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Development of E-LKPD Based on Group Investigation Integrated with Citizen Science Project to Improve Analytical Thinking and Collaboration Abilities of Junior High School Students

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Abstract: This study aims to develop and evaluate the effectiveness of an E-LKPD based on group investigation integrated with a citizen science project on ecology and biodiversity material for junior high school students. The research employed a 4D development model (Define, Design, Develop, Disseminate) and was conducted at SMP Negeri 13 Semarang with a sample of 32 Grade VII students selected via cluster random sampling. Data collection methods included interviews, observations, questionnaires, and tests. Validation by material and media experts yielded Aiken's V scores of 0.89 and 0.88, indicating high validity. The readability test scored 69.90% (very good), while the field practitioner test scored 98.07% (very feasible). The effectiveness analysis using N-Gain showed an increase in students' analytical thinking skills by 66.5% and collaboration skills by 62.30%, both categorized as moderate. These findings indicate that the E-LKPD is valid, practical, and moderately effective in enhancing students' analytical thinking and collaboration skills in science learning.

Keywords: Citizen Science Project; Collaboration Group Investigation; E-LKPD; Media Selection.

Introduction

Science education at the junior high school has role strategic in to form base knowledge and skills student in understand concepts scientific as well as apply it in life daily (Huda & Waluyo, 2025). Science learning is more focus on giving direct experience to students in develop competence, so that student more easy understand environment (Suliwa et al., 2021). Because involved in the process of discovery and action (Dabran-Zivan & Baram-Tsabari, 2025). This approach allows students to gain more knowledge than just following the learning process without being directly involved (Hastiana et al., 2025). The current curriculum has also attempted to accommodate these needs by focusing on activity-based learning, collaboration, and problem solving (Chomsun et al., 2025).

According to Dewi & Rahayu (2023), in the 21st century learning era, the skills that students must master include analytical thinking and collaboration skills (Luciana et al., 2025). Science learning encourages students to study natural phenomena, ask questions, and investigate them in order to find scientific concepts (Kusumawardani & Wibawa, 2024). Analytical skills are an important element because they are needed in the process of investigation and drawing accurate conclusions (Ricky & Zulfiani, 2023) . However, the facts show that only 5% of students in Indonesia have adequate analytical skills (Alhusein & Pratama, 2025). The majority of students are still at the memorization

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level, which reflects low high-level thinking skills (Agustin & Hayati, 2022). This places Indonesia in last place in the global index of cognitive skills released by *The Learning Curve Pearson* in 2014 (Huda & Waluyo, 2025).

These limitations also cause students to tend to be passive in learning (Marlina et al., 2025). The dominant role of teachers in the learning process results in students being less active (Septianingsih et al., 2025). To overcome this, collaboration skills are crucial because they can increase student activity while broadening their horizons through group interactions (Putra et al., 2023). Collaboration also trains efficient division of tasks, builds character, and supports the integration of information from various perspectives (Ulhusna et al., 2020). In integrated science learning, collaboration between students and teachers, as well as between students, significantly contributes to tackling learning challenges and maximizing educational success. (Nursiamti et al., 2022).

According to Mustafa et al (2021) one important aspect in strengthening students' analytical thinking is utilizing instructional resources suited to 21st-century learning needs, namely teaching materials that contain aspects of scientific literacy and materials that are in accordance with the competencies and analysis of student needs (Novinda et al., 2022). Knowledge and application of science learning that only relies on textbooks has not fully touched the souls of students so that lessons become boring and students do not understand the subject matter in the context of life (Suparya et al., 2022). Accordingly, instructors are encouraged to prepare suitable teaching materials that make students active as a tool in the learning process and can be used as a learning resource (Khaira et al., 2025). One strategy to foster active and independent learning is through the use of Student Worksheets (LKPD) (Wardhani et al., 2025). LKPD as teaching materials functions to minimize the involvement of teachers in fostering active student participation in learning. In the use of LKPD, the teacher acts as a facilitator so that the learning process is more effective because the teacher guides his students in understanding the learning material (Manasikana & Rahau, 2025). Along with technological advances, LKPD can be accessed via electronic media so that now it can be called the Electronic Student Worksheet (E-LKPD) (Wahyuni et al., 2025). The advantage of E-LKPD is that it does not require expensive costs because it is in the form of an application or e-learning website and can be used freely regardless of time and place (Arnidha et al., 2023).

E-LKPD can be integrated with real-world-based learning projects such as citizen science. Students actively engage in authentic scientific practices, including data collection, environmental monitoring, or systematic observation of phenomena within their own communities (Saputri & Suyatna, 2024). Through this integration, E-LKPD not only becomes a medium for delivering instructional content, but also transforms into a platform for experiential and inquiry-based learning. Citizen science initiatives provide opportunities for students to contribute to real scientific investigations, often in collaboration with researchers, institutions, or local stakeholders, thereby enhancing their sense of agency and responsibility toward societal and environmental issues (Ricky & Zulfiani, 2023). This experiential engagement fosters the development of scientific literacy, critical thinking, and collaborative skills, which are essential in the 21st-century learning framework. E-LKPD is important because it is valuable educational tool that support both analytical thinking and collaborative skills. Its interactive design, alignment with digital literacy, and capacity to engage learners in critical and cooperative learning processes make them highly relevant in today's educational landscape. As noted by Mitasari & Hidayah (2022), e-LKPD based on problem-based learning can improve students' analytical skills and collaboration, as it requires learners to analyze information and solve problems together in digital environments. Additionally, by participating in projects that have tangible impacts on their surroundings, students develop a stronger emotional and cognitive connection to the subject matter, which increases motivation.

Relevant research was also conducted by Devi et al. (2023) entitled "Improving Students' Collaboration Skills Through the Application of Group Investigation Type Cooperative Model Based on Differentiated Learning in Science Subjects in Elementary Schools". Based on this study, the results showed that there was a significant increase in collaboration skills. In cycle 1, the average student collaboration skills were recorded at 80.6% (good category), which then increased to 95.6% (very good category) in cycle 2. This learning model facilitates students to work effectively in groups, respect each other, be responsible, and make active contributions. With differentiated learning that adapts to students' interests and needs, this model has been shown to be able to significantly improve students' social and collaboration skills.

This research was conducted with the aim of determining the validity and effectiveness of developing group-based E-LKPD integrated with a citizen science project in learning ecology and biodiversity material at the junior high school level. Specifically, this research seeks to assess the validity of the E-LKPD in improving students' analytical and collaboration skills. In addition,

it also evaluates the extent to which the group-based E-LKPD is effective in enhancing students' analytical thinking, as well as its contribution to fostering collaboration during the learning process. The novelty of this research lies in the integration of the group investigation model with citizen science projects into digital teaching materials (E-LKPD), which is still rarely applied in secondary education. This approach not only encourages active student participation through inquiry and teamwork but also engages them in real-world scientific practices relevant to their local environment. Such integration is expected to enhance higher-order thinking and social interaction skills simultaneously. Therefore, this study is important to conduct as it addresses the need for innovative, participatory, and contextualized learning media in science education, and contributes to the broader effort of preparing students with 21st-century competencies.

Method

This study employs a Research and Development (R&D) approach using the 4D development model by Thiagarajan, which includes four stages, namely Define, Design, Develop, and Disseminate. Research held at SMP Negeri 13 Semarang in the even semester year 2024/2025 academic year. Population study is all over student Class VII with 288 participants educate, divide in nine class (VII A to VII I). After conducting homogeneity tests and analysis uniformity, established in a way random class VII E as class sample , using cluster random sampling technique (Sukmadianata, 2005).

Variables free in study This is use of E-LKPD learning media based on the Group Investigation model on the material ecology and diversity life. Variables bound is ability think analysis and collaboration participant educate. Meanwhile that, variable control includes teaching teacher, teaching materials, and allocation time learning. In the define stage, it is carried out analysis need through studies literature and observation field. Observation results show that science learning has not accommodate collaborative and investigative strategies that support development ability analysis student.

This research uses type study development or *Research and Development (RnD)*. Method this research and development is method research that produces product specific and test effectiveness from the product (Sugiyono, 2014). The 4D method includes four stages, stage *define* done through studies literature and observation activities. Skills that must be owned participant education in the 21st century including ability literacy science. The design stage includes design the beginning of the development of E-LKPD use device Canva software with friendly visual display learner and compilation device evaluation. Product the initial result is draft I of learning media, which is later validated through develop stage. The develop stage includes validation by experts materials and media experts, readability test on a scale small, and trial media effectiveness in general direct in activity classroom learning. According to Ahmad et al. (2024), Validation process use approach quantitative descriptive For evaluate the suitability of the media developed. Evaluation validity done with use Aiken's V formula, namely:

$$V = \frac{\Sigma s}{[n(c-1)]} \quad (1)$$

Information:
V = Index validator agreement regarding validity grain
S = Score assigned by the validator minus score lowest
s = r-lo
lo = Rating number validity lowest (example 1)
r = Number given by the validator
n = number of validators
c = Number given by the validator

Validation was conducted by five validators, consisting of lecturers and science teachers, to evaluate the suitability of the media to the aspects of material, visual design, and integration with the investigative model. If the media has not reached a valid value, then a revision is made based on input from the validator. The research data were collected through the methods included teacher interviews, observations of the learning process, questionnaires from students and validators, and student pretest and posttests. The research instruments included expert validation sheets, collaborative observation sheets, readability questionnaires, and essay tests based on high-level analytical thinking indicators (C4–C6). The validity of the test items was evaluated through content validity and construct validity, while the reliability of the test items was calculated using the Kuder-Richardson formula (KR-20). In addition, the level of difficulty and the discriminating power of the test items were analyzed to ensure the quality of the evaluation instrument (Nuzulah et al., 2023).

Data analysis was conducted quantitatively descriptively. To assess the effectiveness of the media on analytical thinking skills, the N-gain score calculation was used, comparing the pretest and posttest scores of students. The readability and collaboration ability scores were analyzed using the percentage formula, while the data normality test was conducted using the chi -square test. Based on these results, the effectiveness of the E-LKPD media in improving students' analytical and

collaborative thinking skills can be concluded objectively and scientifically.

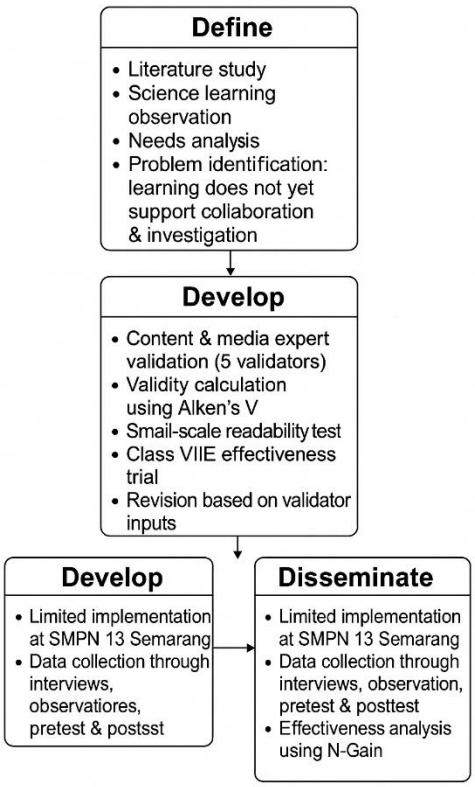

Figure 1. Flow of Research and Development

Result and Discussion

Define Stage

Analysis Early-Late

The initial-final analysis was conducted to identify the problems of science learning at SMP Negeri 13 Semarang, especially in the ecology and biodiversity material. The observation results showed that learning was still dominated by lecture methods without the support of media that could develop students' analytical skills. In addition, almost all students have mobile phones and are allowed to use them in learning. This is the basis for the development of group- based E-LKPD integrated citizen investigation science projects to improve students' activities and analytical skills.

Analysis Participant Educate

Analysis of student characteristics shows that students are less active, not used to working collaboratively, and have low analytical skills. The media used previously did not support the development of social skills and critical thinking. Therefore, innovative learning media is needed so that students are more involved and can develop analytical and collaborative thinking skills.

Analysis Task

The developed E-LKPD is aligned with the independent curriculum, which emphasizes science process skills and high-level thinking skills (HOTS) (Diniya et al., 2024). Based on the learning achievements of phase D of junior high school science subjects, this media is designed to train skills such as observing, planning investigations, processing information, and communicating results scientifically. Based on application data search independent teaching developed by the Ministry of Education and Culture, obtained achievement learning eye Junior High School science lessons presented in the Table 1.

Table 1. Table Achievements Learning

Element	Achievements Learning
Science Understanding	Participant educate own competence think scientific If participant educate own understanding whole science. Ability think will impact progressive for development knowledge knowledge. Reasoning critical in understanding coverage content is things to expect for participant educate. Science understanding is always associated with ability think level high (HOTS).
Process Skills	Observing Questioning and predicting Planning and doing investigation Processing Evaluate and reflect Communicating results

Achievements the learning becomes standard necessary qualifications achieved by participants educate in learning activities use using E-LKPD based *group investigation* integrated *citizen science project* on material ecology and diversity biological. Learning activities in E-LKPD are based on *group investigation* integrated *citizen science project* on material ecology and diversity biological load step learning that train ability think analysis and collaboration participant educate.

Analysis Draft

Analysis draft done with organize material ecology and diversity biological in a way systematic to make it easier participant educate understand contents learning. Compilation draft done in a way structured to be in harmony with objective learning and support development ability analysis.

Formulation Objective Learning

Based on results analysis beginning-end, characteristics participant educate, concept materials and achievements curriculum, formulated objective development of this media is produce E-LKPD based on group investigation integrated citizen science project which is capable of increase ability think analysis and collaboration participant educate on the material ecology and diversity life.

Design Stage

Media Selection

Canva software that allows for the customization of visual design and layout of E-LKPD to be attractive and easy to read. The selection of design elements includes A4 paper size, the use of font types such as Squada One, League Gothic, and Prompt, and a font size of 39 pt for the title and 12 pt for the content. The base color of the page uses a combination of white, cream, light green, light brown, and dark green to strengthen the educational and reader-friendly visual appearance.

Initial Design

This stage is an integration of the results of the analysis and design concepts, which produces an initial prototype of E-LKPD. The initial design includes the arrangement of the main parts of the learning media, such as the cover page, instructions for use, summary of the material, and student worksheets. E-LKPD is designed to facilitate investigation-based group activities to develop students' analytical and collaboration skills systematically. The design E-LKPD *prototype* based on *group investigation* integrated *citizen science project* as follows.

Figure I. Front Cover and Content View of E-LKPD

Preparation of Test Standards

In addition to media development, researchers also compiled evaluation tools in the form of validation questionnaires by material and media experts, readability sheets for students, collaborative observation sheets, and pretest and posttest instruments. All of these instruments are used to measure the feasibility, readability, and effectiveness of the media on improving students' analytical and collaborative thinking skills.

Develop Stage

At this stage, the researcher realized the design in the previous stage by carrying out three stages, namely the E-LKPD based on *group investigation* media validation stage by experts, product readability test stage, and trial stage of using E-LKPD media based on *investigation group* integrated with *citizen science project* which is developed.

Expert Validation

The expert validation is done by an expert materials and media experts, namely three lecturers Science education of Semarang State University and one teacher of class VII of SMP Negeri 13 Semarang. In addition, experts were also asked to provide assessments and suggestions that researchers will use as a guide in improving E-LKPD based on *investigation group* integrated *citizen science project* that developed.

Subject Matter Expert Validation

Validation material aim for give assessment of the level validity material on E-LKPD based on *group investigation* integrated *citizen science project* and suggestions for improvement. The following are recapitulation evaluation use Aiken's V formula by expert material on each aspect study can seen in the Table 2.

Table 2. Subject Matter Expert Validation

Aspect	Σs	V
Content Eligibility	214	0.89
Eligibility Presentation	127	0.88
Average		0.89
Information		Valid

Based on the table 2 is known that results evaluation from expert material for aspect eligibility contents consisting of from 20 grains statement own Aiken's V index with an average of 0.89 which indicates aspect eligibility contents declared valid. In the aspect eligibility presentation consisting of from 12 grains statement own Aiken's V index with an average of 0.88 which indicates aspect eligibility Contents declared valid. Based on the results, in general overall the average Aiken's V index was 0.89 which was declared valid.

Besides results evaluation validation, the validator also provides suggestions and comments to developed material. The following are comments and suggestions for improvement from the expert material validator. This is in line with research conducted by Jannah & Darvina (2017) which supports validation using Aiken's V Index.

Table 3. Media Expert Repair

Improvement Suggestions	Before Repair	After Repair
Chain diagram section food clarified and not may take source that is not credible or its image broken.		
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Media Expert Validation

Validation of media purposes for give assessment of the level Validity of E-LKPD media based on *group investigation* integrated *citizen science project* and suggestions for improvement. The following are recapitulation evaluation use Aiken's V formula by media experts in each aspect study can see in the Table 4.

Table 4. Media Expert Validation

Aspect	Σs	V
Graphics	244	0.88
Linguistics	115	0.87
Average		0.88
Information		Valid

Based on the Table 4 is known that results evaluation from media expert for aspect graphics consisting of from 23 grains statement own Aiken's V index with an average of 0.88 which indicates aspect graphics declared valid. In the aspect linguistics consisting of from 11 grains statement own Aiken's V index with an average of 0.87 which indicates aspect linguistics declared valid. Based on the results, in general overall the average Aiken's V index was 0.88 which was declared valid. Besides results evaluation validation, the validator also provides suggestions and comments on the media developed. The following are comments and suggestions for improvement from expert media validators. These findings are in line with research by Suliwa et al. (2021), who also reported high validity scores in the evaluation of educational media using Aiken's V, where values above 0.80 were consistently interpreted as indicators of strong content and design validity.

Validation Instrument Question

Validation instrument question aim for give assessment of the level validity instrument the question that will be used. The following is recapitulation evaluation use Aiken's V formula by experts in each aspect study can see in the Table 6.

Table 5. Media Expert Improvement

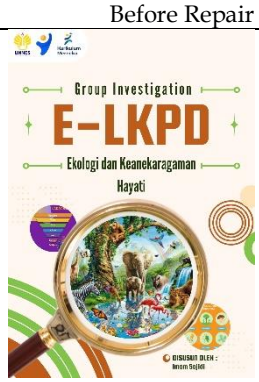
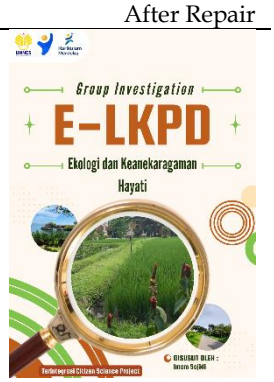
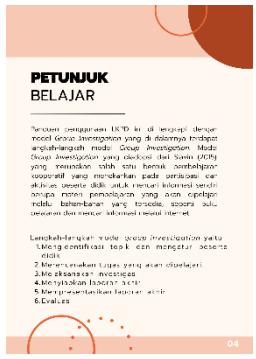
Improvement Suggestions	Before Repair	After Repair
Image on the cover is recommended lecturer for replaced with photo original No in the form of Photo animation		
The writing at the top of the page is in English. English removed because more good if using the same language		
The video media section or link that leads to another site is given a barcode scan.		

Table 6. Validation Instrument Question

Aspect	Σs	V
Contents	64	0.89
Construct	68	0.94
Language	78	0.87
Average		0.91
Information		Valid

Based on the Table 6 is known that results evaluation from expert for aspect evaluation contents consisting of from 4 grains statement own Aiken's V index with an average of 0.89 which indicates aspect evaluation Contents declared valid. In the aspect evaluation construct consisting of from 4 grains statement own Aiken's V index with an average of 0.94 which indicates aspect evaluation construct declared valid. In the aspect evaluation language consisting of from 5 grains statement own Aiken's V index with an average of 0.87 which indicates aspect evaluation language declared valid. Based on the results, in general overall the average Aiken's V index was obtained as 0.91 so that instrument question declared valid. In a similar research, Diniya et al. (2024) confirmed that an instrument with an Aiken's V index above 0.85 across content, construct, and language aspects could be considered highly valid and suitable for use in educational research.

Practitioner Test Field

After going through a validity test by experts Materials and media, E-LKPD based on group investigation integrated with citizen science project tested by practitioner field for evaluate eligibility implementation of media in the classroom. Practitioners involved is an experienced science teacher, namely Mrs. Soimatussa'diyah, S.Pd., from SMP Negeri 13 Semarang. Evaluation done on 13 aspects, including power pull

appearance, convenience usage, relevance material, up to conformity illustrations and language. From the total score maximum 52, media obtain score 51 based on Formula 2.

$$P = \frac{51}{52} \times 100\% \quad (2)$$
$$P = 98.07\%$$

Based on the calculated percentage, the E-LKPD integrating group-based citizen science projects reached a validity level of 98.07% of the responses from expert practitioner tests with very good criteria. The strong acceptance level supports the findings of Marlina et al. (2025), which highlight the effectiveness of participatory, project-based digital learning tools particularly those emphasizing real-world engagement such as *citizen science* tend to receive strong positive feedback from educators, often scoring above 90% in expert feasibility assessments.

Readability Test

The product readability test was conducted through a small-scale test. The purpose of the product readability test is to determine the level of readability of the *group- based E-LKPD media product.* integrated *citizen investigation science project* that has been developed. The readability test involved 8 students which were obtained as follows.

Table 7. Readability Test Results

Criteria	Score
Average Score	46.5
Maximum Score	48
Percentage	96.9%
Criteria	Very good

Based on the calculation of the results of the readability test, it can be concluded that the E-LKPD *based group investigation* integrated *citizen science project* on ecology and biodiversity material obtained a percentage of 96.9% for the readability test responses with very good criteria. This finding is supported by Ahmad et al. (2024), who stated that teaching materials with a readability score above 90% are generally considered highly suitable for learners in terms of clarity and user-friendliness. Nuzulah et al., (2023) emphasized the importance of readability in digital learning media, asserting that readability scores above 85% typically indicate strong alignment between the material's language structure and the cognitive level of the learners.

Product Trial

The results of student responses to the *group-based investigative* E-LKPD, assessed through large-scale trials, show an average score of 85.6%, indicating a very good level for materials on ecology and biodiversity integrated with *citizen science projects*. This shows that E-LKPD is based on *group investigation* integrated *citizen science projects* on ecology and biodiversity materials are very good for use in science learning activities. This outcome corresponds with the findings of Nursiamti et al. (2022), indicating that students positively respond to interactive, context-based digital educational resources, particularly when the content is relevant to their environment and allows for active participation. In their study, digital modules that integrated real-world projects like *citizen science* achieved average student satisfaction scores above 85%, indicating both motivation and clarity in the learning process.

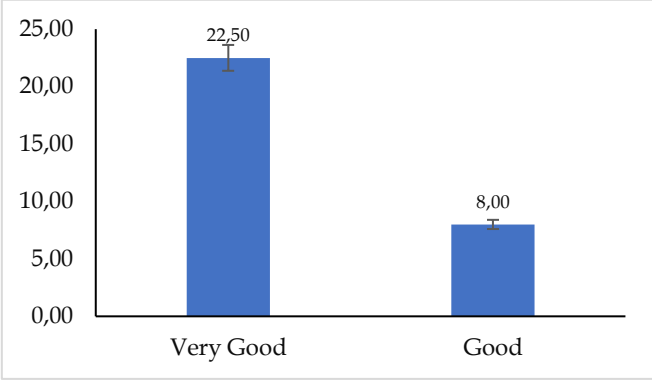


Figure 2. Distribution of Student Responses

Disseminate Stages

Dissemination stage is the final stage in the development model. E-LKPD *based group-investigation* integrated *citizen science the project* on the ecology and biodiversity material has been tested for validity by experts, has been tested for readability, and has been tested on students. After improvements were made based on expert advice and field test results, the final product of the E-LKPD based *group-investigation* integrated *citizen science project* on ecology and biodiversity material was presented.

Quantitative Data Analysis

Capability Data Think Analysis

Based on the results in the Table 8, it can be seen that in the pretest, the average analytical ability was 49.06 with a range of values from 16 to 86 and a standard deviation of 21.565. Furthermore, in the posttest data, it can be observed that the average has increased to 85.87 with a range of values from 68 to 98 and a standard deviation of 7.038. Based on the categorization of collaboration ability, the following comparison was

obtained. These findings align with the study by Luciana et al. (2025), which found that learning models incorporating group investigation and real-world scientific inquiry significantly improved students' higher-order thinking skills and collaborative competence. Their research emphasizes that structured and contextually rich learning materials, such as E-LKPDs embedded with citizen science components, can lead to measurable gains in both individual understanding and group-based learning dynamics.

Table 8. Capability Data Description Analysis

Data	N	Min	Max	Mean	Std. Deviation
Pretest	32	16	86	49.06	21,565
Posttest	32	68	98	85.87	7.038

Statistics Descriptive

Based on the criteria in the pretest and posttest, it is known that the analytical ability before being given group- based E-LKPD investigation integrated citizen science project, the majority of students have low analytical skills, while in terms of analytical skills after being given E-LKPD based *group-investigation* integrated *citizen science project*. Most students have analytical skills at high criteria. This aligns with research conducted by Nurdin et al (2019), which also found that students demonstrated improved reasoning skills after learning with group investigation-based worksheets. This suggests that group investigation-based worksheets have been shown to improve students' analytical reasoning.

Table 9. Criteria Ability Analysis

Criteria	Pretest		Posttest	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Tall	2	6.30	23	71.90
Currently	8	25	9	28.10
Low	22	68.80	0	0

Normality Test

Shapiro Wilk normality test was used in this research because sample amounted to <50. The data is deemed to follow a normal distribution when the significance (sig.) value exceeds 0.05, based on the test criteria. The results of the normality test of the analysis ability data are as follows.

Table 10. Test of Normality of Ability Data Analysis

Data	Statistics	df	Sig.	Information
Pretest	0.940	32	0.075	Normal
Posttest	0.937	32	0.063	Normal

Table 11. N-Gain Capability Analysis Analysis

Interval	Category	N	%	Average N-Gain
$\langle g \rangle > 70\%$	Tall	18	56.30	
$30\ \% < \langle g \rangle \leq 70\%$	Currently	12	37.50	66.50%
$\langle g \rangle \leq 30\%$	Low	2	6.30	
Amount		32	100	

Capability Data Collaboration

Based on the results in the Table 12, it can be seen that in the pretest, the average score of the collaboration ability questionnaire was 99.97 with a score range of 69 to 136 and a standard deviation of 12.878. Furthermore, in the posttest data pretest obtained an average score of the collaboration ability questionnaire of 135.53 with a range of values 100 to 157 and a standard deviation of 13.154. Based on the categorization of collaboration ability, the following comparison was obtained. These findings are supported by the study of Ulhusna et al. (2020) which demonstrated that the integration of group investigation models with citizen science project significantly enhances collaborative behavior, communication skills, and student engagement. Their results also highlight that collaborative learning environments encourage shared responsibility and active participation.

Table 12. Capability Data Description Collaboration

Data	N	Min	Max	Mean	Std. Deviation
Pretest	32	69	136	99.97	12.878
Posttest	32	100	157	135.53	13.154

Statistics Descriptive

Based on the criteria in the pretest and posttest questionnaire data, it is known that collaboration skills before being given E-LKPD *based group-investigation* integrated *citizen science project,* most students have collaboration skills in the good and fairly good criteria, while in terms of collaboration skills after being given E-

LKPD *based group-investigation* integrated *citizen science project,* most students have collaboration skills at very good criteria.

Table 13. Criteria Ability Collaboration

Criteria	Pretest		Posttest	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Very good	1	3.1	22	68.80
Good	15	46.9	10	31.30
Enough Good	15	46.9	0	0
No Good	1	3.1	0	0

Normality Test

Before data analysis, a normality test is applied to determine if the data from the study meets the assumption of normal distribution. The normality test is carried out with the help of *SPSS Version 25 software* with the normality test. *Shapiro Wilks* because the sample size is <50. The data is deemed to follow a normal distribution when the significance (sig.) value exceeds 0.05. The results of the normality test of the collaboration ability score data are as follows.

Table 14. Test of Normality of Ability Data Collaboration

Data	Statistics	df	Sig.	Information
Pretest	0.973	32	0.595	Normal
Posttest	0.957	32	0.225	Normal

Normality test show that the pretest and posttest scores of collaboration ability are normally distributed. So that both questionnaire scores can be analyzed N-Gain.

Table 15. N-Gain Capability Analysis Collaboration

Interval N Gain	Category	N	%	Average N-Gain
$\langle g \rangle > 70\%$	Tall	7	21.90	
$30\ \% < \langle g \rangle \leq 70\%$	Currently	24	75.0	62.30%
$\langle g \rangle \leq 30\%$	Low	1	3.10	
Amount		32	100	

N-Gain Analysis

Based on results N-Gain analysis, it is known that there is improvement ability collaboration participant educate after given E-LKPD based group-investigation integrated citizen science project amounted to 66.5% which is included in the medium category. With thus, it is withdrawn conclusion that E-LKPD based group-investigation integrated citizen science project on material ecology and diversity biological effective natural increase ability collaboration participant junior high school education.

Conclusion

This study concludes that the E-LKPD developed using the group investigation model integrated with a citizen science project is valid, practical, and moderately effective in enhancing students' analytical thinking and collaboration skills in science learning. The validation results from material and media experts showed high validity scores (Aiken's V = 0.89 and 0.88), while the readability and field test scores indicated that the product was very feasible for classroom use. The effectiveness analysis using the N-Gain method revealed that students' analytical thinking skills improved by 66.5%, and their collaboration skills improved by 62.30%, both categorized as moderate improvement. These findings suggest that integrating group-investigation models and citizen science projects into digital teaching materials can meaningfully support 21st-century skill development in students. Although the implementation was limited to one junior high school class, the approach has the potential to be applied to other learning contexts, including different grade levels and subject areas that emphasize analytical thinking and collaboration. Practically, this E-LKPD can serve as an innovative instructional tool for science teachers seeking to create more engaging, student-centered, and collaborative learning environments. It also provides a model for future development of instructional materials that blend digital technology with participatory and contextual learning strategies.

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Author Contribution
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The authors declare no conflict of interest.

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