The urgenly need of aplication	11. Do you think it is important for interactive digital multimedia education based on android applications for understanding renewable energy?	80.4	19.6
	12. Do you think it is important and necessary for an interactive digital multimedia education based on an android application for understanding renewable energy, specifically on geothermal energy in schools / universities in Indonesia?	81.5	18.5

Smartphones have become the most familiar multifunctional communication tool among students. 97.8% of students can operate, and have sufficient ability to operate as a multimedia learning support. As many as 67.4% of respondents are aware of the interactive educational media feature on their smartphone's grip. 78.3% of students also stated that they needed interactive digital multimedia education based on android applications for learning renewable energy. The data also shows that 63% of them have used it as a learning medium in the classroom. This electronic device has the opportunity to continue to be developed as a medium of introduction as well as learning aids that are expected by students [46,47]. Of course this is a positive trend that needs to be maintained, so that it can be used for the sake of attaining the convenience of science.

The development of multimedia android applications has an urgency that deserves to be considered, where 80.4% of respondents stated the urgency. 81.5% of respondents agreed with the development of applications on the topic of geothermal energy. This shows that this energy attracts students' attention as a part that needs to be explored more deeply. However, it is necessary to carry out various feasibility tests, before it becomes public consumption or public facilities. The aspect of economic feasibility, which concerns the characteristics of each facility, as well as the orientation of the energy-saving capacity resulting from the application need to be considered [48]. Ease of access in the field and feasibility of media based on user criteria are also priorities [49].

Based on the results of the interview, it indicates that the energy literacy of students is still low. Students are quite comfortable with their lives today, so that energy knowledge, which is not the main learning material, has not become a priority scale. Energy literacy in daily life is not introduced directly, so it is difficult for them to answer contextually. Likewise, the impact of knowledge on students' attitudes and psychomotor in everyday life. On the other hand, Jan [20] stated that energy literacy, which includes broad content knowledge as well as affective and behavioral aspects, will empower individuals to make energy-related choices and actions as they go about their daily lives. Intervention is needed as a stimulus, as well as a strategy for energy literacy attitudes that should be [50]. Overall, multimedia that helps students' learning process is highly anticipated, especially based on mobile android which is familiar to them [51]. Mobile learning media have an influence on the ability to absorb information or knowledge [52,53]. The geothermal energy android application will make it easier to control the use of direct-application geothermal energy applications in the field [54].

The development of a GIS-based android-geofinder application on geothermal energy is feasible to be developed. Students also have a tendency to use smartphones compared to other media. Although not all universities use it as the main learning media. Seeing the existing situation, as well as the level of familiarity among students, the development of this media deserves to be considered as a medium of information for teachers. The learning media used today can still be used, while this application can be a relevant complement. Thus teachers can apply various models and development of teaching strategies based on the Android application on

the topic of geothemal energy literacy.

IV. CONCLUSION

Finally, a common thread that needs analysis to provide intervention needs to be pursued in the development of a GIS-based android-geofinder application considering several factors: 1) Geothermal energy is still not familiar enough among students, even though the potential generated is greater than other types of renewable energy, 2) Smartphone media is the most familiar media among students, 3) Four aspects of needs analysis show a positive trend and support the acceleration of application development. So that the development of the GIS-based androd giofinder application has a great opportunity to be applied and can be a solution to increasing geothermal energy literacy in Indonesia.

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