

DEVELOPMENT OF ARTICULATE STORYLINE LEARNING MEDIA BASED ON KASEPUHAN CITOREK ETHNOZOOLOGY INTEGRATED WITH ANIMAL IDENTIFIER TO SUPPORT HIGH SCHOOL GRADUATE PROFILES

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ABSTRACT

Low levels of students critical thinking and communication skills highlight the need for interactive, contextual, technology-based biology learning. Previous studies have demonstrated Articulate Storyline as an interactive learning medium, ethnozoology as a contextual source of biological knowledge, and organism-identification applications as digital learning tools. However, these approaches have generally been developed separately, and their integration into a single biology learning medium remains limited. Evidence of their simultaneous effectiveness in supporting critical thinking and communication is also limited. This study aimed to develop Articulate Storyline learning media based on Kasepuhan Citorek ethnozoology and integrated with the Animal Identifier application to support critical thinking and communication. The study employed Research and Development (R&D). Effectiveness was analyzed using N-Gain and Repeated Measures MANOVA, while practicality was evaluated through user responses. The results showed N-Gain scores of 48.66% for critical thinking and 47.21% for communication, both categorized as moderately effective. Repeated Measures MANOVA showed a significant simultaneous effect (Pillai's Trace = 0.834, $p < 0.001$). User responses of 83–91% indicated that the media was practical, interactive, and contextual. Thus, the developed media is feasible and has potential to support critical thinking and communication through technology-enhanced biology learning grounded in local wisdom.

Keywords: *Articulate storyline; animal identifier; ethnozoology; critical thinking; communication.*

INTRODUCTION

Critical thinking and communication are essential 21st-century competencies and important dimensions of high school graduate profiles (Suroso et al., 2022; Tohani & Aulia, 2022). However, students' communication skills remain insufficiently developed, particularly in asking questions, expressing ideas, and responding to others' ideas (Angganing et al., 2022). This condition reflects a pedagogical challenge: biology learning needs to provide more opportunities for students to observe, inquire, reason, discuss, and communicate through meaningful contexts. Although interactive digital media, ethnozoology-

based learning, and organism-identification applications have each shown educational potential, their pedagogical integration to simultaneously develop critical thinking and communication remains limited. Therefore, a learning medium is needed that combines local ethnozoological contexts with interactive and exploratory digital learning experiences to address these two competencies simultaneously

Skills think critical and communication is part from profile high school graduates at the same time skills important 21st century (Suroso et al., 2021; Syofyan et al., 2021). However, the ability the Still low. The 2022 PISA results show

literacy Indonesian students are below the international average, while skills communication Still low in submit questions, expressing, and responding to ideas (Nabila & Rusyati, 2024; Angganing, 2023). Conditions This related with learning that is still ongoing dominated memorization, less student-centered, minimal activity inquiry and discussion, as well as limited in utilization technology (Sundawiyani *et al.*, 2022; Purbowati & Dewi, 2024).

Problems the show the need for interactive, contextual and data-based learning media technology. *Articulate Storyline* can serve material in a way interactive for push involvement and activity think students (Saadah *et al.*, 2022). Integration of ethnozoology Elderly Citorek give context wisdom local in learning zoology, whereas application *Animal Identifier* AI-based support activity observation and identification animal in a way directly. Integration of the three potential push student analyze information, connecting knowledge scientific with wisdom local, as well as communicate results his findings.

Previous studies have demonstrated the effectiveness of Articulate Storyline for interactive learning, the potential of AI-based applications for animal identification, and the value of Kasepuhan Citorek ethnozoological knowledge in documenting local biodiversity (Sudiantara *et al.*, 2024; Lestari, 2024; Utami *et al.*, 2025). However, these studies have not yet addressed how local knowledge of animal diversity, characteristics, and habitats can be connected with scientific biological concepts to support students' critical thinking and communication. Therefore, this study develops an interactive Articulate Storyline medium integrating Kasepuhan

Citorek ethnozoology and Animal Identifier as a contextual technology-based biology learning innovation.

METHOD

This type of research uses **Research and Development (R&D)** with the Borg and Gall model consisting of 10 stages (Figure 3). The research was conducted at SMAN 1 Warunggunung with the research subjects being class X students. The research flow is presented in Figure 3.



Figure 3. Research Flow

This study used a sample of 35 students and one biology teacher selected at sample random. The research method used *mixed methods*, namely qualitative and quantitative. The qualitative approach was used for product development through observation and interviews, with instruments in the form of an initial observation sheet, a learning implementation sheet, and a user interview guide. The quantitative approach was used to measure the validity, practicality, and effectiveness of the product through questionnaires and tests. Qualitative data were analyzed through data reduction, data presentation, and drawing conclusions, while quantitative data were analyzed using the following techniques:

Product feasibility testing is analyzed in the following way:

$$\text{Persentase (\%)} = \frac{N}{X} \times 100\%$$

Information:

N = eligibility test score

X = total score

Then, the percentage is calculated as the average using the following formula:

$$\text{Skor rata - rata} = \frac{\text{Skor total}}{\text{jumlah evaluator}} \times 100\%$$

Furthermore, the average scores categorized can be seen in Table 1.

Table 1. Product eligibility categories

Percentage (%)	Criteria
80 – 100%	Very worthy
60 – 80%	Worthy
40 - 60%	Enough worthy
20 – 40%	Not feasible
0 – 20%	Absolutely not worthy

To test the influence of independent variables on several dependent variables simultaneously, MANOVA (*Multivariate Analysis of Variance*) was used with the help of SPSS, while the increase in *pretest-posttest scores* was analyzed using N-Gain.

$$N - \text{Gain} = \frac{\text{Posttest} - \text{Pretest}}{\text{Skor ideal} - \text{Pretest}} \times 100\%$$

The N-Gain value will be converted into several categories as follows (Table 2).

Table 2. N-Gain score categories

Percentage (%)	Criteria
< 40	Ineffective
40 – 55	Enough effective
56 – 75	Effective
> 76	Very effective

User responses to the product are analyzed as follows:

Respon

$$= \frac{\text{Total skor yang diperoleh}}{\text{total maksimum yang diperoleh}} \times 100\%$$

User response scores for the product will be converted into categories as seen in Table 3.

Table 3. User response categories

Percentage (%)	Criteria
81 – 100%	Very suitable
61 – 80%	In accordance
41 – 60%	Enough in accordance
21 – 40%	It is not in accordance with
< 21%	Absolutely not in accordance

RESULTS AND DISCUSSION

The Articulate Storyline ethnozoology media of Kasepuhan Citorek integrated with the *Animal Identifier application* include the results of product development, feasibility and validity tests, practicality, user responses, and the effectiveness of the media in supporting students' critical thinking and communication skills.

1. Articulate Storyline Media Development Ethnozoology Elderly Citorek integrated application *Animal Identifier*

A. Research and information collecting

1) Analysis need

A needs analysis conducted through interviews with 1 Biology teachers and 5 students at SMAN 1 Warunggunung showed that learning is still dominated by lectures and books, while interactive media and digital technology are not yet optimal (Sipinte *et al.*, 2025). Student engagement and knowledge about Kasepuhan Citorek are also still limited, so interactive and contextual media are needed to support critical thinking skills (Nurhasanah *et al.*, 2024; Aditiyarini & Sismulyasih, 2025). This is supported by Darmawa *et al.* (2025) who showed a very positive response to the local culture-based *Articulate Storyline*. Therefore, *the Articulate Storyline media was developed* that integrates the ethnozoology of Kasepuhan Citorek and *Animal Identifier* to support interactive, contextual learning, and critical thinking and communication skills (Ramadhani *et al.*, 2026).

2) Literature study:

Literature studies show that ethnosience supports contextual learning, critical thinking, and cultural literacy (Atmojo *et al.*, 2025). *Articulate Storyline* also has the potential to increase interactivity and critical thinking (Khadijah *et al.*, 2025), with a student response rate of 83.9% for Kasepuhan Citorek-based media (Darmawa *et al.*, 2025). However, the integration of Kasepuhan Citorek ethnozoology with *Animal Identifier* has

not been found. This study develops this integration to support interactive and contextual biology learning as well as critical thinking and communication skills.

B. Planning

Media integrates material ethnozoology Elderly Citorek, *Articulate Storyline* For materials and activities interactive, as well as *Animal Identifier* For identification animals. Activities designed contextual for practice ability observe, analyze, and communicate results thinking.

C. Develop preliminary form of product

The stage of developing a preliminary form of product is the implementation of the planning results into the initial form of the *Articulate Storyline* media for Kasepuhan Citorek ethnozoology integrated with *Animal Identifier* which is designed contextually and interactively to support students' critical thinking and communication skills.

1) Development of Media and Learning Materials *Articulate Storyline*

Media development uses *Articulate Storyline* to organize materials, navigation, images, videos, quizzes, reflections, and *Animal Identifier* links according to the learning flow from instructions for use to conclusions (Figure 1a–b).



(a) (b)

Figure 1. (a) Home page and user manual; (b) *Articulate Storyline* ethnozoology learning media menu for Kasepuhan Citorek.

Ethnozoology material developed as substance main media. Compilation material done with integrate draft biological with knowledge local public Elderly

Citorek. The material is presented in a way systematic from draft base going to further discussion deep (Figure 2).



Figure 2. Systematic presentation of ethnozoology material from Kasepuhan Citorek, from basic concepts to more complex material.

2) Application Integration *Animal Identifier*
Animal Identifier application is integrated into *Articulate Storyline* via buttons or *hyperlinks* to support fauna identification (Figure 3).



Figure 3. *Animal Identifier* Integration in Media

3) Development Activity Learning Based Ethnozoology

Learning activities are designed to engage students in exploring ethnozoology through the stages of observing, identifying, gathering information, analyzing, evaluating, and communicating. Students observe the fauna of Kasepuhan Citorek, identify them using the *Animal Identifier*, and compare the results with scientific information. Next, students analyze the habitat, ecological role, utilization, and community knowledge through contextual problems. The results of the analysis are then summarized and communicated through written answers, discussions, presentations, or learning products.

4) Media Development for Supports Two Dimensional Profiles High school graduate

Media was developed to support two dimensions of the High School Graduate Profile: critical thinking and communication. Critical thinking is developed through case studies, while communication is developed through discussions and the delivery of analytical results (Figure 4a-b).



(a) (b)

Figure 4. (a) Activity Integration Learning through Case Studies for Stimulate Skills Critical Thinking and (b) Communication Through Delivery Answer Quiz

5) Development Evaluation Learning

Evaluation arranged for measure achievement objective learning through question choice double, description, fauna identification, analysis case, and reflection (Figure 5).

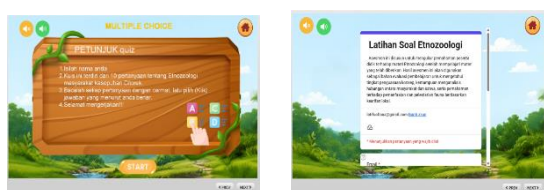


Figure 5. Example of Learning Evaluation Section

6) Validation Learning Media Products

The initial media was validated by content, media, and language experts to assess the suitability of the material, design, interactivity, language, and *Animal Identifier* integration. The validation results were used as the basis for revisions before being piloted with students.

7) Development and Validation Instrument

The research instrument was developed to measure the quality, usability, and effectiveness of the media, including interviews, observations, user feasibility and response questionnaires, as well as tests on the achievement of learning objectives and two dimensions of the High School Graduate Profile.

D. Trials product scale small (*Preliminary field testing*).

Scale test results small show that the *Articulate Storyline* media ethnozoology Elderly Citorek integrated *Animal Identifier* get response as big as 82.54% with very worthy category of 10 students class X. This result show that the media has fulfil media, language and material aspects as well as worthy to be continued after done improvement.

In the media aspect, students evaluate appearance, navigation, images, and interactivity interesting as well as easy used. Repair required on layout, quality image, clarity buttons, and instructions *Animal Identifier*. Findings This in line with Sipinte et al. (2025) that *Articulate Storyline* worthy support understanding and motivation Study student.

In this aspect language, media is assessed clear and easy understood, although a number of term need explanation additional. Improvements covering simplification sentence, size text, and instructions use *Animal Identifier*. This in line with Khadijah et al. (2025) that *Articulate Storyline* interactive can support learning and skills think critical.

In this aspect material, students evaluate material easy understood, appropriate with learning biology class X, and interesting Because lift utilization of fauna by the community. Improvement covering summary material, addition information images, and variations

contextual questions. Use context local the in line with Atmojo et al. (2025) that ethnoscience can connect draft science with knowledge and culture local.

E. Revision product Main product revision

The main product was revised based on small-scale test results and students' feedback on media, language, and content to improve readability, usability, and interactivity before the large-scale trial. Unlike previous studies that mainly developed digital media or documented ethnozoological knowledge separately, this study introduces an integrated learning medium that connects Kasepuhan Citorek ethnozoological knowledge with scientific biology concepts through *Articulate Storyline* and *Animal Identifier*. This integration provides a contextual learning experience designed to engage students in interpreting biological information, supporting critical thinking and communication while maintaining a clear and cognitively manageable multimedia presentation (Mayer, 2017).

Revision product main done based on scale test results small and input students in aspects media, language, and materials for increase quality, readability, usability, and interactivity before scale test big. Approach This in accordance with principle clear, structured, and uncluttered multimedia presentation burdensome cognitive students (Mayer, 2017).

In the media aspect, revision includes layout, appearance, quality images, buttons, and navigation for direct attention students on information important in accordance principle *signaling*, *spatial contiguity*, and *coherence* (Mayer, 2017). *Animal Identifier Integration* repaired through instruction more use clear in accordance principle *pre-training* and *segmenting* (Mayer, 2017).

In this aspect language and materials, revision covers simplification sentence, explanation terms, adjustments size text, summary materials, repairs images, and addition examples and exercises contextual. Presentation of relevant words and images support formation verbal and visual representations (Mayer, 2017). Context Elderly Citorek still maintained Because Darmawa et al. (2025) report response student by 83.9% with very good category.

F. Trials product scale large (Main field testing)

Scale test results big show that the *Articulate Storyline* media ethnozoology Elderly Citorek integrated *Animal Identifier* get response as big as 87.75% with very worthy category, increase compared to scale tests small after done revisions to the appearance, images, navigation, language, instructions, and materials.

In the media aspect, student evaluate appearance, navigation, images, and integration *Animal Identifier* interesting as well as easy used. Some repair Still required in variations appearance, quality pictures and instructions use *Animal Identifier*. Findings This in line with Khadijah et al. (2025) that *Articulate Storyline* support learning interactive and skills think critical.

In this aspect language, media is assessed clear, short, easy understood, and used term as well as appropriate typography. However, some part Still need summarized so that the information more easy understood.

In this aspect material, students evaluate material ethnozoology Elderly Citorek in accordance with learning biology Class X, interesting, and contextual. Pictures, quizzes, and *Animal Identifier* help understanding material, although a number of fauna information needed

enriched in a way concise. This is in line with Atmojo et al. (2025) that ethnoscience can connect draft science with knowledge and culture local as well as support think critical and literacy culture.

G. Revision Product Operational (Operational product revision)

Revision product operational done based on scale test results small in aspect media, language, and materials for increase quality and convenience Usage. Media improvements include layout, images, buttons, and navigation. in accordance principle *signaling*, *coherence*, and *spatial contiguity* (Mayer, 2021), as well as supported by Legina and Sari (2022).

Animal Identifier Integration clarified through instruction use in accordance principle *pre-training* and *segmenting* (Mayer, 2021). The language is simplified, while material summarized, image clarified, and practice made more contextual (Mayer, 2021). This in line with Riyanto et al. (2024) which shows validation material *Articulate Storyline* by 84.33%.

H. Effectiveness Test Product (Operational field testing)

Media tested in learning through *pretest* and *posttest* for know its effectiveness to skills think critical and communication.

I. Revision Final Product Revision

The revision was conducted based on the results of the product effectiveness test. At this stage, all feedback obtained from the product effectiveness testing process was analyzed to determine the final improvements to the media.

J. Dissemination and Implementation Product (Final Dissemination and Implementation)

Stage end done through media dissemination, publication research, video documentation, and IPR registration as well implementation in learning biology.

2. Feasibility, Validity and Practicality of Articulate Storyline Media Ethnozoology Elderly Citorek integrated application Animal Identifier

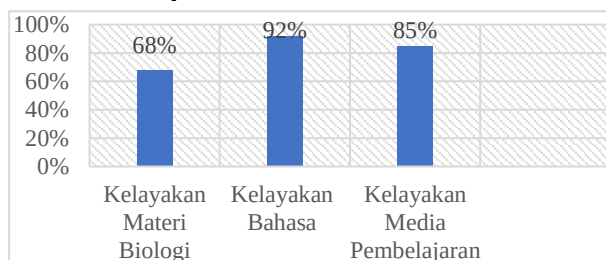


Figure 6. Eligibility Product According to experts

The results of the material feasibility test obtained 68% (Figure 7), indicating that the material was informative, but still needed improvement in terms of suitability of learning outcomes, depth, accuracy, local context, and analytical activities.

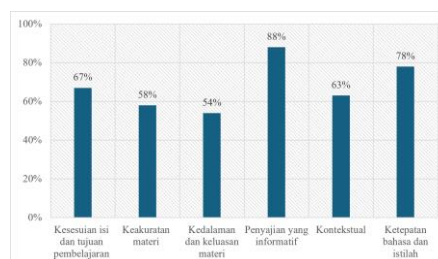


Figure 7. Eligibility Product Based on Dimension of Matter

Presentation informative got 88%, but some fauna still need information scientific such as name, classification, characteristics, and habitat. Development need maintain visuals at the same time strengthen description scientific, in line with Mursalin et al. (2025) that ethnobiology potential connect knowledge local with draft biological.

Compliance content with objective learning obtained 67%, so that material

need more directed at analysis problems and formulation solution through CP–TP mapping and addition case analytical (Figure 8a-b), according to Adinugraha (2022) regarding importance integration wisdom local in learning meaningful and contextual biology.



(a)

(b)

Figure 8. a. Material not yet equipped cases that encourage participant educate analyze and formulate solution; b. The material has been supplemented with cases for analysis and solution formulation.

Accuracy material obtained 58%, so that need strengthening scientific names, classification, characteristics, habitats, and roles ecological fauna and adjustment information utilization with context Elderly Citorek (Figure 9a-b).



(a)

(b)

Figure 9. a. The object has not been provided with scientific information regarding its classification and biological characteristics; b. The object has been equipped with scientific information related to its classification and biological characteristics.

The depth and breadth of the material achieved 54%, making it the aspect that

needs the most development. The material needs to be expanded from definitions to the relationships between fauna, society, the environment, utilization, culture, and sustainability, and to utilize local knowledge as a source of biological understanding and higher-order thinking. This is in line with Sirojjuddin et al. (2025) who emphasized the integration of biological substance, local wisdom, and learning strategies in ethnobiology teaching materials.



(a)

(b)

Figure 10. a. One-question reflection is not sufficient to measure analytical skills; b. The reflection has been supplemented with several questions to measure analytical skills

The contextual aspect received 63%. The context of Kasepuhan Citorek needs to be strengthened through case studies, research data, and activities that link fauna, communities, and the environment as objects of biological analysis.

The assessment and learning flow still need improvement. Reflection needs to be expanded to include cases, problem identification, impact analysis, and solution formulation, and navigation and instructions should be structured more systematically (Figure 10a–b).

The accuracy of language and terminology achieved 100%, making it a key feature of the media (Figure 11). The terminology aligns with ethnozoological and biological concepts, including a combination of scientific and local terms from Kasepuhan Citorek. This finding aligns with Afifah et al. (2022) who

emphasized the importance of accurate language and terminology in learning media.

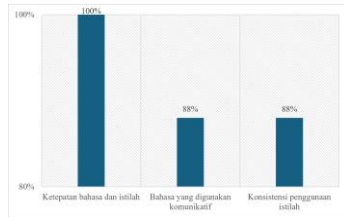


Figure 11. Eligibility Product Based on Dimensions of Language

The communicative language aspect scored 88%, indicating that the language was relatively easy to understand but still needs to be strengthened with prompting questions that connect the material to students' prior knowledge or experiences (Figure 12).



Figure 12. Media display *before* without trigger questions and *after* with trigger questions to develop critical thinking skills.

Communicative language obtained 88% and was assessed easy understood, but need strengthened with question hook -up lighter material with experience students (Afidah et al., 2023). Consistency term also gained 88%, with revisions to symbols, abbreviations, nomenclature, and labeling QR code (Figure 13). In overall, quality very good language, in line with Afifah et al. (2022), Afidah et al. (2023), and Akhyaruddin et al. (2024).

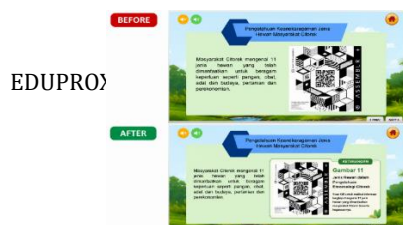


Figure 13. Media display *before* without QR code information and *after* with QR code information .

Based on Figure 6, the feasibility of the learning media dimensions obtained an average of 85% (very feasible), including aspects of navigation, readability, audio-visual, interactivity, and compatibility (Figure 14).

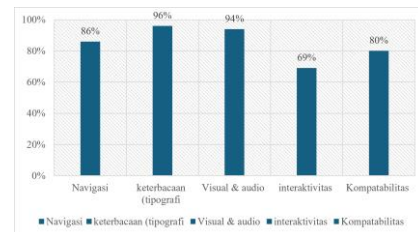


Figure 14. Eligibility Product Based on Media Dimensions

Navigation got 86% and 80% compatibility, so Still need improvement consistency knob as well as testing on various devices and connections. While that, interactivity get mark lowest (69%) and became priority revision. Interactivity need directed at activities meaningful like fauna identification, *drag and drop*, quizzes, and giving bait back in harmony with objective learning (Figure 15). This in line with Tarigan et al. (2021) that feature interactive can increase activity and independence Study.

In a way Overall, the media has strength in readability and visual-audio, whereas interactivity, compatibility, and navigation become focus development furthermore with still maintain quality

designs that have been good (Wulandari et al., 2019; Tarigan et al., 2021).



Figure 15. Media display with interactive drag and drop quizzes and communication activities through presentation of student answers.

3. The Effectiveness of Articulate Storyline Media Ethnozoology Elderly Citorek integrated application Animal Identifier Against two profiles high school graduates

Effectiveness was measured through pretest and posttest for critical thinking and communication skills before and after the implementation of *Articulate Storyline media* integrated with *Animal Identifier*. The descriptive statistics results are presented in the following table.

Table 1. Descriptive Statistics of Pretest and Posttest Scores for Critical Thinking Skills and Communication Abilities

Variables	N	Min	Max	Average	Standard Deviation
Critical Pretest	35	20	65	34.43	11,033
Posttest Critical	35	40	95	67.57	14,920
Pretest Communication	35	0	62.5	26.43	16,542
Posttest Communication	35	20	100	60.36	25,089

Table 1 shows an increase in the average critical thinking skills from 34.43 to 67.57 and communication skills from 26.43 to 60.36 in 35 students after using the *Articulate Storyline* ethnozoology media of Kasepuhan Citorek. This improvement demonstrates that the developed learning

media serves not only as a vehicle for conveying ethnozoological material but also as a source of learning experiences. Regarding communication skills, the improvement is evident in the students' ability to present their observations and animal identifications, express opinions, provide explanations based on gathered information, and share discussion outcomes with both their group members and the class. Integrating the *Animal Identifier* application provides students with hands-on experience in identifying animals based on their observations. The information obtained through this process then serves as a basis for students to discuss the animals' characteristics, names, and habitats, as well as their significance to the lives of the Kasepuhan Citorek community. Consequently, students do not merely receive information passively; instead, they possess tangible material and experiences that they can communicate to others.

Meanwhile, regarding collaboration skills, improvement stems from learning activities within the media that require students to complete tasks in groups. Students must divide tasks, exchange identification results, outline findings, consider the opinions of group members, and reach a consensus on the final outcome. This process indirectly fosters students' abilities to function as effective group members, participate actively, value the contributions of others, and take responsibility for the completion of shared tasks.

A. Prerequisite Test

1. Normality Test

Table 2. Results of the Shapiro-Wilk Normality Test for Pretest and Posttest Data

Variables	Statistics	df	Sig.	Information
Critical Pretest	0.909	35	0.007	Abnormal

Posttest Critical	0.965	35	0.330	Normal
Pretest Communication	0.936	35	0.043	Abnormal
Posttest Communication	0.955	35	0.158	Normal

Table 2 shows that the Critical Pretest ($p = 0.007$) and Communication Pretest ($p = 0.043$) were not normally distributed, while both *posttest data* were normally distributed ($p > 0.05$). Therefore, the analysis used the Wilcoxon Signed Ranks Test as a nonparametric test and MANOVA Repeated Measures to test the effect of the treatment simultaneously.

2. Mauchly's Test of Sphericity

Table 3. Results of Mauchly's Test of Sphericity

Efek With in-Subj ects	Mauchly's W	Chi-Square	df	Sig.	Greenhouse-Geisser ϵ	Huynh-Feldt ϵ
Waktu	1,000	0,000	0	—	1,000	1,000
Variabel	1,000	0,000	0	—	1,000	1,000
Waktu $\times$ Variabel	1,000	0,000	0	—	1,000	1,000

B. Analysis MANOVA Repeated Measures (Effect of Simultan to Skills Critical Thinking and Communication Skills)

Table 4. Results of Multivariate Tests (MANOVA Repeated Measure)

Effect	Statistic	Mark	F	df Hypothesis	df Error	Sig.	Partial η^2
Time	Pillai's Trace	0,834	170,590	1,000	34,000	<0,001	0,834
Variable	Pillai's Trace	0,135	5,284	1,000	34,000	0,028	0,135

ce	Pillai's Trace	0,001	0,028	1,000	34,000	0,834	0,028
Waktu	0,001	0,028	1,000	34,000	0,834	0,028	0,001
Variable	0,001	0,028	1,000	34,000	0,834	0,028	0,001

Table 4 shows that the Time effect is significant (*Pillai's Trace* = 0.834; $F = 170.590$; $p < 0.001$; *partial* $\eta^2 = 0.834$) with a very large effect. The Variable effect is also significant ($p = 0.028$), while the Time $\times$ Variable interaction is not significant ($p = 0.868$), so that the increase in both variables is relatively parallel. Thus, the *Articulate Storyline media* integrated with *Animal Identifier* has a significant effect on critical thinking and communication skills simultaneously.

C. Follow-Up Test Univariate (Influence against Each Variable)

Follow-Up Test Results — Critical Thinking Skills

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Time	19,222,857	1	19,222,857	103,707	<0,001	0,753
Error	6,302,143	3	185,357	—	—	—
Total (Time)	—	—	—	—	—	—

Follow-Up Test Results — Communication Skills

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Time	20,145,089	1	20,145,089	85,000	<0,001	0,714
Error	8,058,036	3	237,001	—	—	—
Total (Time)	—	—	—	—	—	—

Tables 5 and 6 show that critical thinking skills ($F = 103.707$; $p < 0.001$; *partial* $\eta^2 = 0.753$) and communication

skills ($F = 85.000$; $p < 0.001$; $partial \eta^2 = 0.714$) experienced a significant increase with a very large effect. The influence of media was slightly greater on critical thinking, with a $partial \eta^2$ difference of 0.039.

D. Signed Ranks Test

Table 7. Results of the Wilcoxon Signed Ranks Test

Variab les	Negat ive Ratin g (N)	Positi ve Ratin g (N)	Seri es (N)	Z	Sig. (2- taile d)
Kritis Posttest – Pretest	1	33	1	5,0 64	<0,0 01
Komuni kasi Posttest – Pretest	1	32	2	4,8 88	<0,0 01

Table 7 shows that the *Wilcoxon Signed Ranks Test* produced significant differences in both variables. Critical thinking skills obtained $Z = -5.064$ with $p < 0.001$, with 33 students (94.3%) experiencing an increase, 1 experiencing a decrease, and 1 remaining the same. Communication skills obtained $Z = -4.888$ with $p < 0.001$, with 32 students (91.4%) experiencing an increase, 1 experiencing a decrease, and 2 remaining the same. Thus, there is a significant difference between the *pretest* and *posttest* scores on critical thinking skills and communication skills after using the developed media.

E. Analysis N-Gain

Table 8. Descriptive Statistics of N-Gain Critical Thinking Skills and Communication Abilities

Variab les	N	Mini mum	Maxi mum	Aver age	Stand ard Devia tion
N- Gain (%)	3 5	-9.09	93.75	48.66	25,73 5

N- Gain (%)	3 5	-50.00	100.00	47.21	32,10 5
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Table 9. N-Gain Effectiveness Categories

Percentage (%)	Category
< 40	Ineffective
40 – 55	Quite Effective
56 – 75	Effective
> 76	Very Effective

Table 8 shows the *N-Gain* for critical thinking at 48.66% and communication at 47.21%, both categorized as quite effective. Overall, the media provided measurable improvements, although there is still room for improvement.

Discussion

A. Application of Articulate Storyline Media Ethnozoology Elderly Citorek Integrated Animal Identifier to Skills Critical thinking

Analysis results show improvement significant skills think critical (Wilcoxon $Z = -5.064$; $p < 0.001$; *Follow-Up Univariate* $F = 103.707$; $p < 0.001$; $partial \eta^2 = 0.753$). The average score increase from 34.43 to 67.57 with *N-Gain* 48.66% (enough) effective). Increase supported by interactive media, context ethnozoology, and *Animal Identifier* which encourages interpretation, analysis, observation, and verification information (Maulidiya & Asih, 2025; Rea et al., 2024; Utami et al., 2025).

B. Application of Articulate Storyline Media Ethnozoology Elderly Citorek Integrated Animal Identifier to Ability Communication

Ability communication increase significant (Wilcoxon $Z = -4.888$; $p < 0.001$; *Follow-Up Univariate* $F = 85.000$; $p < 0.001$; $partial \eta^2 = 0.714$). The average score increase from 26.43 to 60.36 with *N-Gain* 47.21% (enough) (effective). Activities compilation graphs, reports, and conclusions scientific as well as utilization *Animal Identifier* support visual and written

communication. The effect is enormous shows media contributes to improvement ability communication. This is in line with Nugraheni et al. (2025) who showed that the integration of local wisdom and visual identification technology effectively improves science skills, including scientific communication.

C. Influence Simultan to Skills Critical Thinking and Communication

Repeated Measures MANOVA showed a significant simultaneous effect (Pillai's Trace = 0.834; $F = 170.590$; $p < 0.001$; partial $\eta^2 = 0.834$), with improvements in both skills being relatively parallel ($p = 0.868$). This finding is in line with Mukhoyyaroh et al. (2022) that interactive digital media can support various skills equally.

4. User Responses to Articulate Storyline Ethnozoology Media Elderly Citorek integrated application *Animal Identifier*

Response results users show evaluation positive throughout indicators, namely convenience 85% usage, 90% usability, support *Animal Identifier* 85%, integration technology 83%, support skills 91% and 90%, as well as practicality 85% (Figure 16). The media is assessed interactive, practical, and contextual.

Convenience use 85 % indicates easy media operated and its flow can followed with good, appropriate principle subtraction unprocessed processing relevant (Fiorella & Mayer, 2021). Usefulness 90 % shows that the media helps understanding through text, images, activities, quizzes, and identification animals, in line with Khadijah et al. (2025).

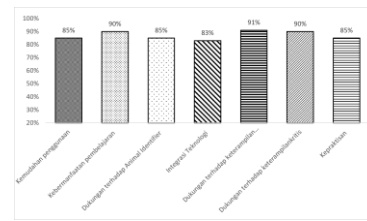


Figure 16. User Response to the Articulate Storyline Media of Kasepuhan Citorek ethnozoology integrated with the *Animal Identifier* application.

Support *Animal Identifier* by 85% and integration technology 83 % indicates technology has support learning, even though Still can optimized (Khadijah et al., 2025). Support to skills get values of 91% and 90%, in line with Nurhasanah et al. (2024) and Khadijah et al. (2025) regarding potential *Articulate Storyline* in support skills think critical. Practicality 85% is also in line with Legina and Sari (2022) who reported response student by 89% with very good category.

In a way overall, earned media response positive with mark highest in support skills and lowest on integration technology. Therefore that, integration *Animal Identifier* and features technology need Keep going optimized to be more in harmony with objective learning.

CONCLUSION

Based on the one-group pretest–posttest results, the use of Articulate Storyline media integrated with Animal Identifier was associated with an increase in students' critical thinking and communication skills, with N-Gain scores of 48.66% and 47.21%, respectively, categorized as moderately effective. Repeated Measures MANOVA indicated a significant difference between pretest and posttest scores (Pillai's Trace = 0.834; $p < 0.001$). User responses of 83–91%

indicated that the media was perceived as easy to use, practical, interactive, useful, and contextual for biology learning and 21st-century skills. However, the product still has limitations in the depth, breadth, and accuracy of its content, as reflected in the relatively lower expert validation scores for these aspects.

Based on the research results, the *Articulate Storyline* media integrated with *Animal Identifier* significantly improved critical thinking and communication skills, with *N-Gain* of 48.66% and 47.21%, respectively (quite effective category). Simultaneously, *MANOVA Repeated Measures* showed a significant effect (*Pillai's Trace* = 0.834; $p < 0.001$). User responses of 83–91% indicated that the media was considered easy, practical, interactive, useful, and contextual in supporting biology learning and 21st-century skills.

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