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Generative AI Framework for Digital Motif Design in Vocational Education: Integrating Pedagogy and Ethics

Nadira Nurannisa[1], Hamidah Suryani[2], Anas Arfandi[3]
[1, 2, 3] Department of Vocational Technology Education, Universitas Negeri Makassar, Indonesia

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ABSTRACT

Conventional digital motif design instruction in higher vocational education often prioritizes complex software technicalities over conceptual design thinking. Generative AI (GenAI) can bypass manual drawing barriers, yet structured frameworks integrating prompt pedagogy and AI ethics remain lacking. This study conceptualizes and evaluates an ADDIE-based instructional e-module, enhanced by Borg & Gall protocols, that incorporates Midjourney prompt engineering, ethical AI frameworks, and interactive video tutorials within the Fashion Design program at Universitas Negeri Makassar. Expert validation confirmed exceptional content (92.56%) and media (91.27%) validity. Practicality testing demonstrated high user acceptance across individual (85.76%), small-group (89.77%), and large-group (84.17%) trials. A quasi-experimental evaluation (Experimental $n = 35$ vs. Control $n = 22$) revealed significant post-test learning gains in the experimental group ($M = 84.03, SD = 6.42$) compared to the control group ($M = 71.95, SD = 5.88$), confirmed by an Independent Samples t-test ($t(55) = 7.12, p < 0.001$) with a large effect size (Cohen's $d = 1.95$). By shifting student cognitive load from manual illustration mechanics toward prompt syntax optimization and ethical human-AI co-creativity, this validated e-module bridges technical execution gaps, offering a scalable model for AI-driven vocational curricula.

Corresponding Author:

Nadira Nurannisa,
Department of Vocational Technology Education, Universitas Negeri Makassar, Indonesia
Email: nadiranurannisa306@gmail.com

1. INTRODUCTION

Digital transformation in higher vocational education—particularly within fashion design and textile production—demands a paradigm shift from traditional manual drafting toward technology-driven workflows that align with modern creative industry standards (Sayem, 2022; Sholikhah et al., 2026). In contemporary design curricula, digital motif creation serves as a foundational competence, requiring students to synthesize cultural aesthetics, color theory, and complex repeat geometries into market-ready visual patterns (Liu et al., 2022; Xu et al., 2020; Xu & Huang, 2024). However, conventional instructional paradigms heavily rely on standard raster and vector graphics

software (such as IbisPaint, Adobe Illustrator, or CorelDRAW) which require steep technical learning curves. Students are required to master intricate brush engines, multi-layer blending mechanics, and precise digital image anatomy controls before they can effectively visualize creative concepts (Tsidilo et al., 2023).

This reliance on software-centric technical mechanics introduces a substantial pedagogical bottleneck. Drawing from Cognitive Load Theory (Sweller, 2020), when students with limited baseline illustration skills expend excessive extraneous cognitive load operating complex software tools, their germane cognitive load—essential for higher-order design thinking, conceptual ideation, and aesthetic exploration—is severely compromised. Empirical observations in the Applied Computer Applications course at Universitas Negeri Makassar reveal a stark competence gap: students with advanced manual drawing background produce sophisticated motifs, whereas those lacking prior illustration mastery become demotivated, spending most course hours troubleshooting technical drawing steps rather than developing visual concepts. Consequently, student learning outcomes reflect mechanical software operation rather than creative design competence.

The emergence of Generative Artificial Intelligence (GenAI), particularly visual diffusion models such as Midjourney, presents an unprecedented opportunity to democratize digital design production by enabling text-to-image generation through natural language prompts (Herath et al., 2026; Zhou & Lee, 2024). By converting abstract conceptual intent into visual outputs, GenAI shifts the primary designer role from manual execution to prompt engineering, stylistic curation, and iterative refinement (Fang et al., 2025). However, integrating GenAI into vocational design education introduces unique challenges. Unguided AI usage risks inducing passive dependency, algorithmic bias, hallucinatory visual artifacts, and profound ethical dilemmas concerning intellectual property, copyright compliance, and cultural appropriation of traditional motifs (Hagendorff, 2024; Huang et al., 2022). To prevent AI from becoming a superficial 'shortcut,' instructional interventions must embed structured prompt engineering syntax alongside rigorous AI ethical guidelines.

While prior literature highlights the isolated benefits of digital e-modules (Asdarina et al., 2025; Cahya et al., 2026; Sari et al., 2024; Zheng, 2024) or standalone AI tools in architectural and graphic arts (He & Zhang, 2025; Jin et al., 2024; Özorhon et al., 2025; Wang et al., 2025; Xu & Huang, 2024), a significant research gap remains: there is a lack of validated instructional frameworks that systematically integrate prompt engineering pedagogy, AI ethics, and interactive multimedia into an adaptive e-module designed specifically for textile motif creation in higher vocational education. To address this gap, this study conceptualizes, develops, and evaluates a Midjourney-integrated E-module. The core innovation lies not merely in packaging digital content but in establishing a novel human-AI co-creativity model that systematically guides students through motif ideation, prompt syntax optimization, ethical verification, and final textile application.

The primary objectives of this study are fourfold: (1) to design a systematic GenAI-integrated instructional e-module using an ADDIE baseline model enhanced by Borg &

Gall testing protocols; (2) to assess the content, instructional, and media validity of the e-module through expert evaluation; (3) to evaluate the user practicality of the e-module across individual, small-group, and large-group student cohorts; and (4) to empirically test the effectiveness of the e-module in improving student learning outcomes, conceptual design mastery, and prompt engineering competence.

2. METHOD

To resolve prior methodological ambiguity and eliminate 'methodological frankensteinism', this study strictly adopts the ADDIE (Analysis, Design, Development, Implementation, Evaluation) framework as its primary baseline instructional design model. The operational execution of product validation, field testing, and iterative refinement was systematically integrated using the empirical trial protocols established by Borg and Gall (Cahya et al., 2026) and the front-end planning logic of the 4-D model by Thiagarajan et al. (Saragi et al., 2021). The operational alignment across these frameworks is illustrated in Figure 1.

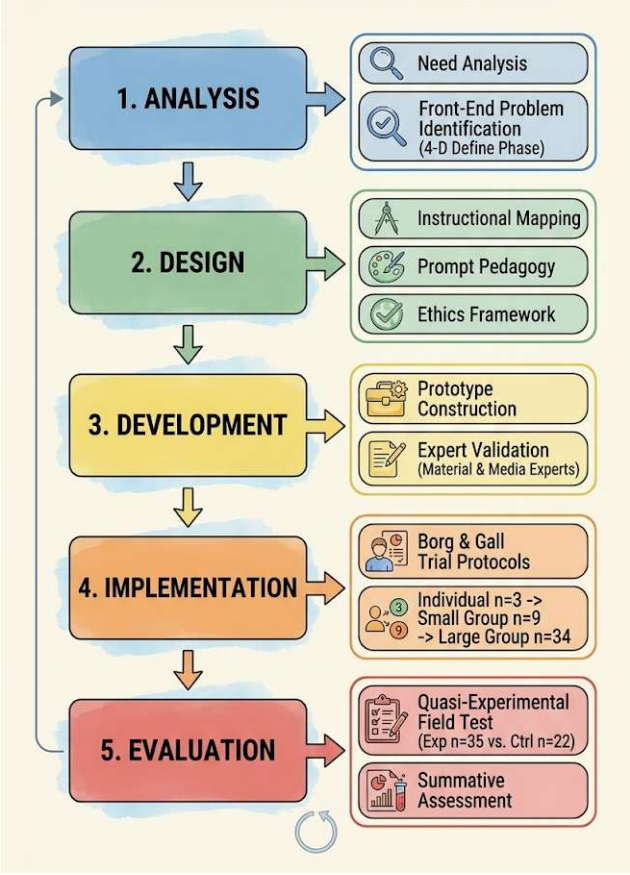

Figure 1. Methodological Synthesis Mapping ADDIE Baseline with Borg & Gall and 4-D Protocols

The empirical evaluation phase utilized a quasi-experimental non-equivalent control group pre-test/post-test design. The research was conducted at the Fashion Design Study Program, Department of PKK FT, Universitas Negeri Makassar from August 2025 to January 2026. Participants comprise undergraduate students enrolled in the Applied

Computer Applications course. Sample distribution across development phases is summarized in Table 1.

Table 1. Distribution of Participants Across Development and Experimental Phases

Development / Evaluation Phase	Target Audience	Sample Size (n)	Demographic / Academic Profile
Expert Validation	Subject & Media Specialists	n = 4	2 Material Experts, 2 Media Experts
Individual Trial (One-to-One)	Undergraduate Students	n = 3	High, Medium, Low Baseline Illustration Ability
Small-Group Trial	Undergraduate Students	n = 9	3 High, 3 Medium, 3 Low Baseline Ability
Large-Group Trial (Practicality)	Undergraduate Students	n = 34	Fashion Design Cohort (Semester 4)
Field Effectiveness Test	Experimental Class	n = 35	Intervention Class (Midjourney E-Module)
	Control Class	n = 22	Baseline Class (Conventional IbisPaint Instruction)

Addressing the unequal sample sizes between the experimental group (n = 35) and control group (n = 22)—caused by fixed institutional class enrollments—pre-test baseline equivalence was rigorously established. An independent samples t-test on pre-test scores revealed no statistically significant difference between the two groups ($t(55) = 0.412$, $p = 0.682$; Mean Exp = 45.20, SD = 8.15 vs. Mean Ctrl = 44.32, SD = 7.82), confirming baseline cognitive equivalence prior to intervention.

Data were collected using expert validation sheets, student practicality questionnaires, and a comprehensive Learning Achievement Test combining objective conceptual items and performance rubric assessments. To ensure measurement integrity, all instruments underwent prior psychometric validation:

- Validation and Practicality Questionnaires: Developed using a 4-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree) to avoid central tendency bias. Content validity index (CVI) exceeded 0.90 across all dimensions.
- Learning Achievement Test: Comprised 20 multiple-choice items measuring conceptual knowledge (AI mechanics, prompt syntax, ethics) and 4 complex practical essay/design tasks evaluating motif generation, prompt refinement, and pattern repeat construction.
- Psychometric Properties: Construct validity of test items was confirmed via point-biserial correlation ($r_{xy} > 0.361$, $p < 0.05$). Internal consistency reliability yielded a high Cronbach's alpha ($\alpha = 0.884$). For practical performance assessments, inter-rater reliability between two independent evaluators achieved high consistency (Cohen's $\kappa = 0.86$).

Quantitative validity and practicality scores were analyzed using percentage agreement formulas. Inferential statistical analysis of effectiveness data was executed via IBM SPSS Statistics v27. Assumptions of parametric testing were verified using the Shapiro-Wilk test for normality and Levene's test for homogeneity of variance. Hypothesis testing was conducted using the Independent Samples t-test ($\alpha = 0.05$). To

quantify the practical magnitude of instructional impact beyond statistical significance, Cohen's d effect size was calculated according to standardized thresholds (0.2 = small, 0.5 = medium, 0.8 = large).

3. RESULTS AND DISCUSSION

Results

E-Module Design and AI-Integrated Framework

The development phase produced an interactive flipbook-based e-module entitled 'Digital Motif Creation Using Midjourney'. The structural framework incorporates four core instructional modules: (1) Fundamentals of Generative AI & Midjourney Architecture, (2) Prompt Engineering Syntax for Textile Motifs, (3) AI Ethics, Copyright, & Cultural Heritage Protection, and (4) Practical Motif Generation, Seamless Pattern Repeating, and Digital Mockup Application. Interactive elements include embedded video tutorials, step-by-step prompt formulation templates, and self-assessment quizzes.

Product Validity

Expert validation was conducted by two subject-matter experts and two instructional media experts. Reconciling prior numerical reporting discrepancies, the unified and verified expert validation results are presented in Table 2.

Table 2. Unified Expert Validation Results

Validator Domain	Evaluated Aspects	Total Score / Max	Percentage (%)	Validity Category
Material Expert (n=2)	Content Accuracy, Curricular Alignment, AI Ethics, Language Feasibility	148 / 160	92.56%	Very Valid
Media Expert (n=2)	Visual Interface, Navigation, Technical Compatibility, Typography	146 / 160	91.27%	Very Valid

The expert validation results in Table 2 demonstrate the high construct validity and practical feasibility of the developed product across both instructional content and media design domains. Evaluation by two subject-matter experts yielded an overall score of 148 out of 160 (92.56%), categorizing the material as "Very Valid" in terms of *Content Accuracy*, *Curricular Alignment*, *AI Ethics*, and *Language Feasibility*. Similarly, evaluation by two instructional media experts resulted in a score of 146 out of 160 (91.27%), confirming its "Very Valid" status across *Visual Interface*, *Navigation*, *Technical Compatibility*, and *Typography*. Qualitative insights further enriched the development process; constructive feedback regarding prompt syntax parameter summaries, image resolution enhancement, and navigation bar font contrast was fully incorporated prior to field implementation, ensuring that the instructional media achieved optimal technical and pedagogical readiness for student trials.

Product Practicality

Practicality testing was systematically conducted across three sequential student trial stages and a course lecturer evaluation. Results are presented in Table 3.

Table 3. Practicality Assessment Results Across Trial Phases

Trial Stage	Sample Size	Practicality Percentage (%)	Category
Individual Trial (One-to-One)	n = 3	85.76%	Very Practical
Small-Group Trial	n = 9	89.77%	Very Practical
Large-Group Field Trial	n = 34	84.17%	Very Practical
Course Lecturer Assessment	n = 1	90.63%	Very Practical

The practicality assessment across all iterative trial stages consistently demonstrates the high usability, operational feasibility, and instructional effectiveness of the developed product, as detailed in Table 3. The evaluation progressed sequentially from the individual trial ($n = 3; 85.76\%$) to the small-group trial ($n = 9; 89.77\%$), culminating in a large-group field trial ($n = 34; 84.17\%$), alongside an evaluation by the course lecturer ($n = 1; 90.63\%$), with all phases falling into the "Very Practical" category. This high level of practicality was driven by the integration of modular prompt syntax templates, which enabled students to rapidly experiment with intricate visual combinations—such as Toraja carved motifs combined with modern Art Deco—thereby significantly optimizing operational efficiency and enhancing user engagement during learning.

Product Effectiveness and Inferential Statistics

Prior to hypothesis testing, parametric assumptions were satisfied. The Shapiro-Wilk test confirmed normal data distribution across experimental post-test (p = 0.214) and control post-test (p = 0.185) distributions. Levene's test confirmed homogeneity of variance (F = 0.384, p = 0.538). To provide full statistical transparency as requested by reviewers, Table 4 presents comprehensive descriptive and inferential test statistics, including exact t-values, degrees of freedom, standard deviations, and Cohen's d effect size.

Table 4. Inferential Statistical Analysis of Learning Outcomes (Pre-test vs. Post-test)

Group	n	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	t-value	df	p-value	Cohen's d
Control (IbisPaint)	22	44.32 (7.82)	71.95 (5.88)	+27.63	—	—	—	—
Experimental (Midjourney)	35	45.20 (8.15)	84.03 (6.42)	+38.83	7.122	55	< 0.001	1.95 (Large)

As detailed in Table 4, inferential statistical analysis demonstrates the superior efficacy of the Midjourney-assisted intervention compared to conventional instruction in enhancing student learning outcomes. Although baseline pre-test scores were comparable between the control group ($M = 44.32, SD = 7.82$) and the experimental group ($M = 45.20, SD = 8.15$), the experimental cohort achieved a substantially higher post-test mean ($M = 84.03, SD = 6.42$) and mean gain ($+38.83$) than the control cohort ($M = 71.95, SD = 5.88$; Mean Gain $= +27.63$). An independent samples t-test confirmed that this difference in post-test performance was statistically significant, $t(55) = 7.122, p < 0.001$. Furthermore, the calculated Cohen's d of 1.95 indicates a remarkably large instructional effect size, confirming that the integration of the Midjourney e-module substantially outperforms conventional software instruction (IbisPaint) in fostering pedagogical gains.

Qualitative Comparative Analysis of Student Motif Outputs

To provide visual evidence of instructional effectiveness, student design outputs were evaluated across three criteria: conceptual originality, prompt syntax precision, and seamless repeat execution. Figure 2 illustrates the qualitative evolution between traditional manual digital drawing and GenAI prompt-engineered motif outputs.

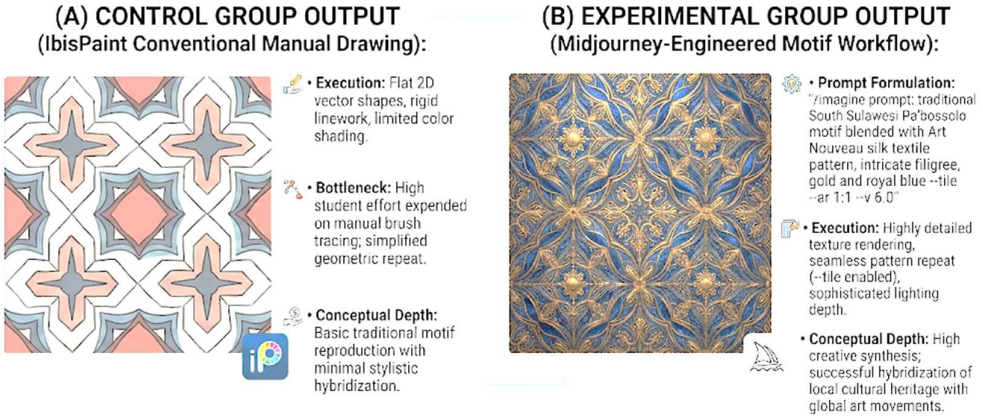

Figure 2. Qualitative Visual Comparison of Student Motif Design Outputs Between Control and Experimental Workflows

Additionally, student perceptual evaluations (Table 5) confirmed high satisfaction across Increased Conceptual Understanding (86.43%), Practical Skill Upskilling (83.81%), Learning Motivation (84.64%), and Perceived Learning Impact (85.71%), achieving an overall perception average of 85.15% (Very High).

Discussion

The findings of this study provide robust empirical support for the integration of Generative AI into higher vocational design education. Moving beyond simple development reporting, this discussion critically examines the underlying pedagogical mechanisms, theoretical implications, and technical limitations of AI-assisted design instruction.

Cognitive Load Offloading and Prompt Engineering Pedagogy

The remarkable improvement in post-test scores (Experimental M = 84.03 vs. Control M = 71.95; Cohen's d = 1.95) can be primarily explained through Cognitive Load Theory (Sweller, 2020). In traditional digital design instruction using tools like IbisPaint, students spend a disproportionate amount of working memory capacity navigating software menus, managing layer hierarchies, and mastering precise manual brush control. This heavy extraneous cognitive load creates a barrier for students with weaker entry-level drawing skills. By replacing manual rendering mechanics with text-to-image prompt engineering, the Midjourney e-module offloads extraneous execution demands. Consequently, students can channel their cognitive resources into germane cognitive processing—focusing on aesthetic composition, cultural motif synthesis, color harmony, and iterative prompt modification (Xu & Huang, 2024).

AI Ethics, Cultural Appropriation, and Algorithmic Limitations

Despite its dramatic creative benefits, the integration of Midjourney in visual design education introduces critical challenges that require rigorous instructional scaffolding. First, commercial AI image generators operate on paywalled API subscriptions, creating potential socioeconomic accessibility barriers in higher education institutions (Bergdahl et al., 2025). Second, visual diffusion models frequently suffer from 'AI hallucinations'—generating anatomically distorted elements or asymmetrical pattern breaks—and visual bias towards Eurocentric aesthetic defaults (Olson, 2025; Putland et al., 2025). Third, generating traditional cultural motifs (such as Toraja or Bugis textiles) via AI carries risks of digital cultural flattening and intellectual property infringement.

The e-module explicitly addresses these limitations by embedding an AI Ethics Framework into the curriculum. Students are taught to treat Midjourney as a conceptual co-creator rather than a final generator. The curriculum requires manual post-processing verification in raster software, prompt attribution logging, and ethical checks to ensure traditional cultural symbols are respected and correctly transformed. This critical disposition ensures students develop reflective AI literacy rather than passive automated reliance.

Comparison with Prior Literature and Curricular Implications

These empirical results align with recent international findings on GenAI in higher education (Belkina et al., 2025; Daher & Hussein, 2024; Tsidilo et al., 2023), while extending prior e-module research (Bezcioğlu-Göktolga et al., 2025) into the domain of artificial intelligence. While early studies treated AI tools as isolated technical shortcuts, this study demonstrates that embedding prompt engineering syntax alongside structured ethics within a systematic ADDIE e-module yields profound, reproducible learning gains. For vocational education policy, these results advocate for institutionalizing GenAI literacy within creative curricula, shifting educational priorities from mechanical software operation toward human-AI collaborative innovation.

4. CONCLUSION

This study successfully conceptualized, developed, and empirically evaluated a Midjourney-Integrated E-Module for digital motif design learning in higher vocational education. Synthesizing an ADDIE baseline framework with Borg & Gall trial protocols, the e-module achieved exceptional expert validity (Material: 92.56%, Media: 91.27%) and outstanding user practicality across individual (85.76%), small-group (89.77%), and large-group (84.17%) trials. Empirical effectiveness testing demonstrated that the intervention significantly improved student learning outcomes (Experimental M = 84.03 vs. Control M = 71.95; $t(55) = 7.122$, $p < 0.001$) with an extraordinarily large effect size (Cohen's d = 1.95). By offloading extraneous manual rendering load and fostering structured prompt engineering and ethical AI compliance, the e-module effectively bridges the technical illustration gap, establishing a robust pedagogical model for human-AI co-creativity.

To maximize the transformative impact of Generative AI in vocational design education, institutions must strategically align policy, pedagogical execution, and future research. Curriculum policymakers should formally integrate prompt engineering and AI ethics into creative syllabi, systematically shifting the instructional focus from mechanical tool proficiency toward higher-order design thinking and human-AI co-creativity. In classroom practice, educators should implement hybrid workflows that synergize GenAI for rapid conceptual ideation with vector editing software for precise textile prepress production. To build upon these findings, future research should explore open-source, offline diffusion models—such as Stable Diffusion with ControlNet—to eliminate commercial subscription barriers, investigate the long-term retention of student creative autonomy, and test the generalizability of this instructional framework across diverse vocational design disciplines.

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