Blended Learning for Character Education: Integrating Tri Hita Karana Wisdom to Develop Graduate Competencies Aligned with SDGs

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Article Info

ABSTRACT

Purpose of the study: This study examines the effectiveness of a technology-enhanced character education model based on the Balinese *Tri Hita Karana* philosophy in developing primary students' competencies aligned with SDG 4. Using blended learning, it addresses gaps in research on culturally grounded technology integration in character education.

Methodology: This quasi-experimental study involved 92 fifth-grade students from four primary schools in Karangasem, Bali, comparing a Technology-Enhanced Tri Hita Karana Character Education Model with conventional instruction. Using LMS, digital portfolios, gamification, and learning analytics, competencies were assessed through questionnaires, portfolios, and observations, with data analyzed using t-tests, ANCOVA, and thematic analysis.

Main Findings: The experimental group demonstrated significantly higher graduate competency scores (M=81.89, SD=9.78) compared to the control group (M=70.02, SD=10.02), t(90)=5.98, p<.001, Cohen's d=1.25, indicating a large effect size. Analysis of digital portfolio data revealed enhanced self-regulated learning behaviors and deeper engagement with character development activities. Qualitative analysis showed that students appreciated the gamification elements and found the LMS-mediated learning more engaging and meaningful. Learning analytics data indicated consistent progress tracking and timely teacher interventions.

Novelty/Originality of this study: The technology-enhanced Tri Hita Karana character education model effectively develops primary students' competencies through culturally grounded digital pedagogy. This study strengthens evidence on technology-mediated character education and shows how local wisdom supports global educational goals. It highlights the need for teacher professional development and policy support to implement culturally responsive, technology-enhanced, and sustainable blended learning in primary education.

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1.   INTRODUCTION

In an era characterized by rapid technological advancement and increasing moral complexities, character education has emerged as a critical component of holistic education aimed at developing not only academically proficient but also ethically grounded citizens [1]-[3]. The integration of technology in character education, however, remains an underexplored frontier, particularly in culturally diverse contexts where indigenous knowledge systems offer unique pedagogical approaches [4]-[6]. This study seeks to address this gap by investigating how educational technology can enhance character education grounded in Tri Hita Karana, a Balinese philosophical framework emphasizing harmonious relationships with God (parahyangan), fellow humans (pawongan), and nature (palemahan) [7]-[9].

The urgency of character education in Indonesia is underscored by alarming statistics on moral degradation. Indonesia's Anti-Corruption Behavior Index (IPAK) decreased from 3.92 in 2023 to 3.85 in 2024, indicating persistent integrity challenges [10]. Drug abuse among the 15-64 age demographic increased from 1.80% (2009) to 1.95% (2021), affecting approximately 4.8 million individuals [11]-[13]. Youth delinquency, including brawls, rose from 12.9% (2017) to 14.0% (2018) [14], while bullying cases surged from 119 (2020) to 241 (2023). The Indonesian Child Protection Commission (KPAI) reported 37 child suicide cases in January-November 2023 alone [15], [16]. These disturbing trends emphasize the need for innovative, effective character education interventions that resonate with students' cultural contexts while leveraging contemporary technological affordances.

While the Indonesian government has initiated the Character Education Strengthening (Penguatan Pendidikan Karakter/PPK) program, its implementation has yielded suboptimal results, partly due to insufficient integration of technology and lack of cultural contextualization [17]-[19]. This research highlights the novelty of integrating a local wisdom framework, Tri Hita Karana, with educational technology to fill this gap and improve character education delivery in primary schools. Recent scholarship highlights the potential of technology-enhanced learning (TEL) to scale effective pedagogical practices, provide personalized learning experiences, and facilitate continuous assessment and feedback [20]-[22]. However, most TEL research focuses on cognitive outcomes in Western contexts, with limited attention to affective and character development in non-Western settings [4], [23]-[25].

This study is grounded in three interconnected theoretical frameworks: (1) sociocultural learning theory [26], which posits that learning is mediated by cultural tools and social interactions; (2) the TPACK (Technological Pedagogical Content Knowledge) framework [27], which guides the integration of technology, pedagogy, and content knowledge; and (3) indigenous knowledge systems theory [28], which recognizes the validity and pedagogical value of culturally-grounded epistemologies.

Tri Hita Karana, as a holistic philosophical framework, aligns remarkably well with the four pillars of education proposed by Fang et al. [29], learning to know, learning to do, learning to be, and learning to live together. The parahyangan dimension cultivates spiritual intelligence and ethical grounding (learning to be); pawongan fosters social skills and collaborative competencies (learning to live together); and palemahan develops environmental consciousness and responsible citizenship (learning to do). When mediated through technology, these dimensions can be systematically developed through structured learning activities, continuous assessment, and data-driven pedagogical interventions.

Educational technology offers unique affordances for character education: (1) scalability, enabling consistent implementation across diverse contexts; (2) personalization, adapting to individual learning paces and styles; (3) engagement, utilizing multimedia and gamification to motivate learners; (4) assessment, providing real-time data on character development; and (5) reflection, facilitating metacognitive processes through digital portfolios and e-journals [30], [31]. This study conceptualizes technology not as a replacement for face-to-face character education but as a mediating tool that amplifies and extends culturally-grounded pedagogical practices, a blended learning approach that combines the best of traditional and digital pedagogies [32]-[34].

Despite growing interest in both character education and educational technology, three critical gaps persist in the literature. First, most character education research focuses on Western contexts with limited exploration of how indigenous knowledge systems can inform and enrich character development pedagogies [35]-[37]. Second, while educational technology research abundantly documents cognitive outcomes, affective and character-related outcomes remain understudied [38]-[40]. Third, there is insufficient understanding of how technology can serve as a cultural bridge, scaling locally-grounded pedagogies while maintaining their cultural authenticity and effectiveness [41], [42].

This study addresses these gaps by investigating the following research questions: (1) To what extent does a technology-enhanced character education model based on Tri Hita Karana improve primary students' graduate competencies compared to conventional character education? (2) How do students and teachers experience and perceive technology-mediated character education grounded in local wisdom? (3) What are the mechanisms through which educational technology enhances the effectiveness of culturally-grounded character education?

The significance of this study is threefold. Theoretically, it contributes to understanding how indigenous epistemologies and educational technology can synergistically enhance character development, extending sociocultural learning theory into digital contexts. Empirically, it provides evidence-based insights into effective technology-enhanced character education models, with potential transferability to other culturally diverse settings. Practically, it offers educators and policymakers a scalable, culturally-responsive approach to character education aligned with SDG 4.7, which calls for education that promotes sustainable development, global citizenship, and appreciation of cultural diversity.

2.   THE COMPREHENSIVE THEORETICAL BASIS

2.1. Character Education in the 21st Century
Character education, broadly defined as the deliberate effort to develop virtues that enable individuals to flourish personally and contribute positively to society [43], has received renewed attention in 21st-century educational discourse [44]. Contemporary approaches emphasize not only moral reasoning but also emotional, social, and civic competencies, often conceptualized as social-emotional learning (SEL) [45], [46]. The CASEL framework identifies five core SEL competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making [40], which align with many character education goals. However, critiques of character education highlight its potential for cultural imposition when Western values are applied uncritically to non-Western contexts [47], [48]. This has led to calls for culturally responsive character education that grounds virtue development in local cultural values while maintaining universal ethical principles [49], [50], [51]. Research demonstrates that culturally grounded character education yields higher student engagement, deeper internalization of values, and greater parental support.

2.2. Tri Hita Karana as a Holistic Character Education Framework
Tri Hita Karana (THK), literally "three causes of prosperity/happiness," is a foundational philosophy in Balinese Hinduism that prescribes balanced, harmonious relationships across three dimensions: parahyangan (human–God), pawongan (human–human), and palemahan (human–nature) [7]. Recent scholarship has explored THK's pedagogical applications, demonstrating its effectiveness in developing students' character [52], critical thinking [53], and environmental consciousness [54].

The parahyangan dimension cultivates spiritual awareness, gratitude, ethical grounding, and purpose, corresponding to the "faith and piety" dimension of Indonesia's graduate competency profile. The pawongan dimension develops interpersonal skills, empathy, cooperation, and respect for diversity, aligned with "collaboration" competencies. The palemahan dimension fosters environmental stewardship, systems thinking, and sustainable practices, relevant to "critical reasoning" about human–environment interactions. Collectively, THK provides a comprehensive framework that addresses cognitive, affective, behavioral, and spiritual dimensions of character development [53].

Importantly, while THK originates from Balinese culture, its core principles resonate with universal values across cultures: spiritual grounding (found in all major religions), social harmony (central to Ubuntu, Confucianism, and other philosophies), and environmental responsibility (increasingly recognized as a global imperative) [7]. This universality within cultural specificity makes THK a valuable case study for developing culturally responsive yet globally relevant character education models.

2.3. Technology-Enhanced Learning and Character Development
Educational technology has increasingly been recognized for its potential in enhancing learning outcomes, not only in cognitive domains but also in affective and moral development. The role of technology in fostering character education is an area that remains underexplored, despite its promising capabilities in making abstract values tangible and engaging for students. To explore this in greater depth, we provide two explicit subsections: Educational Technology Design for Affective Learning and Technology-Supported Character and Moral Education.

2.3.1. Educational Technology Design for Affective Learning
Educational technology plays a critical role in enhancing affective learning, which focuses on the development of students' emotions, attitudes, and values. This aspect of learning is essential for fostering holistic development, particularly in shaping moral and social competencies [39], [55], [56]. Traditional teaching methods often struggle to address these dimensions effectively, as they rely on passive forms of engagement. Technology, however, offers dynamic solutions that enable deeper emotional and ethical involvement in the learning process. Learning Management Systems (LMS) such as Moodle and Canvas integrate multimedia elements videos, simulations, and interactive modules that allow for an engaging learning experience. These systems provide a platform for students to confront ethical dilemmas and moral challenges, making abstract concepts more accessible

and emotionally resonant. Research indicates that multimedia-based learning enhances student engagement by addressing both cognitive and emotional processing needs [57]-[59]. The ability to engage with diverse perspectives through these platforms helps students develop critical emotional competencies such as empathy and compassion [60]-[62].

Incorporating gamification within educational platforms further strengthens emotional engagement. Through the use of points, badges, and leaderboards, gamification taps into students' intrinsic motivation, encouraging them to participate actively in character education. When these elements are aligned with educational goals, they not only enhance engagement but also support the internalization of values such as collaboration and ethical decision-making [49], [50]. Studies have demonstrated that gamified environments can foster a sense of accomplishment and responsibility, essential components of character development [63]-[65]. The personalization of learning experiences is another critical factor in affective learning. Adaptive technologies tailor content and pacing to the individual needs of students, ensuring that emotional engagement remains high and that learners progress at a comfortable pace. This personalization fosters emotional self-regulation and enhances students' ability to reflect on their emotional and moral growth [66]-[68]. Digital portfolios provide a powerful tool for this reflection, allowing students to track their emotional development over time and engage in metacognitive practices. These tools encourage deeper self-awareness and foster intentional emotional growth.

Immersive technologies, particularly Virtual Reality (VR), offer a transformative approach to affective learning. VR enables students to step into real-world moral dilemmas, where they can experience firsthand the consequences of their decisions. This immersive experience deepens empathy and helps students engage with complex emotional and ethical issues in a safe, controlled environment. Research suggests that VR can significantly enhance emotional learning by providing interactive, scenario-based learning opportunities [69], [70]. The use of learning analytics enhances the ability to monitor and support students' emotional and moral engagement. By tracking metrics such as participation rates, time spent on tasks, and student interactions with character-related content, educators can identify patterns in emotional engagement and adjust their teaching strategies accordingly. This data-driven approach allows for targeted interventions that address specific emotional needs, ensuring students receive the support they need to develop both cognitively and emotionally [71]. The thoughtful design and implementation of educational technology provide significant benefits for affective learning. By integrating tools such as LMS, gamification, personalized learning paths, VR, and learning analytics, educators can create environments that not only foster academic growth but also support the emotional and ethical development of students, which is essential for character education.

2.3.2. Technology-Supported Character and Moral Education

The integration of technology into character and moral education offers a range of possibilities for enhancing student engagement and supporting the development of ethical competencies. Traditional methods of character education often rely on static, teacher-driven instruction, which may not adequately engage students in the complex processes of moral reasoning and emotional development. By incorporating technology, educators can provide more dynamic and personalized experiences that foster deeper connections with ethical concepts. Digital portfolios have proven effective in facilitating ongoing reflection and self-assessment in character education. These tools enable students to document their moral development over time, reflecting on actions, ethical decisions, and personal growth. Digital portfolios not only support metacognitive processes but also allow educators to track individual progress and provide tailored feedback, thereby enhancing the learning experience [72]-[75]. This continuous feedback loop encourages students to take ownership of their moral growth and actively engage in character development. The use of gamification within educational platforms further supports character education by incorporating motivational game elements such as points, badges, and leaderboards. These elements encourage students to engage with character-building tasks and moral dilemmas in a more interactive and enjoyable manner. Research has shown that gamification can be particularly effective in promoting intrinsic motivation for character development, fostering positive behaviors such as collaboration, ethical decision-making, and perseverance [76]-[78]. However, careful design is required to ensure that external rewards do not overshadow the intrinsic value of moral development.

Immersive technologies, particularly VR, provide unique opportunities for students to engage in moral decision-making through simulated experiences. VR allows students to experience real-world ethical dilemmas and understand the consequences of their actions from multiple perspectives. This immersive engagement promotes empathy, critical thinking, and moral reasoning in a way that traditional methods cannot replicate [62], [79], [80]. By creating environments where students must navigate complex social and moral situations, VR helps them develop practical skills for making ethical decisions in real life. The use of learning analytics is another key feature of technology-supported character education. By tracking student engagement with moral content, participation in discussions, and completion of character-building tasks, learning analytics provide educators with real-time data on students' emotional and ethical development. This data can be used to identify students who may require additional support and to adjust teaching strategies to better address individual needs [3], [81]. Learning analytics allow for more informed, data-driven interventions that enhance the effectiveness of character education

programs [10], [13], [15]. Technology-supported character and moral education, through tools such as digital portfolios, gamication, immersive technologies, and learning analytics, offers a multifaceted approach to developing students' moral competencies. These technologies not only enhance engagement but also provide educators with valuable insights to support students' growth as ethical and responsible individuals.

2.4. Blended Learning Approaches in Primary Education

Blended learning, combining face-to-face instruction with online learning experiences [31], has evolved from a technological innovation to an established pedagogical approach supported by substantial research evidence [32]. Meta-analyses consistently show that well-designed blended learning produces equal or superior outcomes compared to purely face-to-face or purely online instruction across age groups and subjects [33].

In primary education, blended learning requires careful consideration of developmental appropriateness, digital literacy support, and parental involvement [80]. Successful models typically feature: (1) limited, purposeful technology use aligned with learning objectives; (2) scaffolded development of digital competencies; (3) strong teacher presence and guidance; (4) opportunities for both individual and collaborative activities; and (5) clear communication with parents about technology integration [82], [83]. Research in Indonesian primary schools demonstrates feasibility and effectiveness of blended learning when proper infrastructure and teacher professional development are provided [84], [85].

2.5. Synthesis and Conceptual Framework

Synthesizing the literature reviewed above, we propose a conceptual framework (Figure 1) for technology-enhanced character education grounded in local wisdom. This framework posits that educational technology serves as a mediating tool that amplifies culturally grounded pedagogies through four mechanisms: (1) enhanced accessibility, making character education content available anytime and anywhere; (2) increased engagement, utilizing multimedia and interactive elements to sustain attention and motivation; (3) continuous assessment, providing ongoing monitoring and feedback on character development; and (4) reflective practice, facilitating metacognitive processes through journaling and portfolio development.

These technological affordances, when applied to THK-based character education, are hypothesized to yield superior outcomes in graduate competencies compared with conventional approaches. Importantly, technology does not replace the cultural content or the teacher's role, but rather extends and enhances them, creating a synergy between traditional wisdom and contemporary tools, a synthesis that is particularly relevant for 21st-century education in culturally diverse societies.
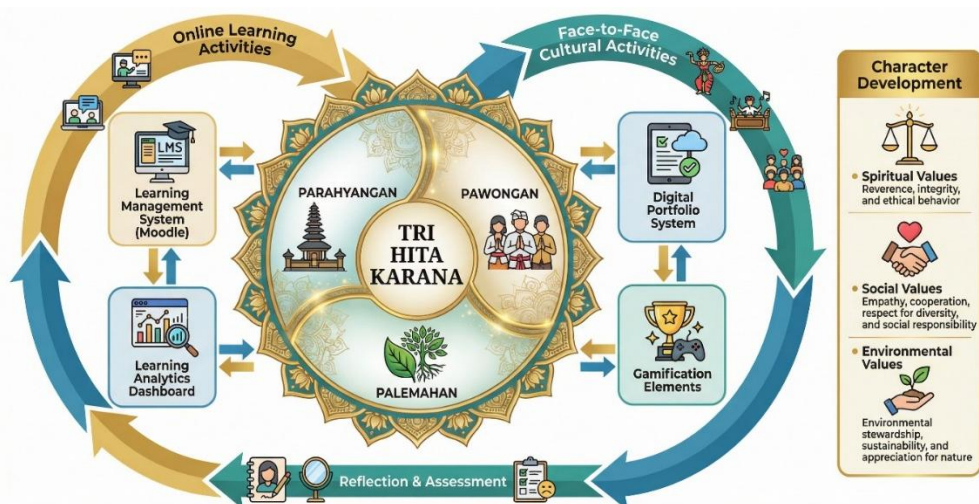

Figure 1. Conceptual Framework - Technology-Enhanced Tri Hita Karana Character Education Model

3.   RESEARCH METHOD

3.1.   Research Design

This study employed a mixed-methods quasi-experimental design with a non-equivalent pretest-posttest control group design for the quantitative component and qualitative case study methods for the process evaluation. The quasi-experimental approach was necessitated by the school context, where random assignment of individual students was not feasible due to existing class structures [86], [87]. This design is appropriate for educational field experiments and allows for causal inference when properly executed with equivalent groups and adequate controls for confounding variables [88].

The study design can be represented as:

Experimental Group: O_1 → X → O_2

Control Group: O_3 → — → O_4

Where O_1 and O_3 represent pretest measurements, X represents the Technology-Enhanced THK Character Education Model intervention, and O_2 and O_4 represent posttest measurements. The study was conducted over one full semester (16 weeks) to ensure adequate exposure to the intervention and allow for meaningful character development.
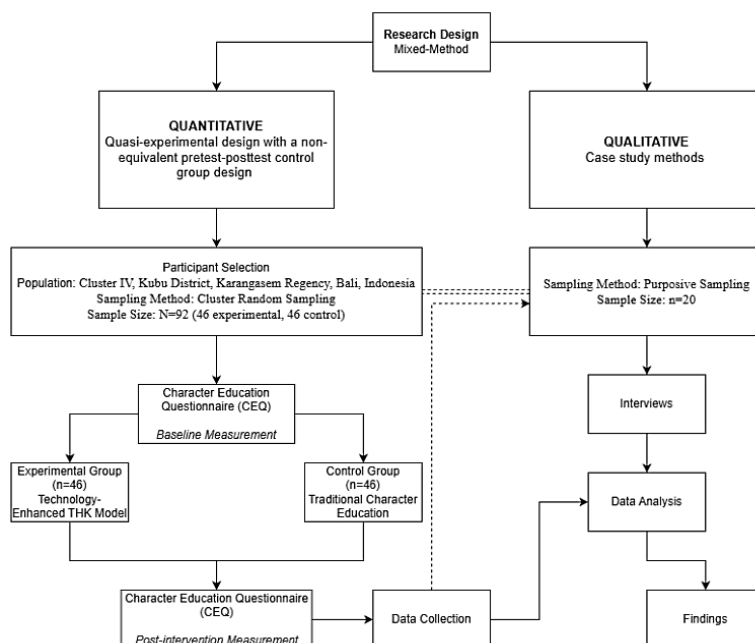

Figure 2. Research Procedure Flowchart

3.2. Participants and Setting

The study was conducted in Cluster IV, Kubu District, Karangasem Regency, Bali, Indonesia. The cluster comprises eight public primary schools serving predominantly rural communities. The target population was fifth-grade students (N=320 across 8 schools), selected because this grade level coincides with critical character development and represents the upper primary education phase where students have sufficient digital literacy for technology-enhanced learning.

Using cluster random sampling, four schools were randomly selected from the eight, and then two schools were randomly assigned to the experimental condition (SD Negeri 2 Tianyar Barat and SD Negeri 4 Tianyar Barat) and two to the control condition (SD Negeri 3 Tianyar Barat and SD Negeri 5 Tianyar Barat). The final sample consisted of 92 students (46 experimental, 46 control). Sample size was determined based on power analysis (G*Power 3.1) targeting 80% power to detect a medium effect size (Cohen's d=0.6) with α=.05, yielding a minimum required sample of 84 (42 per group).

Demographic characteristics of the sample were as follows: age range 10-11 years (M=10.4, SD=0.5); gender distribution 52% male, 48% female; all students from Balinese Hindu families with varying socioeconomic backgrounds (predominantly middle to lower-middle class). Chi-square and independent t-tests confirmed no significant differences between experimental and control groups on demographic variables, pretest scores, or school characteristics (all ps > .05), supporting group equivalence.

3.3. The Technology-Enhanced Tri Hita Karana Character Education Model (TE-THKCEM)

The TE-THKCEM represents a theoretically-grounded, systematically designed blended learning intervention integrating THK philosophy with educational technology affordances. The model was developed through an iterative design process involving literature review, expert consultations (educational technologists, character education specialists, and Balinese cultural experts), pilot testing, and refinement based on feedback.

3.3.1. Model Components

a) Learning Management System (LMS) Platform: We implemented Moodle as the central platform for organizing learning resources, facilitating discussions, and managing assessments. The LMS provided: (a) structured modules for each THK dimension; (b) multimedia content including videos, interactive presentations, and digital stories illustrating THK principles; (c) discussion forums for ethical deliberation

and peer interaction; (d) assignment submission portals for reflective writing and character development activities.

b)   Digital Portfolio System: Each student maintained a digital portfolio documenting their character development journey across the three THK dimensions. Portfolio entries included: (a) weekly reflective journals on character learning; (b) evidence of character-related actions (photos, descriptions of helping behaviors, environmental projects); (c) peer and teacher feedback; (d) self-assessment rubrics; (e) goal-setting and progress tracking. The portfolio served both learning (prompting reflection) and assessment (documenting growth) purposes.

c)   Gamification Elements: To enhance engagement, we incorporated age-appropriate gamification: (a) "Character Quest" narrative framework where students progressed through challenges related to each THK dimension; (b) point system for completing activities and demonstrating character behaviors; (c) digital badges recognizing specific character achievements (e.g., "Parahyangan Devotee," "Pawongan Peacemaker," "Palemahan Guardian"); (d) collaborative class goals (not individual competition) to maintain focus on intrinsic motivation and collective growth.

d)   Learning Analytics Dashboard: Teachers accessed a dashboard displaying: (a) individual and class-level engagement metrics (login frequency, time on task, activity completion rates); (b) portfolio submission patterns; (c) discussion forum participation; (d) assessment scores across THK dimensions. This enabled data-informed differentiation and timely interventions for students showing disengagement or struggling with specific competencies.

3.3.2.   Pedagogical Implementation:

The model employed a flipped classroom approach within a blended learning framework. Each week followed this cycle:

a) Online Phase (3x45 minutes at home): Students accessed LMS content introducing a THK-related character concept through videos, readings, and interactive activities. They participated in asynchronous discussions responding to ethical dilemmas and completed digital journal entries.

b) Face-to-Face Phase (2x60 minutes in class): Teachers facilitated deeper discussions, guided experiential activities (e.g., service projects for pawongan, nature exploration for palemahan, prayer/meditation for parahyangan), and provided personalized feedback. This phase emphasized human connection and culturally-grounded practices that cannot be replicated online.

c) Reflection Phase (1x30 minutes): Students updated their digital portfolios with evidence and reflections from the week's learning, set goals for the coming week, and peer-reviewed one another's portfolios.

Teacher professional development was provided through two full-day workshops before implementation, weekly support meetings during the intervention, and ongoing technical assistance. Training covered: THK philosophy and pedagogy, LMS platform operation, digital portfolio facilitation, gamification principles, learning analytics interpretation, and blended learning classroom management.

3.4. Control Condition

The control group received conventional character education as typically implemented in Indonesian primary schools, consisting of: (a) character education integrated into regular subject lessons (religion, civics, Indonesian language) without systematic structure; (b) weekly flag ceremony with character-related messages; (c) occasional character-themed events; (d) teacher modeling and informal guidance. This condition represents authentic "business as usual" practice, providing a valid comparison for assessing the added value of the TE-THKCEM.

3.5. Data Collection Instruments

Graduate Competency Questionnaire: A 40-item self-report questionnaire assessed four dimensions of graduate competencies: (1) Faith and Piety (10 items, e.g., *"I regularly engage in prayer/meditation"*); (2) Creativity (10 items, e.g., *"I generate original ideas to solve problems"*); (3) Collaboration (10 items, e.g., *"I work effectively with diverse peers"*); (4) Critical Reasoning (10 items, e.g., *"I analyze problems from multiple perspectives"*). Items used a 5-point Likert scale (1=Never to 5=Always). The instrument was adapted from Indonesia's graduate competency standards and validated through expert review and pilot testing (n=50 students not in the main study). Cronbach's alpha reliability coefficients were: Faith and Piety α=.87, Creativity α=.85, Collaboration α=.89, Critical Reasoning α=.86, Overall α=.89. Confirmatory factor analysis supported the four-factor structure (CFI=.94, TLI=.93, RMSEA=.06).

Digital Portfolio Rubric: A rubric assessed portfolio quality across four criteria: depth of reflection (4 levels), evidence quality (4 levels), demonstrated growth (4 levels), and self-regulation (4 levels), yielding scores

of 4-16 per criterion and 16-64 total. Two trained raters independently scored 20% of portfolios, achieving high inter-rater reliability (ICC=.88).

Teacher Observation Checklist: Teachers completed weekly checklists documenting observed character behaviors in three categories aligned with THK dimensions: spiritual practices, social interactions, and environmental behaviors. This provided behavioral data triangulating self-reported competencies.

Student Reflection Interviews: Semi-structured interviews (n=20 experimental group students, purposively selected for maximum variation) explored students' experiences with the TE-THKCEM, perceptions of technology's role in character learning, and suggestions for improvement. Interviews were audio-recorded and transcribed verbatim.

Learning Analytics Data: The LMS automatically logged engagement metrics (login frequency, time on platform, activity completions, discussion posts) providing objective behavioral data on technology use patterns.

3.6. Procedures

The study proceeded in four phases over 20 weeks:

a) Preparation Phase (Weeks 1-2): Obtained ethical approval, recruited schools, secured parental consent, conducted teacher training, and set up LMS infrastructure.

b) Pre-intervention Phase (Week 3): Administered pretest questionnaires to both groups to establish baseline competency levels.

c) Intervention Phase (Weeks 4-19, 16 weeks): Implemented TE-THKCEM in experimental schools while control schools continued conventional practices. Research assistants conducted weekly fidelity checks using a protocol checklist to ensure consistent implementation.

d) Post-intervention Phase (Week 20): Administered posttest questionnaires, collected digital portfolios, conducted student interviews, and compiled learning analytics data.

3.7. Data Analysis

Quantitative Analysis: Data were analyzed using SPSS 26.0. Preliminary analyses examined data normality (Kolmogorov-Smirnov and Shapiro-Wilk tests), homogeneity of variance (Levene's test), and group equivalence at pretest (independent t-tests). Main analyses used:

a) Independent samples t-tests to compare posttest scores between groups.

b) Analysis of Covariance (ANCOVA) with pretest scores as covariates to control for initial differences and increase statistical power.

c) Effect size calculations (Cohen's d) to assess practical significance.

d) Descriptive statistics for learning analytics data.

Significance level was set at α=.05. Missing data (<3%) were handled using expectation-maximization algorithm.

Qualitative Analysis: Interview transcripts and portfolio reflections were analyzed using thematic analysis following Braun and Clarke's [89] six-phase process: familiarization, initial coding, theme searching, theme reviewing, theme defining, and report production. Two researchers independently coded the data, then met to discuss, compare, and reach consensus on themes. NVivo 12 software supported the analysis. Trustworthiness was enhanced through member checking (participants reviewed theme summaries), peer debriefing, and triangulation across multiple data sources.

Integration: Quantitative and qualitative findings were integrated at the interpretation phase to provide a comprehensive understanding of intervention effects and mechanisms. Convergence, complementarity, and divergence across data sources were systematically examined.

4. RESULTS

4.1. Preliminary Analyses

Assumption Testing: Kolmogorov-Smirnov and Shapiro-Wilk tests indicated that all posttest data were normally distributed for both groups (all ps > .05). Levene's tests confirmed homogeneity of variance across groups for all outcome variables (all ps > .05), supporting the use of parametric tests.

Baseline Equivalence: Independent t-tests revealed no significant differences between experimental and control groups at pretest on overall graduate competencies (t(90)=0.61, p=.544) or any subscale: Faith and Piety (t(90)=0.44, p=.662), Creativity (t(90)=0.73, p=.467), Collaboration (t(90)=0.55, p=.583), and Critical Reasoning (t(90)=0.68, p=.499). Pretest means for experimental and control groups were M=67.20 (SD=10.61) and M=65.91 (SD=9.99) respectively, confirming group equivalence.

4.2. Main Effects: Graduate Competency Outcomes

Table 1 presents the descriptive statistics and independent samples t-test results comparing pretest and posttest scores of graduate competency outcomes between groups.

Table 1. Descriptive Statistics and T-Test Results

Competency	Group	Pretest M(SD)	Posttest M(SD)	t-value	Cohen's d
Overall	Exp (n=46)	67.20(10.61)	81.89(9.78)	$t(90)=5.98^{***}$	d=1.25
	Cont (n=46)	65.91(9.99)	70.02(10.02)		
Faith & Piety	Exp	16.85(3.12)	21.24(2.45)	$t(90)=6.12^{***}$	d=1.28
	Cont	16.52(2.98)	17.89(2.88)		
Creativity	Exp	16.12(2.87)	20.08(2.56)	$t(90)=5.34^{***}$	d=1.12
	Cont	15.89(2.76)	17.23(2.69)		
Collaboration	Exp	17.45(2.94)	20.67(2.34)	$t(90)=5.61^{***}$	d=1.17
	Cont	17.12(2.88)	17.91(2.56)		
Critical Reasoning	Exp	16.78(3.01)	19.90(2.87)	$t(90)=4.98^{***}$	d=1.04
	Cont	16.38(2.95)	16.99(2.92)		

*Note: ***$p < .001$. Exp = Experimental; Cont = Control.*

Table 1 presents descriptive statistics and t-test results. Independent samples t-tests revealed significantly higher posttest scores for the experimental group compared to the control group on overall graduate competencies ($t(90)=5.98$, $p<.001$, Cohen's d=1.25) and all four subscales (all ps<.001, ds ranging from 1.04 to 1.28). Effect sizes were large across all outcomes, indicating substantial practical significance. The experimental group improved an average of 14.69 points (21.9% gain) from pretest to posttest, while the control group improved only 4.11 points (6.2% gain).

ANCOVA analyses, controlling for pretest scores, confirmed these findings with even stronger effects: $F(1,89)=48.73$, $p<.001$, partial $\eta^2=.35$, indicating that group membership (TE-THKCEM vs. conventional) accounted for 35% of variance in posttest competencies after controlling for baseline differences. This large effect provides robust evidence for intervention effectiveness.

4.3. Digital Portfolio Quality and Growth Patterns

Analysis of digital portfolios (experimental group only) revealed high-quality reflective practice. Mean portfolio scores were M=52.3 (SD=7.8) out of 64 possible points. Longitudinal analysis showed consistent growth across the semester: Week 4 M=38.5, Week 8 M=45.2, Week 12 M=49.8, Week 16 M=52.3, demonstrating progressive development. Pearson correlation between portfolio scores and posttest competencies was strong and positive (r=.68, p<.001), supporting portfolio validity as an indicator of character development.

4.4. Learning Analytics: Technology Engagement Patterns

Learning analytics data revealed high and sustained engagement with the LMS platform. On average, experimental group students logged in 3.4 times per week (SD=0.8), spent 126 minutes per week on the platform (SD=34 minutes), completed 94% of assigned activities, and contributed an average of 2.8 discussion posts per week. Engagement remained stable across the intervention period with no significant decline over time ($F(15,675)=1.23$, $p=.245$), suggesting sustained motivation. Correlation analyses showed significant positive relationships between LMS engagement metrics and posttest competencies (rs=.42-.58, all ps<.01), indicating that higher technology engagement was associated with better character development outcomes.

4.5. Qualitative Findings: Student Experiences and Perceived Mechanisms

Thematic analysis of student interviews (n=20) yielded four major themes explaining how and why the TE-THKCEM enhanced character learning:

Theme 1: Making the Invisible Visible. Students reported that technology made abstract character concepts more concrete and visible. Digital portfolios allowed them to "see" their character growth over time through accumulated evidence, whereas previously character development felt intangible. One student reflected: *"Before, I didn't really think about my character. But now with the portfolio, I can see how I'm growing. I look back at my old reflections and see how much I've changed."*

Theme 2: Culturally-Grounded Engagement. Students appreciated how technology delivered THK content in engaging multimedia formats while maintaining cultural authenticity. Videos of local temples for parahyangan, documentary stories of Balinese environmental projects for palemahan, and interactive activities about community traditions for pawongan resonated deeply. As one student stated: *"The videos and stories are about our culture, so it feels real and important, not like learning from foreign textbooks."*

Theme 3: Peer Learning and Accountability. The LMS discussion forums and collaborative features facilitated peer learning and social accountability. Students learned from peers' ethical reasoning, received support

during challenges, and felt motivated by collective progress. One explained: *"When I read my friends' discussions about how they helped someone, it makes me want to do good things too."*

Theme 4: Teacher as Guide, Not Lecturer. Students valued how technology shifted teacher roles from lecturers to facilitators and mentors. With content available online, face-to-face time focused on deeper discussions, experiential activities, and personalized feedback. One student noted: *"Our teacher has more time to talk with us individually about our portfolios and help us when we have problems with character."*

This study investigated whether and how educational technology can enhance character education grounded in indigenous wisdom, specifically examining the effectiveness of a technology-enhanced Tri Hita Karana character education model in developing primary students' graduate competencies. The findings provide robust empirical evidence for the model's effectiveness while illuminating mechanisms through which technology amplifies culturally-grounded character education. This discussion situates findings within existing literature, examines theoretical and practical implications, acknowledges limitations, and proposes future research directions. The experimental group's substantial improvement in graduate competencies (Cohen's d=1.25) represents a large, educationally meaningful effect that exceeds typical character education intervention effects. Meta-analyses of character education programs report average effect sizes of d=0.3–0.5 [90], making our findings particularly noteworthy. Several factors may explain this enhanced effectiveness.

First, the synergy between culturally grounded content and technology-mediated delivery appears critical. Consistent with sociocultural learning theory Vygotsky [26], students engaged more deeply with character education when it was embedded in familiar cultural frameworks (THK) while delivered through engaging technological tools. This addresses longstanding tensions in character education between universal values and cultural specificity [7], [47], suggesting that technology can serve as a bridge, making culturally specific content accessible and engaging while maintaining authenticity. Second, the blended learning design leveraged complementary strengths of online and face-to-face modalities. Online components provided structured, consistent content delivery and opportunities for individual reflection, while face-to-face sessions enabled deeper discussion, experiential learning, and human connection essential for character development. This aligns with best practices in blended learning design [67] and extends them to the affective domain, where research has been limited. Third, digital portfolios facilitated metacognitive processes crucial for intentional character development. By regularly documenting, reviewing, and reflecting on their character growth, students developed self-awareness and self-regulation, foundational elements of character [91]. This finding extends e-portfolio research, which has primarily focused on cognitive outcomes to character education contexts [73], [92].

The qualitative findings illuminate four mechanisms through which technology enhanced character learning: visibility, cultural engagement, peer learning, and teacher role transformation. These mechanisms provide process insights that quantitative data alone cannot reveal, contributing to a more complete understanding of how technology-mediated character education works. The "making the invisible visible" mechanism is particularly significant theoretically. Character development is inherently gradual and abstract, making it difficult for young learners to perceive their own growth, yang pada gilirannya dapat melemahkan motivasi dan intensionalitas. Digital portfolios addressed this challenge by creating a cumulative, reviewable record of character development, essentially externalizing an internal process. This aligns with distributed cognition theory, which posits that tools can extend cognitive processes [93], and extends it to affective and moral development. The cultural engagement mechanism suggests that technology's affordances (multimedia, interactivity, narrative) can present cultural content in ways that resonate with digital-native students without compromising authenticity. This addresses concerns that educational technology might erode cultural traditions [69], demonstrating that thoughtfully designed technology can actually strengthen cultural engagement, a crucial finding for globalized education systems seeking to balance technological advancement with cultural preservation.

This study directly addresses SDG 4.7, which calls for education that promotes sustainable development, human rights, gender equality, peace, global citizenship, and appreciation of cultural diversity [94]. The THK framework inherently embodies these principles: parahyangan cultivates ethical grounding and purpose; pawongan promotes social harmony, respect for diversity, and peacebuilding; palemahan develops environmental stewardship essential for sustainable development. Moreover, by demonstrating that educational technology can effectively scale culturally responsive character education, this study offers a potential pathway for achieving SDG 4.7 in diverse global contexts. Rather than imposing Western character education frameworks globally, an approach criticized as neocolonial, technology can be leveraged to identify, document, and disseminate effective indigenous pedagogies. This "glocalization" approach, thinking globally and acting locally, may be essential for culturally sustainable educational development.

This study makes three key theoretical contributions. First, it extends sociocultural learning theory by demonstrating how digital tools can serve as cultural mediators, amplifying culturally grounded pedagogies rather than replacing them. This nuances technological determinism, showing that technology's educational impact depends critically on how it is designed and integrated with cultural content and practices. Second, it advances character education theory by providing empirical evidence for technology-mediated character development at the primary education level. Most character education research focuses on face-to-face methods, creating a theoretical

gap regarding technology's role. Our TPACK-informed framework [95] for character education, integrating technological knowledge, pedagogical knowledge, and content knowledge (THK philosophy), offers a model for future research and practice. Third, it contributes to indigenous knowledge systems theory by demonstrating empirical pathways for validating and scaling indigenous pedagogies through research–practice partnerships. The study shows that indigenous knowledge is not merely folklore to be preserved but active, evolving pedagogy that can be rigorously studied and systematically implemented through contemporary educational tools. Building on these theoretical contributions, the following section outlines the practical implications, limitations, and future research directions to guide implementation and further refinement of this model in diverse educational contexts.

For educators, teachers should consider blended learning approaches for character education, utilizing LMS platforms not just for cognitive subjects but also for affective learning. Digital portfolios are particularly powerful tools for making character development visible and intentional. However, technology should complement, not replace, face-to-face experiential activities and human relationships that remain central to character formation. The gamification elements must be carefully designed to support intrinsic motivation rather than undermining it through excessive extrinsic rewards.

For school leaders, implementation of technology-enhanced character education requires investment in three areas: digital infrastructure (LMS platforms, devices, internet connectivity), teacher professional development in both technological and pedagogical aspects, and ongoing technical and pedagogical support. Schools should start with pilot implementations, gather data, refine approaches, and scale gradually. Learning analytics dashboards can inform data-driven decision making about character education effectiveness. For policymakers, education policies should recognize character education as equally important as academic achievement and support its systematic implementation through technology integration. This requires curriculum guidelines that explicitly incorporate character education, infrastructure investments in educational technology accessible to all schools including rural areas, teacher preparation programs that include technology-enhanced character education, and assessment frameworks that value character alongside academics. Importantly, policies should encourage culturally responsive approaches rather than one-size-fits-all models. For educational technology designers, designers of educational technology should consider affective and character development outcomes, not only cognitive ones. Platforms should include features supporting reflection, portfolio development, peer interaction around values, and culturally diverse content. Collaboration with cultural experts can ensure that technological designs honor and enhance rather than distort cultural pedagogies.

Several limitations warrant acknowledgment. First, the quasi-experimental design, while appropriate for school contexts, limits causal inference compared to true experiments. Although we confirmed group equivalence and controlled for confounds, unmeasured variables (e.g., teacher enthusiasm, school culture) may have contributed to effects. Future research should employ randomized controlled trials where feasible. Second, the study was conducted in one district in Bali with a culturally homogeneous sample (all Balinese Hindu students). This limits generalizability to other cultural contexts and religious backgrounds. Replication studies in diverse settings are needed to assess transferability. However, this cultural specificity was also a deliberate feature, allowing deep understanding of how one indigenous framework can be effectively integrated with technology. Third, the 16-week intervention period, while longer than many educational studies, remains relatively short for assessing lasting character development. Longitudinal follow-up studies are needed to determine whether competency gains persist and translate into long-term behavioral changes and life outcomes. Fourth, reliance on self-report questionnaires as the primary outcome measure introduces potential biases (social desirability, self-awareness limitations). While we triangulated with portfolios and teacher observations, more objective behavioral measures (e.g., peer nominations, actual helping behaviors) would strengthen future research. Fifth, we did not experimentally isolate the effects of individual technology components (LMS vs. portfolio vs. gamification). Future dismantling studies could identify which elements are most critical, informing efficient implementation. Similarly, we did not directly compare technology-enhanced THK education with technology-enhanced conventional character education, leaving open whether effects are due to THK content, technology, or their combination. Finally, this study focused on student outcomes without deeply examining teacher experiences, challenges, and professional development needs. Future research should explore the teacher perspective, implementation fidelity factors, and conditions that support or hinder effective delivery.

Building on this study's findings and limitations, we propose several research directions. Transferability studies should replicate the TE-THKCEM approach with other indigenous knowledge systems (e.g., Ubuntu in Africa, indigenous wisdom in Latin America, Confucian values in East Asia) to assess whether the model's effectiveness generalizes across cultural contexts. Comparative studies should directly compare technology-enhanced culturally grounded character education with technology-enhanced Western character education models to isolate the added value of cultural grounding. Longitudinal studies should follow participants over several years to assess long-term retention of competencies, behavioral manifestations in adolescence and adulthood, and life outcomes. Mechanism studies should use advanced methodologies (e.g., experience sampling, social network analysis, learning analytics mining) to more precisely identify active ingredients and causal mechanisms. Optimization studies should employ design-based research to iteratively refine the model, testing variations in

technology components, dosage, and pedagogical strategies. Scaling studies should examine challenges and strategies for scaling implementation to larger populations, different school contexts (urban vs. rural, well-resourced vs. under-resourced), and various grade levels. Cost-effectiveness studies should analyze resource requirements and cost-effectiveness compared to conventional approaches to inform policy decisions. Teacher perspective studies should deeply investigate teacher experiences, professional development needs, and conditions supporting successful implementation.

5.   CONCLUSION

This study demonstrates that technology-enhanced character education, grounded in indigenous wisdom, can significantly improve primary students' competencies in alignment with global educational goals. The Technology-Enhanced Tri Hita Karana Character Education Model successfully utilized educational technologies such as Learning Management Systems, digital portfolios, gamification, and learning analytics to amplify culturally grounded character development, yielding substantial improvements in competencies such as faith and piety, creativity, collaboration, and critical reasoning. Qualitative findings revealed that technology made character growth visible, deepened cultural engagement, supported peer learning, and redefined teacher roles. These insights contribute to theory by extending sociocultural learning theory into technology-mediated contexts and validating indigenous knowledge systems in contemporary education. Practically, the study offers a viable model for integrating technology and character education in a culturally responsive manner, providing a pathway for educators, school leaders, and policymakers to balance technological innovation with cultural preservation. As education systems worldwide navigate moral and ethical challenges, this research emphasizes the potential of combining indigenous wisdom with modern technology to foster holistic, culturally sustainable, and globally relevant education. For future research, studies should explore the long-term impact of this model on students' moral behaviors, investigate its applicability in diverse cultural contexts, and examine the role of technology in supporting teacher professional development in character education.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

REFERENCES

[1]   J. Lobo et al., "Revolutionizing dance education through the assessment of online videoconferencing to increase participation in dance: Learning Philippine traditional dances," *Empir. Stud. Arts*, vol. 43, no. 2, pp. 1070–1096, Jul. 2025, doi: 10.1177/02762374241288701.

[2]   N. T. Huong, "The impact of AI chatbot integration on Vietnamese EFL learners' speaking performance, fluency, and confidence," *Lang. Technol. Soc. Media*, 2025, doi: 10.70211/ltsm.3026-7196.314.

[3]   L. S. Pek, F. S. C. Yob, R. W. M. Mee, W. Wider, M. Z. Miftah, and J. S. Camara, "Mobile gaming in education: A bibliometric analysis of trends and performance," *Int. J. Eval. Res. Educ.*, vol. 14, no. 4, p. 2676, Aug. 2025, doi: 10.11591/ijere.v14i4.32991.

[4]   T. O. Babalola, A. Usman, and O. S. Adenubi, "Teachers ' perceptions of AI classroom management tools for enhancing personalization and academic engagement of secondary school students in Ilorin," *Blockchain, Artif. Intell. Futur. Res.*, vol. 1, no. 2, pp. 15–32, 2025.

[5]   Y. F. Tang and W. Y. Leong, "Integrating AI-generated art styles into traditional illustration design teaching course," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 21, no. 7, p. em2668, Jul. 2025, doi: 10.29333/ejmste/16602.

[6]   S. Hamid and Bushra Sumaya, "Women's roles in education and social welfare development: Insights from a qualitative study," *Women, Educ. Soc. Welf.*, vol. 2, no. 2, pp. 63–71, Oct. 2025, doi: 10.70211/wesw.v2i2.301.

[7]   K. Wirahyuni, I. N. Suandi, I. N. Martha, and I. N. Sudiana, "Integrating Balinese local wisdom of tri hita karana: primary school teachers' belief," *Alinteri J. Agric. Sci.*, vol. 36, no. 2, pp. 132–139, Jul. 2021, doi: 10.47059/alinteri/V36I2/AJAS21133.

[8]   I. G. M. Metera, I. G. Sugiarka, I. W. Sukrayasa, N. P. Widyastuti, and C. A. Rumbay, "Designing etnopedagogy: The philosophy of tri hita karana as the foundation of educational values," *Adv. Soc. Humanit. Res.*, vol. 3, no. 3, pp. 175–185, Mar. 2025, doi: 10.46799/adv.v3i3.356.

[9]   A. Puspayanti, I. W. Lasmawan, and I. G. P. Suharta, "Konsep Tri Hita Karana untuk pengembangan budaya harmoni melalui pendidikan karakter [The Tri Hita Karana concept for developing a culture of harmony through character

education]," *Andragogi J. Diklat Tek. Pendidik. dan Keagamaan*, vol. 11, no. 1, pp. 87–98, Jun. 2023, doi: 10.36052/andragogi.v11i1.314.

[10] U. Umar, M. Hamzah, R. Rahmatullah, and S. Ni'mah, "Integrity character education in indonesia: systematic literature review and bibliometric analysis," *AL-ISHLAH J. Pendidik.*, vol. 16, no. 4, Dec. 2024, doi: 10.35445/alishlah.v16i4.5644.

[11] J. Sankar, V. Rajendran, B. B. Kuriakose, A. H. Alhazmi, L. S. Wong, and K. Muthusamy, "ML enhanced bioactivity prediction for angiotensin II receptor: A potential anti-hypertensive drug target," *Sci. Rep.*, vol. 15, no. 1, p. 25367, Jul. 2025, doi: 10.1038/s41598-025-08653-4.

[12] B. Jia *et al.*, "Global and regional burden of four drug use disorders in the elderly, 1990 to 2021: an analysis of the global burden of disease study," *BMC Geriatr.*, vol. 25, no. 1, p. 434, Jul. 2025, doi: 10.1186/s12877-025-06075-5.

[13] N. N. Le and M. Z. Aye, "The effect of integrating green sustainable science and technology into STEM learning on students ' environmental literacy," *Integr. Sci. Educ. J.*, vol. 6, no. 3, pp. 232–239, 2025, doi: 10.37251/isej.v6i3.2116.

[14] Aulya Syifa Sagita, "Analyzing the public perception of brawl phenomena involving juvenile delinquency in Jakarta," *IJESS Int. J. Educ. Soc. Sci.*, vol. 4, no. 2, pp. 82–95, Oct. 2023, doi: 10.56371/ijess.v4i2.182.

[15] P. B. Ooi, N. N. Chan, W. L. Ku, P. Ahrumugam, W. M. Wan Jaafar, and W. O. Choo, "Navigating cyberspace: defending self-efficacy, empathy, and teacher support as protective factors against cyberbullying among Malaysian Youths With visual impairments," *J. Vis. Impair. Blind.*, vol. 119, no. 6, pp. 455–472, Nov. 2025, doi: 10.1177/0145482X251394349.

[16] A. B. M. Fathoni, M. Sulaeman, E. A. N. Azizah, Y. Styawati, and M. U. C. Ramadhan, "The new direction of Indonesian character education: Bullying, moral decadence, and juvenile delinquency," *J. Pendidik. agama Islam*, vol. 21, no. 1, pp. 22–39, Jun. 2024, doi: 10.14421/jpai.v21i1.7759.

[17] Amanda Salsa Nabila, Wika Hardika Legiani, and Dinar Sugiana Fitrayadi, "The implementation of character education strengthening program (PPK) in the new adaptation era in civic education learning (descriptive study at SMP Negeri 1 Rangkasbitung)," *J. Civ. Soc. Stud.*, vol. 7, no. 2, pp. 78–85, Dec. 2023, doi: 10.31980/journalcss.v7i2.759.

[18] A. Buchori Muslim, "Character education curriculum in the government of Indonesia strengthening character education program," *JIEBAR J. Islam. Educ. Basic Appl. Res.*, vol. 1, no. 2, pp. 137–153, Dec. 2020, doi: 10.33853/jiebar.v1i1.101.

[19] Z. Zainuddin, A. Nafisah, and M. Muttaqin, "Transforming character education through the implementation of the independent curriculum in Indonesia," *Int. J. Educ. Humanit.*, vol. 5, no. 3, pp. 560–572, Jun. 2025, doi: 10.58557/(ijeh).v5i3.346.

[20] N. Eltaiba, S. Hosseini, and K. Okoye, "Benefits and impact of technology-enhanced learning applications in higher education in Middle East and North Africa: A systematic review," *Glob. Transitions*, vol. 7, pp. 350–374, 2025, doi: 10.1016/j.glt.2025.06.004.

[21] N. S. Mohd Rasid and S. Sahara, "Tech-enabled inclusive math education: reimagining learning for marginalized indonesian learners in Malaysia," *Lit. Int. J. Soc. Sci. Humanit.*, vol. 3, no. 1, pp. 155–177, 2024, doi: 10.52005/literate.v3i1.49.

[22] G. P. Georgiou, "Mapping the ethical discourse in generative artificial intelligence: A topic modeling analysis of scholarly communication," *Lang. Technol. Soc. Media*, vol. 3, no. 2, pp. 250–265, 2025.

[23] A. Gutchess and S. Rajaram, "Consideration of culture in cognition: How we can enrich methodology and theory," *Psychon. Bull. Rev.*, vol. 30, no. 3, pp. 914–931, Jun. 2023, doi: 10.3758/s13423-022-02227-5.

[24] D. Jeffery-Schwikkard, J. Li, P. Nagpal, and T. Lomas, "Systematic review of character development in low- and middle-income countries," *J. Posit. Psychol.*, vol. 20, no. 1, pp. 169–191, Jan. 2025, doi: 10.1080/17439760.2024.2322464.

[25] A. R. C. Gurion, D. E. V. Mateo, R. A. Ganiban, and J. A. Villarama, "Artificial intelligence integration in pedagogy and its influence on learning styles," *Blockchain, Artif. Intell. Futur. Res.*, vol. 1, no. 2, pp. 1–14, 2025.

[26] L. S. Vygotsky, *Mind in society: The development of higher psychological processes*. Harvard University Press, 1978.

[27] D. Petko, P. Mishra, and M. J. Koehler, "TPACK in context: An updated model," *Comput. Educ. Open*, vol. 8, p. 100244, Jun. 2025, doi: 10.1016/j.caeo.2025.100244.

[28] L. M. Semali, J. L. Kincheloe, and L. M. Semali, *What is Indigenous Knowledge?* Routledge, 2002. doi: 10.4324/9780203906804.

[29] J. T. Y. Fang, B. Muniady, and P. D. Souza, "The heart of education: Learning to live together," in *United Nations Educational, Scientific and Cultural Organization*, 2014.

[30] K. I. Vorobyeva, S. Belous, N. V. Savchenko, L. M. Smirnova, S. A. Nikitina, and S. P. Zhdanov, "Personalized learning through AI: Pedagogical approaches and critical insights," *Contemp. Educ. Technol.*, vol. 17, no. 2, p. ep574, Apr. 2025, doi: 10.30935/cedtech/16108.

[31] B. Khosrawi-Rad *et al.*, "Promoting students' motivation in language education with gamified pedagogical conversational agents," *Comput. Educ.*, vol. 238, p. 105374, Dec. 2025, doi: 10.1016/j.compedu.2025.105374.

[32] H. K. Putri, E. Risdianto, and A. A. Ramandani, "Enhancing social studies achievement through the make a match cooperative model: The moderating role of student motivation," *Digit. Learn. Soc. Sci. Life-course Stud.*, vol. 1, no. 1, pp. 39–51, Jun. 2025, doi: 10.70211/disolife.v1i1.258.

[33] C. Forde *et al.*, "Comparing face-to-face, blended and online teaching approaches for practical skill acquisition: A randomised controlled trial," *Med. Sci. Educ.*, vol. 34, no. 3, pp. 627–637, Apr. 2024, doi: 10.1007/s40670-024-02026-8.

[34] N. Bitar and N. Davidovich, "Transforming pedagogy: The digital revolution in higher education," *Educ. Sci.*, vol. 14, no. 8, p. 811, Jul. 2024, doi: 10.3390/educsci14080811.

[35] J. E. Mambu, E. T. Murtisari, H. Sanoto, A. Kurniawan, Elisathusilawani, and Y. Yustin, "Incorporating Indigenous knowledge into character education in English language classrooms: a critical spiritual pedagogy perspective," *Pedagog. Cult. Soc.*, pp. 1–23, Sep. 2025, doi: 10.1080/14681366.2025.2552696.

[36] K. Raman and Haidaa Umiera Hashim, "Enhancing learning outcomes through discovery learning: A gender-inclusive approach in secondary education," *Women, Educ. Soc. Welf.*, vol. 2, no. 2, Oct. 2025, doi: 10.70211/wesw.v2i2.304.

[37] E. N. Putri, M. Mahdavi, and M. S. Awlqadir, "An analysis of students' motivation and their achievement in learning

english at the department of english education," *J. Lang. Lit. Educ. Res.*, vol. 2, no. 1 SE-Articles, pp. 43–50, Jun. 2025, doi: 10.37251/jolle.v2i1.1698.

[38] J. Koivisto and J. Hamari, "The rise of motivational information systems: A review of gamification research," *Int. J. Inf. Manage.*, vol. 45, pp. 191–210, Apr. 2019, doi: 10.1016/j.ijinfomgt.2018.10.013.

[39] W. Puspitasari, "The influence of health education through social media on students' knowledge about anemia," *J. Heal. Innov. Environ. Educ.*, vol. 1, no. 1, pp. 14–19, 2024, doi: 10.37251/jhiee.v1i1.1034.

[40] F. K. Lawal, H. Isfa, and N. A. Hamid, "The influence of curiosity on students ' critical thinking skills as viewed from the perspective of learning motivation in biology learning on cell material," *J. Acad. Biol. Biol. Educ.*, vol. 2, no. 1, pp. 88–96, 2025, doi: 10.37251/jouabe.v2i1.1913.

[41] H. Y. Anchunda, P. Prachanban, T. Sawangmek, and S. Anchunda, "Development of a culturally responsive, technology-assisted peer coaching collaborative program to enhance foreign teachers' instructional skills and learner empowerment in Thailand," *Soc. Sci. Humanit. Open*, vol. 12, p. 102035, 2025, doi: 10.1016/j.ssaho.2025.102035.

[42] A. Ghalby and L. A. Malaluan, "Safety first? Exploring occupational health and safety knowledge levels of chemistry education students in laboratory setting," *J. Chem. Learn. Innov.*, vol. 2, no. 1, pp. 12–22, Jun. 2025, doi: 10.37251/jocli.v2i1.1562.

[43] N. H. Mayerson, "The character strengths response: An urgent call to action," *Front. Psychol.*, vol. 11, Aug. 2020, doi: 10.3389/fpsyg.2020.02106.

[44] B. S. Haug and S. M. Mork, "Taking 21st century skills from vision to classroom: What teachers highlight as supportive professional development in the light of new demands from educational reforms," *Teach. Teach. Educ.*, vol. 100, p. 103286, Apr. 2021, doi: 10.1016/j.tate.2021.103286.

[45] A. Nurhasanah, Nadiroh, and A. Maksum, "Bridging cognition and ethics: Socio-emotional skills and digital history literacy in fostering critical thinking," *Soc. Sci. Humanit. Open*, vol. 12, p. 101786, 2025, doi: 10.1016/j.ssaho.2025.101786.

[46] T. Nachtigal, A. Zetlin, and L. U. Shen, "Becoming changemakers: How social-emotional learning can enhance civic agency development," *J. Soc. Stud. Res.*, vol. 48, no. 4, pp. 223–242, Oct. 2024, doi: 10.1177/23522798241252137.

[47] Y. Osman, "Understanding how to develop an effective role-modelling character education programme in Saudi Arabia," *Glob. Soc. Educ.*, pp. 1–16, Mar. 2024, doi: 10.1080/14767724.2024.2330363.

[48] E. Nurjanah and R. P. Laguatan, "Enhancing plant diversity learning with an ethnobotany-based e- booklet : A focus on the Pandeglang community," *J. Acad. Biol. Biol. Educ.*, vol. 2, no. 1, pp. 58–68, 2025, doi: 10.37251/jouabe.v2i1.1989.

[49] S. A. Sakti, S. Endraswara, and A. Rohman, "Integrating Local Cultural Values into Early Childhood Education to Promote Character Building," *Int. J. Learn. Teach. Educ. Res.*, vol. 23, no. 7, pp. 84–101, Jul. 2024, doi: 10.26803/ijlter.23.7.5.

[50] Y.-C. Lu, "Exploring virtue diversity to develop a multiculturally sensitive character education," *Ethics Educ.*, pp. 1–17, Dec. 2025, doi: 10.1080/17449642.2025.2602982.

[51] K. A. A. Gamage, D. M. S. C. P. K. Dehideniya, and S. Y. Ekanayake, "The role of personal values in learning approaches and student achievements," *Behav. Sci. (Basel).*, vol. 11, no. 7, p. 102, Jul. 2021, doi: 10.3390/bs11070102.

[52] L. P. C. N. Putri, I. G. Astawan, and N. K. D. Tristiantari, "E-LKPD with a STEM approach to enhance creative thinking skills in science content on light and its properties among fifth-grade elementary school students," *J. Pedagog. dan Pembelajaran*, vol. 8, no. 2, pp. 277–288, Jul. 2025, doi: 10.23887/jp2.v8i2.96575.

[53] M. D. Yulianti, I. G. Astawan, and P. N. Riastini, "The relationship of the teachers' growth mindset to the students'mutual cooperation character in primary school," *Indones. Values Character Educ. J.*, vol. 7, no. 1, pp. 45–55, Mar. 2024, doi: 10.23887/ivcej.v7i1.76209.

[54] N. Kim and K. Lee, "Environmental consciousness, purchase intention, and actual purchase behavior of eco-friendly products: The moderating impact of situational context," *Int. J. Environ. Res. Public Health*, vol. 20, no. 7, p. 5312, Mar. 2023, doi: 10.3390/ijerph20075312.

[55] S. J. Niu *et al.*, "From play to progress: Student learning of social skills with a solution-focused approach," *Educ. Sci.*, vol. 15, no. 2, p. 218, Feb. 2025, doi: 10.3390/educsci15020218.

[56] M. Aridan, U. Hijriyah, K. N. Khabibjonovna, H. Geng, I. Azad, and T. Elyas, "Pre-service language teachers' readiness for deep learning approaches: insights from a cross-regional study in Asia," *LLT J. A J. Lang. Lang. Teach.*, vol. 28, no. 2, pp. 527–551, Sep. 2025, doi: 10.24071/llt.v28i2.12274.

[57] R. E. Mayer, "The past, present, and future of the cognitive theory of multimedia learning," *Educ. Psychol. Rev.*, vol. 36, no. 1, p. 8, Mar. 2024, doi: 10.1007/s10648-023-09842-1.

[58] J. A. M. Fareen, "Digital learning in higher education: A road to transformation and reform," *Eur. J. Interact. Multimed. Educ.*, vol. 3, no. 1, p. e02206, Jan. 2022, doi: 10.30935/ejimed/11493.

[59] E. Sepianti and S. Sulastri, "Investigating anecdotal text writing ability in tenth grade learners," *J. Lang. Lit. Educ. Res.*, vol. 2, no. 1 SE-Articles, p. 126=132, Jul. 2025, doi: 10.37251/jolle.v2i1.1961.

[60] G. Zwoliński, A. Dubiel, and D. Kamińska, "Teaching empathy: A comparative analysis of real, virtual, and AI-driven methods," *Interact. Learn. Environ.*, pp. 1–17, Sep. 2025, doi: 10.1080/10494820.2025.2563090.

[61] A. C. Santos *et al.*, "A systematic review of the association between social and emotional competencies and student engagement in youth," *Educ. Res. Rev.*, vol. 39, p. 100535, May 2023, doi: 10.1016/j.edurev.2023.100535.

[62] F. R. Rasyid, T. A. R. P. Kesuma, and Karsiwan, "Design and development of flash-based learning media for enhancing students ' learning interest," *Digit. Learn. Soc. Sci. Life-course Stud.*, vol. 1, no. 1, pp. 52–67, 2025.

[63] S. Suroso and F. Husin, "Analyzing Thomas Lickona's Ideas in Character Education (A Library Research)," 2024, pp. 39–47. doi: 10.2991/978-2-38476-220-0_5.

[64] V. D. Anggraini and W. Widodo, "Increasing student awareness of the school environment through the adiwiyata program," *J. Heal. Innov. Environ. Educ.*, vol. 2, no. 1 SE-Articles, pp. 130–141, Jun. 2025, doi: 10.37251/jhiee.v2i1.2358.

[65] P. H. Putri and M. Steenvoorden, "User insights: Understanding the acceptance and utilization of the national health insurance mobile application," *J. Heal. Innov. Environ. Educ.*, vol. 2, no. 1 SE-Articles, pp. 102–112, Jun. 2025, doi: 10.37251/jhiee.v2i1.2321.

[66] H. Yaseen, A. S. Mohammad, N. Ashal, H. Abusaimeh, A. Ali, and A.-A. A. Sharabati, "The Impact of adaptive learning technologies, personalized feedback, and interactive ai tools on student engagement: The moderating role of digital literacy," *Sustainability*, vol. 17, no. 3, p. 1133, Jan. 2025, doi: 10.3390/su17031133.

[67] Y. N. Somantri, "Analysis of the physical education learning process through online media," *Multidiscip. J. Tour. Hosp. Sport Phys. Educ.*, vol. 1, no. 1, pp. 11–15, 2024, doi: 10.37251/jthpe.v1i1.1037.

[68] T. T. T. Linh, T. T. M. Huong, and N. Thammachot, "Sustainable nutrient management for nft hydroponic lettuce: integrating kipahit (Tithonia diversifolia) liquid organic fertilizer with AB-mix," *Integr. Sci. Educ. J.*, vol. 6, no. 3, pp. 240–248, Sep. 2025, doi: 10.37251/isej.v6i3.2118.

[69] Q. Feng, G. Li, Y. Chen, F. Zhang, W. Li, and H. Luo, "Can virtual reality improve social-emotional learning among adolescents? An experimental study," *Comput. Educ.*, vol. 240, p. 105462, Jan. 2026, doi: 10.1016/j.compedu.2025.105462.

[70] S. Riches and I. Kaleva, "Virtual reality training as enhanced experiential learning," *J. Technol. Behav. Sci.*, Feb. 2025, doi: 10.1007/s41347-024-00477-9.

[71] A. Davoodi, "EQUAL AI: A framework for enhancing equity, quality, understanding and accessibility in liberal arts through ai for multilingual learners," *Lang. Technol. Soc. Media*, vol. 2, no. 2, pp. 178–203, Nov. 2024, doi: 10.70211/ltsm.v2i2.139.

[72] D. D. D. Fahrni, G. Iten, D. Prasse, and T. Hascher, "Teachers' practices in the use of digital technology to promote students' self-regulated learning and metacognition: A systematic review," *Teach. Teach. Educ.*, vol. 165, p. 105150, Oct. 2025, doi: 10.1016/j.tate.2025.105150.

[73] J. S. Barrot, "Social Media as an E-Portfolio Platform," in *The Palgrave Encyclopedia of Computer-Assisted Language Learning*, Cham: Springer Nature Switzerland, 2025, pp. 1–6. doi: 10.1007/978-3-031-51447-0_174-1.

[74] Koderi, M. Sufian, and Erlina, "Developing Lampung Local wisdom film of arabic communication skills for madrasah tsanawiyah students," *Int. J. Inf. Educ. Technol.*, vol. 13, no. 12, pp. 2004–2013, 2023, doi: 10.18178/ijiet.2023.13.12.2015.

[75] E. Erlina, K. Koderi, and M. Sufian, "Designing a gender-responsive qira'ah learning module: bridging equality and inclusivity in islamic higher education," *J. Ilm. Islam Futur.*, vol. 25, no. 1, pp. 239–262, Feb. 2025, doi: 10.22373/jiif.v25i1.29305.

[76] I. Aldalur and A. Perez, "Gamification and discovery learning: Motivating and involving students in the learning process," *Heliyon*, vol. 9, no. 1, p. e13135, Jan. 2023, doi: 10.1016/j.heliyon.2023.e13135.

[77] S. N. Amin, "Gamification of duolingo in rising student's english language learning motivation," *J. Bhs. Ling. Sci.*, vol. 13, no. 2, pp. 191–213, Nov. 2021, doi: 10.21274/ls.2021.13.2.191-213.

[78] M. Falakhi, T. Khamyod, and M. Jlassi, "Social criticism in Seno Gumira Ajidarma's short stories and its implication for literary learning," *J. Lang. Lit. Educ. Res.*, vol. 2, no. 1, pp. 51–58, Jun. 2025, doi: 10.37251/jolle.v2i1.1703.

[79] N. Partarakis and X. Zabulis, "A review of immersive technologies, knowledge representation, and ai for human-centered digital experiences," 2024. doi: 10.3390/electronics13020269.

[80] M. Bond, K. Buntins, S. Bedenlier, O. Zawacki-Richter, and M. Kerres, "Mapping research in student engagement and educational technology in higher education: A systematic evidence map," *Int. J. Educ. Technol. High. Educ.*, vol. 17, no. 1, p. 2, Dec. 2020, doi: 10.1186/s41239-019-0176-8.

[81] E. du Plooy, D. Casteleijn, and D. Franzsen, "Personalized adaptive learning in higher education: A scoping review of key characteristics and impact on academic performance and engagement," *Heliyon*, vol. 10, no. 21, Nov. 2024, doi: 10.1016/j.heliyon.2024.e39630.

[82] H. D. Osorio Vanegas, Y. de M. Segovia Cifuentes, and A. Sobrino Morrás, "Educational technology in teacher training: A systematic review of competencies, skills, models, and methods," *Educ. Sci.*, vol. 15, no. 8, p. 1036, Aug. 2025, doi: 10.3390/educsci15081036.

[83] S. Worachananant, S. Shamshiri, and G. R. Semilla, "Approach management in marine protected areas : A case study of Surin Marine National Park, Thailand," *Multidiscip. J. Tour. Hosp. Sport Phys. Educ.*, vol. 2, no. 1, pp. 11–18, 2025, doi: 10.37251/jthpe.v2i1.1655.

[84] D. Ismawati, B. Haryanto, and E. F. Fahyuni, "Blended learning in elementary schools," *KnE Soc. Sci.*, pp. 318–329, Jun. 2022, doi: 10.18502/kss.v7i10.11234.

[85] M. S. Rahajo and A. Kumyat, "Analysis of driving factors for the implementation of clean technology to optimize green manufacturing in the wiradesa batik Small and Medium Enterprises (SMEs)," *Integr. Sci. Educ. J.*, vol. 6, no. 3, pp. 258–268, Sep. 2025, doi: 10.37251/isej.v6i3.2115.

[86] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed. Thousand Oaks, CA: SAGE Publications, 2018.

[87] H. R. Hagad and H. Riah, "Augmented reality-based interactive learning media: Enhancing understanding of chemical bonding concepts," *J. Chem. Learn. Innov.*, vol. 2, no. 1, pp. 52–59, 2025, doi: 10.37251/jocli.v2i1.1919.

[88] "R Is for Random," in *Experimental Designs*, 1 Oliver's Yard, 55 City Road London EC1Y 1SP: SAGE Publications Ltd, 2021, pp. 15–52. doi: 10.4135/9781529682779.n2.

[89] V. Braun and V. Clarke, *Thematic Analysis: A Practical Guide*. London, UK: SAGE Publications, 2022. [Online]. Available: https://books.google.co.id/books/about/Thematic_Analysis.html?id=eMArEAAAQBAJ

[90] H.-Y. Chang *et al.*, "Ten years of augmented reality in education: A meta-analysis of (quasi-) experimental studies to investigate the impact," *Comput. Educ.*, vol. 191, p. 104641, Dec. 2022, doi: 10.1016/j.compedu.2022.104641.

[91] M. Moheghi, M. Ghorbanzadeh, and J. Abedi, "The investigation and criticism moral development ideas of Kohlberg, Piaget and Gilligan," *Int. J. Multicult. Multireligious Underst.*, vol. 7, no. 2, p. 362, Mar. 2020, doi:

10.18415/ijmmu.v7i2.1516.

[92] R. Lam, "E-Portfolios for self-regulated and co-regulated learning: A review," *Front. Psychol.*, vol. 13, Nov. 2022, doi: 10.3389/fpsyg.2022.1079385.

[93] A. Jensen, D. Secchi, and T. W. Jensen, "A distributed framework for the study of organizational cognition in meetings," *Front. Psychol.*, vol. 13, May 2022, doi: 10.3389/fpsyg.2022.769007.

[94] I. Hemmer, C. Koch, and A. Peitz, "ESD training for university teachers: Which is more effective, the face-to-face or digital format? Results of an intervention study," *Int. J. Sustain. High. Educ.*, vol. 25, no. 8, pp. 1732–1750, Nov. 2024, doi: 10.1108/IJSHE-05-2023-0178.

[95] I. H. Y. Yim and R. Wegerif, "Teachers' perceptions, attitudes, and acceptance of artificial intelligence (AI) educational learning tools: An exploratory study on AI literacy for young students," *Futur. Educ. Res.*, vol. 2, no. 4, pp. 318–345, Dec. 2024, doi: 10.1002/fer3.65.