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Exploratory Factor Analysis of Students' Responses to a Glocal Wisdom-Based Physics Application on Rigid Body Equilibrium

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ABSTRACT

Objective: *This study aims to develop and evaluate the effectiveness of the Dhysning (Dynamic Hybrid System for Integrating Glocal Wisdom) application, which integrates the local wisdom of the Boranan Lamongan Dance into physics learning, specifically on the topic of rigid body equilibrium.* ***Method:*** *The development of the Dhysning application followed the ADDIE model (Analysis, Design, and Development). The application was designed using Adobe Flash CS6 and included teaching modules, interactive multimedia, student worksheets, virtual laboratory simulations, and quizzes. The research was conducted through a limited trial involving three classes and three physics teachers at senior high school. Data were collected through response questionnaires and analyzed using descriptive statistics and Exploratory Factor Analysis (EFA) to examine the construct validity and reliability of student responses.* ***Results:*** *The results show that the application effectively supports science learning with strong student engagement. The Kaiser-Meyer-Olkin (KMO) measure of 0.638 and Bartlett's test of significance ($p < 0.001$) confirmed the suitability of the data for factor analysis. Eight factors were extracted, explaining 78.63% of the total variance, with an overall Cronbach's Alpha of 0.884, indicating high internal consistency. Students showed positive responses toward the contextual content, visual interactivity, and cultural relevance of the learning media.* ***Novelty:*** *This study introduces a glocalized science learning approach by incorporating regional cultural elements into physics education through interactive technology. It bridges local cultural identity with global scientific competencies, fostering deeper student engagement and scientific literacy in a unique and meaningful way.*

INTRODUCTION

Education is one of the primary pillars for developing high-quality human resources (Santoso & Kusuma, 2022). In the current era of globalization, education is not only aimed at transferring knowledge but also at developing the character of students who can adapt to the challenges of the times. In this context, a learning approach that is creative, innovative, and relevant to students' needs is necessary. One approach is the application of scientific literacy (Deta et al., 2024). Scientific literacy is a crucial skill for students in the learning process. It encompasses understanding of scientific concepts, critical thinking skills, and the ability to apply science in everyday life (Wulandari & Hadi, 2020; Deta et al., 2023; Alhusni et al., 2024). A firm grasp of scientific literacy enables students to interpret scientific information objectively and make evidence based decisions (Astutik & Prahani, 2018; Wayudi et al., 2020). These competencies are essential for addressing increasingly complex global challenges, particularly those that require science informed decision making.

Despite its importance, scientific literacy in Indonesia still encounters various obstacles. According to the Programme for International Student Assessment (PISA) 2022, Indonesia's reading literacy score was only 359 points, a decline compared to 2018 (OECD, 2022). Several factors contribute to this low performance, including the dominance of test-oriented curricula, a lack of interactivity in science learning, and limited access to high-quality science teaching resources (Pratama & Rahman, 2021; Sukowati & Rusilowati, 2023; Sunni & Sunarti, 2023; Yusmar & Fadilah, 2023). The abstract nature of science, especially physics, also hinders students' understanding. This highlights the need for more concrete and contextualized learning approaches, such as the Multiple Intelligences theory proposed by Gardner (Wulandari & Hadi, 2020; Irianti et al., 2023).

Multiple Intelligences theory emphasizes that individuals possess a range of intelligence, including linguistic, logical-mathematical, kinesthetic, musical, interpersonal, intrapersonal, naturalist, and spatial intelligence (Romli & Ixfina, 2023). These intelligences can be optimized through diverse and contextualized learning strategies that engage students' full potential (Yulianti, 2017). One effective method to implement this theory is by integrating local wisdom into learning process, such as the Boranan Dance from Lamongan Regency. This traditional dance embodies cultural values such as perseverance, togetherness, and diligence. By incorporating elements of the Boranan Dance into science learning, students not only better understand the subject matter but also strengthen their connection to cultural identity. Such a contextual approach fosters greater interest and promotes more meaningful learning experiences, particularly in developing scientific literacy.

The use of digital-based learning media plays a vital role in supporting teaching and learning in the modern era (Wayudi et al., 2020; Prahani et al., 2022; Sunarti, 2024). Digital platforms enable material delivery to be more interactive, engaging, and accessible at any time and from anywhere (Hidyanto et al., 2016). Technology also enables students to learn independently and flexibly while empowering teachers to present materials through diverse media formats, such as animations, videos, and simulations (Wardani & Suniasih, 2022). Digital learning environments foster creativity and critical thinking, equipping students to tackle challenges in an increasingly connected digital society.

To support this paradigm, an application called Dhysning (Dynamic Hybrid System for Integrating Glocal Wisdom) was developed. The Dhysning application is designed to integrate the local wisdom of the Boranan Lamongan Dance into physics instruction, specifically the topic of rigid body equilibrium. It presents an interactive, visual, and culturally contextualized learning experience. This study aims to evaluate students' responses to the Dhysning application, which integrates the local wisdom of the Boranan Lamongan Dance into digital physics learning on the topic of rigid body equilibrium, as a means to enhance scientific literacy through a culturally contextualized and interactive learning experience. To achieve this, Exploratory Factor Analysis (EFA) was employed to examine the construct validity and reliability of the student response instrument.

RESEARCH METHOD

Scientific literacy plays a crucial role in preparing students to address global challenges through contextualized science learning. In Indonesia, the integration of local wisdom in digital-based learning has become an innovative strategy to enhance scientific literacy (Deta et al., 2023). The Dhysning application was developed to address this educational need by embedding the Boranan Lamongan Dance, a form of local cultural heritage, into physics instruction, particularly on the topic of rigid body equilibrium. Given the nature of the research, which aimed to explore students' perceptions and responses toward the application, a descriptive quantitative approach was considered the most appropriate to describe observable trends and evaluate the effectiveness of the learning media quantitatively (Sugiyono, 2019).

This study employed a descriptive quantitative method supported by a development framework based on the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which is commonly used in instructional design (Cahyadi, 2019). While the ADDIE model guided the systematic development of the Dhysning application, the core research focus was on collecting and analyzing students' responses to the application. The results were used to evaluate its potential to enhance scientific literacy in a culturally relevant context.

The research was conducted at a senior high school. It involved a limited trial with three physics teachers and three classes of eleventh-grade students who used the Dhysning application in their physics learning. Participants were selected through purposive sampling, targeting classes that had covered the topic of rigid body equilibrium in the curriculum (Fraenkel et al., 2012). The study employed a student response questionnaire as the primary data collection instrument, designed to assess the engagement, understanding, interactivity, and cultural relevance of the application. The questionnaire items were constructed based on indicators adapted from the PISA 2022 scientific literacy framework (OECD, 2022). Students accessed the application through a shared link, and their responses were collected using Google Forms. Before its use, the instrument underwent validation by subject matter experts to ensure content validity. Brief interviews with physics teachers complemented data collection to gain an understanding of the classroom context and media needs.

The collected quantitative data were first analyzed using descriptive statistics to determine the percentage of positive, neutral, and negative responses. To further explore the construct validity of the questionnaire and group the items into meaningful dimensions, the data were subjected to Exploratory Factor Analysis (EFA). This included:

- Principal Component Analysis (PCA) as the extraction method.
- Varimax rotation is used to improve the interpretability of the factor structure.
- Kaiser-Meyer-Olkin (KMO) test to measure sampling adequacy (KMO ≥ 0.6).
- Bartlett's Test of Sphericity to test the suitability of data for factor analysis ($p < 0.05$).
- Retention of factors with eigenvalues ≥ 1.0.
- Interpretation of factor loadings ≥ 0.4 as significant.

The internal consistency of each factor and the overall instrument was assessed using Cronbach's Alpha, with values ≥ 0.7 considered acceptable and ≥ 0.8 deemed high (Taber, 2018).

This methodological framework provides both the development and validation process necessary for scientific rigor and replicability, allowing future researchers to adapt or extend the findings in broader educational contexts. The use of a descriptive quantitative approach ensures that student responses are systematically quantified, interpreted, and linked back to the research objectives. The research flow diagram as shown in Figure 1.

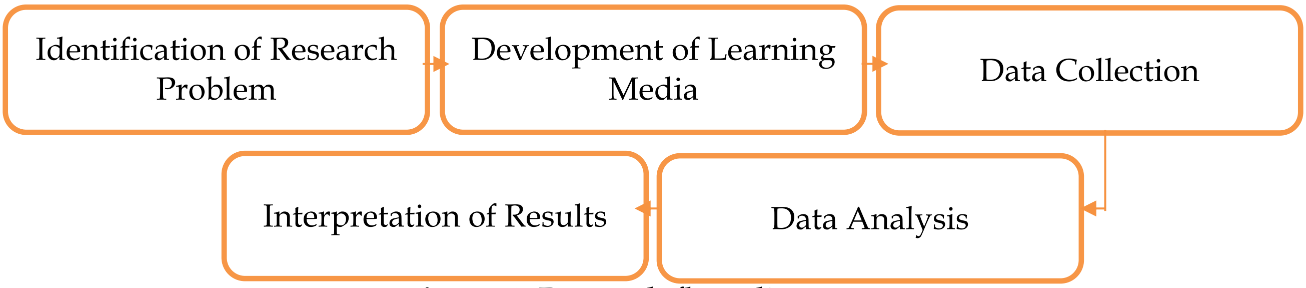

Figure 1. Research flow diagram

RESULTS AND DISCUSSION

Results

Analysis of Research Problem

Preliminary observations and interviews with physics teachers at senior high school revealed that students often experience low motivation in learning physics, perceiving it as abstract and complex. The current learning approach remains conventional, lacking integration of real-life phenomena or local cultural contexts. Although some examples of natural phenomena are occasionally mentioned, digital learning media that holistically incorporate local wisdom, such as the Boranan Lamongan Dance, are not yet utilized in physics instruction. This gap is concerning, given the growing importance of digital literacy and culturally contextualized science learning in the 21st century (Wardani & Suniasih, 2022). Research has shown that embedding local wisdom in science learning can enhance student engagement, convey moral values, and improve scientific literacy through the contextual relevance of the material (Satriawan et al., 2016; Deta et al., 2023). Therefore, the absence of such media highlights the urgent need to develop learning tools that integrate local cultural elements to support students' scientific literacy development.

Design of Learning Media

The initial design of the Dhysning application was developed to integrate the concept of rigid body equilibrium with the local wisdom of the Boranan Lamongan Dance, aiming to contextualize physics learning and train students' scientific literacy. The application includes teaching modules, student worksheets, and assessment instruments aligned with the independent curriculum, emphasizing observable and applicable learning objectives. The content design was guided by indicators from the PISA 2022 scientific literacy framework, such as evaluating scientific phenomena, interpreting data, and making evidence-based decisions (OECD, 2022). The application employs a multimodal approach linguistic, visual, and kinesthetic by presenting interactive material supplemented with cultural narratives and straightforward explanations, enabling students to grasp abstract physics concepts through local relevance and digital engagement (Deta et al., 2023). Supporting instruments such as validation sheets and observation forms were also prepared to ensure feasibility and implementation quality during classroom trials.

Development of Learning Media

The Dhysning application was developed as a culturally contextualized digital learning tool that integrates the physics concept of rigid body equilibrium with the local wisdom of the Boranan Lamongan Dance, aiming to enhance students' scientific literacy. Built using Adobe Flash CS6, the application combines interactive elements such as animations, simulations, and multimedia content to deliver material in an engaging and accessible format (Estianino et al., 2017). Its design emphasizes relevance to students' real-life and cultural environments, thereby increasing motivation and comprehension through familiar contexts. Beyond facilitating conceptual understanding, the Dhysning application serves as a medium for preserving local heritage while promoting 21st-century science competencies (Deta et al., 2023). This integration supports a more meaningful, interactive, and identity-based learning experience for high school students.

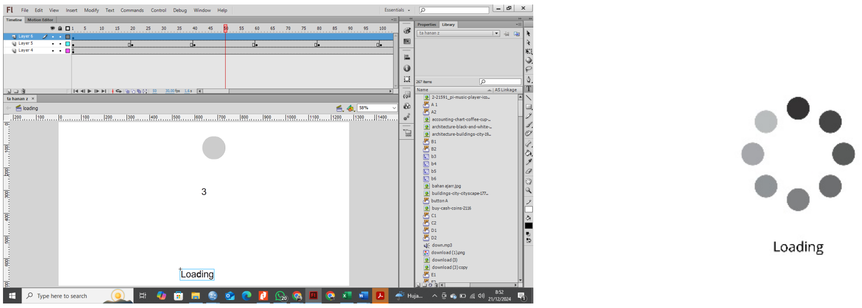

Figure 2. Loading section

The loading as shown in Figure 2 and intro sections as shown in Figure 3 of the Dhysning app are designed to provide an engaging and informative initial experience for users. When the app starts, the screen displays an interactive animation

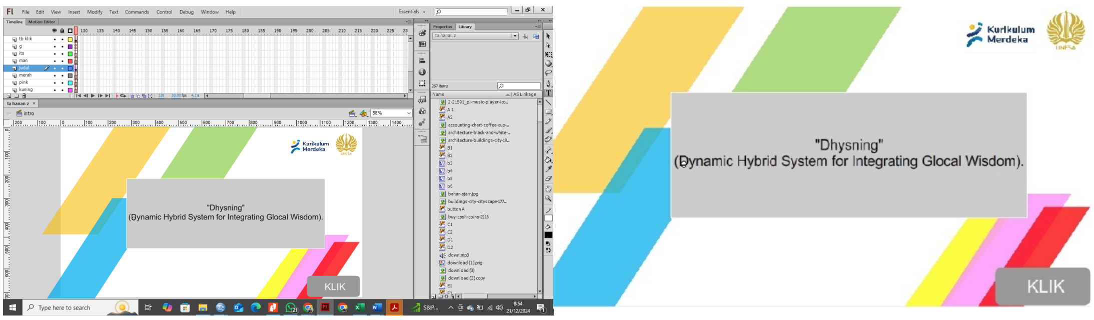

Figure 3. Intro section

The Dhysning application is an innovative learning application that integrates the local wisdom of the Boranan Lamongan Dance as a Multiple Intelligences approach to train high school students' scientific literacy in the Rigid Object Equilibrium material. The menu section screen of this application is shown in Figure 4.

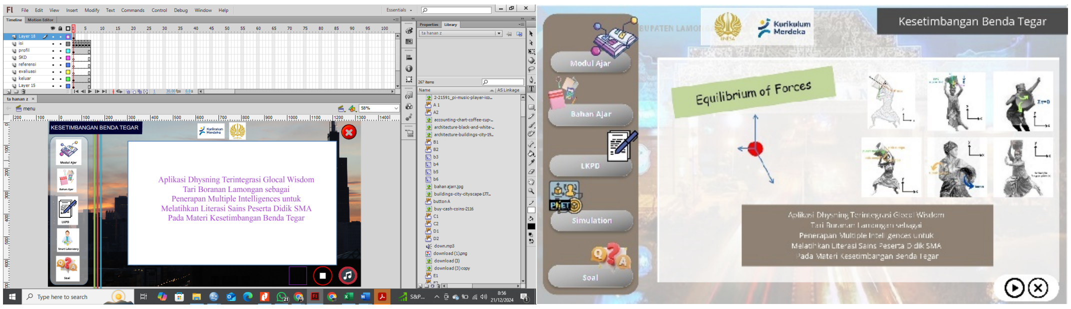

Figure 4. Main menu section

This application is equipped with:

1) Curriculum Tools (Teaching Modules): Teaching modules are designed according to the curriculum, supporting understanding of the material with activities based on multiple intelligences. The module interface is shown in Figure 5.

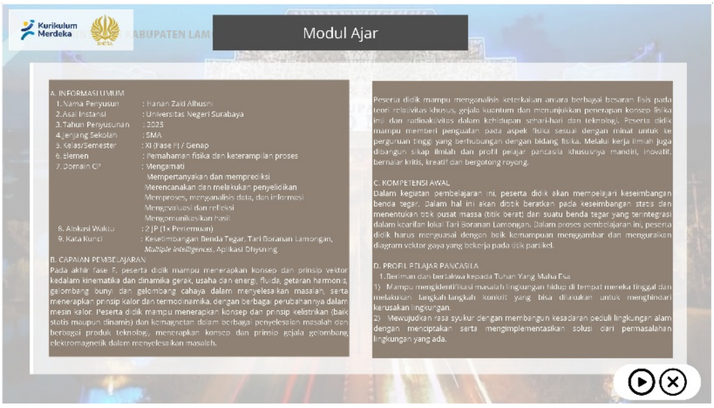

Figure 5. Teaching module view

2) Teaching Materials: There are three types of teaching materials to accommodate verbal (explanatory text), visual (pictures and animations), and kinesthetic (direct practical activities) intelligence. The Teaching materials display is shown in Figure 6.

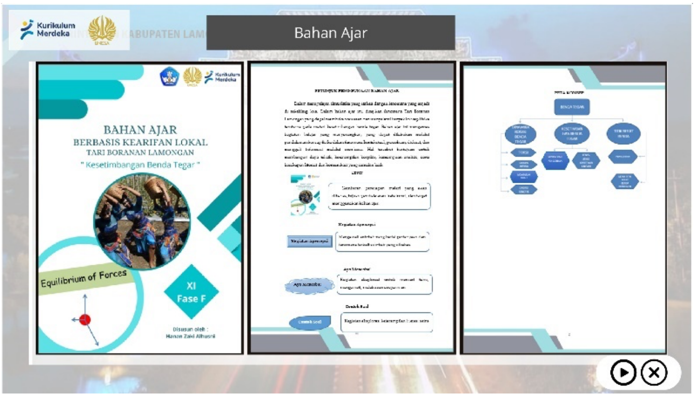

Figure 6. Teaching materials display

3) Worksheet: Student worksheets designed to train science literacy skills and apply material concepts with a practical and interesting approach. The Worksheets consist of three parts namely kinesthetic worksheet as shown in Figure 7, linguistic worksheet display as shown in Figure 8, and visual worksheet in Figure 9.

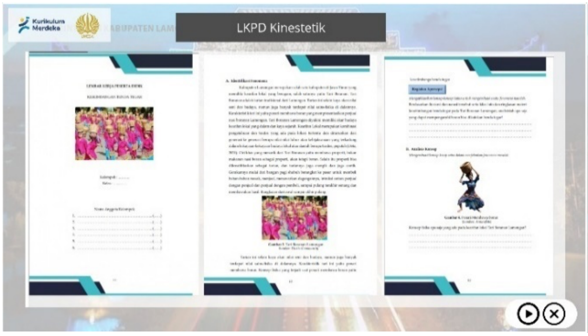

Figure 7. Kinesthetic worksheet display

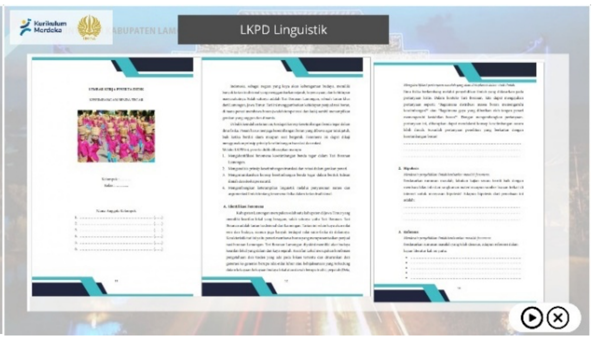

Figure 8. Linguistic worksheet display

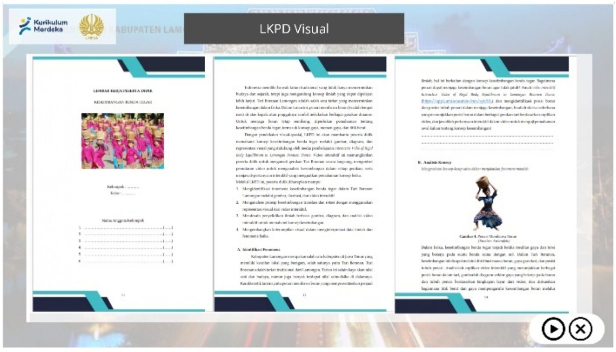

Figure 9. Visual worksheet display

4) Smart Laboratory: An interactive virtual laboratory feature, enabling realistic simulation of rigid body equilibrium materials.
5) Sample Questions, Practice Questions, and Quizzes: Designed to help students hone their understanding of concepts through graded questions, regular practice, and interesting and challenging quizzes. The question display as shown in Figure 10.

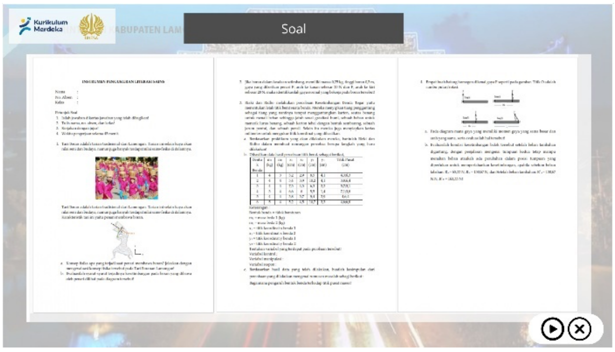

Figure 10. Question display

With these features, the Dhysning application is able to improve students' scientific literacy through a creative, relevant, and multiple intelligence-based approach.

Response Questionnaire Results

In this study, the data obtained from the questionnaire were also analyzed using Exploratory Factor Analysis (EFA) to explore and identify the underlying factor structure of the questionnaire items. EFA aims to determine the extent to which the items can be grouped into factors that have conceptual similarities or high correlations. This analysis was carried out using the Principal Component Analysis (PCA) extraction method and Varimax rotation to facilitate the interpretation of the results. Before the analysis was carried out, a sample adequacy test was carried out using the Kaiser-Meyer-Olkin (KMO), the results of which must meet a minimum value of 0.6 and Bartlett's Test of Sphericity, which must be significant ($p < 0.05$) to ensure the data is suitable for use in factor analysis. The results of the EFA provide information on the dominant factors formed, valid items in each factor, and the proportion of total variance that these factors can explain. By using EFA, the questionnaire used in this study can be validated for its factor structure and reliability, thus ensuring that the instrument has good quality to measure research variables accurately and relevantly.

Table 1. KMO dan Bartlest's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.638
Bartlett's Test of Sphericity	Approx. Chi-Square	589.700
	df	300
	Sig.	.000

The results of the KMO and Bartlett's Test as shown in Table 1 is indicate that factor analysis can be performed on the data used. The Kaiser-Meyer-Olkin (KMO) value of 0.638 indicates that the level of sample adequacy is sufficient because the value has met the minimum limit of 0.6. This means that the variables in the data have sufficient correlation to be analyzed using factor analysis. In addition, the results of Bartlett's Test of Sphericity show a Chi-Square value of 589.700 with 300 degrees of freedom (df) and a significance level (Sig.) of 0.000. A significance value smaller than 0.05 indicates that the correlation matrix between variables differs from the identity matrix, so the data are suitable for factor analysis. Overall, these two indicators suggest that the data meet the requirements to proceed with further factor analysis.

Table 2. Total Varian

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.993	31.970	31.970	7.993	31.970	31.970	4.015	16.061	16.061
2	2.942	11.767	43.737	2.942	11.767	43.737	2.392	9.570	25.631
3	2.094	8.375	52.112	2.094	8.375	52.112	2.341	9.365	34.995
4	1.687	6.747	58.860	1.687	6.747	58.860	2.318	9.271	44.266
5	1.432	5.727	64.586	1.432	5.727	64.586	2.289	9.155	53.421
6	1.340	5.361	69.947	1.340	5.361	69.947	2.125	8.499	61.920
7	1.138	4.553	74.500	1.138	4.553	74.500	2.124	8.496	70.416
8	1.033	4.134	78.634	1.033	4.134	78.634	2.054	8.218	78.634
…	…	…							

Extraction Method: Principal Component Analysis.

The results of the total variance explained analysis as shown in Table 2 is indicate that the instrument or questionnaire analyzed can explain 78.634% of the total variance, which suggests that the data has excellent quality, as it exceeds the ideal limit of at least 60%. This value indicates that the eight main components extracted through the Principal Component Analysis (PCA) method can explain most of the information in the data. After rotation, the proportion of each component's contribution becomes more even, with the first component explaining 16.061% of the variance and the last component (8th) contributing 8.218% of the variance. This indicates that the instrument has a fairly complex structure, yet it remains capable of representing data efficiently and reliably in eight main factors.

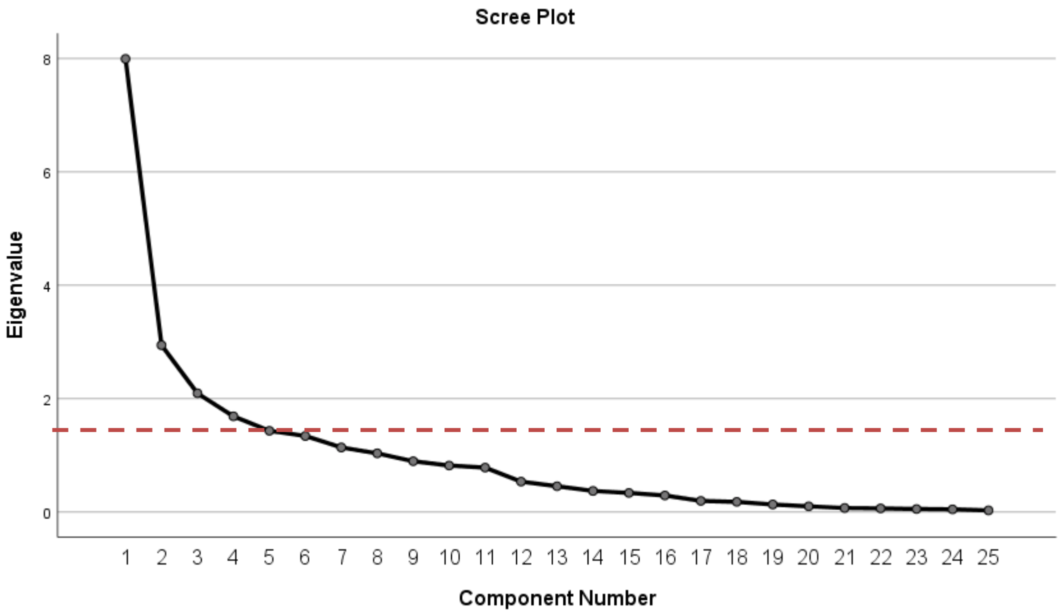

Figure 11. Scree Plot

The graph as shown Figure 11 is a scree plot showing the eigenvalue for each component in factor analysis. From this graph, it can be seen that the first component has the highest eigenvalue, which is around 8, and its contribution value decreases sharply until the second component. After that, the decrease in eigenvalue value begins to slope in the third component and continues in this manner. The "elbow" point, or the most obvious curve, is observed after the 8th component, indicating that the eight main components are sufficient to explain most of the variance in the data. The following components have smaller eigenvalues (below 1), so their contribution to explaining the variance is considered less significant. Thus, these results support the use of eight main factors in the model resulting from factor analysis.

Table 3. Rotation of Factor Components

Rotated Component Matrix[a]								
	Component							
	1	2	3	4	5	6	7	8
c5	.828							
a5	.813							
d5	.800							

c3	.697							
b4	.552				.474			
d1	.493			.447				
e1		.818						
e3		.773						
b1		.595				.497		
c2	.437		.735					
b2			.729					
d4			.578			.515		
b3				.828				
a3				.656	.419			
d3	.464			.590				
a4					.752			
d2			.466		.707			
a1					.581		.559	
c4						.814		
a2						.556	.425	
c1							.777	
b5							.562	
e5								.808
e2								.708
e4								.683

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 20 iterations.

The Rotated Component Matrix in Table 3 displays the results of factor rotation in principal component analysis, performed using the Varimax method with Kaiser normalization. This table displays the loading factor of each variable against the eight components formed. Only loadings with significant values (generally above 0.4) are considered for interpretation. From the table, the variables that have a dominant contribution to each component can be identified as follows:

a. Component 1: Variables c5, a5, d5, c3, b4, and d1 have high loadings on this component, with the highest value on variable c5 (0.828). This indicates that the first component groups these variables based on their similar characteristics.
b. Component 2: The dominant variables on the second component are e1 (0.818), e3 (0.773), and b1 (0.595). These variables form a new dimension or group that is different from the other components.
c. Component 3: Variables c2 (0.735), b2 (0.729), and d4 (0.578) show a strong relationship with the third component, which may represent other specific factors.
d. Component 4: Variables b3 (0.828), a3 (0.656), and d3 (0.590) have the highest loadings on the fourth component, indicating a separate group.
e. Component 5: Variables a4 (0.752) and d2 (0.707) are dominant in this component, reflecting different dimensions from the previous components.

f. Component 6: The dominant variables are c4 (0.814) and a1 (0.581), which form the sixth factor.
g. Component 7: The variables with the highest loadings are c1 (0.777) and b5 (0.562), which are grouped in the seventh component.
h. Component 8: Variables e5 (0.808), e2 (0.708), and e4 (0.683) contribute significantly to the eighth component.

Overall, this rotation helped to group the variables into eight components that had strong internal relationships, facilitating the interpretation of the dimensions contained in the data. The rotation reached convergence after 20 iterations, indicating the stability of the rotation process.

Table 4. Reliability of factors

Factor	Cronbach's Alpha	N of Items
Overall reliability	.884	25
Reliability factor 1	.872	6
Reliability factor 2	.730	3
Reliability factor 3	.720	3
Reliability factor 4	.763	3
Reliability factor 5	.688	3
Reliability factor 6	.767	2
Reliability factor 7	.550	2
Reliability factor 8	.634	3

The results of the Reliability Statistics analysis show the Cronbach's Alpha value for the entire instrument and each factor. Cronbach's Alpha measures the internal consistency of the items in the instrument, where values above 0.7 are generally considered reliable, while values between 0.6-0.7 are still acceptable in some research contexts.

a. Overall Reliability: The Cronbach's Alpha value for the entire instrument (25 items) is 0.884, indicating that the instrument has a very good level of internal consistency overall.
b. Factor 1: Has 6 items with a Cronbach's Alpha of 0.872, indicating a very good level of reliability. This indicates that the items in this factor have high internal consistency.
c. Factor 2: Has 3 items with a Cronbach's Alpha value of 0.730, which meets the minimum reliability limit and indicates that the items in this factor have adequate consistency.
d. Factor 3: Has 3 items with a Cronbach's Alpha of 0.720, which is also in the reliable category with a fairly good level of internal consistency.
e. Factor 4: Has 3 items with a Cronbach's Alpha of 0.763, indicating good internal consistency for this factor.
f. Factor 5: Has 3 items with Cronbach's Alpha of 0.688, which is below the ideal value of 0.7 but is still acceptable for exploratory research.
g. Factor 6: Consists of 2 items with Cronbach's Alpha of 0.767, indicating a good level of internal consistency despite the small number of items.

h. Factor 7: Has 2 items with Cronbach's Alpha of 0.550, indicating a low level of reliability. This may indicate that the items in this factor have weak internal consistency and may require further review.
i. Factor 8: Has 3 items with Cronbach's Alpha of 0.634, indicating a level of reliability that is still acceptable although not ideal.

Overall, most factors showed good to excellent reliability, except for Factor 7, which had a Cronbach's Alpha value below 0.6. This suggests that the factor requires further analysis to ensure the validity and consistency of its items.

The results of the analysis of student responses to various components in the Dhysning application showed positive responses. In the Curriculum Devices (Teaching Module) section, students felt helped in understanding the Rigid Object Equilibrium material because it was presented in a structured and contextual manner. For Teaching Materials, the response showed that interactive visual illustrations and narratives helped them understand physics concepts more easily. LKPD (Student Worksheets) were considered adequate in actively involving students in learning, with challenging activities but still relevant to local culture. The Smart Laboratory feature received a positive response because it allows students to conduct virtual experiment simulations, enabling them to understand the concept of equilibrium through an interactive and in-depth approach. The sample questions and practice questions provided in the application were also appreciated because they helped improve understanding of the concepts. Overall, students felt that the Dhysning application succeeded in creating an engaging, interactive, and meaningful learning experience while increasing their appreciation of local culture.

Based on the results of the limited trial response questionnaire, it is recommended that the development of the Dhysning application focus more on adding specific features (rather than links) to support in-depth learning. For example, an interactive module should be added to facilitate virtual group discussions, allowing students to discuss the results of their simulations or assignments. Additionally, the enrichment of higher-order thinking Skills (HOTS)-based questions in exercises and quizzes needs to be improved to encourage higher levels of critical thinking. Development can also include the integration of more in-depth Boranan Dance movement video tutorials so that students not only understand the theory but also get a richer visual and kinesthetic experience. For teaching materials, it is recommended to enhance the quality of multimedia content, such as 3D animations that accurately depict physics concepts dynamically and realistically. Additionally, it is necessary to consider adding an automatic learning outcome reporting feature that teachers can access to monitor student progress more effectively. With these various developments, the Dhysning application is expected to provide greater benefits and support technology-based learning to its maximum potential.

Discussion

The findings of this study demonstrate that the Dhysning application, an educational tool that integrates the concept of rigid body equilibrium with the local wisdom of the Boranan Lamongan Dance, has the potential to enhance students' scientific literacy significantly. This is evident from both the qualitative responses and the quantitative data analysis, which utilized Exploratory Factor Analysis (EFA) and revealed strong construct validity and reliability across eight principal components.

The use of local cultural context in science education aligns with the framework of Multiple Intelligences proposed by Gardner, where students' diverse cognitive strengths are addressed through linguistic, kinesthetic, spatial, and interpersonal elements embedded in the application (Yulianti, 2017; Romli & Ixfina, 2023). By incorporating the Boranan Lamongan Dance, students are not only introduced to scientific concepts like torque and equilibrium in a contextualized manner but also exposed to their cultural heritage, which promotes deeper engagement and meaning-making (Hartini et al., 2017; Putra et al, 2021). Furthermore, the KMO value of 0.638 and the significant Bartlett's Test ($p < 0.001$) indicate that the dataset is adequate and suitable for factor analysis. These results are consistent with psychometric standards in educational research, where a minimum KMO value of 0.6 is acceptable (Purwanto, 2009). The eight extracted factors explained a cumulative variance of 78.63%, exceeding the ideal threshold of 60% typically recommended for social science instruments (OECD, 2022). This suggests that the constructs measured in the student questionnaire effectively capture the multifaceted impact of the application on students' learning experiences.

Each factor identified in the EFA corresponds to different domains of scientific literacy and engagement. For instance, Factor 1, with a Cronbach's alpha of 0.872, strongly relates to students' conceptual understanding and contextual interpretation of physics phenomena. Other factors (e.g., Factor 2 and Factor 4) capture elements such as interactivity, the usefulness of visual and kinesthetic materials, and the cultural relevance of the content. Although Factor 7 showed a relatively low-reliability coefficient ($\alpha = 0.550$), this may be attributed to the limited number of items or overlap with other constructs. Future refinement of the instrument could address this limitation (Wati, Hakim, & Lia, 2021). Students responded positively to all significant components of the Dhysning application. The curriculum-aligned teaching modules and worksheets (LKPD) provided structured guidance while allowing flexibility for exploration. The virtual Smart Laboratory feature enabled simulation-based learning, facilitating conceptual visualization and enhancing the inquiry-based learning process, an essential component in fostering scientific literacy (Pratiwi et al, 2019). These findings align with those of Greipl et al. (2020), who argue that gamified and interactive learning systems support sustained student motivation and deeper comprehension.

In terms of pedagogical value, the integration of local wisdom not only enriches the content delivery but also helps students appreciate science as a culturally embedded and socially relevant field of study. This echoes the findings of Ahmadi et al. (2019) and Deta et al. (2023), who emphasized the benefits of integrating ethnoscience and cultural contexts into science instruction to foster identity, motivation, and understanding. Additionally, the application supports the 21st century learning vision where digital fluency and cultural awareness are key learning outcomes (Cahyani et al, 2021). The application of the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation) provided a robust instructional design framework, ensuring that the final product was both pedagogically sound and technically accessible (Cahyadi, 2019). The use of Adobe Flash CS6, although now considered a legacy platform, was instrumental in combining animations, simulations, and interactive assessments into a single, integrated package (Estianino et al., 2017).

Despite the promising results, several improvements are suggested for future iterations. The inclusion of HOTS (Higher Order Thinking Skills)-based questions, group collaboration features, and richer multimedia elements (e.g., 3D animations) could further enhance engagement and cognitive challenge (Adawiyah et al., 2021). Additionally, an automated reporting system for teachers would support formative assessment practices and personalized feedback (Gunawan et al, 2020). Dhysning application serves as an innovative example of how localized digital learning tools can bridge scientific knowledge with cultural relevance. It provides a holistic approach to science education that empowers students both cognitively and culturally and supports national efforts to improve Indonesia's scientific literacy profile in international assessments, such as PISA.

CONCLUSION

Fundamental Finding: This study highlights the effectiveness of the Dhysning application in integrating local wisdom specifically the Boranan Lamongan Dance into the teaching of rigid body equilibrium to enhance students' scientific literacy. The application was developed using the ADDIE model and validated through Exploratory Factor Analysis (EFA), which confirmed the robustness of its construct validity and internal consistency. With a total variance of 78.63% and high overall reliability (Cronbach's Alpha = 0.884), the instrument successfully captured students' perceptions across eight reliable factors. Furthermore, the students responded positively to the application, indicating that culturally relevant and interactive learning tools can bridge the gap between abstract physics concepts and students' real-life contexts. **Implication:** The findings underscore the importance of contextually and culturally grounded science learning as a strategy to enhance scientific literacy among Indonesian students, particularly in response to declining performance in international assessments, such as the Programme for International Student Assessment (PISA). By embedding local wisdom into digital media, educators can foster not only cognitive understanding but also emotional and cultural engagement, which are essential for deeper learning. The Dhysning application serves as a practical model of how glocal wisdom can be harmoniously integrated into science curricula to promote critical thinking, conceptual understanding, and cultural appreciation in secondary education. **Limitation:** Despite its promising results, the study has certain limitations. The application was only trialed in a limited setting involving three classes at one school and a small sample of physics teachers. Furthermore, the technological platform used (Adobe Flash CS6) is no longer widely supported, which may affect long-term accessibility and scalability. Some components, such as Factor 7 in the EFA, showed low reliability, suggesting the need for further refinement of questionnaire items and application content. **Future Research:** Future studies should explore the broader implementation of the Dhysning application across diverse educational settings and student populations to validate its effectiveness on a larger scale. Comparative studies between students exposed to culturally integrated learning tools and those using conventional methods could provide deeper insight into their long-term impacts on scientific literacy. Additionally, future development should consider integrating modern development platforms (e.g., HTML5 or mobile apps), collaborative features for group learning, and automatic assessment reporting systems to enhance user experience and pedagogical value.

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