The Use of Smartphones in Geography Learning: A 21st Century Learning Innovation in Identifying Nature Appearances Based on Fieldwork

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Abstract—Geography learning process can be done both indoor and outdoor. Geography learning can provide new findings/ concepts from a natural phenomenon which exists in the field. In order to build an understanding, concept, and even findings; geographer can utilize fieldwork-based geography learning. It is necessary to have a framework that explains the existence of the study location. The purpose of this study is to give space or scope for geography learning which emphasizes fieldwork-based learning in natural laboratories using a smartphone in data collection. The method used is a field survey conducted by determining the location points that will be used as access in field-based geography learning, with a landscape and social approach. After that, it is processed to get routes and learning areas that are ready with smartphones. Furthermore, it is applied to students to carry out field-based learning using smartphones. The result of this study shows some areas that can be used as fieldwork by using a smartphone during a field survey. There are 15 spots recorded on smartphone that can be used as geography learning fieldwork. Learners can do observation, measurements, interview about natural and social landscape in these areas. Fieldwork-based learning in Sumbermanjing Wetan has its estimation in leaning based on the aims. Besides, things like funding, licensing, and the security of the learning areas should be paid attention, in order to reach the learning outcome. It is also need a preliminary survey or observation to be able to estimate fieldwork leaning areas in Sumbermanjing Wetan district.

Keywords—geography, smartphone, fieldwork, nature laboratory

1 Introduction

Teaching and learning process is not only done indoors where students and teachers interact. Teaching and learning in a scope of theories, case studies, discussion, and presentation; may be delivered in classical learning. Geography learning has its unique

scope, where learning process can be done both in and outside classroom. Outside class learning is generally used to deliver contextual study deal with reality in field/nature, by considering that geography is related to geosphere phenomena with spatial, environmental, and regional complex approaches.

Fieldwork-based geography learning is used to elaborate concepts or methods in collecting field data. It is conducted as reinforcement of the passed course materials and called field course. It is also done annually. In relation to the fieldwork, there are some steps to go through, based on lectures level; whether in a scope of explanation/description about natural phenomenon, or in a scope of collecting data or research and case studies to solve existed geosphere phenomena or appearances.

Fieldwork can deepen students understanding about courses they got during lectures in class. Students with their abilities can create, arrange, and assemble activities to do fieldwork under the supervision and guidance of the teachers/lecturers. Students can explore the knowledge and skills in collecting the data from observation, interview, and measurements. In addition, students can process the result of the study to strengthen the hypothesis or find new concepts and solve the existed problem.

Nature laboratory becomes important thing in fieldwork-based geography learning implementation. Nature laboratory holds special and central role in science education and has benefits for teaching and learning process. Due to the existence of nature laboratory, concepts and theories discussed in class can be linked to observations of phenomena that exist in real world [1]. In addition, the existence of a laboratory will be able to develop new ideas that link concepts together which in turn will provide suggestions for new methods, interpretation of new data, and new questions about these natural phenomena [2]. Geography learning or lectures require natural laboratories to support learning process [3]. Utilization of environmental and social conditions is an attraction for applying concepts and case studies in geography learning. Students are invited to the location for observation first, which then takes the steps to be taken in conducting fieldwork lectures in Sumbermanjing Wetan District which has potential as a medium in learning geography. The availability of phenomena and appearances in the sub-district can be used as a natural laboratory in geography learning. The results of previous studies show that the Sumbermanjing Wetan sub-district has study aspects such as geomorphological and geological diversity [4]; [5]; [6]; [7]; [8]; [9], disaster [9]; [10], tourism [11]; [12], social and cultural [13]; [14]; [15]; [16]. Of course, these aspects can be used as the application of geography learning for students. In addition, the object of study in the Sumbermanjing Wetan sub-district can also be used as fieldwork per subject.

The recent technology development should be utilized in teaching and learning geography activities, through the use of supportive devices. The use of GIS and the availability of satellite such as GPS in a smartphone play a main role in lectures [17]. The use of GPS and GIS allow higher specificity and measurement accuracy, data processing, and mapped information presentation [18]. Meanwhile the use of smartphones will ease the students in identifying nature appearances in research location by looking up at map shown in smartphones.

Fieldwork innovation in geography learning during the Covid-19 pandemic is generally carried out virtually [19]; [20]; [21]. Students access technology to find out

the location of the landscape. In this approach, it is used by using a smartphone to identify routes and input data when doing fieldwork. Students can take measurements in these appearances from smartphones after which they can obtain field data. The use of learning media, the application of material in the field, and the implementation of data collection in the field are certainly new innovations in geography learning. The implementation of this fieldwork was carried out with students of Geography Education, Kanjuruhan University, Malang by identifying the landscape in the study location.

Learning geography is very important in the application of science and solving environmental or social problems in an area. Through fieldwork lectures in natural laboratories, students can add knowledge and skills. The use of smartphones can support geography learning outside the classroom. The purpose of this study is to look at existing natural/social phenomena and appearances and to analyse strategies in fieldwork-based geography learning by utilizing smartphone in Sumbermanjing Wetan district, Malang regency.

2 Research method

This research was conducted by a field survey. The field survey is carried out by determining the location points that will be used as access in fieldwork-based geography learning. The location of the fieldwork is based on the results of previous identification [22]. The research location can be seen in Figure 1. The data requirements used are satellite imagery, topography, and geological conditions at the research site. Fieldwork maps were made beforehand to make it easier to identify natural/social characteristics at the research site. The work map that has been created is then entered into a smartphone to provide convenience in carrying out field surveys. Field survey data was collected by conducting field surveys, by visiting locations that have the potential to carry out fieldwork. The data taken related to the appearance is the location of the survey point, survey route, documentation, and description of the landscape/social connected to the smartphone. Data processing is carried out using ArcGIS software to interpret the results of the field survey. The analysis used in this study is descriptive analysis by providing an explanation of the appearance that will be used as an object in fieldwork-based learning, graphic analysis to provide an overview of the location and route of fieldwork. The implementation of this fieldwork uses students from Geography Education, Kanjuruhan University, Malang who are used as implementers of fieldwork-based learning. This application using a smartphone is the result of data processing and aspects of measurement and observation of landscape conditions during fieldwork.

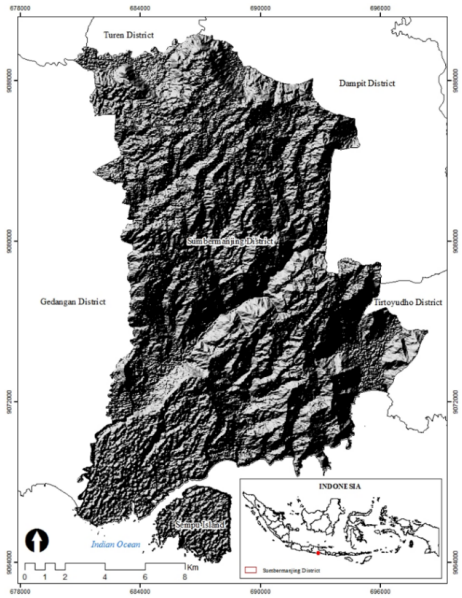

Fig. 1. Study location (Source: Prepared by the author, 2022)

3 Result and discussion

3.1 Smartphone-based fieldwork map

Fieldwork map is made based on the data collected from the previous research. The use of the data was adjusted to the aim of field survey. Smartphone-based fieldwork map had certainly been adjusted to the needs and had been georeferenced before. This is intended to ease survey activities conducting. This smartphone-based fieldwork map is used in recording the field data, such as location coordinates, description, photos, and tracks. Figure 2 shows the results of field survey based on the nature appearances in Sumbermanjing Wetan district. The collected landscape appearancs and phenomenon can be used as tools and media in teaching and learning geography.

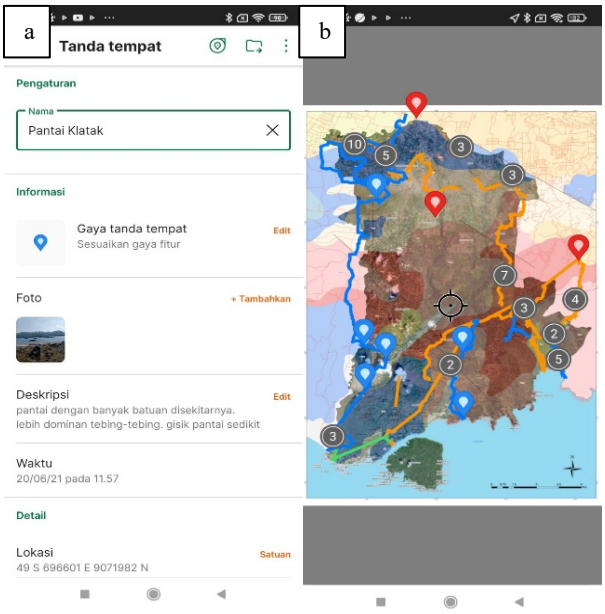

Fig. 2. (a) Input data during field locating point (b) field data collecting tracks in research location (Source: Prepared by the author, 2022)

3.2 Fieldwork location determination

The social and physiographical conditions of the landscape become the main attraction in geography learning. Sumbermanjing Wetan has a social and nature laboratory that can be studied. Physiographically, the landscape at the site is the result of the process of lifting rocks, which is located in the north and south sides of this subdistrict. In the central part of this subdistrict forms a watershed, whose hills and alluvial deposits connect to the coast. The marine development processes and coastal dynamics happens in southern area. The social and cultural landscape in Subermanjing Wetan District can be seen from the local wisdom of the community in anticipating flash floods, the diversity of religious communities in the coastal area, and ceremonies in the coastal environment.

Fieldwork can be carried out at observation spots. Figure 3 is the location of fieldwork in Sumbermanjing Wetan District. There are several locations that can be used as fieldwork-based learning area. These location spots can be done by students by collecting data, observing, measuring. The locations of the fieldwork are as mentioned below:

1. Rest area, is a large place that can observe the results of rock removal during the light period. The limestone deposits of the Wonosari Formation developed in this area. In addition, it can be seen that there are niches/caves resulting from marine processes that occurred in the past.

2. Limestone mining area, observing environmental conditions and the community around the mine.
3. Alluvial plains, observations conducted to see fluvial landforms in the Penggularan watershed, measurement of river quantity and quality, and land use in the area. The disaster aspect is related to the flash flood that hit the village. The cultural landscape can be seen that there is local wisdom in mitigating the danger of flood (banjir bandang).
4. Mas Cave, a karst landscape that is the output of the subterranean river. Beside, this cave also observes fluvial landforms.
5. Penggularan River Estuary, observing the morphology of the karst area and the Punggularan river estuary.
6. Springs Sendang Biru is a karst spring, in this landscape it can be used to measure the quality and quantity of springs.
7. Sendang Biru Harbor, the social landscape regarding the social interactions that exist in coastal communities, the cultural landscape related to the sea picking ceremony for coastal communities, the landscape of Sempu Island which has marine and karst landforms.
8. Clungup Magrove Conservation. Management of coastal areas based on conservation, besides that there are karst and marine landforms that build the area.
9. Sendang Gambir, a karst spring, in this landscape can be used to measure the quality and quantity of springs.
10. Harta Cave, is a karst landscape in the form of a horizontal cave with many cave ornaments. Karst morphological features developed in this area.
11. Tamban Beach, a coastal landscape that has a long coastline. The social condition and morphology of the watershed can be used as a study in fieldwork.
12. Sempu Island, conducted observations and measurements of karst and coastal morphology on Sempu Island.
13. Perawan Beach, identification of watershed morphology and coastal formations on Perawan beach coastal area.
14. Rock outcrops, conducting soil profiles, topographic measurements, and identification of morphological features in the study area.
15. Water sources and limestone cliffs, measure the quality and quantity of springs.

Fieldwork can also be done to solve social and environmental problems as well as to aim new research findings. Social problems in the study area are in the form of village/sub-district boundaries, social inequality in coastal areas and upstream areas, aspects of poverty and unemployed human resources in the study area, and others. New discoveries that are used as objects of fieldwork activities such as subterranean river systems in karst areas, flood periods in Sitirejo village, karst development models on Sempu Island, and others. Environmental problems are in the form of limestone mining, logging in the upstream area, decreasing quality and quantity of springs.

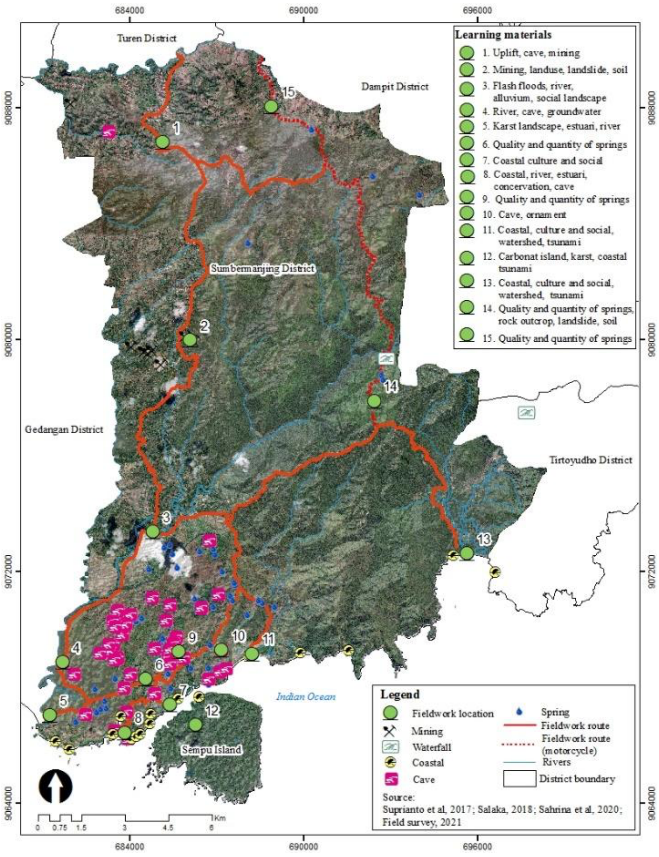

Fig. 3. Fieldwork Spots and Paths (Source: Prepared by the author, 2022)

3.3 Fieldwork spots landscape

Sumbermanjing Wetan District has features that can be used in geography learning. Figure 4 shows the appearance and phenomena found in the location of the spots in geography learning. Fieldwork can be done at various spots to be achieved in the learning objectives. On roads that have steep cliffs, of course, the land will easily become landslides. (Figure 4a) Besides that changes in land use in the form of built-up land and for mining businesses (Figure 4b) will affect the surrounding environmental conditions. Clay deposits are abundant in the upstream part of the Punggularan watershed (Figure 4c). In the upstream part of the watershed there are also surface rivers (Figure 4d), waterfalls, springs (Figure 3e), and solid rocks (Figure 4f) which are in the upstream area. The alluvial plain in the downstream area is an area that has a lot of settlements. This area is a basin area bounded by limestone cliffs (Figure 4i). The basin area makes it very easy for flooding to occur, as happened in Sitirejo Village, so that people in the area adapt to nature, by making evacuation spots, and modifying the shape of their houses to be safe from flooding (Figure 4h). Limestones in the southern part of

Sumbermanjing Wetan sub-district form a karst topography with the formation of karst springs (Figure 4j), caves (Figure 4l), and exokarst features (Figure 3k). In the coastal area, there are river mouths connected to sea water (Figure 4m), and the formation of beaches (Figure 4o) which are tourist attractions in the southern coast of Malang Regency. The existence of sediment deposits on the coast is a place for growth of mangroves (Figure 4n) which can be used as educational tourism and Sempu Island has a variety of geo-diversity and biodiversity in the archipelago.

Fig. 4. Fieldwork spots and paths (Source: Prepared by the author, 2022)

These landscape/social features can be identified in terms of fieldwork. Activities of observation, measurement, interviews, can be carried out by students in these locations to answer problems and find new knowledge. This identification can of course use data collection techniques that are in accordance with the existing landscape, such as air sampling techniques, air quality measurements, slope measurement techniques,

interview techniques to informants and others. The application in the field is of course closely related to the learning that has been done previously. Fieldwork activities can also be used as geography learning related to learning materials during class meetings. The topics of study that students can do at these locations can be seen in Table 1.

Table 1. Application of the material in the study area

Natural phenomena	Material study	Material application	Teaching activity
Landscape Aspect			
Karst	● Definition of karst landscape, ● The processes that occur ● The types and characteristics of the landform units, ● Utilization and adaptation of karst area communities ● Drought disaster and the importance of protecting springs	● Definition of landscape in Rest area ● Process, types and characteristics of landform units in Sitiarjo-Rowoterate-JLS ● Utilization and adaptation of the Tambakrejo Village community ● Sendang Biru Springs	● Students do observations, profiling, sampling and measurement of hydrology and landscapes
Fluvial	● Definition of fluvial landscape, ● The processes that occur ● The types and characteristics of the landform units, ● Utilization and adaptation of the community,	● Definition of fluvial landscape in Sitiarjo Village ● Fluvial process in the village of Rowoterate ● Landforms in the village of Rowoterate ● Utilization and adaptation of the Rowoterate-Pantai Clungup hamlet community	● Students do observations of watersheds, river profiling, sampling and hydrological measurements
Coastal	● Definition of marine landscape ● The processes that occur ● The types and characteristics of the landform units ● Utilization and adaptation of marine area communities ,	● Definition of marine landscape on Bajulmati Beach ● The process of sedimentation and erosion of Bajulmati Beach ● The recruitment process at Teluk Asmara Beach ● Marine landforms on the beach ● Utilization and adaptation of the community in the hamlet of Pondokdadap	● Students make observations, typology of coastal landforms, measurement of coastal dynamics, and sampling
Disaster Aspect			
Flood	● Distribution and potential for flooding	● Measuring the discharge of the Bajulmati river ● Measuring the potential for runoff entering the Rowoterate hamlet ● River and river border profiling in the Rowoterate area	● Students do observations, identify flood disaster problems, distribution and mitigation efforts in dealing with flood problems

Drought	• Potential for drought and the distribution of affected communities	• Distribution of potential springs in Tambakrejo Village • Sendang biru spring quality and quantity • Residential distribution • Tambakrejo Village water level analysis	• Students identify areas that are prone to drought
Landslide	• Landslide distribution and potential	• Types of landslides • Making a landslide risk map	• Students conduct observations, identify landslide problems, distribution and mitigation efforts in dealing with landslide problems
Earthquake	• Distribution of the impact of the Earthquake in South Malang	• Map of the distribution of disaster impacts in Tambakrejo Village	• Students conduct post-earthquake observations, distribution of damage due to earthquakes, identification of damaged materials, and earthquake disaster mitigation efforts
Tsunami	• Tsunami potential in southern Malang	• Making a tsunami risk map for Tambakrejo Village • Evaluate and determine evacuation gathering spots in Tambakrejo Village	• Students conduct observations, examine areas that are prone to tsunami disasters and the mitigation efforts that can be done
Social and cultural aspects			
Petik Laut ceremony	• Coastal culture	• Local wisdom of the coastal area	• Students conduct interviews and observations of the existing culture
Flood Mitigation	• Characteristics of flooding in Sitiarjo Village	• Changes in the shape and pattern of society in dealing with floods	• Students conduct observations and interviews with communities in flood-prone areas
Drought Mitigation	• Disaster management	• Tracing the springs at Sendang Biru	• Students conduct observations and interviews with the community
Tourism and conservation aspects			
Tourism	• Coastal tourism potential	• Coastal tourism potential of Tiga Warna beach, Teluk Asmara, Sendang Biru and other beaches in South Malang	• Students conduct interviews with visitors/managers/tourist stakeholders and observe the attractions in the tourist attractions
Clungup Magrove Conservation (CMC)	• Conservation in coastal areas • Mangrove biodiversity	• Clungup, Gatra, Tiga Warna, and Teluk Asmara (Turtle) beach conservation	• Students conduct interviews with conservation area managers, as well as visitors who are in the area

Source: Prepared by the author, 2022

3.4 Fieldwork-based geography learning strategies in the nature

Fieldwork learning certainly provides preparation, funding, and mature licensing, of course in accordance with the objectives to be obtained. Preparation of fieldwork learning is related to the objectives to be achieved, such as fieldwork for research purposes, problem solving, or just to introduce nature landscape/social landscapes. In addition, preparation includes implementation details that are adjusted to the agreed objectives.

Funding is related to accommodation costs carried out in the study area. When entering the tourist/conservation area, there are costs that come out such as entering the Clungup Magrove Conservation area, the beach, and Sempu Island. In conservation areas, a field guide is needed to lead the way to the location. In addition, the cost of transportation, meals, and lodging will cost more if the fieldwork-based learning is carried out in a few days.

Licensing for fieldwork activities should be done before implementation begins. To enter a conservation or tourism area, prior permission must be obtained from the tourism manager under the Sumbermanjing Wetan sub-district government. In addition, to enter the Sempu Island conservation area, you must first obtain permission to the Natural Resources Conservation Center of East Java Province (BBKSDA East Java). The implementation of fieldwork requires a long preparation to prepare existing permits.

In addition to covering the implementation of licensing, it also requires a preliminary survey. The purpose of this initial survey is to ensure that all kinds of things that will happen in the implementation can be estimated as needed. Preparation also requires the preparation of fieldwork equipment, work maps, and the manufacture of other instruments, which support fieldwork.

Safety during the fieldwork process also needs to be considered. The steep topography of the slopes, when entering the cave with minimal lighting, fast river flows, are also obstacles when collecting data in the field. Care must be taken in collecting data. In addition, external security factors can also affect the implementation of fieldwork.

Fieldwork learning in Sumbermanjing Wetan District can be carried out in several schemes, depending on the objectives, costs, and time to be achieved. Before the implementation needs to be discussed first, so that it is in line with expectations. Table 2 shows the estimation of fieldwork learning in Sumbermanjing Wetan District.

Table 2. Estimation in fieldwork learning

Estimation	Destinations	Weaknesses	Strengths
5 days	1 day Upstream area	More licensing and funding	All field activities can be achieved
	1 day coastal area		
	1 day conservation area		
	1 day Sempu island		
	1 day karst area		
3 days	1 day Upstream area		

	1 day coastal area and conservation	There are spots that cannot be entered, there needs to be more permits and funding	Can reduce costs and permits to Sempu Island
	1 day karst area		
2 days	1 day Upstream area and karst area	There are spots that cannot be entered and the application is still lacking	Less cost
	1 day coastal area and conservation		
Fieldwork with the aim of research to find new findings, solving environmental or social problems certainly requires preparation and a long time to answer these goals.			

Source: Prepared by the author, 2022

The fieldwork was carried out by students of Geography Education, Kanjuruhan University, Malang in Sumbermanjing Wetan District. Fieldwork was carried out for two days by observing, measuring, and interviewing. Observations were made at each destination, measurements were made by measuring soil pH, slope dryness, water quality, and conducting interviews with communities in flood-affected areas. The areas visited were at the top of the hills, alluvial plains, Gua Mas, Sendang Biru springs, and coastal areas were used as learning locations. There is an obstacle in the Gua Mas area so that it is passed, because the area in the cave is too narrow, so the car being ridden cannot be parked. These activities can be seen in Figure 5.

Fig. 5. Fieldwork activity in Sumbermanjing Wetan (a) Measuring water quality in Sendang Biru spring (b) Measuring of slope in rest area (c) Soil pH instrument usage (d) Conducting interview to the disaster-affected people (Source: Geography Education Kanjuruhan University)

3.5 Discussion

The laboratory is a medium that can be used in learning and teaching in science education [1]; [23]. Laboratories have important benefits in learning, the experience gained while in the laboratory, of course, students will have the opportunity to think critically to solve problems based on science/scientific thinking, as well as acquire skills, and teamwork to solve these problems.

The nature laboratory in geography learning studies the nature and social landscapes that exist in the Geosphere. Nature and social landscapes will produce interactions, appearances, phenomena that will produce knowledge, and then continuously create a scientific theory, research studies, and experimental data [1]. Research activities, data collection require cautious preparation, surveys, and data analysis, one of the activities that can be used as learning for students is by doing fieldwork. Fieldwork can test hypotheses or solve problems by collecting and interpreting data [24]. Fieldwork-based learning will provide many benefits to learning geography [17]; [24]; [25]; [26].

Fieldwork-based learning provides students skills in conducting a research, identifying, experimenting, doing teamwork and applying the use of technology.The result of measurement collected gives knowledge and skills in the implementation of fieldwork. The use of smartphone in geography learning and teaching gives an overview about spatial condition of the fieldwork location. It also can improve students' learning outcomes [27] and affect students' learning achievement [28]. Besides, it increases students' learning abilities during the fieldwork visits [29].

In implementing fieldwork, it is necessary for students to be independent in preparing, implementing, and managing data [30]. Students make preparations for permission, tools, and materials used. Students, of course, in the implementation do team work in field data collection either through measurements, interviews, or the use of technology that can facilitate data collection. Students can analyze various phenomena that exist in the study area, which are then presented in the form of a final research report/case study/service.

Geography learning activities are carried out with various activities such as fieldwork lectures, internships, and other programs. Fieldwork course activities can be carried out in subject areas, such as geomorphology, hydrology, social, and environmental. In addition, the fieldwork course is also a mandatory campus program, by implementing SKS (semester credit units), so that every student is required to follow it. The approach taken is different, in each implementation of fieldwork lectures on campus, namely stage 1 of teacher-centered learning, stage II has carried out field measurements as a laboratory, and stage III is project-oriented by forming a team for research preparation by looking for problems and then making hypotheses then tested so that they can find solutions to these problems [22].

The use of smartphones in the implementation of fieldwork is very helpful. Taking fieldwork locations does not need to use GPS, printed maps, protractors, compasses that can be replaced with smartphones [17], besides that the presentation of information is also easier with the use of various applications [18]. The work map that has been made can be used to input data and access some of the data that has been obtained in

the field. The use of smartphones is certainly a rational approach with the current development of technology and information in fieldwork-based geography learning

Determination of the location of fieldwork has the appearance of criteria related to landscape and social conditions in the form of karst, coastal, structural, and fluvial landscapes. Social conditions are related to the religious and cultural diversity of the coastal areas. So that the location of this fieldwork is more diverse and different when compared to the natural laboratory in the Mount Galunggung and Kampung Naga areas with the context of a volcanic landscape [31]; [32], and the Lemor Botanical Gardens [33]. This is also different from the context of the landscape in the southern mountains of Java and Malang, even though they both experience a learning process [34].

The implementation of fieldwork in natural laboratories must also pay attention to the objectives to be achieved. Such as the implementation of Kanjuruhan University geography education students by considering the location and material of each individual. This will affect the implementation time of fieldwork. Fieldwork also has a flow in preparation, implementation, and pre-implementation. Where each will have challenges such as costs, health and safety in the field, access to the field [35]. This is of course because of the difficult terrain to reach and safety at work and seeing the damage to the area around the work field due to excessive sampling [17].

4 Conclusion

The use of smartphones in fieldwork-based learning can be applied in Sumbermanjing Wetan District, which has great potential to be used as a natural laboratory in geography learning. Through fieldwork-based learning, students can take advantage of the natural/social landscape in Sumermanjing Wetan District for learning. Various places/locations are presented in the lesson to apply the material learned in class. In addition, the implementation of fieldwork can be arranged according to the needs and objectives to be achieved. However, there are some weaknesses when doing fieldwork, including those related to thorough preparation, permits, terrain, and security at the research site. If all these obstacles can be overcome, then the learning of fieldwork for students can be carried properly.

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