

## Culturally Responsive Science Education: Developing and Evaluating Ethnoscience-Integrated Animated Videos for Middle School Learners

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**Abstract:** This study aimed to develop and evaluate a Canva-based animated video integrated with Kaili ethnoscience to support students' conceptual understanding of the human respiratory system in junior high school. The study employed a Research and Development (R&D) approach using the ADDIE model, consisting of five sequential stages: analysis, design, development, implementation, and evaluation. The developed media was validated by material and media experts, followed by a limited classroom implementation involving 17 eighth-grade students at MTs Nida'ul Khairaat Pombewe. Data were collected through expert validation questionnaires, student response questionnaires, and conceptual understanding tests administered using a one-group pretest-posttest design. The material expert validation yielded an average score of 96.7%. In comparison, the media expert validation produced an average score of 91.7%, both of which were categorized as Very Good, confirming the high validity and technical quality of the developed media. Student reaction was also very favorable across six dimensions: attractiveness, ease of use, clarity, relevance, engagement, and usefulness, which indicate high practicality and acceptance in the classroom. Effectiveness testing results showed a significant increase in students' conceptual knowledge, with an average N-gain of 0.85 (high category) and a large effect size (Cohen's  $d = 2.49$ ). Improvements in learning were observed across all seven conceptual understanding indicators, with the greatest increases in classifying (N-gain=1.000), explaining (N-gain=0.947), and comparing (N-gain=0.917). Such results suggest that providing culturally relevant ethnoscience material to students, together with available digital animation resources, may facilitate significant learning in science by helping abstract physiological ideas relate to students' cultural lives. However, because this study employed a one-group pretest-posttest design without a control group and had a limited sample size, the findings should be interpreted with caution. Future studies using controlled experimental designs with larger and more diverse samples are recommended to further validate the effectiveness of ethnoscience-integrated animated learning media.

**Keywords:** animated video, canva, culturally responsive teaching, conceptual understanding, respiratory system, ethnoscience.

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### ■ INTRODUCTION

The 21st-century digitalization of education requires a paradigm shift in the approach to learning (McCarthy, Maor, McConney, & Cavanaugh, 2023; Mukul & Büyüközkan, 2023), especially in science education, which in many cases requires visualization of complex

concepts (Schoenherr, Strohmaier, & Schukajlow, 2024; Teplá, Teplý, & Šmejkal, 2022). Studies emphasize the significance of visual representation in the process of scientific knowledge and communication (Zhang & Jenkinson, 2024). ICT-based education and MOOCs are considered instrumental in

producing globally competitive human resources in the 21st century (Budiarto, Rahman, Asrowi, Gunarhadi, & Efendi, 2024). Research has demonstrated that extrinsic visualizations, including animations, can improve students' visualization abilities and alleviate learning challenges in science instruction, especially in conceptual comprehension (Mnguni & Moyo, 2021). The skills of the 21st century, such as critical thinking, creativity, communication, collaboration, and digital literacy, are built on conceptual understanding (Afandi, Sajidan, Akhyar, & Suryani, 2019; Mi, Lu, & Bi, 2020). These are the most essential skills that will help students keep up with the demands of globalization and rapid technological development (Dishon & Gilead, 2021).

Science education is challenged by the difficulties in conveying abstract concepts, which need visual explanation to help students construct knowledge (Cirkony, Tytler, & Hubber, 2022; Kim & Jin, 2022). The human respiratory system is an important subject in the science subjects of junior high schools, especially the grade VIII learning outcomes of learning to analyse the interrelationships of organ systems, their functions, disorders, and trying to ensure the health of the respiratory organs (Apriliyani, Susantini, & Yuliani, 2023). This substance is very complex (Humbert et al., 2022), being filled with physiological processes, anatomical systems, and biochemical processes that would be difficult to visualise with traditional approaches (Clark, Burrowes, & Tawhai, 2021; Kageyama, Ito, Tanaka, & Nakajima, 2024). It has been discovered that students experience severe issues of miscomprehending microscopic and processual concepts of the respiratory system, which also led to the lack of learning competencies achievement (Bhetwal & Wilson, 2023; Reinoso Tapia, Delgado-Iglesias, & Fernández, 2019). The limitations of the traditional learning media of visualizing the

dynamic images of the respiratory processes are determined as a factor that affects the learning efficiency (Jeddi et al., 2024; Wallace & Angus, 2021).

According to recent research, students' conceptual knowledge and learning performance across various fields can be enhanced through animated videos (Albaw, AL-Haddad, & Sammour, 2022; Caella & Yulianto, 2024). When it comes to the most suitable learning media, it has been viewed that animated video can be considered one of the most preferable ones as it can be easy to follow, generate interest and make students learn concepts more easily (Albaw et al., 2022; A. R. Sari, Sujana, & I. Isrok'atun, 2023), and increase the likelihood of remembering the material and transfer of knowledge between students (da Silva & de Oliveira, 2023). Similarly, Caella & Yulianto (2024) reported that animated video media were more effective than conventional learning, supporting the view that animation is a powerful and enjoyable learning tool. Animated videos based on motion contribute to students' science learning (Hapsari, Hanif, Gunarhadi, & Roemintoyo, 2019). The study aligns with the theory of Cognitive Multimedia Learning, which holds that cognitive constraints should be considered when developing learning resources (da Silva & de Oliveira, 2023). Canva is a graphic design program used across most domains, including education and business (O'Neill, 2019). Canva can also have a significant impact on visual communication in the digital era and promote efficiency and innovation across various industries (Catubig, Kilat, Laurito, Patoc, & Valle, 2024; Gehred, 2020; O'Neill, 2019). Canva proves useful for boosting students' visual literacy in terms of familiarity, efficiency, and creative phases (Catubig et al., 2024). Canva can be seen as versatile, with applications in social media and classroom-based learning, where high-quality graphics, such as flashy pictures, can boost

interaction levels (O'Neill, 2019). Research shows that Canva learning media can incorporate local wisdom in an attractive and relevant way for students, thereby improving their learning outcomes (Kasmi & Mahmud, 2024; Tri Astuti & Wiyono, 2024). Thus, the creation of new learning tools, such as animated videos and Canva, should align with strategies premised on cultural backgrounds and local wisdom.

The creation of local and applicable learning would be ethnocentric, meaning it would require an ethnosience or an inclusion of the values of the local wisdom in the scientific knowledge (Fadilah, Sari, Ramadhani, Basuki, & Fitaloka, 2019a; Sihombing et al., 2025). The technique has been discovered to be effective in the improvement of conceptual learning, critical thinking capacities, scientific attitude, and character development (Ali, Bektiarso, Fransje Walukow, & Narulita, 2025; Hamna & Muh. Khaerul Ummah BK, 2024; Sotero, Alves, Arandas, & Medeiros, 2020). The approach has proven helpful with regards to improving conceptual learning, critical thinking abilities, scientific attitudes, and character development (Hapid et al., 2023). One of the practices that has been intergenerational transferred is the use of miana leaves (*Plectranthus scutellarioides*) as a traditional concoction to guarantee the well-being of the respiratory system (Dianto, Anam, & Khumaidi, 2015; Hapid et al., 2023; Muthmainnah, Ibrahim, & Hardani, 2018). Scientific studies have also confirmed the antimicrobial, anti-inflammatory, and immunomodulatory properties of miana leaves (Junita et al., 2023; Yanto, Hatta, Bukhari, & Natzir, 2020). These facts demonstrate the topicality of miana leaves as a contextual and meaningful object of ethnosience that must be incorporated into science education.

Previous studies have shown that animation-based media can facilitate and improve students' science learning outcomes (El

Hammoumi, Zerhane, & Janati Idrissi, 2022; Liu & Elms, 2019; Putri, Rohmani, Apriza, & Elizar, 2024; Teplá et al., 2022). However, most of these studies focus primarily on enhancing conceptual visualization and cognitive processing, without explicitly integrating local cultural contexts into digital instructional design. As a result, animation media often remain culturally neutral, potentially limiting their relevance to students' socio-cultural backgrounds. Conversely, research on ethnosience-based learning has demonstrated its potential to increase students' motivation, contextual understanding, and meaningful learning experiences (Ali et al., 2025; Fadilah et al., 2019; MacKenzie et al., 2021). Nevertheless, these studies largely emphasize non-digital instructional approaches such as contextual discussions, printed modules, or project-based activities. The systematic integration of ethnosience into animated digital media remains underexplored, particularly within junior secondary science education.

Furthermore, studies on Canva-based learning media tend to highlight aspects of design creativity and technical feasibility (Stadlinger, Jepsen, Chapple, Sanz, & Terheyden, 2021) with limited empirical evidence demonstrating its effectiveness in improving measurable conceptual understanding when combined with culturally grounded content. Thus, there is a need for research that not only develops animation-based digital media but also rigorously validates its pedagogical effectiveness through empirical testing. In this respect, it is yet to be explored how teaching media in the form of Canva animated videos (Farrokhnia, Meulenbroeks, & van Joolingen, 2020; Kleftodimos, 2024) can be developed to present learning material on the human respiratory system, incorporating ethnosience to make it more pertinent.

The limited integration of Canva-based animated media with ethnosience practices indicates a significant instructional gap. Although

digital animation and ethnoscience have been examined separately, their systematic combination within a validated instructional framework remains scarce. Accordingly, educators tend to be privy to digitized media, whose capability to advantageously combine technological affordances with culturally pertinent contexts of science. This is especially pertinent in areas like Central Sulawesi, where students are raised in a highly ethnoscientific culture that incorporates traditional respiratory health practices. Science teaching, however, often treats concepts decontextualized and out of context, concerning students' lived cultural experience. This kind of disconnection can reduce interest and make conceptual understanding difficult.

In this gap, the current research develops and empirically validates an animated video created in Canva that incorporates Kaili ethnoscience to teach the human respiratory system. Through the integration of multimedia learning principles, cultural contextualization, and statistical validation of acquired conceptual understandings, the research provides a more complete form of instructional design, bridging digital innovation and local knowledge interweaving. In this regard, the following research questions aim to answer the following major questions: (1) To what extent is the development of ethnoscience-integrated Canva animated video media considered valid? (2) How feasible is the implementation of this media in teaching the human respiratory system? Furthermore, (3) How effective is the Canva animated video media in enhancing students' conceptual understanding of the human respiratory system when integrated with ethnoscience?

## ■ METHOD

### Participants

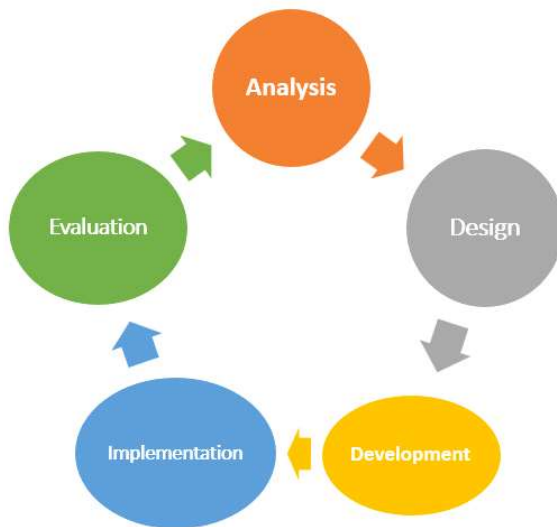
The media trial sample in this research consisted of 17 eighth-grade students from Junior High School (MTs) Nida'ul Khairaat Pombewe,

Indonesia. This number equals the existing population, so the sampling technique used was saturated sampling, in which all population members were included as research participants. The selection of this technique was based on the consideration that the population size was relatively small, allowing researchers to study all members for more representative research results (Cohen, 1988; Sugiyono, 2018). In addition, the sample selection is based on the school's environment, which remains rich in Kaili tribal culture. Of all students, 17 participated in both the pretest and posttest, while 10 were purposively selected to complete the learning media response questionnaire. The ten students were purposively selected to represent varying levels of learning activity (high, moderate, and low), as identified through prior classroom observations and teacher records. This was intended as a strategy to capture a broader range of student reactions to the developed media. However, this small sample from a single school limits the generalizability of the results. The outcomes can be construed as situational interpretations rather than generalized conclusions. The study to be undertaken in the future is expected to use more extensive and diverse samples across various schools and other regional settings to confirm these initial findings and improve their external validity.

### Research Design and Procedures

In this study, the research and development (R&D) techniques are employed using the ADDIE framework, comprising five steps: analysis, design, development, implementation, and evaluation (Alghazzawi et al., 2021). This strategy was selected to develop and experiment with learning products, making them practical and feasible. Figure 1 can be regarded as the ADDIE research model.

The analysis stage involved classroom observations and informal discussions with



**Figure 1.** ADDIE research model

teachers to identify students' learning difficulties and the limitations of existing instructional media in explaining abstract concepts of the human respiratory system. The results of this stage served as the basis for determining the need to develop animated learning media integrated with ethnoscience. The design stage included organizing learning materials based on the curriculum's learning outcomes, developing a storyboard and narration script for the animated video, and collecting ethnoscience content on the use of miana leaves in Kaili local wisdom. In addition, visual elements, illustrations, animations, and audio narration were planned to support the conceptual explanation of respiratory system processes. The development stage involved producing the animated video in Canva using the previously prepared design.

Two experts, including a material expert and a media expert, were then used to confirm the developed media and check the accuracy of the content, the way it has been presented, the visual design, and the technical quality of the media. Changes were made according to the validators' recommendations. The implementation phase was based on a small-scale trial conducted in a classroom with 17 8th-grade students. The

learning activity involved all students, and the pretest and posttest were administered to assess improvement in conceptual understanding. Nevertheless, 10 students were purposively selected to complete the learning media response questionnaire. The selection aimed to represent students with different levels of learning activity (high, moderate, and low), allowing the researcher to obtain more varied feedback regarding the attractiveness, usability, and usefulness of the developed media. Finally, the evaluation stage aimed to examine the effectiveness of the developed media in improving students' conceptual understanding of the human respiratory system. A one-group pretest-posttest design was employed, and the results were analyzed using N-gain and effect size calculations.

### Instruments

This study employed both test and non-test instruments to assess the quality and effectiveness of the developed media. Non-test instruments consisted of validation questionnaires and student response questionnaires, adapted from Daryono, Rochmadi, & Hidayat (2021) and customized to the specific context of ethnoscience-integrated animated video development. The material expert validation questionnaire comprised 15 items across four aspects: material alignment with learning objectives (CP) and learning outcomes (TP), material accuracy, presentation systematics, and ethnoscience integration. The media expert validation questionnaire consisted of 22 items across four aspects: video and language clarity, narration and audio, visual attractiveness, and general feasibility. The student response questionnaire included 17 items measuring six dimensions: media attractiveness, ease of use, content and display clarity, material relevance to needs, learning involvement, and media usefulness.

Media attractiveness refers to students' interest in the video's visual appearance and

overall appeal (e.g., “I am interested in using this animated video in science learning”). Ease of use measures students’ ability to operate and follow the video independently (e.g., “I can follow the video content without assistance”). Clarity of content and presentation evaluates readability, audio clarity, and comprehensibility of the material. The relevance of the material is assessed for its alignment with curriculum content and its integration of local ethnoscience, including students’ increased understanding of Kaili local wisdom. Learning engagement measures students’ motivation, enthusiasm, and active involvement while using the media. Finally, media usefulness evaluates the perceived benefits of the video in improving conceptual understanding and cultural awareness.

All validation instruments used a 4-point Likert scale, while the student response questionnaire employed a 4-point agreement scale (1=strongly disagree to 4=strongly agree). In this study, two validators, that is, material experts and media experts, were used in validation testing according to the usual procedures in the development research (Arikunto, 2020; Cresswell, 2018; Sugiyono, 2018). The material expert validator is a lecturer in science education with an academic background in Biology Education. The validator has experience in teaching and developing science learning materials at the university level. The media expert validator is also a university lecturer with a Doctoral degree specializing in Technology Innovation. The validator has expertise in instructional media development and educational technology integration.

In addition to validating the developed media, the study also ensured the quality and

appropriateness of the assessment instrument used to measure students’ conceptual understanding. The test instrument initially consisted of 40 multiple-choice items developed based on conceptual understanding indicators adapted from A Taxonomy for Learning, Teaching, and Assessing. The instrument was empirically tested with eighth-grade students (Class VIII-G) at MTsN 3 Kota Palu. The trial data were analyzed using SPSS version 27 to examine item validity and reliability. Item validity was assessed using point-biserial correlation to determine the extent to which each item measured the intended construct, while reliability was evaluated using Cronbach’s alpha to assess internal consistency (Taber, 2018). As demonstrated in the analysis, 15 items met the validity criteria ( $r > 0.30$ ,  $p < 0.05$ ) and were included in the pretest and posttest. The coefficient of reliability,  $\alpha = 0.862$ , was high, suggesting high internal consistency.

The validated items depicted various indicators of knowledge of concepts such as explaining, classifying, and inferring. As an illustration, a question under the explaining indicator asked students to name the leading role of the human respiratory system (Item 1), and a question that asked students to categorize items asked them to differentiate between upper and lower respiratory organs (Items 8 and 13). An inference item expected students to conclude the potential impact of not filtering air through the nose (Item 5). The concept of ethnoscience was reflected in item 9, which measured students’ knowledge of the use of miana leaves in Kaili local wisdom for treating respiratory conditions. Table 1 will supply the entire test blueprint in conceptual understanding indicators.

**Table 1.** Conceptual understanding indicators

<b>Conceptual Understanding Indicators</b>	<b>Behavioral Description</b>
Explaining	Explaining specific concepts or processes
Interpreting	Interpreting data, images, or illustrations

Inferring	Drawing logical conclusions from given information or facts
Exemplifying	Providing concrete examples that represent abstract concepts
Summarizing	Summarizing main ideas into brief statements
Classifying	Grouping objects, phenomena, or ideas based on specific characteristics
Comparing	Identifying similarities and differences between two or more concepts

This animated video was designed to facilitate various kinds of conceptual knowledge. To explain, vivid animations were used, such as blue O<sub>2</sub> circles entering and leaving the body, or two animated children with growing and shrinking abdomens, providing students with examples and definitions of the breathing mechanisms. Skills interpretation: The interpretation of skills was performed through symbolic representations: students were required to guess what the blue O<sub>2</sub> circles indicated as they moved through organs, or why their dirt particles would be filtered by nasal hairs and their oxygen propelled onward. To draw inferences, the video depicted the visible symptoms of respiratory diseases, then showed what happens inside, such as viruses entering the lungs during the flu, or how compounds that destroy those viruses made the students relate what they observed to invisible biological processes.

The exemplification took the form of specific cases: influenza was discussed in some detail as a concrete case, and it was demonstrated that Kaili's practice of miana leaf use is a real cultural experience of traditional medicine. The last quiz was a summarization test that asked students to

summarize their knowledge by identifying the major differences between inspiration and expiration. Classifying occurred naturally as organs were grouped along the air pathway, diseases were grouped, and Miana's bioactive compounds were presented in distinct categories (each colored circle representing a different compound type). Finally, comparing was most obvious in the side-by-side animation of the two children breathing, one inhaling with an expanding abdomen, one exhaling with a contracting abdomen, plus the contrast between infected lungs (with viruses) and healed lungs (after miana treatment).

### Data Analysis

Descriptive and quantitative analyses were conducted on data from expert validation results, student responses, and tests. The validation criteria to assess feasibility are shown in Table 2. The students' responses were then evaluated against the criteria outlined in Table 3. This discussion will seek to establish the validity of the learning media in terms of material and media factors, and the product's practicality in students' responses.

**Table 2.** Product validity assessment criteria

Average Score Interval	Qualitative Criteria	Description
$3.00 < X \leq 4.00$	Very Good	No Revision Needed
$2.00 < X \leq 3.00$	Good	Partial Revision
$1.00 < X \leq 2.00$	Poor	Partial Revision
$0 < X \leq 1.00$	Very Poor	Total Revision

**Table 3.** Practicality level interpretation criteria

Percentage	Practicality Level
$75\% \leq P \leq 100\%$	High
$50\% \leq P < 75\%$	Medium
$25\% \leq P < 50\%$	Low
$0\% \leq P < 25\%$	Very Low

N-gain (Normalized gain) analysis was used to measure the improvement in students' conceptual understanding through the learning media. The pretest and posttest data were subsequently compared using the N-gain formula. The calculation of the N-gain is then transformed according to the criteria in Table 4.

**Table 4.** N-gain interpretation criteria

N-gain Range	Improvement Category
$G \geq 0.7$	High
$0.3 \leq G < 0.7$	Medium
$G < 0.3$	Low

Learning media are considered effective in enhancing conceptual knowledge when the N-gain value is moderate ( $e \geq 0.3$ ). In addition to the N-gain analysis, an effect size analysis was conducted to determine the magnitude of the learning media's impact on students' conceptual understanding. The effect size was determined using Cohen's *d*, which compares the difference between the mean pretest and posttest scores to the standard deviation of the pooled mean. This analysis complements the N-gain results by indicating not only whether an improvement has been made but also how significant it is.

In order to identify the degree of the impact of the learning media, the values of the effect sizes were interpreted based on Cohen (1988) classification as indicated in Table 5.

**Table 5.** Interpretation of effect size

d Value	Category
0.00 – 0.20	Small
0.21 – 0,50	Medium
0.51 – 1.00	Large
> 1.00	Very Large

## ■ RESULT AND DISCUSSION

This study developed and evaluated a Canva-based animated video that integrates Kaili ethnoscience to teach the human respiratory system, using the ADDIE instructional design model. The implementation of the ADDIE framework in this study consisted of five stages: analysis, design, development, implementation, and evaluation (Hakim et al., 2025).

### Analyze

The analysis stage focused on identifying students' needs and science learning conditions at MTs Nida'ul Khairaat Pombewe. Observation results showed that human respiratory system materials are still taught using simple media such as posters, which are inadequate for visualizing abstract concepts. Meanwhile, the use of animated media, such as videos, can improve students' understanding of science learning because they can represent concepts that are difficult to visualize conventionally (O'Day, 2007; Teplá et al., 2022). Recent meta-analyses also confirm that visualization strategies contribute significantly to the development of students' scientific conceptions in science learning (Suknarusaithagul, 2020). Based on a curriculum review and an examination of the learning modules used, respiratory system materials have not been integrated with the Kaili people's local wisdom values, making the learning context less relevant to students' environment. Meanwhile, research shows that ethnoscience integration can increase the relevance and meaning of science learning through connection with local wisdom (Sumarni, Sudarmin, Sumarti, & Kadarwati, 2022), and culture-based learning strengthens students' connection with science (Dentzau, 2019). Interviews with the school also reinforced the finding that available media remain limited and not contextual, so it is necessary to develop learning media in the form of Canva-based animated videos with content integrated with ethnoscience, making the materials easier to understand and more meaningful for students.

## Design

The design stage aimed to develop the product concept and facilitate researchers in carrying out the development (J. M. Sari et al., 2025). Design began with arranging learning materials according to Learning Outcomes and Learning Objectives for 8th-grade science. Human respiratory system materials were formulated into a video content framework that unites conceptual, visual, and contextual aspects. Media elements, such as text, illustrations, animations, and audio, were selected and combined based on material characteristics. The design was developed according to the principles of Multimedia Learning Theory, which include integrating the visual and auditory channels to enable more efficient information delivery (da Silva & de Oliveira, 2023). The design of the audio narration was derived from the materials gathered. The process of collecting ethno-science content was carried out through a literature review on the local wisdom of the Kaili people. The content of the material was designed to incorporate the local wisdom of Kaili, which involves the use of miana leaves, which have a positive effect on respiratory health (Dianto et al., 2015; Hapid et al., 2023; Muthmainnah et al., 2018). Such

knowledge was accompanied by scientific ideologies regarding the bioactive compound content in miana leaves and its link to the respiratory system. Such knowledge was accompanied by scientific ideologies regarding the bioactive compound content in miana leaves, linked to the health of the respiratory system. This design approach is consistent with previous studies that emphasize the importance of integrating local cultural knowledge with scientific explanations to create more contextual and meaningful science learning experiences (Dentzau, 2019; Sumarni et al., 2022). Other studies of the same type also claim that culturally contextualized instructional media can promote student engagement in science classrooms and help them understand concepts more deeply.

## Development

In the development phase, the principles of validity were considered, with assistance from expert validation conducted by material and media experts, a traditional intervention in the development of research in educational media (Cresswell, 2018; Sugiyono, 2018). Tables 6 and 7 present the results of material and media expert validation, respectively.

**Table 6.** Material expert validation results data

Indicators	Score	Average Score	Percentage	Criteria
Material alignment with CP and TP	16	4.0	100%	Very Good
Material accuracy	12	4.0	100%	Very Good
Presentation systematics	19	3.8	95%	Very Good
Ethnoscience integration	11	3.6	91.6%	Very Good
Average		3.85	96.7%	Very Good

The outcomes of material expert validation demonstrate the scientific soundness and curriculum alignment of the video content. The score in the area of curriculum alignment is high due to the detailed mapping undertaken during the design phase, in which each video fragment was created to explicitly address specific Learning

Outcomes and Learning Objectives for eighth grade. This is a deliberate attempt to turn the video into a legitimate teaching device and not an incidental feature. The scientific accuracy scores are high because the validation was done in great detail in the process of development in order to ensure that anatomical structures and

physiological processes were correctly represented, a significant factor because visual media tends to simplify complicated biological concepts and promote myths (Mayer, 2009).

The favorable critique of the organization of the material provided reveals that the video implements the main principles of research on multimedia learning. The material is logically arranged: I will begin by discussing fundamental ideas about respiration, then proceed to the mechanisms of breathing and the functions of various organs, and conclude with examples of respiratory illnesses and historical treatments. This development helps students build knowledge bit by bit without being overwhelmed. The clarity of transitions between parts and the stability of highlighting of key points assist learners in putting information in mental coherent frames, rather than being overwhelmed by information overload (Mayer, 2009).

The high level of validation of the integration of ethnoscience implies that traditional Kaili

knowledge was integrated and not just placed as an appendix. The video would find a way to relate ethnoscience and formal science as two different issues. However, it shows that Miana leaves deal with the same respiratory issues that contemporary medicine aims to reduce inflammation and clear airways. Students can connect abstract scientific concepts to other practices in their culture, making the content more engaging. The learners perceive and remember what they already know in their daily life when they identify any relationships between the newly introduced information and what they have previously known, as opposed to the situation when they are introduced to facts in a vacuum (Mayer, 2014). Following this principle, the material expert advised that the miana leaf decoction be colored red rather than yellow to better resemble the real one in Kaili culture, thereby strengthening the cultural application of the learning material and familiarity with it.



Figure 2. Before revision



Figure 3. After revision

Table 7. Media expert validation results data

Indicators	Score	Average Score	Percentage	Criteria
Video and language clarity	15	3.75	93.8%	Very Good
Narration and audio	25	3.57	89.2%	Very Good
Visual attractiveness	27	3.85	96.4%	Very Good
General feasibility	14	3.50	87.5%	Very Good
Average		3.66	91.7%	Very Good

The media expert’s validation confirms that the video has good technical quality and design efficiency across all evaluated dimensions.

Attractiveness, in visual terms, was the most highly evaluated aspect, indicating the effective implementation of multimedia design in the

development of an interactive learning process. The aesthetic coherence is evident in the combination of serviceable animations, the choice of color schemes that complement rather than distract from the content, and the organization of the layouts. Such visual appeal is not a mere ornamental study demonstrates that appealing media professionally created and designed encourages learners to be more motivated and eager to work with educational media (Clark & Mayer, 2016). Similar visual effects throughout the video, such as color-coding the organs of the respiratory system and using similar animation effects for related concepts, help students identify patterns and form mental associations among its parts.

The high score in the video and the clarity of the language indicate that the technical production quality can be improved to meet educational standards. The fact that the video can be read in black and white makes the anatomy visible even when the animation shifts to a microscopic view of the body, and the fact that the language used is friendly, balancing between scientific terms and simple explanations, makes the complicated physiological processes understandable to the students in the eighth grade. Such a dual language strategy, in this case, helps in reinforcing what (Mayer, 2009) refers to the personalization principle, wherein conversational language, rather than formal language, facilitates deeper cognitive processing.

The narration and audio were well assessed, yet some areas for improvement were identified. The voice narration effectively shows students the different parts of the work, and the pacing is appropriate, enabling learners to follow the visual information as it is explained. The match between what the students are watching and what they are hearing is based on the principle of temporal contiguity, which introduces matching visual and auditory information at the same time and not in sequence, which lessens the cognitive load

(Mayer, 2009). Background music was kept at an appropriate level that did not distract during narration, but rather did not violate the principle of coherence in multimedia learning, where extraneous sounds may distract from the main content.

The favorable results for material organization and media validation can be interpreted more deeply through the lens of the Cognitive Theory of Multimedia Learning (CTML). In addition to adhering to multimedia principles, the design of this animated video operationalizes several CTML mechanisms simultaneously. The chronological flow of ideas in the definitions of respiration to the breathing patterns and respiratory issues is logical and consistent with the principles of segmentation and coherence that aim to minimize the extraneous cognitive load and to avoid cognitive overload (Mayer, 2009). The video facilitates the use of limited working memory capacity and ensures that information is meaningfully incorporated into long-term memory by organizing it in a progressive manner.

More to the point, by incorporating Kaili ethnoscience, CTML becomes a culturally responsive field. The very fact that the example of miana leaf treatment is provided as a culturally recognizable example could serve as a cognitive scaffold by triggering the existence of the knowledge structure in the students. The video does not use scientific notions in a vacuum but instead links the formal biological explanation to the cultural practices people live by. This correlation enhances generative processing, enabling students to develop firmer mental images of respiratory mechanisms. Ethnoscience integration in this sense can help alleviate intrinsic cognitive load by providing a basis for abstract physiological concepts by linking them to tangible, culturally significant points of reference. Moreover, the use of color-coding, animation patterns, and synchronized narration

demonstrates the principles of signaling and temporal contiguity. The analogy between healthy and inflamed respiratory systems and outdated and updated treatment methods probably enriched students' capacity to categorize and contrast conceptual groups. Such systematic visual differences could explain why N-Gain scores were higher for indicators of analysis. Therefore, the research paper not only indicates the possibility of culturally integrated animated media but also explains that culturally contextualized multimedia can lead to greater cognitive efficiency, hypothesized by CTML.

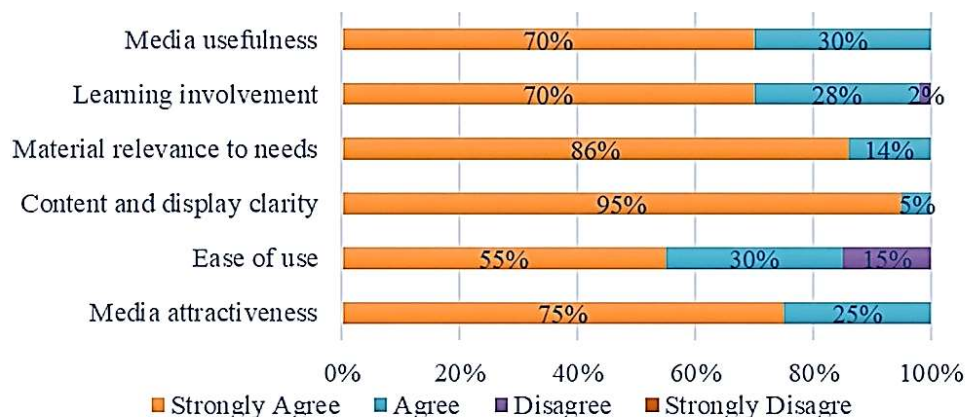
The overall viability analysis shows that the media can be used in practice in the classroom. This includes technical factors such as compatibility across file formats, the appropriate video length for a class session, and ease of use for teachers with varying degrees of technological expertise. The practical usability of the Canva platform, where no specialized software is needed, only a web browser, and the fact that the video is also downloadable, is useful as it can be used in various situations in schools, irrespective of the internet connectivity and the technology infrastructure in place.

**Implementation**

To validate this empirical viability in a real learning scenario, a pilot media trial was conducted in a small classroom (Kuo, Setiawan, Fernandez, Putra, & Derisman, 2024). During

this stage, the developed learning media were tested with a small group of 10 purposively selected students representing varying levels of learning ability. Students were shown the Canva-based animated video and then responded to the questions on the response questionnaire, which evaluated media attractiveness, ease of use, clarity, relevance of the material, engagement, and usefulness. Though no significant conceptual errors were detected during the limited trial, some minor improvements were made based on student responses and classroom observations. According to some students, some of the explanatory parts could be narrated more slowly and displayed for longer to better understand them. To this end, the researcher has adjusted the speed of slide transitions, made the use of audio in certain parts of the content more acceptable, and made the text easier to read by increasing the font size and enhancing the color contrast. These revisions, made during the formative stage, made the media teaching more intuitive and easier to use, so that the final product became more accessible and better aligned with students' learning requirements. The limited trial thus helped strengthen the practical quality of the developed Canva-based animated video before wider implementation. Figure 4 presents the data on student responses.

Figure 4 presents the students' reactions to the Canva-based animated video learning media across six dimensions. On the whole, the media



**Figure 4.** Students' responses to the canva-based animated video learning media

was rated very positively by students, most of whom strongly agreed with all measured aspects. Media attractiveness had the strongest positive rating, and most students strongly agreed that the animated videos were appealing and engaging. It means the Canva-based design effectively attracted students' interest and attention. Equally, content and display clarity received good scores, with almost all students indicating clarity in how information was delivered and that it was comprehensible, which implies that the incorporation of visual animations was effective for understanding concepts of the respiratory system.

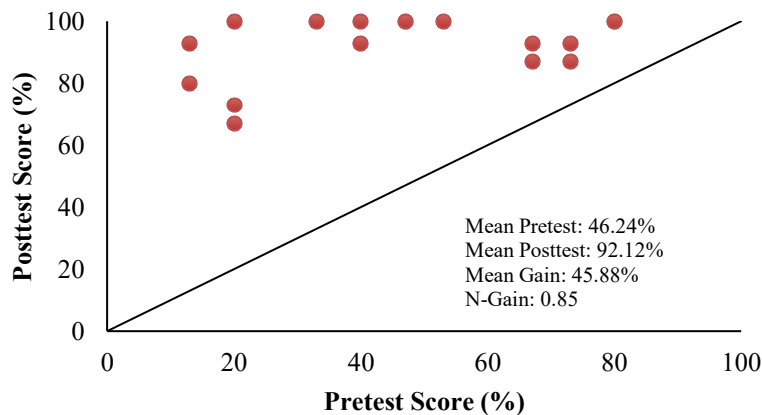
Relevance to material needs was also well received, with the majority of the students strongly agreeing that the material was relevant to their needs and reflected on their experiences. Such a high level of agreement indicates good assimilation of Kaili ethnoscientific knowledge and scientific ideas, making the material culturally relevant and personally significant to students. Both involvement in the learning and usefulness of the media got very positive scores, with a very large majority of the participants agreeing that the animated videos were effective in terms of encouraging active participation in the process of learning, and that they felt as valuable learning resources to learn about the respiratory system in the human body. The fact that there is minimal

disagreement across these dimensions reflects the media's effectiveness in keeping students interested and in underpinning learning process.

The most diverse responses were about ease of use, which, however, were mostly positive. Although most students found the media easy to explore and use, a significant number reported some difficulty. This implies that some students had minor difficulties with technical issues or navigation, and future versions could be enhanced to make access easier for all learners. Overall, student response data show that the Canva-based animated video learning media, accompanied by ethnoscience, received high ratings in all aspects. However, the most significant achievements were in the areas of attractiveness, clarity, and relevance, demonstrating the practicality and appeal of the animated video as an educational resource for eighth-grade science learning.

### Evaluation

The evaluation phase measured effectiveness using a one-group pretest-posttest design by comparing students' conceptual understanding before and after exposure to Canva-based animated videos. Figure 5 shows the results of the analysis of improvement in students' conceptual understanding based on the N-gain test.



**Figure 5.** Scatter plot of students' pretest and posttest scores

Figure 5 shows a scatter plot of pretest and posttest scores for all 17 students, and the straight line indicates no improvement. All the data points are way above this line, signifying generalized learning. The trend indicates that students with initial performance abilities ranging from 13% to 80% on the pretest converged toward high posttest scores (80%-100%). The cohort of students with lower pretest scores showed particularly large posttest gains, with some scoring a perfect or near-perfect posttest score even though they scored below 30% on the pretests. Such convergence demonstrates the media’s usefulness across ability levels and their ability to minimize the achievement gap, as evidenced by the close range of posttest scores, in contrast to the broad spread of pretest scores.

In addition to the quantitative results, qualitative data were drawn from the open-ended reflection section of the student response questionnaire. They were analyzed thematically to discuss how and why conceptual improvement occurred. There were three prevailing themes. To begin with, cultural relevance was influential, as many students noted that the combination of miana leaves and Kaili traditional practices made the lesson more relatable and easier to comprehend. This familiarity seemed to ease the conceptual bridging between the students’

previous cultural background and the formal biological explanations. Second, abstract respiratory processes, in particular airflow processes and organ functions, were understood through visual clarity and animation, suggesting that the multimedia elements stimulated cognitive processing. Third, some technical issues were also noted, such as the need to slow down the narration or make the audio more understandable in certain parts. In general, these qualitative data can be used to describe the noted conceptual benefits by emphasizing the functions of cultural contextualization, the representation of the visual image, and students’ participation in the implementation process.

Results of the N-gain test indicated a significant improvement in conceptual understanding, with an average N-gain of 0.8515 (85.15 percent). The N-gain value, according to the criteria (Hake, 1998), is classified as high ( $g > 0.7$ ), which implies that Canva-based animated videos that use an ethnoscience approach are effective for students’ conceptual learning. The lowest N-gain was 0.52 (51.85%), with a maximum of 1.00 (100%). The standard deviation of 0.17348 indicates that the differences in improvement among the students were relatively small and that the learning media were effective for most research participants.

**Table 8.** N-Gain of students’ conceptual understanding indicators

Indicators	Pretest (%)	Posttest (%)	N-Gain	Category
Explaining	44.12	97.06	0.947	High
Interpreting	52.94	85.29	0.688	Medium
Inferring	52.94	92.16	0.833	High
Exemplifying	50.98	94.12	0.880	High
Summarizing	35.92	85.29	0.773	High
Classifying	47.06	100.00	1.000	High
Comparing	29.41	94.12	0.917	High
Overall Average	46.24	92.12	0.852	High

Table 8 indicates learning gains across seven indicators of conceptual understanding, with differences in media effectiveness across

cognitive skills. The highest gains were observed in Classifying (N-gain=1.000), showing a perfect increase from 47.06% to 100%, followed by

Explaining (N-gain=0.947), improving from 44.12% to 97.06%, and Comparing (N-gain=0.917), rising from 29.41% to 94.12%. The exceptional gain in Classifying can be attributed to animation segments that clearly distinguished healthy respiratory mechanisms from those in infected conditions. Explanations in the video were organized into separate cases, separating normal airflow processes from inflammatory interruptions to help students recognize the distinguishing features of each condition. Also, the traditional Kaili therapies using miana leaves were introduced as an independent therapeutic measure before being compared with contemporary pharmacological treatment, thereby justifying their conceptual grouping.

The high enhancement in Comparing seems to be due to scenes that contrasted healthy and infected respiratory processes within the same explanatory series. Changes in the normal exchange of oxygen and the restricted exchange of air in the inflamed bronchi were contrasted through the animation, hence, explicitly represented. Similarly, the display of traditional Kaili remedies, as well as the contemporary medical applications, taught the students to see similarities and differences between the two modes. The high gain could be attributed to the step-by-step animated depiction of airflow pathways and organ functions, which helped students express causal sequences more coherently. Inferring (N-gain=0.833), Summarizing (N-gain=0.773), and Exemplifying (N-gain=0.880) also showed a considerable improvement. The use of culturally relevant examples, visual cause-and-effect of the respiratory disorders, and recap segments summarizing the main ideas at the end of the video were probably what the gains were founded on. Interpreting (N-gain=0.688) had the lowest gain but is in the medium-high category. This relatively poor result can indicate that interpreting diagrams or visual representations requires more explicit

practice in deriving meaning from graphical and anatomical presentations, rather than through explanatory animation alone.

These differences notwithstanding, all seven indicators showed considerable positive changes, and the total average N-gain of 0.852 was listed in the high category. The consistency of outcomes across different cognitive skills testifies to the media's overall performance in mediating various elements of conceptual knowledge. The relatively high standard deviation of the total N-gain scores (0.17348) suggests that, initially, the media were used in a manner that made the scores appear real and reliable, implying that they are easily accessible and effective for different learners.

To estimate the size of the intervention effect, the pooled standard deviation method was used to calculate Cohen's *d*. The analysis gave a  $d=2.49$ , which is significantly greater than the value of a large effect ( $d = 0.8$ ) of (Cohen, 1988). This effect size is extremely large, indicating significant growth in students' conceptual understanding after the introduction of the ethnoscience-based Canva animated video. Nevertheless, since the study involved a one-group pre-test post-test design with no control group, the effect size should be interpreted as the within-group change, not necessarily as evidence of instructional superiority. The design is susceptible to compromises in internal validity, such as testing effects, maturation, and historical effects. Thus, despite significant learning achievements in the findings, one should be careful when making causal conclusions.

The large effect size can be pedagogically explained by reference to the instructional design characteristics of the developed media. Existing literature suggests that focused on either the use of technology in science education (El Hammoumi et al., 2022; Putri et al., 2024; Teplá et al., 2022) or the integration of ethnoscience in the learning process (Ali et al., 2025; Fadilah et al., 2019) one at a time, but rarely both. On the

contrary, the new research incorporates the culturally based ethnoscience material into an animated multimedia design, thus forming a dual-layered teaching plan. An example of a culturally familiar item, such as miana leaves, was used as an accessible introduction to the presentation of microscopic physiological processes. Those students who had previously had informal knowledge of traditional remedies could relate the cultural practices they observed to biological processes they could not. Using animation, the interactions between plant compounds and respiratory tissues were visualized at the cellular level, reducing the cognitive distance between macroscopic experiences and microscopic scientific explanations. This strategy probably reduced irrelevant cognitive processing and enhanced the significance of meaningful conceptual assimilation.

Still, several limitations need to be admitted. The lack of a comparison group prevents estimation of the specific contribution of the ethnoscience-integrated animated video relative to other instructional methods. Also, the sample size ( $n=17$ ) is small, and the study was conducted in a single school, which limits the generalizability of the results. The reported effect size reflects an overall pretest-posttest change within a single group and cannot be used to infer causal superiority. Future studies should adopt quasi-experimental or randomised controlled research, a larger and more diverse sample, and longitudinal follow-up measurements to determine the strength and the long-term viability of such results. Further ethnoscientific research on the comparative use of animated instruction, with and without ethnocentric integration, would illuminate the specific contribution of cultural contextualization. In addition, future research can include measures of affective outcomes, such as cultural appreciation or identity formation, as well as cognitive gains.

Altogether, the present research has provided initial evidence suggesting that the

combination of culturally based content and the availability of digital animation tools like Canva could be important for creating meaningful and engaging learning experiences in science. The results are relevant to the current discussion on culturally responsive science education and advance the hypothesis that culturally contextualized multimedia environments expand the explanatory power of the Cognitive Theory of Multimedia Learning, especially in the classroom, where local traditions strongly influence students' prior knowledge. Although the current findings are still subject to further empirical validation, they show potential promise in using ethnoscience and multimedia design in Indonesian science education settings.

## ■ CONCLUSION

The current research created a Canva animation video that incorporates Kaili's ethnoscience and teaches students about the human respiratory system as the eighth-grade activity, following the ADDIE framework. The developed media had high validity, with material expert validation scores of 3.85 (96.7%) and media expert validation scores of 3.66 (91.7%), both rated Very Good. The responses of the students were immensely favorable on all the dimensions: attractiveness, clarity, relevance, engagement, and usefulness, proving the high practical acceptance of the media in the classroom. The testing of effectiveness showed a significant improvement in the conceptual understanding of the students with an average N-gain of 0.85 (high category) and a very large effect size (Cohen's  $d=2.49$ ), with improvements being found in all seven indicators of conceptual understanding, with the most improvement happening in classifying, explaining, and comparing. The results of these studies indicate that the systematic incorporation of culturally useful ethnoscience content and the availability of digital animation tools can significantly facilitate science learning by relating abstract physiological

understanding to students' cultural experiences. Nonetheless, due to the one-group pretest-posttest study design, the lack of a control group, and a small sample size (n=17) in one school, the findings cannot be perceived as conclusive. It is highly recommended to use semi-experimental or experimental studies with larger, more heterogeneous samples in future research to establish the strengths of the present results and/or to more precisely determine the specific role of ethnoscience-based animated media in students' conceptual learning outcomes.

#### ■ **DECLARATION OF GENERATIVE AI USAGA IN THE WRITING PROCESS**

In preparing this manuscript, the author(s) used Grammarly to help them refine their language, correct grammar, and improve sentence structure in the English version of the text. The content produced by this tool is reviewed and edited by the author(s), and the author(s) are fully responsible for the contents of the published article.

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