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PAPER

The Development of Geomobile App-Based Outdoor Study to Improve Critical-Social Abilities and Collaborative in the 21st Century

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ABSTRACT

Geography learning in high school is built through field and contextual experiences to verify the theories. The learning method used by the geography teacher is not quite effective in improving students' critical-social and collaborative abilities. This study aims to 1) develop a Geomobile app-based outdoor study that is valid and practical, and 2) determine its effectiveness in improving students' critical-social and collaborative abilities in the 21st century. This study used research and development with a modified version of the Borg and Gall model. This research utilized validity tests conducted by material experts, media professionals, and learning specialists. The authentic instruments used to measure critical-social and collaboration abilities. The data analyst used descriptive statistics to assess the quality of the product and conducted an independent sample t-test to evaluate the effectiveness of the Geomobile app for outdoor study. The research was conducted on 216 eleventh-grade Social Science students in five high schools in East Java Province during the academic year 2021–2022. Research findings show that students need tools to enhance essential skills in the 21st century through the use of Geomobile app-based outdoor study. The development results indicate that expert validation feedback on the Geomobile app is very positive, with an average rating of 93%. Additionally, the Geomobile app has been found to effectively enhance critical-social abilities by 59% and collaborative abilities by 63%. Therefore, this development effectively improves students' abilities in the 21st century. The research has provided support for students to become future social agents, especially in terms of building a better working place and social community in the 21st century.

KEYWORDS

development, Geomobile, outdoor study, critical-social, collaboration

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1 INTRODUCTION

The subject of geography as social-environmental science faces challenges in 21st-century learning. Student abilities of 5.0 are needed in order to provide a support system and build better habits in the community for the future [1]. Student abilities in the 21st century are a means to transform teachers and schools. It is formulated to develop exceptional human resources, foster lifelong learners, cultivate global competence, and promote behavior in accordance with Pancasila values [2] [3]. Critical social skills are needed to improve emotional and academic well-being [4], while collaborative skills are essential for effective cooperative learning [5]. The increasing development of student abilities in the 21st century has significant implications for personal resilience [6–8]. Teachers play a crucial role in shaping the lives of students [9]. Improving student abilities in the 21st century must be prioritized within the school setting, as it allows for a strong foundation through collaboration between teachers and students.

Due to the post-COVID-19 pandemic, the 5.0 era of learning is expected to improve students' learning abilities. This uses authentic instruments to measure critical-social abilities, as proposed by Emilia Fägerstam [10], and collaboration abilities, as proposed by Emily R. Lai [11] [12]. Considering the new normal conditions of COVID-19, there is a need for innovation to enhance the provision of teaching materials [13]. The limitations of outdoor studies during the pandemic can be overcome through mobile learning. Blended learning is easy to understand and widely adopted by high school students during the new normal COVID-19 condition [14–16].

The pandemic has hindered many schools worldwide, including those in Indonesia, from conducting study tours to tourist attractions for their students to learn. In its implementation, many study tour strategies were found to be inappropriate, which affected students' motivation and learning interest negatively [1] [17] [18]. Additionally, the goals to be achieved were hindered significantly due to the amount funds spent [17]. Hampered by the pandemic, they cannot participate in outdoor classes [19] [20]. During the study tour, the teacher focused on taking care of the students and assigning tasks to ensure that learning goals were met. Learning should utilize materials to enhance students' learning abilities [21]. The teaching process and assessment system organize the skills of 21st-century students to achieve maximum learning [22]. Therefore, the main objective of helping students improve their skills must be aligned with their learning abilities.

Contextual applications can facilitate meaningful learning by leveraging the interaction between mobile technology applications and the natural environment. Mobile technology makes interactive learning more inclusive and exciting [16] [23]. Thus, mobile users will enjoy unlimited learning. During the pandemic, utilizing mobile apps is extremely beneficial for meaningful learning. Using tourism as a learning tool is a way to enhance students' abilities [24] [25]. Outdoor field can not only enhance learning abilities but also improve skills in gathering materials for writing articles in the field studies of geography [21]. The use of mobile apps to support learning success is urgently needed. Outdoor learning integrated with mobile devices is a form of meaningful learning innovation.

Developing the outdoor study model designs conducted by the teachers themselves will be better. In order for studies in the field to be conducted effectively, the stages of planning, implementation, and evaluation must be present [26]. Outdoor learning encompasses meaningful learning experiences in students [27] [28], promotes the development of thinking skills [29] [30], fosters motivation [31], and produces

positive learning outcomes [21]. Developing hybrid methods for the Geomobile app in outdoor studies enhances online classes, making them more engaging and facilitating a deeper understanding of the material. The Geomobile app can analyze real-time conditions while learning objects using technology. Outdoor learning can also be integrated with multimedia data, which encourages students to actively construct concepts [10] [26].

Research conducted by previous scholars has focused on the theoretical and practical aspects of mobile learning and outdoor study as separate modes of learning [21] [32–34]. The results of the research showed that the effectiveness of the development of Geomobile-based outdoor study also has similarities with previous research on learning [16] [35], empowering students' learning abilities [4] [36] [37], mobile learning [38] [39] and outdoor study [40–43]. Learning through contextual research has an impact on class action and exploring constructive solutions [21]. However, little research has focused on the integration of media and learning methods with students' abilities in the 21st century. Geography learning is inseparable from these elements. Thus, this study aims to incorporate elements into a Geomobile app for outdoor study.

Based on the background, this research aims to 1) develop a Geomobile app-based outdoor study that is valid and practical, and 2) determine its effectiveness in improving students' critical-social and collaborative abilities in the 21st century. Advantages of research on mobile technology-centered learning. Teachers and students can collaborate to explore geographical phenomena and conduct investigations in order to develop critical-social skills. The research results have a significant impact on students' ability to apply enhanced learning skills in their everyday lives and in society. Students can transform into 21st century agents of society.

2 METHOD

2.1 Research design

This research method utilized the Borg and Gall model. The Borg and Gall design was selected to develop and validate an educational product based on the following reasons [44]: 1) easier steps to follow; 2) systematic arrangement to minimize product weaknesses; and 3) suitability for developing educational multimedia products. The procedures carried out consist of analyzing research results related to the product being developed, developing the product based on the findings, conducting field trials, and making revisions to correct any deficiencies found during the field trial stage. The development process consists of six stages: needs analysis, product prototype, revision, trial, designing, and evaluation, which are based on the modification proposed by Effendi and Hendriyani [45]. Development research employs quasi-experiments, utilizing a non-equivalent control group design, as shown in Table 1.

Table 1. Quasi experiment: non-equivalent control group design

Class	Pre-Test	Treatment	Post-Test
Experimental	O1	X	O2
Control	O3	Y	O4

Notes: O1 dan O3 = pre-test for the test group and control group; O2 dan O4 = post-test for test group and control group; X = treatment using a Geomobile app in the test group; Y = treatment using Power Point media in the control group.

2.2 Participants

The learning experts, media, material geography, and students validated the subject of the development product feasibility test. A test was conducted on a large group of subjects, which consisted of 216 students from class XI Social Studies in five high schools in East Java Province during the academic year 2021–2022. The schools that were the subjects of the studies were Wachid Hasyim 2 Sidoarjo High School, Al-Hikmah Surabaya High School, Campur Darat Tulungagung Public High School, YPM 2 Sidoarjo High School, and Cendikia Sidoarjo High School. This trial was conducted in eight test groups and eight control groups. Academic ability is used as the basis for purposive sampling of the experimental and control classes.

2.3 Instruments and data collection

Data for the feasibility of the development product exists in both qualitative and quantitative forms. Qualitative data is obtained from questionnaires completed by validators, experts, and students. The quantitative data are in the form of responses to questionnaire scores from the validator experts (learning, media, and materials) and the students. The questionnaire score used a Likert scale of 1 (Yes) and 0 (No).

The data were obtained through an authentic instrument in a questionnaire to assess students' abilities using a Likert scale with measurements ranging from 1 to 5. The Likert scale indicator is used to determine students' responses. This research utilized an authentic instrument modification to assess critical-social skills, which were adapted from Emilia Fägerstam [10], and collaborative abilities, which were adapted from Emily R. Lai [11]. An authentic assessment is given in accordance with real-life conditions in the surrounding environment to ensure meaningfulness. The thematic conditions are selected to create a framework that presents problems for students to observe and analyze. Student ability indicators are shown in Table 2.

Table 2. Students' ability indicators

Critical-Social Abilities (Emilia Fägerstam)	Collaborative Abilities (Emily R. Lai)
Formulate Problem	Perception Equalization
Argument	Negotiation
Solution	Interactivity
Conclusion	Interdependency

Furthermore, the data is obtained through inferential parametric analysis and descriptive statistics. The processed data was first tested for normality and homogeneity prerequisites. The instrument was then conducted to test its validity using the product moment method and its reliability using the Cronbach Alpha test.

To obtain input and evaluate the developed media products, it is necessary to conduct trials. After conducting tests and collecting data, the next step is to evaluate the product to determine if the product design is necessary. Guidelines are used to

correct deficiencies and improve the product based on the feedback received from students participating in research studies.

2.4 Data analysis

The analysis is used to examine product validation by material and media experts. Data analysis was conducted to determine the validity and feasibility of testing the product on students. Data analysis activities utilized both qualitative and quantitative descriptive analysis methods to obtain data from the evaluation results. Quantitative analysis was used to process the data obtained through student and teacher questionnaires. The data was analyzed using criterion score analysis, utilizing a Likert scale. This analysis was conducted to determine the feasibility of media products based on the criteria used in field trials.

The feasibility of the mobile app is based on the criteria outlined in Table 3.

Table 3. Eligibility criteria for research and development of the product

Value	Criteria	Recommendation
≥92.00%	Very Good	Don't need revision
≥71.00% – <91.00%	Good	Minor revision
≥51.00% – <71.00%	Quite Good	Major Revision
<51.00%	Not Good	Rejected

Source: Anonim [16].

To be eligible for product development, a minimum score of 71 must be obtained. The score is obtained from a questionnaire submitted to experts in media, materials, and learning. The data on the learning outcomes of the development of Geomobile app-based outdoor study to improve critical-social abilities and collaboration were analyzed using the normality test, homogeneity test, and t-test. The t-test analysis technique was conducted with a significance level of 5%. To measure the effectiveness of research and product development, the proposed hypothesis is as follows:

H1: There is an effect of using a geospatial mobile application for outdoor studies on improving critical-social and collaborative abilities.

Determination:
If H0 > significance 0.05, meaning that H0 is accepted
If H0 < significance 0.05, meaning that H0 is rejected

3 RESULTS AND DISCUSSION

3.1 Development of Geomobile app-based outdoor study

After revising the development design, the next stage involves product testing through expert validation tests conducted by professionals in the fields of material, media, and learning. A summary of the test results of all participants involved in product development can be found in Table 4.

Table 4. Expert validation conclusion

No.	Correspondent	Percentage (%)	Criteria	Recommendation
1.	Material expert	91.00	Good	Minor revision
2.	Media expert	93.00	Very Good	Don't need revision
3.	Learning expert	95.00	Very Good	Don't need revision
Average		93.00	Very Good	Don't need revision

As shown in Table 3, the results of the expert validation of the product are 93.00%. The conclusion of the expert validation is very good and does not need revision. These results indicate that the model development product can be utilized for geography learning. The questionnaire consists of 16 questions about the Geomobile App-Based Outdoor Study to Improve Critical-Social Abilities and Collaboration. The questionnaire instrument was validated using the product moment validity test, which yielded valid results (0.41). Once validated, the instrument was tested for reliability using Cronbach's alpha, yielding reliable results (0.73). It can be concluded that the results of product development are valid and reliable. Therefore, it is necessary to test the effectiveness using the t-test.

A Geomobile app-based outdoor study was developed using Smart Apps Creator (SAC) software. Making Android applications in SAC is easy. Just follow the instructions: first, design the storyboard for the app's media. Second, install the SAC software. Third, then build the app. The features that SAC offers are free to access for beginner developers. These features include: The SAC application is perfect for developing mobile learning.

Geomobile app-based outdoor is implemented on biosphere material in one of the chapters in the field of geography study at the high school level. The mobile app is named Biosfer.apk file. The media is installed on the student's Android phone, making it easy to access and operate. After the installation, an Earth icon named BIOSFER APPS will appear on the mobile phone screen. You can find the app at https://s.id/1xgH6. Click on the icon to begin your learning journey. Here is an image of the user interface, the Biosphere apps, and the menu after installation on an Android device (see Figure 1).

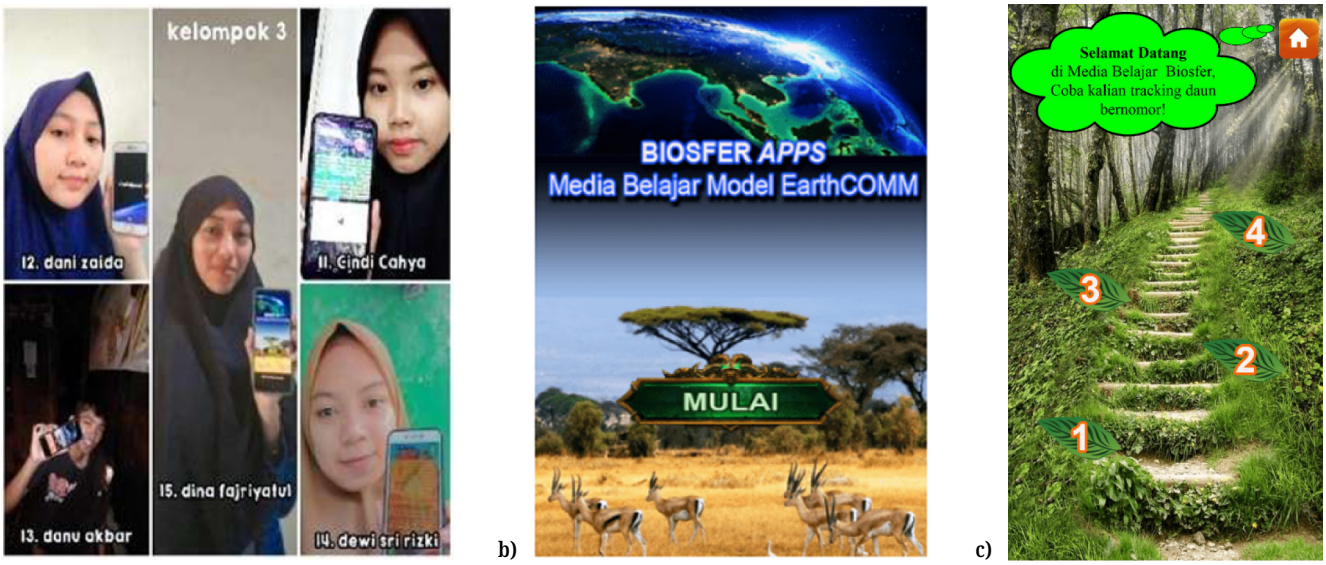

Fig. 1. (a) User or student, (b) front apps, and (c) explore menu

The initial view consists of the opening page and the browsing menu. The opening page appears with the title "Biosphere Apps Media Learn" using the EarthCOMM Model. Students can explore biosphere materials by clicking the MULAI "START" button and selecting the leaf number in the navigation box. After that, it will be directed to the Geomobile app for outdoor study activities. This surfing menu utilized the indicator tracking technique. There are four learning indicators, namely: 1) the concept of biome and its impact on settlement; 2) factors that affect distribution; 3) the distribution pattern of plants and animals; and 4) biosphere conservation. Geomobile app-based outdoor study has one technique that can be adapted during the new normal COVID-19 condition: tracking. The tracking menu collaborates with the Google Earth app to facilitate the process of interaction with and understanding the material. The tracking using location-based web video found loading from the environment. Environmental education is essential for implementing eco-pedagogy in schools [46]. Then, the location is marked as an object of observation, investigation, and student learning. The contents of the mobile app can be found in the study tour menu. The learning menu contains explanations of the distribution of plants in both Indonesia and the rest of the world. In addition, the main subject of the mobile app is the distribution of the biosphere in natural attractions (OWA) Trawas. Students can learn about each conservation by clicking on the navigation button. Here is an image of the tracking menu on the Biosphere app (see Figure 2).

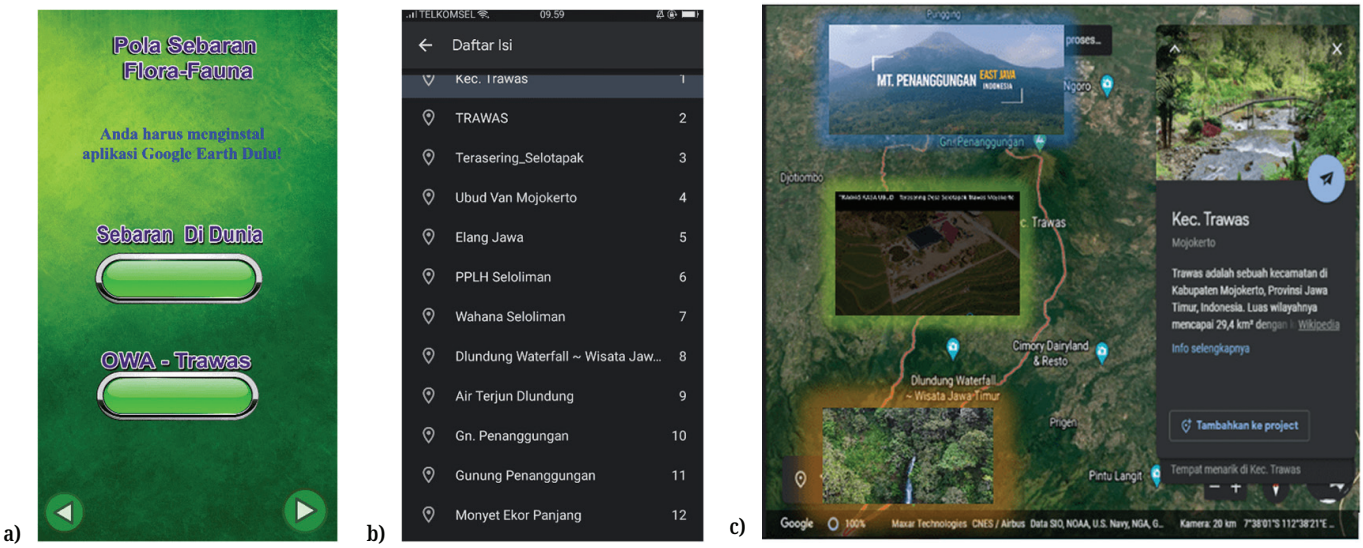

Fig. 2. (a) Submenu app, (b) Tracking location, and (c) Geo-information

To access the track menu on the mobile app, students need to first install the Google Earth application in the Play Store. Once installed, location tracking on the mobile app can be performed. The following is a description of the outdoor study using the Geomobile app and web video. Tracking the phenomenon in natural attractions at Trawas, Mojokerto, and East Java contains location explanations and exploration videos. The distribution location was chosen based on comprehensive criteria. Firstly, Terasering in Selotapak village was selected because it includes a highland rice field ecosystem and supports agricultural livelihood. Secondly, the Environmental Education Center in Seloliman village was chosen due to its focus

on toga plants and protected forest conservation. Thirdly, Dlundung Waterfall in Dlundung village was selected as it is a natural attraction that promotes mountain forest conservation and hydrological conservation. Lastly, Penanggungan Mountain in Tamiajeng-Jolotundo Village was chosen as it is a socio-historical site of Majapahit.

In the mobile app, students record or take note of facts by conducting experiments, reviewing, and visually interpreting, with the hope of obtaining answers to problem solutions using the assistance of Biosphere Apps. In groups, students investigate biosphere phenomena by conducting direct experiments using mobile apps.

At the investigation stage, the students were given several biosphere phenomena related to their indicators. Students conduct investigations using Biosphere Apps. The results of student investigations on biosphere phenomena demonstrate a strong ability to elaborate. This is an excellent process for improving learning outcomes through discussion. For example, investigations of "social impact in OWA Trawas Biosphere Location" yielded student responses in the form of infographics, mind maps, and distribution maps. Here is an image of experiential learning in the experiential situation, with students using apps as shown in Figure 3.

a)

b)

Fig. 3. Use apps (a) mobile outdoor investigation and (b) student product with mobile

Based on the collection of data on student learning outcomes through test instruments. Measurements are made for the pre-learning process and post-learning stages. The evaluation aims to obtain student ability results, specifically focusing on their socio-critical and collaborative abilities in the 21st century. Furthermore, assessment data before and after learning is processed to review the student's progress. The results of data recapitulation in general and external learning in particular show an increase in results.

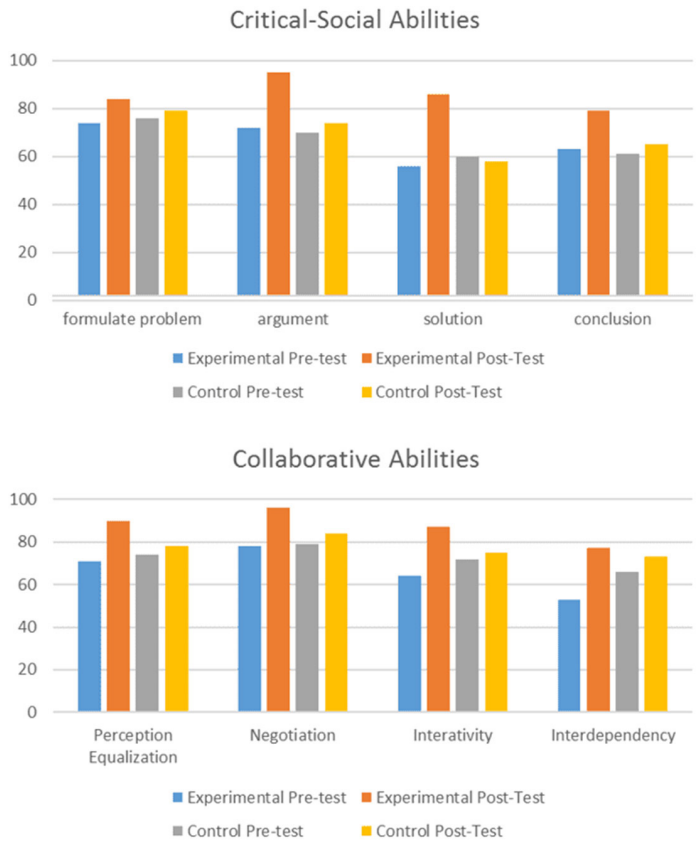

Fig. 4. Subject outcomes in the geography learning

From Figure 4, the N-Gain Score for socio-critical abilities and collaborative abilities in the pre- and post-test class experiments using the Geomobile app for outdoor study with achievement is 59% and 63%, respectively. The achievement of increased student learning outcomes is a strategy to enhance student performance in the 21st century. In the process of learning, it is essential to emphasize reflection in order to achieve optimal results [10] [47] [48].

Observations and data analysis obtained during the learning process indicated that student learning outcomes increased from the stage before and after. Student learning observed is critical for social and collaborative abilities. Learning abilities are essential for students in the face of global competition [11] [29] [49].

Furthermore, the learning process data results were tested on students to assess their effectiveness using data analysis with an independent sample t-test. Previously, normality (Table 5) and homogeneity tests (Table 6) had been performed.

Table 5. Normality test

Abilities	Group	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Critical-Social	Experimental	.178	159	.100	.958	159	.127
	Control	.83	161	.200	.958	161	.083
Collaborative	Experimental	.152	159	.100	.958	159	.093
	Control	.095	161	.200	.958	161	.095

a) Lilliefors Significance Correction

Table 6. Homogeneity test

	Levene Statistic	df1	df2	Sig.
Critical-Social	.109	7	160	.592
Collaborative	.109	7	160	.681

Based on Table 5, the significance level is indicated as "sig." The results obtained for the experimental class were 0.05. The study results of this research are concluded to be normally distributed. Table 6 shows the value of sig. >. It is concluded that the data result of learning for both classes has a homogeneous variance ($p < 0.05$). This means that further testing can be conducted, specifically the independent sample t-test.

Analysis of learning ability data using the independent samples t-test method. The t-test method is used to measure the effectiveness of the development of geomedia-based outdoor study in improving students' critical-social and collaboration abilities. Based on the result of the data processing, an independent sample t-test calculation was performed on the gain score of the experimental class, as shown in Table 7.

Table 7. Independent sample T-test

		F	Sig.	t	df	Sig. (2-tailed)
Experimental Class	Equal variances assumed	3.927	.051	5.298	216	.000
	Equal variances are not assumed.			5.298	68.672	.000

The results of the T-test in Table 7 show significance. The value of 0.000 is less than 0.050, which leads to the conclusion that H1 is accepted and H0 is rejected. It means that using a mobile app for outdoor study has an effect on improving the critical-social and collaborative abilities of experimental classes that received treatment. The T-test results in the experiment have been proven.

The advantages of the Geomobile app-based outdoor study method are the basis for the urgency of implementing modern learning [47] [50]. Therefore, it is expected that there will be a shift from the traditional learning process, which is characterized by stress and fear, to modern learning, which emphasizes interest and attention. This is very effective in increasing interest and improving learning outcomes.

The implementation of the strategy is described as follows: (1) needs analysis, which includes: formulating learning objectives, analyzing material characteristics, formulating learning plans, and designing study tour programs; (2) development of authentic instruments and evaluations, which involves designing metacognitive instruments, questionnaires, and learning outcome tests; (3) mobile app-based outdoor study, which includes the implementation of learning syntax and the use of learning application media; and (4) implementation of evaluations, which includes pre- and post-test learning assessments. The results of the learning effectiveness that has been developed, referring to the Geomobile app outdoor study, are contained in the following Figure 5.

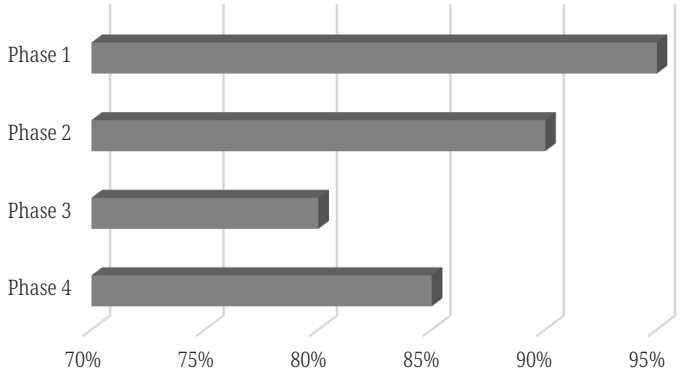

Fig. 5. Effectiveness phases in the outdoor study using Geomobile app

From a learning perspective, the initial phase involves acquiring digital literacy skills and emphasizing the planning and preparation of the trip (pre-trip). This phase is considered highly effective, with a 95% success rate, as it enables students to develop a strong grasp of literacy concepts and proficiency in using mobile technology. Conversely, the third phase, which involves reflecting on the trip, has the lowest effectiveness percentage at 80%. Students are grouped in large numbers, which makes them less effective individually.

Teachers and students provide input and advice on field trial questionnaires for developmental products during product trials. The suggestions are summarized as follows: (1) The mobile application should be able to function offline since there may not always be signals at natural attractions. (2) The rubric for assessing learning outcomes can be incorporated into mobile applications. (3) Prior to learning, it is important to have syntax socialization. Those three pieces of feedback are important enough to serve as a reference for revision. Appropriate learning methods should facilitate students and teachers [51] [52]. The development of a new strategy in Kurikulum Merdeka (the curriculum used in Indonesia) is needed for student recovery from a learning crisis [53]. The implementation design of the new hybrid development strategy on Kurikulum Merdeka is currently in progress [54]. This is because geo-mobile app-based outdoor study can be done offline and online (hybrid learning).

Scientific characteristics and geographical subjects, especially those related to the biosphere, have a significant impact on the application of learning both in the classroom and outdoors. Knowledge transfer of geography material occurs not only through lectures, discussions, and question-and-answer methods but also through meaningful activities that employ goal-oriented and achievement-oriented learning strategies [21] [31]; this approach promotes sustainable learning [55]. Scientific skills in geography are always oriented towards spatial, ecological, and territorial aspects.

Based on the research findings, the utilization of a hybrid strategy in learning, which incorporates aspects of rationalization and objectives of Geomobile app-based outdoor study, effectively improves critical-social abilities. This approach and collaborative abilities can be accepted as a means to enhance student abilities in the 21st century [56]. A valid response from learning experts, trial subject teachers, and trial students supports the rationalization of development goals. Logical methods can be used after receiving expert responses and involving relevant stakeholders [51]. Peer review enhances development [57], as does the implementation of

Kurikulum Merdeka [58]. 21st-century learning materials and supplements are in line with contextual characteristics [59].

Implementation of effective development improves student abilities in the 21st century. The research has provided support and backup for students to become future social agents. Empowering students to become social agents in the future involves nurturing their ability to actively engage with [60] and contribute to society in meaningful ways [36]. Here are some key strategies and principles to help students develop the skills [22] and mindset necessary to be effective social agents [14]. Empowerment requires a holistic approach that combines education, real-world experiences, and the cultivation of essential skills and values. By fostering a sense of agency, empathy, and responsibility, educators can prepare students to make positive contributions to their communities and the world at large in the future [61] [62]. Critical socio-abilities and collaborative abilities have the potential to create a better working environment and social community in the 21st century.

4 CONCLUSION AND SUGGESTIONS

Based on the results, the development of a Geomobile app-based outdoor study shows significant and feasible outcomes. This approach is practical and effective in enhancing students' critical-social and collaborative abilities in the 21st century. Thus, using Geomobile apps for outdoor study has an impact on learning achievement.

The results of this study have theoretical implications for the formation of student learning outcomes. Specifically, it explores how the integration of the environment, teaching materials, and technology can impact student learning behavior. Students' learning ability will increase with the stimulus provided by hands-on learning experiences in the field. In practice, this study demonstrates that the outdoor study model, based on the Geomobile app, effectively enhances student abilities in the 21st century. This research provides a support system for students to become social agents in the future, particularly in the advancement of Geomobile studies within the social science community in the 21st century.

Geomobile app-based outdoor study can be used in learning. In order to maximize the utilization of this method, several suggestions can be made, namely: (1) teachers are advised to install and use the Geomobile app for geography learning; (2) teachers can incorporate other materials into outdoor study using the Geomobile app, such as studying spatial patterns in settlements or disaster mitigation; (3) teachers can develop strategies, techniques, methods, and media that align with the learning objectives in the field; and (4) teachers can identify additional outdoor study locations that can be visited.

More in-depth recommendations include conducting experiments or classroom action research to determine the influence or relationship of the Geomobile app-based outdoor study compared to other media, such as motivation and learning styles in different fields and schools. Recommendations for applicants: First, ensure that outdoor activities can be easily done with a reliable internet connection. Secondly, during the learning process, it is important for students to actively engage in small group discussions, where they can share ideas, explain and defend their own ideas, and provide feedback on the ideas of their peers. Third, provide knowledge about the procedure for using the tool before the lesson begins. This includes techniques for measuring, communicating data, and operating the tool.

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