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Measuring Ethnopedagogical and Ecological Values of Seven-Flower Rituals in East Javanese Traditional Dance

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Abstract

This study examined the pedagogical and ecological significance of bunga tujuh rupa (seven-flower rituals) in traditional East Javanese dance through an ethnopedagogical approach. Previous studies have primarily documented the cultural and spiritual meanings of ritual flowers qualitatively, while quantitative instruments for assessing their educational and ecological values remain limited. This study therefore developed and preliminarily evaluated a 25-item instrument covering five theoretically derived domains: Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy. A purposive sample of 100 respondents from Ponorogo, Banyuwangi, and Lumajang completed the questionnaire. Data were analyzed using descriptive statistics, Cronbach's alpha, corrected item-total correlations, Spearman's rho, principal component analysis (PCA), and hierarchical cluster analysis. Mean scores were high for Ritual Knowledge ($M = 4.56$, $SD = 0.48$), Flower Meaning ($M = 4.37$, $SD = 0.51$), Spiritual Value ($M = 4.41$, $SD = 0.53$), Environmental Preservation ($M = 4.32$, $SD = 0.49$), and Ethnopedagogy ($M = 4.21$, $SD = 0.52$). The instrument demonstrated high internal consistency ($\alpha = 0.945$), with corrected item-total correlations ranging from 0.631 to 0.812. All ten interconstruct correlations were positive and significant ($\rho = 0.603–0.968$, $p < .001$), including a strong association between Environmental Preservation and Ethnopedagogy ($\rho = 0.755$). PCA of the five aggregate construct scores identified one dominant component with an eigenvalue of 4.18, explaining 83.6% of the total variance. The PCA and clustering results provide preliminary evidence of an integrated Ethnopedagogical-Ecological Value Dimension, while also indicating possible construct overlap. The findings support the use of seven-flower ritual knowledge as a contextual resource for biology education, ecological literacy, and cultural learning. They also inform conceptual design requirements for interactive e-book and augmented-reality media that require subsequent prototype development and classroom-based evaluation.

Keywords: Ethnopedagogy; Ethnobotany; Ritual Flowers; Ecological Literacy; Traditional Dance; Augmented Reality

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INTRODUCTION

East Java is home to diverse traditional dances, including Reog Ponorogo, Jejer Gandrung, Remo, Seblang, Muang Sangkal, Thengul, Jaranan Buto, Ambarang, Topeng Guro Gudho, and Gandrung. These traditions express distinct cultural, spiritual, and social values. Beyond their function as artistic performances, the dances serve as media for ritual purification, gratitude, communal identity, and the intergenerational transmission of cultural knowledge. Traditional dance therefore

plays an important role in preserving local identity and provides a culturally meaningful context for character education (Mahmudah et al., 2021). Its integration into educational curricula can strengthen students' understanding and appreciation of cultural heritage while introducing values relevant to their personal and social development (Sakti et al., 2024). Ritual elements associated with these dances, including arrangements of seven types of flowers known as bunga tujuh rupa, carry sacred and philosophical meanings that contribute to the preservation of local wisdom (Rahayu et al., 2014). An ethnopedagogical approach provides a framework for translating these cultural practices into educational resources while maintaining their social and cultural significance (Muzakkir, 2021).

Research on Javanese culture demonstrates that local wisdom can support learning across multiple disciplines. Traditional cultural elements such as wayang and Javanese architectural patterns offer opportunities for contextual and creative learning in the arts, culture, and mathematics (Kidwell & Triyoko, 2024; Zuliana et al., 2023). Ethnobotanical research on Javanese wedding ceremonies has also identified 47 plant species with symbolic and spiritual significance, illustrating the close relationship between botanical knowledge and cultural practice (Anggraini et al., 2018). Traditional decorations such as tarub can be used to contextualize biodiversity and conservation concepts in biology education (Lidi et al., 2021). Local cultural values have similarly been incorporated into accounting education to broaden students' perspectives and increase the relevance of learning experiences (Anas, 2018). Collectively, these studies show that Javanese traditions provide interdisciplinary learning resources for science, the arts, mathematics, and the social sciences.

Flowers occupy a particularly important position in Javanese and Balinese Hindu rituals because their species, colors, fragrances, and arrangements communicate symbolic and spiritual meanings. Within the literature synthesized in this study, the seven-flower arrangement is commonly represented by red rose and white rose (Rosa sp.), jasmine (Jasminum sambac), ylang-ylang or kenanga (Cananga odorata), kantil (Michelia alba), tuberose (Polianthes tuberosa), and frangipani (Plumeria sp.) (Anggraini et al., 2018; Salamah et al., 2024). These flowers are associated with values such as courage, purity, sincerity, loyalty, spiritual attachment, peace, and continuity (Akhmar et al., 2023; Panji Tresna & Saputra, 2024; Zeng & Chantamala, 2025). Their composition may nevertheless vary according to regional traditions and ritual purposes.

Comparable relationships between flowers, ritual practice, and cultural meaning are evident in Balinese Hindu traditions. Thirty-six flower species - 29 cultivated and seven wild species - have been documented in ceremonial practices, with Cananga odorata, Impatiens balsamina, and Plumeria acuminata among the frequently used species (Andila et al., 2022; Darma et al., 2021). Flower colors also represent particular spiritual meanings, with yellow, black, white, and red associated with different deities and ceremonial functions (Ristanto et al., 2020). These practices demonstrate that ritual flowers are not merely decorative objects. They connect botanical diversity with spirituality, cultural continuity, and community-based knowledge of plants.

The spiritual significance of ritual flowers is closely connected to broader Indonesian understandings of relationships among humans, nature, and the spiritual realm. The bunga tujuh rupa arrangement can function as a medium of purification and as a symbolic connection between dancers and the spiritual world (D. R. Putri & Prihwanto, 2024). Ritual flowers are also understood as representations of positive

energy, balance, and harmony. The Ngelukat Gumi ceremony in Bali similarly emphasizes ecological balance as an integral component of spiritual practice, illustrating the interdependence of human communities and their natural environment (Nurdin, 2022; Yulisinta et al., 2024). Flowers additionally contribute aesthetic and emotional value to important life events (Merati, 2022). In traditional performances such as Sintren in Pekalongan, ritual participation may involve spiritual experiences that shape dancers' relationships with themselves, other community members, and their surrounding environment (Ilyas & Abidin, 2017). These examples indicate that spirituality, ecological awareness, and cultural performance are interconnected within Indonesian ritual traditions.

Ethnopedagogy offers a relevant educational framework for interpreting and transmitting these interconnected values. By grounding learning in community knowledge and cultural experience, ethnopedagogical approaches can increase students' understanding of cultural heritage while supporting character development (Oktavianti & Ratnasari, 2018). Learning media based on local wisdom can also create more contextual, active, and meaningful educational experiences (Oktavianti & Ratnasari, 2018). Cultural performances such as Purnama Seruling Penataran demonstrate how local traditions embody values associated with religiosity, nationalism, integrity, independence, and cooperation (Irsyadiah et al., 2024; Nasaruddin et al., 2024). Accordingly, the meanings attached to seven-flower rituals can be interpreted not only as cultural knowledge but also as potential resources for moral, ecological, and character education.

Several learning activities may be developed from ritual flower knowledge. These include documenting ritual processes, identifying flower species, examining their morphological characteristics, discussing their philosophical meanings, simulating selected ritual sequences, and processing flowers into simple educational products such as flower syrup (Pakpahan et al., 2019). Such activities can connect ethnobotanical knowledge with cultural interpretation and experiential learning. However, their educational use requires a systematic framework that distinguishes evidence-based botanical content from symbolic and spiritual interpretation while respecting the integrity of the cultural tradition.

Information and Communication Technology (ICT) provides additional opportunities to present this knowledge through contextual and multimodal learning. Augmented reality (AR), interactive e-books, electronic modules, and digital multimedia can visualize botanical structures, document ritual practices, and connect scientific information with cultural narratives. In science education, ICT can facilitate participatory and multisensory learning while improving access to complex or context-specific content (McFarlane & Sakellariou, 2002). When combined with ethnopedagogy, digital media can support scientific literacy, ecological awareness, and cultural appreciation while contributing to the documentation of cultural and ecological heritage (Maduddin et al., 2024). Nevertheless, digital representations must be based on clearly defined cultural and educational constructs to avoid presenting ritual traditions superficially or inaccurately.

Despite the growing literature on traditional dance, ritual flowers, local wisdom, and culturally responsive education, two important research gaps remain. First, no validated and replicable quantitative instrument has been reported in the literature reviewed for this study for assessing the ethnopedagogical and ecological values associated specifically with seven-flower practices in East Javanese dance rituals.

Previous studies have largely provided descriptive or qualitative accounts of their cultural and spiritual meanings without operationalizing Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy as measurable domains for educational research and curriculum evaluation (Muzakkir, 2021; Sakti et al., 2024). This limitation restricts researchers' and educators' ability to assess baseline perceptions, examine relationships among value domains, and evaluate subsequent learning interventions.

Second, although ICT-mediated ethnopedagogy has considerable theoretical potential, the relationship between empirically examined ritual-flower constructs and the design requirements of digital learning media remains underexplored in the East Javanese context. Interactive e-books and AR applications may present culturally rich content, but their features should be derived from explicit educational, ecological, and cultural dimensions rather than from technological considerations alone. A construct-informed design framework is therefore needed to guide prototype development and subsequent classroom testing.

To address these gaps, this study had four objectives. First, it developed and documented a 25-item questionnaire measuring five theoretically derived domains: Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy. Second, it examined the instrument's internal consistency, corrected item-total relationships, and associations among the five aggregate construct scores using reliability analysis and Spearman's rho. Third, it explored the shared structure among the aggregate construct scores using principal component analysis, supported by the Kaiser-Meyer-Olkin measure and Bartlett's test of sphericity, together with hierarchical cluster analysis. Fourth, it translated the measurement findings into conceptual design requirements for an interactive e-book and AR-based learning media through a construct-to-feature mapping intended to guide future prototype development and pilot testing.

Based on the theoretical integration of cultural, spiritual, ecological, and educational values within seven-flower rituals, the study hypothesized that the five aggregate construct scores would be positively associated and would converge on a dominant shared component. Rather than attempting to confirm five fully distinct psychometric dimensions, the analysis was designed to provide preliminary exploratory evidence regarding the extent to which the theoretically derived domains share an integrated ethnopedagogical-ecological value structure.

The study was designed as an instrument-development investigation informed by a descriptive literature review and contextual documentation of East Javanese ritual traditions, followed by a quantitative survey of 100 participants who were involved in or knowledgeable about traditional dance culture. To support transparency and reproducibility, the study provides an instrument blueprint, the complete item list in the Appendix, and a sequential analytical workflow comprising instrument development, participant screening, reliability assessment, correlation analysis, PCA, hierarchical clustering, and construct-to-media mapping. By combining preliminary psychometric evidence with educational design implications, the study seeks to establish an empirical foundation for integrating seven-flower ritual knowledge into biology education, ecological literacy, character education, and culturally grounded digital learning.

METHOD

Research Design and Setting

This study employed an instrument-development design informed by a descriptive literature review and contextual documentation of seven-flower rituals, followed by a quantitative survey to examine the preliminary psychometric properties of the developed instrument. The contextual component was used to identify the cultural, spiritual, ecological, and educational meanings associated with seven-flower arrangements (bunga tujuh rupa) in East Javanese traditional dance rituals.

Contextual information was obtained through a review of relevant literature, ethnographic documentation, and semi-structured observations of ritual practices and traditional dances at cultural sites in Ponorogo, Banyuwangi, and Lumajang, East Java. Because this component was not analyzed as an independent qualitative dataset, it primarily informed the cultural description, questionnaire development, and interpretation of the quantitative findings rather than constituting a separate qualitative research strand.

The quantitative survey was conducted from May to July 2024. It focused on evaluating item performance, internal consistency, relationships among the construct scores, and their exploratory multivariate structure. The study followed a sequential workflow comprising contextual exploration, construct identification, initial item development, expert content review, item refinement, pilot testing, participant screening, data collection, descriptive analysis, reliability analysis, correlation analysis, principal component analysis, hierarchical cluster analysis, and construct-to-media mapping. Figure 1 presents the complete study workflow.

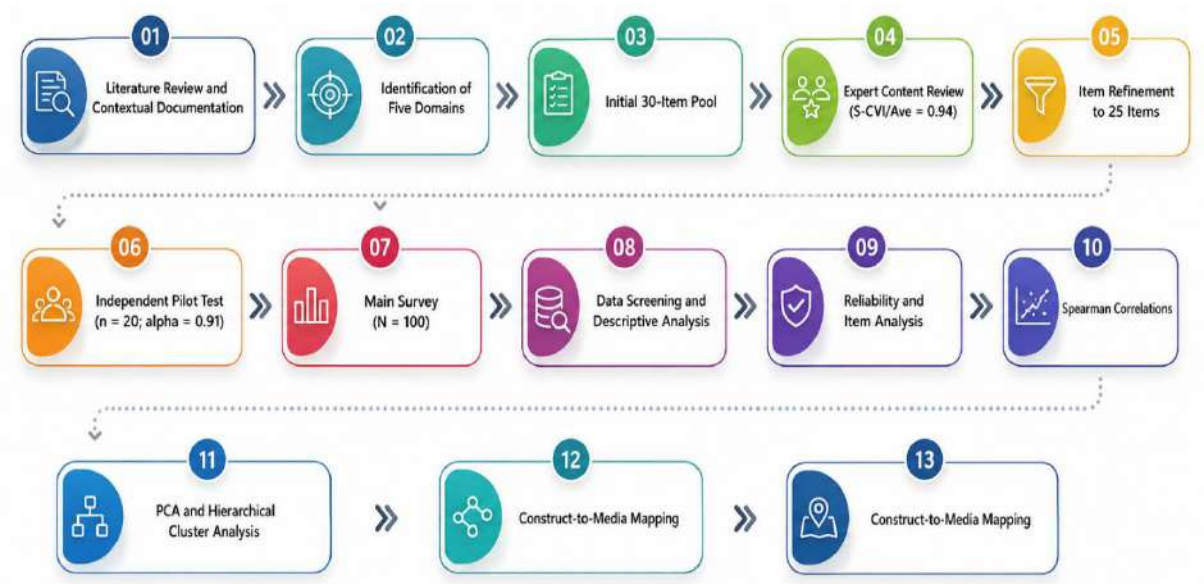

Figure 1. Study Workflow

Contextual Documentation and Descriptive Synthesis

The contextual component documented the traditional dances, ritual-flower arrangements, botanical characteristics, and philosophical meanings used to establish the cultural basis of the study. Information was compiled from the literature review, ethnographic documentation, and semi-structured observations undertaken at the three study locations.

The information was organized descriptively according to dance name, regional origin, reported flower composition, taxonomic classification, morphological

characteristics, and philosophical meaning. No independent thematic or inferential analysis was applied to this component. Instead, the descriptive synthesis was used to establish the study context, identify the theoretical domains represented in the instrument, support item development, and inform interpretation of the quantitative results.

Where the available documentation did not provide sufficient evidence of dance-specific variations in flower composition, the analysis retained the shared seven-flower arrangement consistently represented in the study records. Alternative flowers or regional substitutions were included only when supported by the original documentation. The resulting descriptive synthesis is presented in Tables 7 and 8 in the Results section.

Participants and Sampling

The main quantitative survey involved 100 participants aged 17-35 years (M = 24.3, SD = 4.7), comprising 58 women and 42 men. Participants included students (n = 52), cultural practitioners such as dance instructors and community arts leaders (n = 31), and community members with documented knowledge of or exposure to East Javanese traditional dance rituals (n = 17). Respondents were recruited from Ponorogo (n = 37), Banyuwangi (n = 33), and Lumajang (n = 30).

Regarding educational background, 64 participants had completed senior high school or an equivalent qualification, while 36 had completed or were undertaking undergraduate or postgraduate education. Detailed participant characteristics are reported in Table 2 in the Results section.

Purposive sampling was used because participation required previous direct or indirect exposure to ritual practices involving seven-flower arrangements. Eligibility was confirmed through a screening item administered at the beginning of the questionnaire. Participants were eligible when they reported active participation in, observation of, or prior knowledge about the relevant ritual practices. Before completing the questionnaire, all participants received an explanation of the study purpose and provided informed consent.

Instrument Development

The questionnaire was developed from five theoretically derived domains identified through the literature review and contextual documentation: Ritual Knowledge (RK), Flower Meaning (FM), Spiritual Value (SV), Environmental Preservation (EP), and Ethnopedagogy (ET). An initial pool of 30 items was prepared to represent these domains. Following expert review and item refinement, the final instrument comprised 25 items, with five items assigned to each domain. Responses were recorded using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Ritual Knowledge assessed participants' understanding of the purposes, practices, and cultural meanings associated with ritual flowers. Flower Meaning measured interpretations of the symbolism attached to flower species, colors, and arrangements. Spiritual Value addressed perceived relationships among ritual flowers, sacredness, gratitude, purification, and spiritual connection. Environmental Preservation assessed perceptions of local plant conservation, biodiversity, ecological responsibility, and the preservation of ritual flower species. Ethnopedagogy measured the perceived educational potential of ritual traditions for cultural learning, character development, and the integration of local wisdom into educational contexts.

Table 1 presents the theoretical basis, final item distribution, and representative statement for each domain. The complete questionnaire is provided in the Appendix.

Table 1. Instrument Blueprint, Theoretical Basis, and Representative Items

Construct	Theoretical basis	No. of items	Representative item
Ritual Knowledge (RK)	Ethnobotanical documentation and ritual-practice theory (Rahayu et al., 2014)	5	I understand the purpose of using flowers in traditional dance rituals.
Flower Meaning (FM)	Floral symbolism in Javanese culture (Anggraini et al., 2018; Salamah et al., 2024)	5	Each type of flower used in rituals carries unique symbolic meanings.
Spiritual Value (SV)	Spiritual ecology and ritual-purification literature (Yulisinta et al., 2024)	5	Ritual flowers create a sense of peace and spiritual connection.
Environmental Preservation (EP)	Environmental education and ethnobotanical conservation (Darma et al., 2021)	5	Using local flowers in rituals supports the conservation of native plants.
Ethnopedagogy (ET)	Ethnopedagogical theory and character education (Muzakkir, 2021; Sakti et al., 2024)	5	Traditional dance rituals can be used as educational tools for character development.
Total		**25**	

Content Validation

The initial 30-item pool was independently evaluated by three experts specializing in ethnopedagogy, biology, and cultural studies. Each expert assessed the relevance of every item using a four-point scale: 1 = not relevant, 2 = somewhat relevant, 3 = relevant, and 4 = highly relevant. For the Content Validity Index calculation, ratings of 3 or 4 were classified as relevant, whereas ratings of 1 or 2 were classified as not relevant.

The item-level Content Validity Index (I-CVI) was calculated by dividing the number of experts who rated an item as 3 or 4 by the total number of experts. Because three experts participated, the possible conventional I-CVI values were 0.00, 0.33, 0.67, and 1.00. The scale-level Content Validity Index using the averaging method (S-CVI/Ave) was calculated by summing the I-CVI values for all 30 initial items and dividing the result by the total number of items.

The initial item pool produced an S-CVI/Ave of 0.94, indicating strong overall expert agreement regarding content relevance (Polit & Beck, 2006). The experts' ratings and written comments were then used to revise unclear statements, consolidate semantically overlapping items, and remove items with weaker conceptual relevance. This process reduced the questionnaire from 30 initial items to the final 25-item instrument.

Pilot Testing

The revised 25-item instrument was pilot-tested with 20 respondents who were independent of and were not included among the 100 participants in the main survey. The pilot test assessed item clarity, comprehensibility, response suitability, and preliminary internal consistency.

The pilot instrument produced a Cronbach's alpha coefficient of 0.91, indicating high preliminary internal consistency. Feedback from the pilot participants was used to refine ambiguous wording and ensure that the statements were understandable to respondents with different levels of involvement in East Javanese traditional dance rituals. The finalized 25-item questionnaire was subsequently administered to the main study sample.

Data-Collection Procedure

Data collection began after participants had completed the eligibility screening and informed-consent procedures. Respondents completed the 25 questionnaire items and provided demographic information concerning gender, age, occupation or community role, educational background, region, and level of ritual exposure.

Completed questionnaires were checked for missing responses before data entry. All 100 questionnaires contained complete data and were retained for analysis; therefore, no imputation or case-deletion procedure was required.

A mean score was calculated for each domain by averaging responses to its five constituent items. Consequently, the aggregate scores for Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy remained on the original 1-5 response scale. Higher scores indicated stronger endorsement of the respective cultural, spiritual, ecological, or educational domain.

Statistical Analysis

Quantitative data were analyzed using IBM SPSS Statistics version 26. The analyses were conducted sequentially to examine data completeness, score distributions, internal consistency, item performance, associations among the five aggregate construct scores, and their exploratory multivariate structure.

Descriptive Statistics and Distribution Assessment

Means and standard deviations were calculated for the five aggregate construct scores. Score distributions were examined using the Kolmogorov-Smirnov and Shapiro-Wilk tests. A statistically significant result at $p < 0.05$ was interpreted as evidence of departure from normality. Because all five aggregate scores showed statistically significant departures from a normal distribution, Spearman's rho was used for the interconstruct correlation analysis.

Reliability and Item Analysis

The internal consistency of the complete 25-item instrument was evaluated using Cronbach's alpha. A coefficient of 0.70 or higher was treated as the minimum acceptable criterion. Corrected item-total correlations were examined to determine the contribution of each item to the overall scale, with coefficients of 0.30 or higher considered acceptable (Nunnally & Bernstein, 1994). Alpha-if-item-deleted coefficients were also examined to determine whether removing any individual item would meaningfully improve the overall internal consistency.

Cronbach's alpha was interpreted as evidence of score consistency rather than as confirmation that the five theoretically derived domains represented distinct psychometric dimensions. This distinction was necessary because a high alpha coefficient may also reflect item similarity or semantic redundancy.

Interconstruct Correlation Analysis

Spearman's rho was calculated to examine all ten unique pairwise associations among the five aggregate construct scores: Ritual Knowledge-Flower Meaning, Ritual

Knowledge-Spiritual Value, Ritual Knowledge-Environmental Preservation, Ritual Knowledge-Ethnopedagogy, Flower Meaning-Spiritual Value, Flower Meaning-Environmental Preservation, Flower Meaning-Ethnopedagogy, Spiritual Value-Environmental Preservation, Spiritual Value-Ethnopedagogy, and Environmental Preservation-Ethnopedagogy. All tests were two-tailed, and statistical significance was evaluated at an alpha level of 0.05. The complete correlation matrix is reported in Table 6 in the Results section.

The Environmental Preservation-Ethnopedagogy correlation was calculated between the aggregate Environmental Preservation score, constructed by averaging the five EP items, and the aggregate Ethnopedagogy score, constructed by averaging the five ET items. Thus, the coefficient represented the association between participants' endorsement of ecological-conservation values and their endorsement of the educational use of local ritual knowledge. The same aggregate-score procedure was applied to all other construct pairs.

The coefficients were interpreted as cross-sectional associations among participants' reported perceptions. They were not treated as evidence that one domain caused changes in another. The magnitude and pattern of the correlations were also examined as preliminary evidence of empirical overlap or shared variance among the theoretically derived domains.

Principal Component Analysis

Principal component analysis (PCA) was conducted on the five aggregate construct scores to explore the extent to which they shared a common multivariate dimension. The PCA was therefore performed at the construct-score level rather than at the individual-item level.

The suitability of the correlation matrix for PCA was evaluated using the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity. A Kaiser-Meyer-Olkin value above 0.60 was considered acceptable, while a statistically significant Bartlett's test at $p < 0.05$ indicated that the correlation matrix contained sufficient relationships for component analysis.

The number of components retained was evaluated using the eigenvalue distribution, percentage of explained variance, component loadings, and scree plot. Because one dominant component was retained, no rotation was applied. Component loadings were interpreted as correlations between the five aggregate construct scores and the retained principal component. PCA biplot coordinates were treated only as graphical projection values and were not interpreted as psychometric loadings.

The PCA was intended to provide preliminary evidence of shared variance among the five aggregate domains. It was not used to confirm the dimensionality of the 25 individual questionnaire items or to establish a validated five-factor measurement model. Item-level exploratory factor analysis and confirmatory factor analysis were beyond the scope of the present study.

Hierarchical Cluster Analysis

Hierarchical cluster analysis was conducted to examine similarities among the five aggregate construct scores. Ward's linkage method and squared Euclidean distance were used to identify which domains had the most similar response patterns.

The clustering solution was presented using a dendrogram. The analysis grouped the five constructs rather than individual participants. Consequently, the clusters were interpreted as exploratory patterns of similarity among Ritual

Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy rather than as classifications of respondent groups.

Construct-to-Media Mapping

Following the statistical analyses, the five theoretically derived domains and their empirical relationships were mapped onto proposed features for interactive e-book and augmented-reality learning media. Ritual Knowledge informed content concerning ritual processes and dance traditions; Flower Meaning informed visual and narrative explanations of flower symbolism; Spiritual Value informed reflective activities; Environmental Preservation informed biodiversity and conservation content; and Ethnopedagogy informed character-education and contextual-learning activities.

This mapping generated conceptual design requirements for subsequent media development. The proposed interactive e-book and augmented-reality features were not implemented or empirically tested in the present study.

Ethical Considerations

All procedures involving human participants followed the principles of voluntary participation, informed consent, confidentiality, and the right to withdraw. Before participation, respondents received information about the study's purpose, questionnaire procedures, and intended academic use of the data.

Participation was voluntary, and respondents could discontinue their involvement at any stage without penalty. The questionnaire did not collect personally identifiable information, and the data were used exclusively for academic research.

RESULTS AND DISCUSSION

Participant Characteristics

The main survey included 100 participants aged 17-35 years (M = 24.3, SD = 4.7). As presented in Table 2, the sample comprised 58 women and 42 men. Students constituted the largest participant group (52%), followed by cultural practitioners or dance instructors (31%) and community members with knowledge of East Javanese traditional dance rituals (17%). Participants were recruited from Ponorogo (37%), Banyuwangi (33%), and Lumajang (30%). All participants reported previous exposure to seven-flower ritual practices through active participation, observation, or prior knowledge.

Table 2. Participant Demographic Characteristics (N = 100)

Characteristic	Category	n	%
Gender	Female	58	58.0
	Male	42	42.0
Age group	17-20 years	23	23.0
	21-25 years	41	41.0
	26-35 years	36	36.0
Occupation/role	Student	52	52.0
	Cultural practitioner/dance instructor	31	31.0
	Community member, non-practitioner	17	17.0
Education	Senior high school or equivalent	64	64.0
	Undergraduate/postgraduate	36	36.0
Region	Ponorogo	37	37.0

Characteristic	Category	n	%
	Banyuwangi	33	33.0
	Lumajang	30	30.0
Ritual exposure	High: active participant	38	38.0
	Moderate: observer	44	44.0
	Low: prior knowledge only	18	18.0

Instrument Refinement and Pilot Testing

The initial 30-item pool was independently evaluated by three experts in ethnopedagogy, biology, and cultural studies. The scale-level Content Validity Index using the averaging method was 0.94, indicating strong overall expert agreement regarding item relevance. Based on the experts' quantitative ratings and written comments, five items were revised, consolidated, or removed because of unclear wording, weaker conceptual relevance, or semantic overlap. This process produced the final 25-item instrument, comprising five items for each theoretical domain: Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy.

The revised instrument was pilot-tested with 20 respondents who were independent of the 100 participants included in the main survey. The pilot instrument demonstrated high preliminary internal consistency, with Cronbach's alpha = 0.91. Feedback from the pilot participants was used to clarify item wording and improve comprehensibility before the main data collection.

Data Completeness and Construct-Score Distributions

All 100 questionnaires contained complete responses. As shown in Table 3, no cases were excluded because of missing data. Consequently, no data-imputation or case-deletion procedure was required. Complete data availability supported the planned analyses but did not eliminate the possibility of sampling or response bias.

Table 3. Case Processing Summary

Case status	N	%
Valid	100	100.0
Excluded	0	0.0
Total	100	100.0

A mean score was calculated for each construct by averaging responses to its five constituent items. The aggregate scores therefore remained on the original 1-5 response scale, with higher scores indicating stronger endorsement of the corresponding domain. Table 4 presents the descriptive statistics and normality-test results for the five aggregate construct scores.

Mean scores were high across all five domains. Ritual Knowledge produced the highest mean score (M = 4.56, SD = 0.48), followed by Spiritual Value (M = 4.41, SD = 0.53), Flower Meaning (M = 4.37, SD = 0.51), Environmental Preservation (M = 4.32, SD = 0.49), and Ethnopedagogy (M = 4.21, SD = 0.52).

The Kolmogorov-Smirnov and Shapiro-Wilk tests indicated statistically significant departures from normality for all five construct scores (all $p < .001$). The Kolmogorov-Smirnov statistics ranged from 0.141 to 0.198, while the Shapiro-Wilk statistics ranged from 0.831 to 0.891. These findings supported the use of Spearman's rho for the interconstruct correlation analysis.

Table 4. Descriptive Statistics and Normality Tests for the Five Aggregate Construct Scores (N = 100)

Construct	Mean	SD	K-S D	K-S p	S-W W	S-W p	Distribution
Ritual Knowledge (RK)	4.56	0.48	0.198	< .001	0.831	< .001	Non-normal
Flower Meaning (FM)	4.37	0.51	0.171	< .001	0.856	< .001	Non-normal
Spiritual Value (SV)	4.41	0.53	0.186	< .001	0.843	< .001	Non-normal
Environmental Preservation (EP)	4.32	0.49	0.163	< .001	0.868	< .001	Non-normal
Ethnopedagogy (ET)	4.21	0.52	0.141	< .001	0.891	< .001	Non-normal

Internal Consistency and Item Performance

The final 25-item instrument demonstrated high internal consistency, with an overall Cronbach's alpha of 0.945. This coefficient indicated that the items consistently measured a shared domain of cultural, spiritual, ecological, and educational values. However, the coefficient was interpreted as evidence of score consistency rather than confirmation that the five theoretically derived domains were psychometrically distinct.

Corrected item-total correlations and alpha-if-item-deleted coefficients are presented in Table 5. Corrected item-total correlations ranged from 0.631 to 0.812, exceeding the minimum acceptable criterion of 0.30 (Nunnally & Bernstein, 1994). Alpha-if-item-deleted coefficients ranged from 0.935 to 0.940, indicating that deleting any individual item would not meaningfully increase the overall internal consistency of the instrument.

The strongest corrected item-total correlation was obtained for SV4 (r = 0.812), followed by EP4 (r = 0.802) and SV1 (r = 0.801). The lowest coefficient was observed for FM2 (r = 0.631), although it remained above the acceptable threshold.

Table 5. Corrected Item-Total Correlations for the 25-Item Instrument (N = 100)

Item code	Construct	Corrected item-total r	Alpha if item deleted	Interpretation
RK1	Ritual Knowledge	0.712	0.938	Acceptable
RK2	Ritual Knowledge	0.748	0.937	Acceptable
RK3	Ritual Knowledge	0.691	0.939	Acceptable
RK4	Ritual Knowledge	0.723	0.938	Acceptable
RK5	Ritual Knowledge	0.756	0.937	Acceptable
FM1	Flower Meaning	0.654	0.940	Acceptable
FM2	Flower Meaning	0.631	0.940	Acceptable
FM3	Flower Meaning	0.678	0.939	Acceptable
FM4	Flower Meaning	0.649	0.940	Acceptable
FM5	Flower Meaning	0.663	0.940	Acceptable
SV1	Spiritual Value	0.801	0.935	Strong
SV2	Spiritual Value	0.788	0.936	Strong
SV3	Spiritual Value	0.775	0.936	Strong
SV4	Spiritual Value	0.812	0.935	Strong
SV5	Spiritual Value	0.768	0.936	Strong
EP1	Environmental Preservation	0.795	0.935	Strong
EP2	Environmental Preservation	0.778	0.936	Strong

Item code	Construct	Corrected item-total r	Alpha if item deleted	Interpretation
EP3	Environmental Preservation	0.761	0.936	Strong
EP4	Environmental Preservation	0.802	0.935	Strong
EP5	Environmental Preservation	0.786	0.936	Strong
ET1	Ethnopedagogy	0.683	0.939	Acceptable
ET2	Ethnopedagogy	0.671	0.939	Acceptable
ET3	Ethnopedagogy	0.695	0.939	Acceptable
ET4	Ethnopedagogy	0.712	0.938	Acceptable
ET5	Ethnopedagogy	0.658	0.940	Acceptable

Although every item contributed positively to the total score, the consistently high item-total correlations and overall alpha indicated that several items may have measured closely related content. This possibility was examined further through the interconstruct correlation and principal component analyses.

Associations Among the Five Aggregate Construct Scores

Spearman's rho was used to examine all ten unique pairwise associations among Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy. The complete correlation matrix is presented in Table 6. Each coefficient was calculated using the mean scores derived from the five items assigned to the corresponding constructs.

All ten construct pairs were positively and statistically significantly associated, with coefficients ranging from rho = 0.603 to 0.968 (all $p < .001$). The strongest association was between Flower Meaning and Ethnopedagogy (rho = 0.968), followed by Ritual Knowledge and Environmental Preservation (rho = 0.967), Ritual Knowledge and Spiritual Value (rho = 0.965), and Spiritual Value and Environmental Preservation (rho = 0.928).

Environmental Preservation was strongly associated with Ethnopedagogy (rho = 0.755, $p < .001$). This relationship indicated that respondents who more strongly endorsed the conservation of ritual plants, local biodiversity, and ecological responsibility also tended to assign greater educational value to local ritual knowledge.

Comparatively lower, although still statistically significant, associations were found between Flower Meaning and Spiritual Value (rho = 0.603), Spiritual Value and Ethnopedagogy (rho = 0.634), Ritual Knowledge and Flower Meaning (rho = 0.678), Flower Meaning and Environmental Preservation (rho = 0.680), and Ritual Knowledge and Ethnopedagogy (rho = 0.705).

Table 6. Spearman Correlations Among the Five Aggregate Construct Scores (N = 100)

Construct	1	2	3	4	5
1. Ritual Knowledge	-				
2. Flower Meaning	0.678	-			
3. Spiritual Value	0.965	0.603	-		
4. Environmental Preservation	0.967	0.680	0.928	-	
5. Ethnopedagogy	0.705	0.968	0.634	0.755	-

The coefficients represented cross-sectional associations among participants' reported perceptions and were not interpreted as evidence that one construct caused changes in another. The magnitude of several correlations, particularly those exceeding 0.90, also indicated substantial empirical overlap among some of the theoretically derived domains.

Contextual Documentation of Seven-Flower Rituals

Traditional Dances and Ritual-Flower Arrangements

The contextual documentation component identified ten traditional dances associated with seven-flower ritual arrangements. Table 7 presents the dances, their reported regional origins, and the common flower composition documented in the study records.

The recurring arrangement comprised red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani. Because the available documentation did not consistently establish dance-specific substitutions, Table 7 reports the shared arrangement represented across the study records.

Table 7. East Javanese Traditional Dances and Their Reported Seven-Flower Ritual Arrangement

No.	Dance	Reported origin	Reported ritual flowers
1	Reog Dance	Ponorogo, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
2	Jejer Gandrung Dance	Banyuwangi, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
3	Thengul Dance	Bojonegoro, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
4	Jaranan Buto Dance	Kediri, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
5	Remo Dance	East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
6	Muang Sangkal Dance	Madura, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
7	Tiban Dance	Kediri, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
8	Topeng Guro Gudho Dance	Malang, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
9	Seblang Dance	Banyuwangi, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani
10	Ambarang Dance	Jombang, East Java	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani

The repeated use of the seven flowers indicated a shared ritual vocabulary across the documented dances. Their colors, fragrances, morphological characteristics, and symbolic meanings connected botanical materials with cultural and spiritual interpretations transmitted through traditional performance.

Botanical and Philosophical Characteristics

Table 8 summarizes the taxonomic classifications, principal morphological characteristics, and philosophical meanings assigned to the seven ritual flowers in the study records. The botanical and cultural information was organized descriptively to establish the contextual basis for the questionnaire.

Table 8. Taxonomic, Morphological, and Philosophical Characteristics of the Seven Ritual Flowers

No.	Flower	Taxonomy	Morphological characteristics	Philosophical values in dance rituals
1	Red rose (Rosa damascena)	Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Rosales; Family: Rosaceae; Genus: Rosa	A woody plant with thorny stems, compound leaves with serrated margins, and layered red flowers with a distinctive fragrance.	Courage; passion and enthusiasm; love; strength and perseverance
2	Jasmine (Jasminum sambac)	Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Lamiales; Family: Oleaceae; Genus: Jasminum	A woody or climbing plant with simple, pointed leaves and small white flowers that produce a distinctive fragrance.	Purity and holiness; simplicity; modesty; sincerity
3	Cananga or kenanga (Cananga odorata)	Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Magnoliales; Family: Annonaceae; Genus: Cananga	A tall tree with a sturdy trunk, alternately arranged simple leaves, and greenish-yellow flowers with six elongated petals and a strong fragrance.	Eternity; enduring memories; loyalty to tradition; respect for ancestors
4	Kantil (Michelia alba)	Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Magnoliales; Family: Magnoliaceae; Genus: Michelia	A large tree with simple leaves and layered white flowers that produce a soft fragrance.	Attachment; loyalty and love; close relationships; spiritual protection
5	Tuberose (Polianthes tuberosa)	Kingdom: Plantae; Division: Magnoliophyta; Class: Liliopsida; Order: Asparagales; Family: Agavaceae; Genus: Polianthes	An herbaceous plant with elongated, ribbon-like leaves and white flowers borne on tall stalks. The flowers produce a strong fragrance, particularly at night.	Beauty; romance; nighttime tranquility; peace of mind
6	White rose (Rosa damascena)	Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Rosales;	A woody plant with thorny stems, compound leaves with serrated margins, and layered white flowers with a distinctive fragrance.	Purity; sincerity; devotion; inner peace

No.	Flower	Taxonomy	Morphological characteristics	Philosophical values in dance rituals
7	Frangipani (Plumeria sp.)	Family: Rosaceae; Genus: Rosa Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Order: Gentianales; Family: Apocynaceae; Genus: Plumeria	A small tree with milky sap, thick glossy leaves arranged near the ends of branches, and white or pink five-petaled flowers with a sweet fragrance.	Purity; life after death; eternity; connection with the spiritual world

The descriptive synthesis identified recurring botanical and philosophical characteristics across the seven flowers. Red roses were associated with courage and enthusiasm, whereas white roses represented purity and sincerity. Jasmine represented purity and modesty; cananga represented continuity, memory, and respect for tradition; kantil represented attachment and spiritual protection; tuberose represented beauty and peace; and frangipani represented continuity between physical and spiritual existence.

The contextual documentation also showed that the flowers could be described through observable botanical properties, including growth form, leaf structure, flower color, fragrance, and taxonomic classification. These characteristics provided the scientific content used to connect ritual-flower knowledge with the five theoretical domains represented in the questionnaire.

Exploratory Principal Component Analysis

Component-Space Visualization

Principal component analysis was conducted on the five aggregate construct scores to examine their shared multivariate structure. Figure 2 presents the relative positions of Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy within the space defined by the first two principal components.

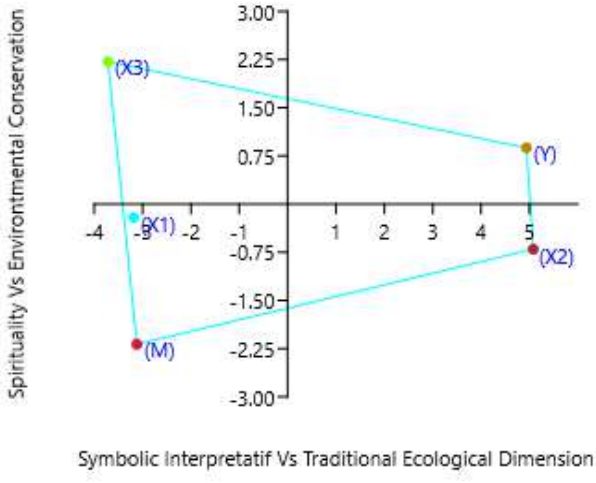

Figure 2. Principal Component Biplot of the Five Aggregate Construct Scores

The biplot was interpreted as a graphical representation of statistical proximity among the five aggregate scores. Positive and negative coordinates represented directions within component space and did not indicate positive or negative cultural, spiritual, educational, or environmental values.

The projection coordinates used to construct the biplot are presented in Table 9. These values are graphical coordinates rather than psychometric component loadings. Negative coordinates were therefore not interpreted as negative loadings or as evidence that a construct was negatively related to the general component.

Table 9. Principal Component Projection Coordinates for the Five Aggregate Construct Scores

Construct	PC1	PC2	PC3	PC4
Ritual Knowledge	-3.1842	-0.2077	-1.4545	-0.3197
Flower Meaning	5.0793	-0.7010	0.8842	-0.3567
Spiritual Value	-3.7159	2.2152	0.9406	0.0125
Environmental Preservation	-3.1183	-2.1823	0.4714	0.3027
Ethnopedagogy	4.9390	0.8758	-0.8417	0.3612

Note. The values are graphical projection coordinates in PCA space and should not be interpreted as component loadings.

Component Retention and Loadings

The scree plot presented in Figure 3 showed a pronounced decline after the first component. Components beyond PC1 contributed comparatively little additional variance, indicating that the five aggregate scores shared one dominant component.

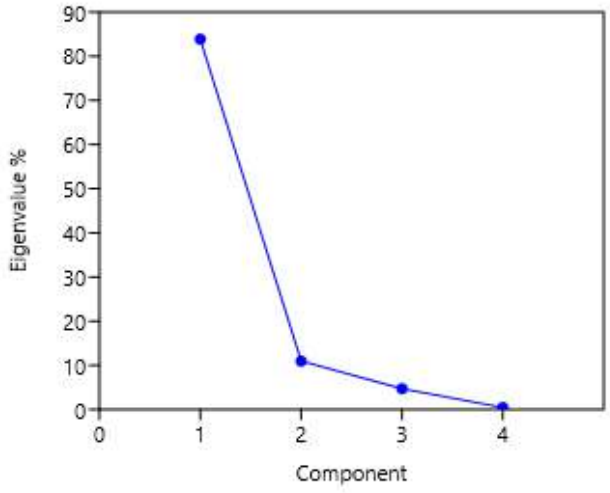

Figure 3. Scree Plot for the Five Aggregate Construct Scores

The PCA diagnostic statistics and PC1 loadings are presented in Table 10. The Kaiser-Meyer-Olkin measure was 0.842, indicating adequate sampling suitability, while Bartlett's test of sphericity was statistically significant, chi-square(10) = 426.37, $p < .001$. These results indicated that the relationships among the five aggregate scores were sufficient for exploratory component analysis.

The first principal component had an eigenvalue of 4.18 and explained 83.6% of the total variance. All five construct scores loaded positively and strongly on PC1. Loadings ranged from 0.856 for Flower Meaning to 0.950 for Spiritual Value, while communalities ranged from 0.733 to 0.903. Because only one component was retained, no rotation was applied.

Table 10. PCA Loadings, Communalities, and Diagnostic Statistics for the Five Aggregate Construct Scores

Construct/statistic	PC1 loading	Communality	Interpretation
Ritual Knowledge	0.943	0.889	Strong loading on PC1
Flower Meaning	0.856	0.733	Strong loading on PC1
Spiritual Value	0.950	0.903	Strong loading on PC1
Environmental Preservation	0.948	0.898	Strong loading on PC1
Ethnopedagogy	0.870	0.757	Strong loading on PC1
Eigenvalue	4.18		Dominant first component
Variance explained by PC1	83.6%		Substantial shared variance
KMO	0.842		Meritorious
Bartlett's test	chi-square = 426.37	df = 10, p < .001	Significant

The dominant component was provisionally interpreted as a shared Ethnopedagogical-Ecological Value Dimension because Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy all loaded positively and strongly on it. This pattern provided exploratory evidence of shared variance among the aggregate construct scores. It did not confirm the dimensionality of the 25 individual questionnaire items or establish five empirically distinct subscales.

Hierarchical Cluster Analysis

Hierarchical cluster analysis was conducted using Ward's method and squared Euclidean distance to examine similarities among the five aggregate construct scores. The resulting dendrogram is presented in Figure 4.

Spiritual Value and Environmental Preservation formed the closest initial cluster, indicating highly similar response patterns across these two domains. Ritual Knowledge subsequently joined this cluster. Flower Meaning and Ethnopedagogy entered the clustering structure at later stages, reflecting their relative similarity to each other and to the broader group of constructs.

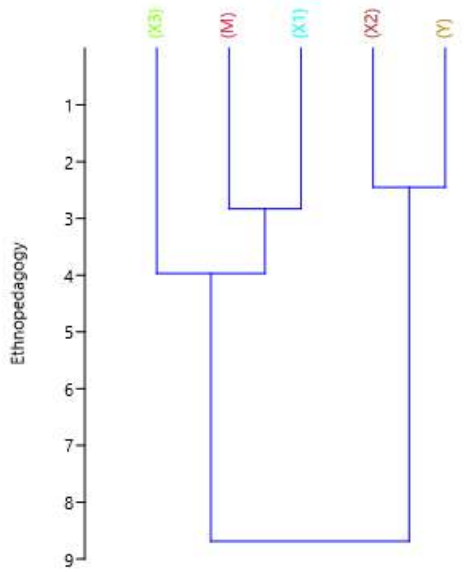

Figure 4. Hierarchical Cluster Dendrogram of the Five Aggregate Construct Scores

The dendrogram represented statistical similarity among the aggregate construct scores and did not indicate causal or hierarchical relationships among the cultural domains. The clustering pattern was consistent with the Spearman correlations and the dominant first principal component, which together indicated substantial shared variance among the cultural, spiritual, ecological, and educational domains.

Discussion

Integrated Ethnopedagogical-Ecological Value Structure

This study examined how Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy are interconnected within seven-flower ritual practices in East Javanese traditional dance. The findings indicate that respondents did not perceive these domains as isolated dimensions. Instead, the high construct scores, significant correlations, dominant first principal component, and hierarchical clustering pattern collectively suggest a closely integrated cultural, spiritual, ecological, and educational value structure.

All ten construct pairs were positively and significantly correlated. Ritual Knowledge showed particularly strong associations with Spiritual Value (rho = 0.965) and Environmental Preservation (rho = 0.967), while Flower Meaning was most strongly associated with Ethnopedagogy (rho = 0.968). Environmental Preservation was also strongly associated with Ethnopedagogy (rho = 0.755). These relationships indicate that respondents who reported greater familiarity with ritual practices also tended to endorse their spiritual, ecological, and educational significance. Because the study used a cross-sectional design, these findings represent co-endorsement and shared perception rather than causal effects.

The principal component analysis reinforced this interpretation. All five aggregate construct scores loaded positively and strongly on the first principal component, which explained 83.6% of the total variance. This dominant component was provisionally interpreted as an Ethnopedagogical-Ecological Value Dimension. The hierarchical cluster analysis produced a compatible pattern: Spiritual Value and Environmental Preservation formed the closest initial cluster, followed by Ritual Knowledge, while Flower Meaning and Ethnopedagogy joined the broader structure at later stages. Together, these findings suggest that spiritual and ecological interpretations are closely embedded in respondents' understanding of ritual knowledge, whereas flower symbolism is particularly aligned with the perceived educational use of local wisdom.

However, the very high correlations among several constructs also require caution. The results may reflect genuine cultural integration, but they may additionally indicate semantic overlap among questionnaire items or insufficient empirical differentiation among the five theoretically defined domains. The study therefore provides preliminary evidence of a shared value structure rather than definitive confirmation of five distinct subscales. Item-level exploratory factor analysis, confirmatory factor analysis, and discriminant-validity assessment are needed in future studies.

Seven-Flower Rituals as Ethnopedagogical Learning Resources

Ethnopedagogy connects formal education with local knowledge, cultural experience, and community values. Previous studies have shown that this approach

can support cultural preservation, character development, and the integration of oral traditions and local practices into school learning (Muzakkir, 2021; Ramli et al., 2024; Sakti et al., 2024; Sinaga & Damanik, 2023). Local knowledge from the Sasak community has similarly been identified as a source of social, economic, artistic, and educational values that can be incorporated into school culture and subject learning (Muzakir & Suastra, 2024).

Within this framework, seven-flower rituals provide more than visual or ceremonial decoration. The flowers function as cultural signs through which communities communicate values related to courage, purity, loyalty, spiritual protection, continuity, peace, and relationships with ancestors and nature. The contextual documentation identified a recurring arrangement comprising red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani. These flowers were associated with traditional dances including Reog Ponorogo, Jejer Gandrung, Thengul, Jaranan Buto, Remo, Muang Sangkal, Tiban, Topeng Guro Gudho, Seblang, and Ambarang.

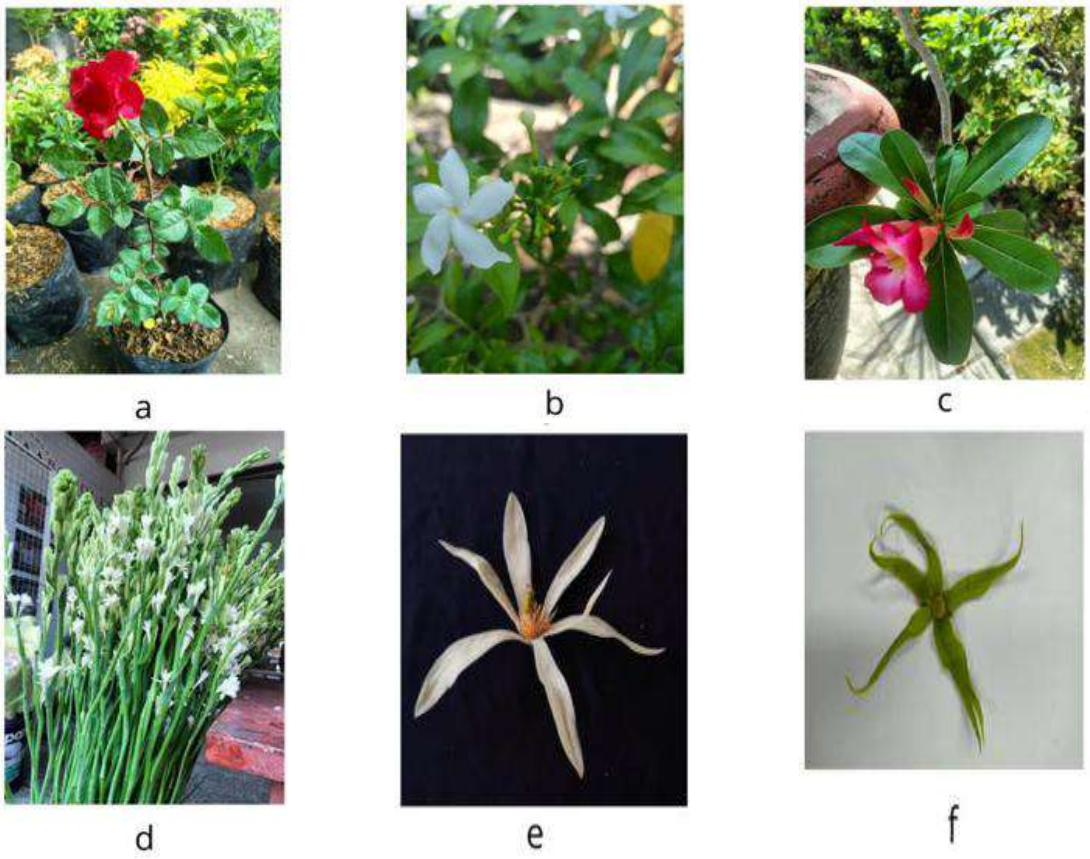

Figure 5. Seven-Flower Ritual Plants Used in East Javanese Traditional Dance. The six image categories represent seven flowers because the red and white roses are grouped within the rose category: (a) red and white roses (Rosa sp.); (b) jasmine (Jasminum sambac); (c) frangipani (Plumeria sp.); (d) tuberose (Polianthes tuberosa); (e) kantil (Michelia alba); and (f) cananga or kenanga (Cananga odorata).

From an ethnopedagogical perspective, the cultural meanings of these flowers can support learning through observation, interpretation, discussion, and reflection. Ritual knowledge can introduce students to the social functions and historical continuity of traditional dance. Flower symbolism can support discussion of moral values and cultural identity. Spiritual meanings can provide opportunities for

reflection on gratitude, respect, and community relationships, while ecological content can connect ritual practices with biodiversity and environmental responsibility. Such integration is consistent with the role of arts education in strengthening cultural identity and connecting learners with community traditions (Setyawan & Dopo, 2020).

Figure 5 presents the principal flower categories documented in the seven-flower ritual arrangement. Red and white roses are represented within the rose category, while the other images show jasmine, frangipani, tuberose, kantil, and cananga.

The symbolic interpretations associated with these flowers can become learning prompts rather than fixed or universal definitions. Red roses may introduce values of courage and perseverance, while white roses and jasmine may support discussion of purity, sincerity, and devotion. Cananga can be associated with continuity and respect for tradition; kantil with attachment, loyalty, and spiritual protection; tuberose with peace and tranquility; and frangipani with the relationship between physical and spiritual existence. Such meanings should be presented as culturally situated interpretations rather than biological properties of the plants.

Learning activities based on these materials may include flower identification, morphological observation, documentation of ritual processes, interviews with cultural practitioners, symbolic interpretation, storytelling through dance, and reflective discussion. Illustrated guides, ethnopedagogical worksheets, and multimedia resources could help students distinguish among observable botanical features, documented ritual uses, and culturally interpreted meanings. This distinction is essential for maintaining both scientific accuracy and respect for cultural knowledge.

Ecological and Conservation Implications

The relationship between ritual knowledge and environmental preservation was one of the strongest findings in the study (rho = 0.967). Spiritual Value was also strongly associated with Environmental Preservation (rho = 0.928), while Environmental Preservation showed a strong relationship with Ethnopedagogy (rho = 0.755). These results indicate that respondents who valued ritual knowledge and its spiritual meanings also tended to endorse the conservation of plants, biodiversity, and ecological responsibility.

The findings do not demonstrate that participation in ritual practices directly produces conservation behavior. Nevertheless, they show that ritual flower traditions provide a culturally meaningful context in which ecological values can be discussed and transmitted. This interpretation is consistent with research emphasizing the role of local wisdom in community-based environmental management and conservation practices (Kiik, 2018; Tetelepta et al., 2023; Turisno, 2023).

The use of flowers in traditional ceremonies may encourage attention to plant availability, cultivation, seasonal cycles, and the continuity of locally important species. In this sense, ritual plants may function as cultural entry points for discussing biodiversity and responsible resource use. Studies of plant use in Javanese ceremonies and other Indonesian cultural settings have similarly demonstrated that ritual practices preserve knowledge about local flora and their social significance (Anggraini et al., 2018; Darma et al., 2021).

Comparable relationships between local knowledge and environmental management have been documented among the Kokoda community in West Papua,

where practices such as marine sasi, sacred forests, and living pharmacies support environmental stewardship (Saputra, 2020). The Tugutil community in North Maluku also uses traditional knowledge to manage forest resources and identify plants for food and medicine (Niapele, 2013). These examples show that local knowledge systems can provide culturally grounded frameworks for ecological responsibility, although each system must be understood within its own social and environmental context.

For seven-flower rituals, conservation education should avoid unsupported claims that all ritual species are threatened or endemic. Instead, learning activities can focus on verified issues such as local cultivation, habitat requirements, plant availability, sustainable harvesting, and the preservation of community knowledge. Ethnobotanical inventories can also inform eco-pedagogical learning materials, as demonstrated in Paciran Village, East Java (Wahyuni et al., 2023).

Traditional dance preservation further supports the continuity of associated plant knowledge. Cultural training and documentation activities can introduce younger generations to the relationships among dance, ritual materials, local identity, and environmental responsibility (Dwi Hartanto et al., 2024). Regional performances may also be reinterpreted for contemporary audiences while retaining their cultural foundations (Kim & Park, 2023; Wiradharma et al., 2024).

Integration into Biology Education

The findings offer a clear basis for connecting seven-flower rituals with biology education. The flowers can be studied through their taxonomy, morphology, anatomy, reproductive biology, ecological relationships, cultivation, and roles in local biodiversity. At the same time, students can examine how communities interpret these plants through ritual, symbolism, and traditional performance.

This dual perspective can support both scientific and cultural literacy. For example, jasmine may be examined through floral anatomy, fragrance, and pollination while also being discussed as a cultural symbol of purity and sincerity. Cananga may be studied in relation to flower structure, volatile compounds, and interactions with pollinators, alongside its documented ritual association with continuity and ancestral respect. Such activities allow learners to distinguish scientific explanations from cultural interpretations while recognizing that both contribute to understanding human relationships with plants.

The strong association between Flower Meaning and Ethnopedagogy (rho = 0.968) suggests that flower symbolism is especially relevant to the educational interpretation of ritual practices. Symbolic content can provide an accessible starting point for students before they move toward botanical observation and ecological analysis. Similarly, the relationship between Environmental Preservation and Ethnopedagogy (rho = 0.755) indicates that conservation themes are compatible with culturally grounded learning activities.

Local-wisdom-based biology modules have previously been used to contextualize ecosystem learning and connect scientific concepts with community environments (Lestari et al., 2019). In the present context, learning units could progress from direct observation of flowers to taxonomic identification, examination of ecological functions, documentation of ritual use, and critical reflection on conservation. This approach would place biodiversity within a lived cultural-environmental system rather than presenting it solely as abstract scientific content.

Such integration can also extend learning beyond the cognitive domain. Cultural interpretation, aesthetic appreciation, and ethical reflection may help students consider why plant diversity matters to particular communities. However, claims that these activities improve character, spirituality, or conservation behavior require direct empirical testing. The present results identify a promising educational framework but do not establish learning effectiveness.

Implications for Interactive E-Book and Augmented-Reality Design

The findings were used to formulate conceptual requirements for an interactive e-book and augmented-reality learning media. These media were not developed or tested in the present study. They should therefore be understood as construct-informed design propositions for a subsequent research phase.

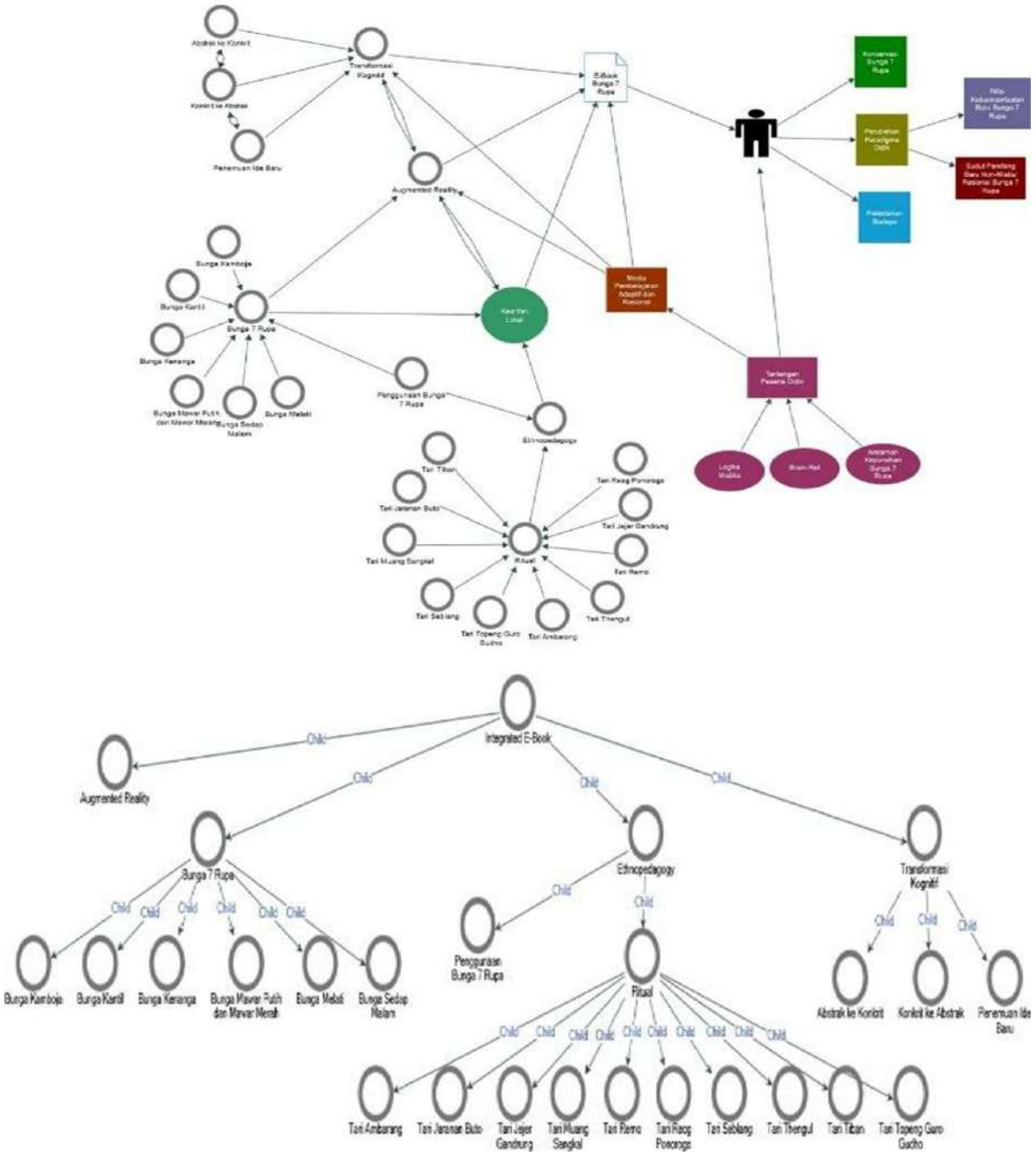

Figure 6. Conceptual Structure of the Interactive E-Book

An interactive e-book could organize content around the five theoretical domains. Ritual Knowledge could inform chapters on dance origins, ritual sequences, and community practices. Flower Meaning could guide illustrated explanations of flower colors, fragrances, arrangements, and symbolic interpretations. Spiritual Value could inform reflective activities concerning gratitude, sacredness, and relationships among people, nature, and tradition. Environmental Preservation could support biodiversity tasks, cultivation activities, and conservation reflections. Ethnopedagogy could connect these materials with character education and contextual biology learning.

Figure 6 illustrates the proposed structure of the interactive e-book, including a chapter map, ethnobotanical pages, cultural narratives, learning activities, and AR-access icons. The mockup represents a conceptual interface rather than an implemented application.

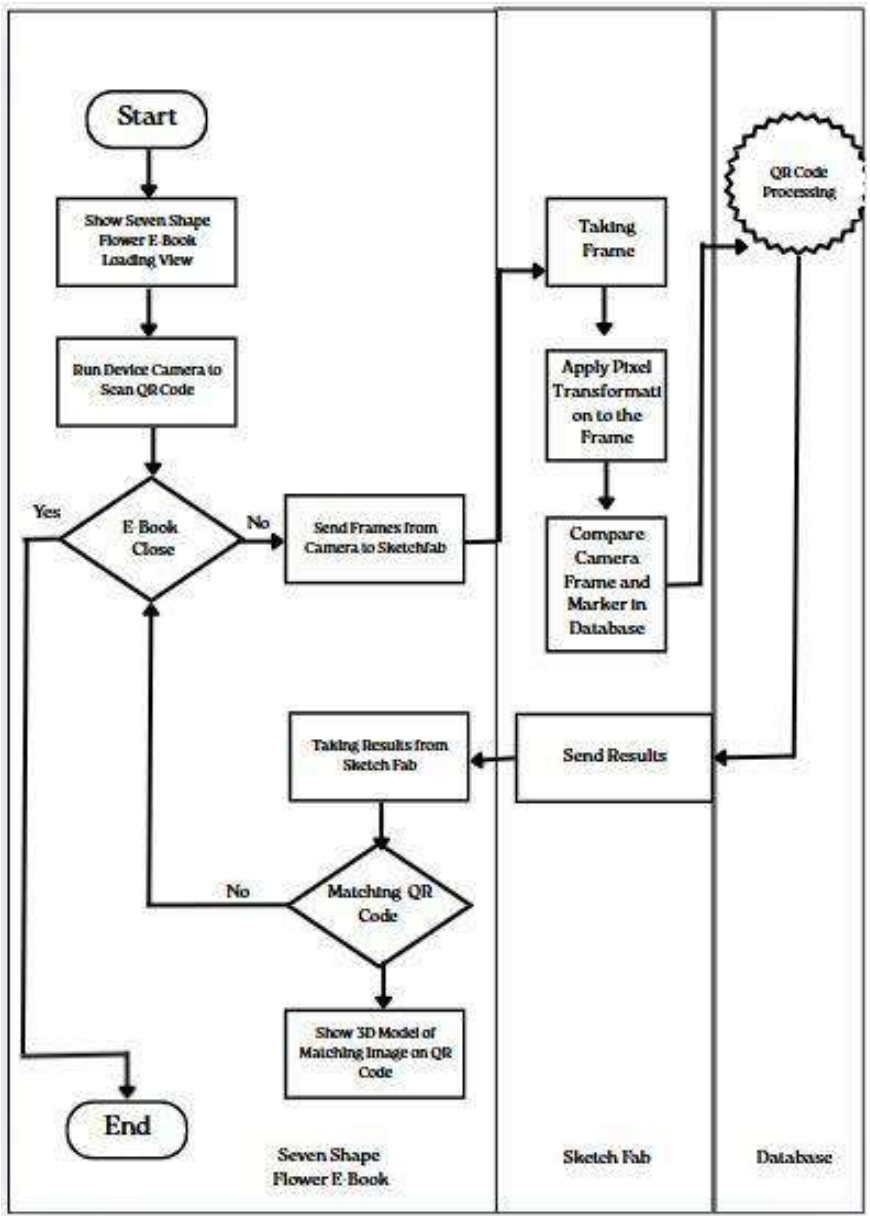

Figure 7. Proposed Augmented-Reality Workflow

Augmented reality is proposed as a complementary visualization tool. A learner could scan a marker or QR-linked trigger to view a three-dimensional flower model

accompanied by botanical labels, cultural narration, and reflection prompts. Research has shown that AR can support the digital preservation and contextual visualization of cultural elements (Shih et al., 2020). Interactive digital quizzes may also promote engagement when they are aligned with clear learning objectives (Zainuddin et al., 2020).

Figure 7 presents the proposed AR workflow, beginning with marker scanning and continuing through image recognition, three-dimensional visualization, audio or text narration, and student reflection. The platform, recognition system, model specifications, and usability requirements remain to be determined through prototype development.

The relationship between the five theoretical domains and the proposed media features is summarized in Table 11. Each feature is linked to an intended educational outcome, but these outcomes remain hypotheses for future testing rather than demonstrated effects of the present study.

Table 11. Mapping of Theoretical Domains to Proposed Interactive E-Book and Augmented-Reality Features

Core component	Content or process	Proposed interactive e-book feature	Proposed AR feature	Intended educational outcome
Seven-flower symbolism	Red rose, white rose, jasmine, cananga, kantil, tuberose, and frangipani	Illustrated ethnobotanical pages describing morphology, color, fragrance, ritual use, and philosophical meaning	Three-dimensional flower models with botanical labels and cultural narration	Learners identify the flowers and distinguish their botanical characteristics from their cultural meanings
Ritual Knowledge	Reog Ponorogo, Jejer Gandrung, Jaranan Buto, Seblang, Muang Sangkal, Thengul, Tiban, Topeng Guro Gudho, and Ambarang	Chapters presenting dance origins, ritual contexts, and reported flower use	Visual sequences showing flower placement and selected ritual stages	Learners describe ritual contexts and the role of flowers in traditional performance
Flower Meaning	Colors, fragrances, arrangements, and symbolic interpretations	Illustrated symbolism sections with comparison and reflection activities	Interactive annotations explaining culturally situated meanings	Learners interpret flower symbolism while recognizing variation across cultural contexts
Spiritual Value	Purification, gratitude, sacredness,	Reflective prompts and culturally sensitive	Audio narration and guided reflection	Learners examine spiritual meanings

Core component	Content or process	Proposed interactive e-book feature	Proposed AR feature	Intended educational outcome
	continuity, and respect	narrative activities	linked to ritual contexts	without presenting them as scientific properties
Environmental Preservation	Local plant diversity, cultivation, sustainable use, and conservation	Biodiversity profiles, habitat information, and conservation activities	Habitat overlays and virtual plant-care or restoration tasks	Learners connect ritual plants with biodiversity and environmental responsibility
Ethnopedagogy	Local wisdom, character education, and contextual biology learning	Lesson activities linking ritual knowledge with biology and cultural education	Scenario-based prompts encouraging cooperation, empathy, and critical reflection	Learners connect scientific content with community knowledge and ethical reflection
Cognitive progression	Observation, identification, interpretation, application, and reflection	Sequential units moving from botanical description to cultural and ecological analysis	Interactive exploration connecting three-dimensional representations with real-world observations	Learners progress from concrete observation to comparative and reflective understanding
Learner challenges	Cognitive overload, cultural oversimplification, and confusion between symbolic and scientific explanations	Layered content, glossaries, formative quizzes, and corrective explanations	Optional information layers and guided interaction	Learners access content at an appropriate level and distinguish evidence-based knowledge from symbolic interpretation
Media integration	Synchronization between the e-book and AR content	Embedded markers or QR-linked access points	Marker recognition followed by model display, narration, and reflection	Learners move between textual, visual, and interactive learning environments

The proposed media design should prioritize cultural accuracy and scientific distinction. Ritual narratives should be reviewed by cultural practitioners, while botanical content should be evaluated by relevant subject specialists. This dual review can reduce the risk of cultural simplification, botanical inaccuracies, or the inappropriate presentation of spiritual meanings as scientific facts.

Digital tools may also support documentation of cultural traditions that are vulnerable to discontinuity. Video recordings, ecological maps, practitioner interviews, and annotated flower models could help preserve contextual information while making it accessible for educational use. When combined with ethnopedagogy, ICT can support learning rooted in cultural identity and ecological context (Maduddin et al., 2024; Rahmawati et al., 2020). Nevertheless, digital representation should complement rather than replace direct engagement with communities, plants, and cultural practitioners.

Limitations and Future Research

This study has several limitations. First, the cross-sectional design does not permit causal conclusions about relationships among ritual knowledge, spirituality, ecological values, and ethnopedagogy. The results indicate associations among self-reported perceptions only.

Second, purposive sampling was necessary to recruit participants with relevant ritual exposure, but it limits the generalizability of the findings. Respondents were recruited from three East Javanese locations and were primarily individuals already connected with traditional dance culture. Their high construct scores may therefore not represent populations with limited familiarity with these practices.

Third, reliance on self-reported Likert-scale responses may have introduced social-desirability and acquiescence biases. The high mean scores and restricted variation also suggest a possible ceiling effect, which may have contributed to non-normal distributions and inflated associations among constructs. Future studies should include behavioral measures, knowledge tests, interviews, and direct observations to complement self-report data.

Fourth, the high overall Cronbach's alpha and several correlations above 0.90 indicate possible semantic redundancy or limited discriminant validity. The PCA was conducted using five aggregate construct scores and therefore cannot confirm the item-level structure of the 25-item questionnaire. Future psychometric research should use larger and more diverse samples to conduct item-level exploratory factor analysis, confirmatory factor analysis, discriminant-validity assessment, and measurement-invariance testing across demographic and cultural groups.

Fifth, the contextual documentation synthesized literature, observations, and ethnographic records descriptively but did not employ an independent qualitative coding procedure. The reported flower arrangement and symbolic meanings should therefore be examined further through systematic interviews, participant observation, and comparison across dance communities. Such work is particularly important for identifying regional variation in flower composition and interpretation.

Finally, the interactive e-book and AR features remain conceptual. Their usability, cultural accuracy, technical feasibility, and educational effectiveness were not tested. Future research should develop functional prototypes and evaluate them through expert review, usability studies, and classroom-based experimental or quasi-experimental designs. Relevant outcomes could include botanical knowledge,

ecological literacy, cultural appreciation, conservation attitudes, and the ability to distinguish scientific explanations from symbolic interpretations.

CONCLUSIONS

This study provides preliminary evidence that Ritual Knowledge, Flower Meaning, Spiritual Value, Environmental Preservation, and Ethnopedagogy are closely interconnected within seven-flower ritual practices in East Javanese traditional dance. The final 25-item instrument demonstrated high internal consistency (Cronbach's alpha = 0.945), and all ten interconstruct correlations were positive and statistically significant, ranging from rho = 0.603 to 0.968. Principal component analysis of the five aggregate construct scores identified one dominant component that explained 83.6% of the total variance, while the hierarchical cluster analysis showed close similarity among the cultural, spiritual, ecological, and educational domains. Together, these findings support the provisional interpretation of an integrated Ethnopedagogical-Ecological Value Dimension.

The results should not, however, be interpreted as final confirmation of five empirically distinct constructs. The very high correlations among several domains and the dominant first component may reflect both genuine cultural integration and possible overlap among questionnaire items. Because item-level exploratory factor analysis, confirmatory factor analysis, and discriminant-validity testing were not conducted, the present findings represent preliminary psychometric evidence rather than full construct validation.

Within this limitation, seven-flower rituals provide a culturally meaningful foundation for contextual biology education. Their botanical characteristics can be connected with taxonomy, morphology, biodiversity, and conservation, while their ritual meanings can support cultural literacy, ethical reflection, and appreciation of local heritage. The construct-to-media mapping developed in this study also offers a conceptual basis for an interactive e-book and augmented-reality learning module. These proposed media remain untested and require expert review, prototype development, usability evaluation, and classroom-based assessment before educational effectiveness can be established.

RECOMMENDATIONS

Biology teachers and curriculum developers may use the five-domain framework to design local-wisdom-based learning activities that connect botanical knowledge with cultural and ecological interpretation. The instrument may also be used provisionally to assess students' initial perceptions or changes following an educational intervention, provided that its exploratory status is clearly acknowledged. Educational technology designers should use the construct-to-media mapping presented in Table 11 as a design guide for developing interactive e-book and augmented-reality prototypes, while ensuring that botanical content is reviewed by subject specialists and ritual narratives are verified by cultural practitioners. Researchers should further evaluate the instrument through item-level exploratory factor analysis, confirmatory factor analysis, discriminant-validity assessment, and measurement-invariance testing across demographic and cultural groups. Subsequent experimental or quasi-experimental studies should compare the proposed digital media with conventional instruction using outcomes such as botanical knowledge, ecological literacy, cultural appreciation, conservation attitudes, and the ability to

distinguish scientific explanations from symbolic interpretations. Collaboration among schools, universities, cultural communities, and heritage institutions is also recommended to document seven-flower ritual practices accurately and support the intergenerational transmission of cultural and ecological knowledge.

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Conflict of Interest Statement
The authors declare that they have no financial, professional, or personal conflicts of interest that could have influenced the conduct, interpretation, or reporting of this study.

Data Availability
Data availability is not applicable to this article because no new data were created or analyzed in this study.

Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

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APPENDIX

Research Instrument for Respondents

Title: Questionnaire on the Ethnopedagogical and Ecological Values of Seven-Flower Rituals

Purpose: This questionnaire collects data on community perceptions of the symbolic, spiritual, ecological, and educational meanings of bunga tujuh rupa used in traditional East Javanese dance rituals.

Instructions: Indicate the extent to which you agree with each statement by selecting one response: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Section A - Ritual Knowledge (RK)

Table A. Ritual Knowledge (RK)

No.	Statement	Response
1	I understand the purpose of using flowers in traditional dance rituals.	1 2 3 4 5
2	Ritual dances in East Java have deep cultural and spiritual meanings.	1 2 3 4 5
3	The use of seven types of flowers in rituals symbolizes important philosophical values.	1 2 3 4 5
4	I can identify the different types of flowers used in East Javanese rituals.	1 2 3 4 5
5	I believe that knowledge of rituals should be preserved through education.	1 2 3 4 5

Section B - Flower Meaning (FM)

Table B. Flower Meaning (FM)

No.	Statement	Response
1	Each type of flower used in rituals carries unique symbolic meanings.	1 2 3 4 5
2	The color of ritual flowers represents moral and emotional values.	1 2 3 4 5
3	Understanding flower symbolism increases appreciation for local culture.	1 2 3 4 5
4	The arrangement of seven flowers in rituals reflects harmony and balance.	1 2 3 4 5
5	Flower symbolism can be used as a learning resource in schools.	1 2 3 4 5

Section C - Spiritual Value (SV)

Table C. Spiritual Value (SV)

No.	Statement	Response
1	Ritual flowers create a sense of peace and spiritual connection.	1 2 3 4 5
2	Participating in traditional dance rituals deepens spiritual awareness.	1 2 3 4 5
3	The fragrance of ritual flowers enhances the sacred atmosphere.	1 2 3 4 5
4	Ritual flowers represent gratitude and purity in spiritual life.	1 2 3 4 5
5	The spiritual value of rituals can guide moral and ethical behavior.	1 2 3 4 5

Section D - Environmental Preservation (EP)

Table D. Environmental Preservation (EP)

No.	Statement	Response
1	Using local flowers in rituals supports the conservation of native plants.	1 2 3 4 5
2	Traditional rituals teach people to respect and care for the environment.	1 2 3 4 5
3	Ritual practices can promote awareness of biodiversity conservation.	1 2 3 4 5
4	Cultivating ritual flowers helps maintain ecological balance.	1 2 3 4 5
5	Local wisdom in rituals contributes to sustainable environmental education.	1 2 3 4 5

Section E - Ethnopedagogy (ET)

Table E. Ethnopedagogy (ET)

No.	Statement	Response
1	Traditional dance rituals can be used as educational tools for character development.	1 2 3 4 5
2	Integrating local culture into learning strengthens students' moral values.	1 2 3 4 5
3	Ethnopedagogical approaches help preserve traditional knowledge.	1 2 3 4 5
4	Ritual flowers can be used in teaching biology, ecology, and environmental science.	1 2 3 4 5
5	Combining digital media (e-book or AR) with local culture enhances learning engagement.	1 2 3 4 5