Development and Evaluation of Constructivist and TPACK–Aligned Digital Resources for Zhuang Dance in Vocational Early Childhood Education: A Mixed–Methods R&D Study

[1]Qi Lyu, and [2]Sureerat Chenpong

Faculty of Fine Arts, Srinakharinwirot University, Thailand

E–mail: [1]qi.lyu@g.swu.ac.th, [2]sureeratc@g.swu.ac.th

Received March 27, 2026; **Revised** May 12, 2026; **Accepted** May 20, 2026

Abstract

This article aimed to 1) develop constructivist and TPACK–aligned digital instructional media resources for Zhuang dance courses in vocational early childhood education, 2) examine the potential of the developed resources to support students' Zhuang dance skill proficiency, and 3) explore students' learning experiences, cultural understanding, and perceived limitations after using the resources. The study was designed as a mixed–methods research and development (R&D) study. Participants were 45 first–year early childhood education students at Baise Vocational College, selected through purposive sampling. Research instruments included a media evaluation form, a Zhuang dance skill rating scale, and semi–structured interview guidelines. Quantitative data were analyzed using descriptive statistics and a pre/post comparison, while qualitative data were analyzed through thematic analysis. Results were as follows: 1) The developed digital resources consisted of segmented videos demonstrating Zhuang dance, rhythm–practice tools, cultural micro–lessons, reflective tasks, peer interaction functions, and teacher–feedback modules. Expert review and pilot revision indicated that the media were appropriate for supporting vocational early childhood education students because the resources connected dance technique, cultural meaning, and future preschool teaching application. 2) The developed resources helped improve the teaching and learning of Zhuang dance, although the improvement in students' dance scores was modest. The post–test mean score (M=68.11) was only slightly higher than the pre–test mean score (M=66.87), suggesting that digital media supported technical review and movement familiarity rather than producing a strong independent effect. 3)

Interviews showed that students valued the resources for self–directed learning, repeated practice, rhythm review, and cultural understanding. However, digital resources demonstrated limited usefulness for developing expressive performance, emotional projection, and stage presence. Therefore, the resources should be used as blended teaching support alongside face–to–face demonstration, correction, and embodied guidance.

Keywords: Zhuang Dance; Research and Development; Vocational Early Childhood Education; Digital Instructional Media; TPACK

Introduction

Zhuang dance is an important form of ethnic cultural expression in Guangxi and a meaningful resource for local early childhood education. In vocational colleges, early childhood education students are expected not only to understand the cultural value of Zhuang dance but also to acquire foundational movement knowledge that can later be transformed into age–appropriate preschool activities. However, the teaching of ethnic dance in vocational early childhood education often faces a mismatch between available resources and learners' professional needs. Many existing materials are designed for professional dance students, while vocational early childhood education students need resources that combine basic technique, cultural interpretation, child–oriented choreography, and teacher–guided application.

Traditional Zhuang dance instruction relies heavily on teacher demonstration, imitation, and repeated in–class practice. This model is valuable because dance learning requires embodied correction and live feedback, but it is often constrained by limited class time, uneven student foundations, insufficient opportunities for repeated review, and weak access to culturally contextualized materials. Students without prior dance experience may have difficulty remembering movement sequences, understanding rhythm, and connecting body movement with cultural meaning. These challenges are particularly significant for early childhood education majors, who are future teachers and therefore require both basic performance competence and the ability to explain dance meaning to children.

Digital instructional media offer a possible way to supplement traditional dance teaching. Segmented videos, rhythm tools, interactive review platforms, and cultural micro–lessons can provide learners with flexible access to demonstrations and explanations outside class. From a constructivist perspective, such resources may support active knowledge construction through repeated practice, reflection, and peer interaction. From a TPACK perspective, effective digital

resources must integrate technology, pedagogy, and Zhuang dance content rather than simply place videos online. From an ADDIE perspective, the resources should be developed through systematic analysis, design, development, implementation, and evaluation so that they are pedagogically coherent and practically usable.

The present study was therefore revised from a general mixed–methods intervention study into a mixed–methods research and development (R&D) study. This revision responds to the need to clarify not only whether the resources influenced students' learning outcomes, but also how the resources were developed, evaluated, revised, and applied. The focus is not to claim that digital media can replace dance teachers or independently produce large performance gains. Rather, the study examines whether constructivist and TPACK–aligned digital resources can serve as supportive teaching materials for Zhuang dance learning in vocational early childhood education.

The research problem addressed in this study is that culturally embedded, pedagogically adapted, and digitally supported resources for Zhuang dance instruction remain insufficient for vocational early childhood education students. By developing and evaluating a WeChat mini–program–based resource package, this study aims to provide a practical model for connecting ethnic dance inheritance, digital instructional design, and teacher–preparation needs in local vocational education.

Research Objectives

1. To develop and evaluate constructivist and TPACK–aligned innovative instructional media resources for Zhuang dance courses in vocational early childhood education.

2. To examine the potential effectiveness of the developed instructional media resources in supporting students' Zhuang dance skill proficiency.

3. To explore students' learning experiences, cultural understanding, and perceived limitations regarding the application of the developed digital resources in Zhuang dance instruction.

Literature Review

Constructivist Theory in Dance Education

Constructivist theory views learning as an active process in which learners construct knowledge through interaction, reflection, and experience rather than passively receiving

information. In higher education, constructivist learning environments have been shown to promote engagement, deeper understanding, and learner–centered participation, particularly when learners are encouraged to explore, interpret, and apply knowledge independently (Kwan & Wong, 2015; Mensah, 2015). In dance education, this perspective is important because dance learning is not limited to imitation. Learners must gradually connect movement, rhythm, spatial awareness, cultural symbolism, and expressive intention through embodied practice.

A constructivist approach can support Zhuang dance learning by allowing students to observe, practice, compare, reflect, and reconstruct their understanding of movement meaning. Digital media can strengthen this process when it provides segmented demonstrations, opportunities for repeated review, self–reflection prompts, peer discussion, and teacher feedback. Therefore, the value of digital media lies not only in technical presentation but also in the learning environment it creates. If the resources allow students to practice actively, revisit difficult movements, and connect dance actions with cultural explanations, they can support meaningful knowledge construction rather than mechanical imitation.

TPACK Framework for Technology–Enhanced Education

The Technological Pedagogical Content Knowledge (TPACK) framework emphasizes the integrated relationship among technological knowledge, pedagogical knowledge, and content knowledge in instructional design. Rather than treating technology as an isolated tool, TPACK requires teachers and designers to consider whether the selected technology truly supports the learning goals, content characteristics, and teaching strategies of the subject (Koehler et al., 2013; Mishra & Koehler, 2006; Schmidt et al., 2009). This framework is useful for dance education because movement learning requires visual demonstration, rhythmic guidance, cultural explanation, feedback, and repeated embodied practice. In this context, a digital tool is appropriate only when it supports these dance–specific learning needs.

For Zhuang dance teaching in vocational early childhood education, TPACK alignment means that technology should help learners see movement structure clearly, understand the cultural meaning of gestures and rhythms, and connect dance learning with future preschool teaching. The pedagogical component should include scaffolding, teacher guidance, collaborative learning, and reflective practice. The content component should include not only Zhuang dance techniques but also cultural symbols, festival contexts, rhythm patterns, and child–oriented

adaptation. Therefore, the integration of TPACK with constructivist theory provides a stronger foundation for developing ethnic dance resources than technology use alone.

ADDIE Model and Media Evaluation in Instructional Resource Development

The ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation, provides a systematic process for developing instructional media. It supports the connection among learner needs, teaching objectives, media design, resource development, classroom implementation, and evaluation (Li & Cheong, 2023; Molenda, 2003; Spatioti et al., 2022). In digital instructional media development, ADDIE is useful because it requires the researcher to clarify the instructional problem before designing materials, to evaluate the usability and appropriateness of resources before full implementation, and to revise resources based on feedback.

In the context of Zhuang dance education, ADDIE is particularly important because the resources must be culturally appropriate, pedagogically sequenced, technically usable, and aligned with early childhood education students' professional orientation. Reviewer feedback on the original manuscript indicated that the development process and media evaluation should be made clearer. Accordingly, this revised study explicitly positions the research as an R&D study and includes expert review and pilot revision as part of the development stage. This adjustment helps distinguish the quality of the developed media from the later evaluation of student dance performance.

Innovative Instructional Media in Dance Education

Innovative instructional media, especially digital and multimodal tools, have increasingly expanded access to learning materials and supported more flexible practice. Previous studies have shown that flipped learning, mobile technology–assisted peer assessment, and other technology–supported approaches may improve learning motivation, self–efficacy, and dance skill development when they are integrated with appropriate pedagogy (Jian, 2019; Li et al., 2018; Lin et al., 2019). Digital media can be useful in dance education because learners can repeatedly view demonstrations, slow down difficult sections, compare their own performance with models, and review rhythm or cultural information outside classroom time.

Nevertheless, digital resources also have limitations. Dance is an embodied and expressive art form. Movement quality, emotional projection, stage presence, and cultural embodiment often require direct teacher observation, correction, and affective coaching. Therefore, the literature

suggests that digital media should not be understood as a replacement for teachers, especially in ethnic dance education. Instead, digital media should serve as learning support that extends practice opportunities, strengthens cultural explanation, and helps teachers organize blended teaching.

Zhuang Dance Education in Vocational Early Childhood Education

Zhuang dance is closely connected to ethnic minority culture, local identity, rhythm, ritual, labor, and festival expression. In vocational early childhood education, Zhuang dance teaching has a dual purpose: it should develop students' foundational dance competence and prepare them to adapt ethnic cultural materials for preschool teaching. This means that early childhood education students do not need to be trained in the same way as professional dance majors, but they should gradually develop basic technical accuracy, rhythm awareness, cultural understanding, and the ability to design simple child-oriented dance activities. This clarification resolves the possible conflict between students' major and the professional expectation of ethnic dance teaching.

Existing studies on dance education and cultural representation indicate that ethnic cultural forms may be visible in educational discourse but not always developed into practical teaching resources (Lin & Jackson, 2022). At the same time, students without prior dance experience need scaffolding, repeated practice, and confidence-building strategies in order to master movement and rhythm (Mainwaring & Krasnow, 2010). The literature therefore supports the need for targeted digital resources that combine technique, culture, teacher guidance, and future teaching application. This study addresses that gap by developing and evaluating digital instructional media specifically for Zhuang dance learning among vocational early childhood education students.

Summary of the Literature Review

The reviewed literature indicates that constructivist learning theory provides the learner-centered foundation, the TPACK framework explains how technology, pedagogy, and content should be integrated, and the ADDIE model offers the systematic R&D process for instructional media development. Studies on dance education further suggest that technology-supported resources can promote repeated practice, learner autonomy, and self-efficacy, while also showing that expressive and embodied qualities still require live teacher support. Therefore, this study integrates constructivism, TPACK, and ADDIE to design culturally grounded digital resources for Zhuang dance and evaluates them through media development review, student performance assessment, and qualitative learning experience analysis.

Conceptual Framework

This research is a mixed-methods R&D study. The conceptual framework links three parts: input, development process, and evaluation output. The input includes Zhuang dance content, the learning characteristics of vocational early childhood education students, cultural meanings, and future preschool teaching needs. The development process uses ADDIE as the overall procedure, constructivist theory as the learning principle, and TPACK as the alignment framework for technology, pedagogy, and content. The evaluation output includes expert review of media appropriateness, a 16-session classroom implementation, pre/post dance skill assessment, and student interviews. The framework emphasizes that digital resources are supportive tools in a blended teaching model rather than replacements for teacher demonstration and embodied correction.

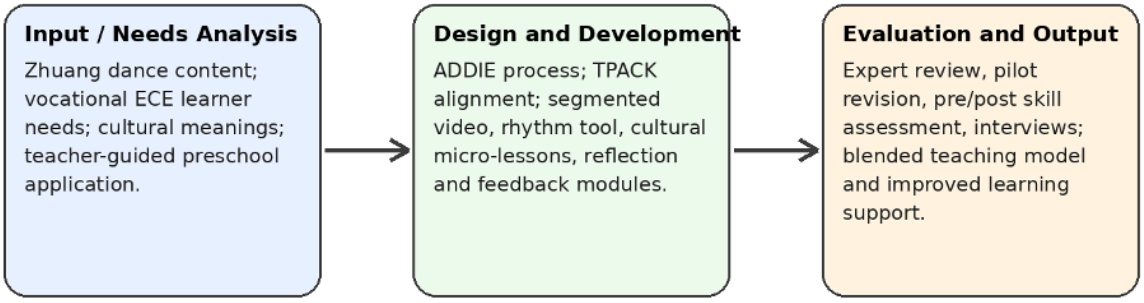


Figure 1 Conceptual Framework

Research Methodology

Research Design

This study used a mixed-methods research and development (R&D) design. The R&D structure was adopted to respond to the nature of the study, which involved not only testing student learning outcomes but also developing, reviewing, revising, and implementing digital instructional media for Zhuang dance. The quantitative component included expert media review and pre/post dance skill assessment, while the qualitative component included student interviews and interpretation of learning experiences. The design was organized into three phases. Phase 1 was the development phase, in which learner needs, Zhuang dance content, cultural materials, technological platform functions, and pedagogical strategies were analyzed and transformed into digital resources. Phase 2 was the implementation phase, in which the developed resources were used during a 16-session Zhuang dance intervention. Phase 3 was the evaluation phase, in which

media suitability, student skill performance, learning experience, cultural understanding, and perceived limitations were analyzed.

Because the study used one class in a natural vocational college setting, it employed a one-group pre-test-post-test structure for the skill assessment. This design allowed the researcher to examine changes after intervention, but it does not provide the same level of causal evidence as a randomized control-group experiment. Therefore, the revised manuscript interprets the score change cautiously as modest learning support rather than strong proof of effectiveness.

Participants

The research population comprised 235 first-year early childhood education majors aged 18–19 from five classes of the 2025 cohort at Baise Vocational College in Guangxi Zhuang Autonomous Region. All students were enrolled in mandatory Zhuang dance courses as part of their professional training. Through purposive sampling, 45 students from one class were selected as the research participants. The sample consisted of 42 female students (93.3%) and 3 male students (6.7%). In terms of ethnicity, 26 students identified as Zhuang (57.8%), 14 as Han (31.1%), and 5 as other ethnic minorities including Yao, Miao, Yi, and Shui (11.1%). Twenty students were 18 years old (44.4%), and 25 students were 19 years old (55.6%).

Table 1 Demographic Characteristics of the Participants (n=45)

Demographic Variable	Category	Number (n)	Percentage (%)
Gender	Male	3	6.7
	Female	42	93.3
Ethnicity	Zhuang	26	57.8
	Han	14	31.1
	Yao	2	4.4
	Miao	1	2.2
	Yi	1	2.2
	Shui	1	2.2
Age	18 years old	20	44.4
	19 years old	25	55.6

Instruments

Media Evaluation Form. A media evaluation form was used to review the appropriateness of the developed digital instructional resources before the formal intervention. The evaluation dimensions included content and cultural accuracy, pedagogical alignment, technological usability,

visual and audio clarity, learner engagement, and applicability to vocational early childhood education. Five experts in dance education, early childhood education, educational technology, and ethnic culture reviewed the materials. Their comments were used to revise the resources before implementation. This instrument was added in the revised manuscript to respond to the recommendation that the quality of the media or innovation should be evaluated before pilot testing and classroom application.

Student Dance Skills Rating Scale. The Student Dance Skills Rating Scale was designed to assess Guangxi Zhuang dance performance. It contained 20 items across four categories: Content Selection, Stage Presence, Dance Technique, and Overall Expression. Each item was rated on a 5-point Likert scale with behaviorally anchored descriptors ranging from very poor to excellent. The total possible score was 100, with higher scores indicating better skill proficiency. Two experienced Zhuang dance instructors conducted independent evaluations after a calibration session, and consensus scores were used when rating differences occurred. The scale's content validity was reviewed by five experts, and the average Item-Objective Congruence (IOC) score exceeded 0.80.

Semi-structured Interview Outline. Semi-structured interviews were used to explore students' perceptions of the digital resources, their learning experiences, the perceived effect on skill learning, cultural understanding, learning motivation, challenges, and suggestions for improvement. The interview protocol included five open-ended questions. It was reviewed by five experts through IOC assessment, with an average score above 0.80. Interview responses were used to complement the quantitative skill assessment and to explain how students experienced the digital resources during learning.

Materials and Media Development

The instructional materials consisted of a 16-session Zhuang dance intervention supported by a WeChat mini-program. The resources were developed according to the ADDIE model. During the Analysis phase, the researcher reviewed learners' foundations, course objectives, Zhuang dance cultural elements, common movement difficulties, and the future teaching needs of early childhood education students. During the Design phase, the researcher organized the resources into technical movement modules, rhythm-practice modules, cultural micro-lessons, reflection tasks, and feedback activities. During the Development phase, the researcher produced segmented demonstration videos, rhythm tools, cultural courseware, movement comparison functions, peer evaluation tasks, reflective journals, and teacher-feedback modules. During the

Implementation phase, the resources were integrated into classroom teaching through pre-class preview, in-class guided practice, and post-class reflection. During the Evaluation phase, expert review, skill assessment, and student interviews were used to evaluate and revise the application model.

The media evaluation process led to several revisions before the full intervention. First, movement videos were segmented into shorter clips to help students review difficult parts repeatedly. Second, cultural explanations were simplified and connected with specific gestures or rhythm patterns so that students could understand meaning while practicing. Third, teacher-feedback and peer-review functions were emphasized because experts noted that expressive quality cannot be developed through video viewing alone. Fourth, the resources were revised to include child-oriented application prompts, so that early childhood education students could connect Zhuang dance learning with future preschool teaching.

Intervention

A 16-session instructional intervention was delivered to the sample group. The intervention integrated self-developed digital teaching media into Zhuang dance teaching and adopted a blended model of pre-class autonomous learning, in-class guided practice, and post-class reflective consolidation. Before class, students used the mini-program to preview segmented videos and cultural micro-lessons. During class, the instructor provided demonstration, correction, rhythm guidance, and expressive coaching. After class, students used the resources for repeated practice, self-review, peer discussion, and reflection. This model was designed to avoid treating digital media as a teacher replacement and to emphasize the complementary relationship between digital resources and face-to-face dance instruction.

Data Collection

Data collection was conducted in three stages. First, the developed resources were reviewed by experts, and revision suggestions were recorded before classroom implementation. Second, quantitative pre-test and post-test data were collected through the Student Dance Skills Rating Scale. The pre-test was administered before the 16-session intervention, and the post-test was administered after the final performance. Third, qualitative data were collected through semi-structured interviews with eight randomly selected students. The interviews explored students' perceptions of the resources, the perceived influence on Zhuang dance learning, learning

advantages, challenges, and recommendations. All interviews were audio-recorded with consent, transcribed verbatim, and anonymized as S1–S8.

Data Analysis

Quantitative data were analyzed using descriptive statistics, including mean, standard deviation, percentage, and pre/post score comparison. Normality tests were used to examine the distribution of scores. Because the mean improvement was small, the revised analysis emphasizes both statistical comparison and practical interpretation. The article therefore avoids overstating the effect and describes the resources as supportive rather than strongly effective. Qualitative interview data were analyzed through thematic analysis. The researcher repeatedly read the transcripts, identified meaningful units, developed initial codes, grouped the codes into themes, and compared the themes with the quantitative results. The integrated interpretation was used to explain how digital resources supported learning and where their limitations remained.

Research Results

1. Results related to Objective 1: Development and evaluation of the digital instructional resources

The first objective was to develop and evaluate constructivist and TPACK-aligned digital instructional media resources for Zhuang dance courses in vocational early childhood education. The results of the development phase indicated that the resources were transformed from a general digital teaching tool into a structured R&D-based resource package. The final resource package included five major components: segmented movement demonstration, rhythm-practice support, cultural micro-lessons, peer interaction and feedback, and preschool application prompts. These components were designed to connect Zhuang dance technique, cultural meaning, learner-centered practice, and future teaching application.

Expert review and pilot feedback suggested that the resources were generally appropriate for supporting vocational early childhood education students, but they also required teacher guidance to function effectively. The experts emphasized that early childhood education students should develop foundational competence and cultural understanding rather than professional-level dance specialization. Therefore, the resource design was revised to include child-oriented application tasks and simplified cultural explanations. The development results also showed that

digital media should be designed as a blended teaching support system, not as a complete substitute for live instruction.

The development process addressed the mismatch identified in the original manuscript. The revised study now reports how the resources were developed, how expert review was used, and how the materials were revised before implementation. This strengthens the R&D logic of the study and makes the title, objectives, methodology, and results more consistent.

2. Results related to Objective 2: Effectiveness of the developed resources in supporting dance skill proficiency

The second objective was to examine the potential effectiveness of the developed resources in supporting students' Zhuang dance skill proficiency. The descriptive results showed that the post-test score was slightly higher than the pre-test score. The pre-test mean was 66.87 (SD = 9.33), while the post-test mean was 68.11 (SD = 9.10). The mean gain was 1.24 points on a 100-point scale. This improvement should be interpreted as modest. The finding suggests that digital resources could help improve the teaching and learning process, especially in movement review and rhythm familiarity, but the score increase does not support a strong claim that digital media produced a large effect.

Table 2 Descriptive Statistics of Student Dance Skills Rating Scale

Variable	n	Max	Min	M	SD	Variance	Kurtosis	Skewness	CV
Pre-test	45	86	45	66.867	9.331	87.073	-0.015	-0.205	0.140
Post-test	45	87	47	68.111	9.099	82.783	-0.070	-0.180	0.134

Note. n = sample size; Max = maximum; Min = minimum; M = mean; SD = standard deviation; CV = coefficient of variation.

The normality test results showed no significant deviation from normality for the pre-test and post-test total scores. However, the paired difference distribution was not normal. Therefore, the revised manuscript treats the pre/post comparison cautiously and emphasizes the magnitude and educational meaning of the change rather than relying only on statistical significance.

Table 3 Normality Test Results of Student Dance Skill Scores

Variable	n	Shapiro–Wilk	Kolmogorov–Smirnov	Interpretation
Pre–test	45	0.989 (p = 0.934)	0.065 (p = 0.908)	No significant deviation from normality
Post–test	45	0.988 (p = 0.917)	0.096 (p = 0.386)	No significant deviation from normality
Paired difference	45	0.820 (p < 0.001)	0.309 (p < 0.001)	Non–normal difference distribution

The paired comparison indicated a small positive change from pre–test to post–test. Students showed clearer improvement in technical aspects such as body alignment, low–stance stability, movement sequence memory, and rhythmic synchronization. However, expressive components such as emotional projection, stage presence, and culturally embodied performance changed less obviously. These results suggest that digital resources were more useful for reviewing structured movement and rhythm than for developing expressive dance quality.

Table 4 Pre–test and Post–test Comparison of Zhuang Dance Skill Scores

Comparison	Pre–test M	Post–test M	Mean Gain	Practical Interpretation
Overall skill score	66.87	68.11	1.24	Modest improvement; digital media could support learning but should not be claimed as strongly effective.
Technical execution	Moderate baseline	Slightly improved	Positive trend	Students benefited from repeated viewing and rhythm practice.
Expressive performance	Moderate baseline	Limited change	Weak trend	Teacher demonstration and embodied feedback remained necessary.

3. Results related to Objective 3: Learning experiences, cultural understanding, and perceived limitations

The third objective was to explore students' learning experiences, cultural understanding, and perceived limitations regarding the use of the developed digital resources. Thematic analysis of the interviews produced four themes: tool usefulness, skill learning support, engagement and autonomous learning, and limitations requiring teacher guidance.

Theme 1: Tool usefulness. Participants reported that the mini–program made Zhuang dance learning more convenient because they could review movement sequences outside class. Students stated that the demonstrations were clear and that they could replay difficult sections

when they forgot movements. The tool was therefore useful as a review and consolidation resource, especially for beginners who needed repeated exposure to movement structure.

"The movements were shown clearly in the program, so I could watch them again and practice step by step." (S2)

"It was helpful that I could open the program anytime and check the movements when I forgot something." (S5)

Theme 2: Skill learning support. Students indicated that the digital resources helped them remember movement order, follow rhythm, and coordinate hand–foot movement. The videos and rhythm tools were especially useful for technical rehearsal. However, students also noted that some complex movements still required instructor explanation and correction. This theme is consistent with the quantitative results, which showed modest improvement mainly in technical aspects.

"I sometimes forgot how certain movements connect, but the program allowed me to watch them again and follow the order more carefully." (S3)

"It was easier to follow the music when I practiced along with the video." (S6)

Theme 3: Engagement and cultural understanding. Students reported that the resources made practice less repetitive and increased their willingness to learn. The cultural micro–lessons helped them understand the meaning behind gestures, rhythm, and festival–related movements. For early childhood education majors, this cultural understanding was important because they need to explain ethnic cultural content to children in the future.

"The program introduced some cultural background, which helped me better understand the dance." (S1)

"After using the program, I had a clearer idea of what the movements represent." (S4)

Theme 4: Challenges and limitations. Students mentioned technical inconvenience, unstable loading, limited explanations for complex movements, and the need for direct teacher guidance. Several students emphasized that watching videos was helpful but could not replace in–class practice with the teacher. These findings confirm that digital media should be integrated into a blended teaching model rather than used as independent instruction.

"For some more complex parts, I still needed the teacher to explain or demonstrate again." (S7)

"I could review the movements in the program, but practicing with the teacher helped me feel more confident." (S2)

Table 5 Summary of Interview Themes

Theme	Main Finding	Educational Meaning
Tool usefulness	Students used the mini-program for repeated review and movement memory.	Digital resources extended practice beyond class.
Skill learning support	Resources helped movement order, rhythm, and coordination, but complex movements needed instructor support.	Digital media supported technical rehearsal but not full mastery.
Engagement and cultural understanding	Students reported stronger interest and clearer understanding of Zhuang cultural meanings.	The resources connected dance learning with cultural education.
Challenges and limitations	Technical problems, limited explanations, and need for face-to-face guidance were reported.	Blended teaching remains necessary.

Discussions

The revised findings suggest that constructivist and TPACK-aligned digital resources can support the teaching of Zhuang dance in vocational early childhood education, but the support should be understood as limited and conditional. The score increase from 66.87 to 68.11 indicates a modest improvement rather than a strong effect. This directly responds to the reviewer's concern that the original manuscript overstated the effectiveness of digital media. The revised interpretation is that the media could help improve the teaching and learning process, especially by providing students with more opportunities for review, rhythm practice, and movement familiarization.

The results are consistent with the idea that technology-supported dance learning is useful when it allows repeated practice and self-directed review. Students valued the mini-program because it allowed them to watch demonstrations repeatedly and practice at their own pace. This supports previous findings that mobile and digital resources can improve learning autonomy, self-efficacy, and skill rehearsal in dance education (Li et al., 2018; Lin et al., 2019). In this study, however, the benefit was more visible in technical rehearsal than in expressive performance. This distinction is important because it shows that digital resources are not equally effective for all dimensions of dance learning.

The study also clarifies the professional role of early childhood education students. They are not being trained as professional ethnic dance performers, but as future teachers who need foundational dance competence, cultural understanding, and the ability to adapt Zhuang dance elements for children. Therefore, the revised manuscript no longer describes the students as lacking professional expertise in a contradictory way. Instead, it explains that the resources are designed to scaffold their development from beginners to culturally aware prospective preschool teachers. The preschool application prompts added to the media design strengthen this professional relevance.

The R&D revision strengthens the coherence of the study. In the original version, the title and first objective emphasized media development, but the results focused mainly on learning effectiveness and student perceptions. In the revised version, the development stage is reported more clearly through needs analysis, media design, expert review, pilot revision, and resource output. This better aligns the title, objectives, methodology, and results. It also responds to the suggestion that the study should be framed as R&D research to ensure greater completeness.

The limitations of digital media are also evident. Expressive performance, emotional projection, body quality, stage presence, and cultural embodiment require direct teacher demonstration, physical correction, and face–to–face feedback. Digital resources may help students remember movements, understand cultural contexts, and practice repeatedly, but they cannot fully replace embodied interaction between teacher and learner. Therefore, the most appropriate teaching model is not fully online or media–only teaching, but a blended approach in which digital resources support preview and review while teachers guide expressive and technical refinement in class.

New Knowledge from Research

The knowledge generated from this research is a blended R&D model for Zhuang dance digital resource development in vocational early childhood education. The model can be summarized as follows: learner needs and cultural content are first analyzed; Zhuang dance skills and cultural meanings are then transformed into TPACK–aligned digital resources; expert review and pilot revision are used to improve media appropriateness; classroom implementation combines digital preview, teacher–guided practice, and reflective review; and final evaluation examines both skill performance and learning experience. This model shows that digital instructional media are

most valuable when they support active practice, repeated review, cultural understanding, and future teaching application.

The study contributes practical knowledge by demonstrating that digital resources for ethnic dance education should include both technique and culture. A useful Zhuang dance resource for early childhood education students should not only show movement but also explain why the movement matters, how it connects with ethnic cultural meaning, and how it can be adapted for children. The study also contributes methodological knowledge by showing that media development studies should include a clear R&D process and media evaluation stage before reporting learning outcomes. Finally, the study contributes pedagogical knowledge by confirming that digital media are supportive but incomplete; expressive dance learning still requires teacher guidance and embodied feedback.

Conclusion

This study concluded that digital teaching materials aligned with constructivist learning principles and the TPACK framework can support the teaching of Zhuang ethnic dance in vocational early childhood education. Through an R&D process based on the ADDIE model, the study developed a WeChat mini-program-based resource package that included segmented videos, rhythm tools, cultural micro-lessons, peer interaction, reflection tasks, and preschool application prompts. Expert review and pilot revision helped improve the appropriateness of the resources before classroom implementation.

The developed resources showed potential to support students' Zhuang dance learning, especially in technical review, movement sequence memory, rhythm practice, learning autonomy, and cultural understanding. However, the quantitative improvement was modest, with the mean score increasing only from 66.87 to 68.11. Therefore, the findings should not be interpreted as evidence that digital media alone can strongly improve dance performance. Instead, the results indicate that digital resources may help improve the teaching process and provide additional learning support for beginners.

The study also found that digital resources were insufficient for developing expressive performance, emotional projection, stage presence, and culturally embodied movement quality. These aspects still require face-to-face demonstration, teacher correction, and guided practice. Therefore, the recommended application of the resources is a blended teaching model that

combines digital preview and review with in-person dance instruction. Overall, the study provides a practical R&D-based model for integrating digital technology, Zhuang ethnic culture, and vocational early childhood education.

Suggestions

Vocational colleges offering Zhuang dance or other ethnic dance courses may use the findings of this study to develop blended instructional resources. Digital media should be used to support pre-class preview, after-class review, rhythm practice, cultural explanation, and student reflection. Instructors should not rely on digital tools alone but should combine them with direct demonstration, correction, emotional guidance, and performance feedback. For early childhood education students, teachers should also include child-oriented choreography and teaching application tasks so that students can connect ethnic dance learning with future preschool practice.

Future studies should expand the sample size and include more institutions in order to improve generalizability. A control group or quasi-experimental design should be used to compare digital-supported blended teaching with traditional instruction. Longitudinal research is also recommended to examine whether students retain Zhuang dance skills and transfer them into preschool teaching practice. In addition, future research may use motion analysis, peer evaluation, expert performance scoring, or multimodal feedback tools to provide more objective evidence of movement quality and expressive development. Further R&D cycles should also refine the media evaluation model and test how the resources can better support expressive performance and cultural embodiment.

References

Jian, Q. (2019). Effects of digital flipped classroom teaching method integrated cooperative learning model on learning motivation and outcome. *The Electronic Library, 37*(5), 842-859. https://doi.org/10.1108/EL-02-2019-0024

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)?. *Journal of Education, 193*(3), 13-19. https://doi.org/10.1177/002205741319300303

Kwan, Y. W., & Wong, A. F. L. (2015). Effects of the constructivist learning environment on students' critical thinking ability: Cognitive and motivational variables as mediators. *International Journal of Educational Research, 70,* 68–79. https://doi.org/10.1016/j.ijer.2015.02.006

Li, H., & Cheong, J. P. G. (2023). Using the ADDIE model to design and develop physical education lessons incorporated with a functional training component. *Frontiers in Public Health, 11,* 1201228. https://doi.org/10.3389/fpubh.2023.1201228

Li, Z., Zhou, M., & Teo, T. (2018). Mobile technology in dance education: A case study of three Canadian high school dance programs. *Research in Dance Education, 19*(2), 183–196. https://doi.org/10.1080/14647893.2017.1370449

Lin, J. C., & Jackson, L. (2022). Just singing and dancing: Official representations of ethnic minority cultures in China. *International Journal of Multicultural Education, 24*(3), 94–117. https://doi.org/10.18251/ijme.v24i3.3007

Lin, Y. N., Hsia, L. H., Sung, M. Y., & Hwang, G. H. (2019). Effects of integrating mobile technology–assisted peer assessment into flipped learning on students' dance skills and self–efficacy. *Interactive Learning Environments, 27*(8), 995–1010. https://doi.org/10.1080/10494820.2018. 1461115

Mainwaring, L. M., & Krasnow, D. H. (2010). Teaching the dance class: Strategies to enhance skill acquisition, mastery and positive self–image. *Journal of Dance Education, 10*(1), 14–21. https://doi.org/10.1080/15290824.2010.10387153

Mensah, E. (2015). Exploring constructivist perspectives in the college classroom. *SAGE Open, 5*(3). https://doi.org/10.1177/2158244015596208

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467–9620.2006.00684.x

Molenda, M. (2003). In search of the elusive ADDIE model. *Performance Improvement, 42*(5), 34–37. https://doi.org/10.1002/pfi.4930420508

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544

Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A comparative study of the ADDIE instructional design model in distance education. *Information, 13*(9), 402. https://doi.org/10.3390/info130 90402