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ARTIFICIAL INTELLIGENCE SHORTCUTS AND INFRASTRUCTURE DEFICITS IN VOCATIONAL PROJECT-BASED LEARNING

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A B S T R A C T

The integration of artificial intelligence (AI) in vocational education poses dual challenges: rigorous technical curriculum mandates clash with severely constrained physical workshop facilities. This structural imbalance drives students to adopt digital shortcuts, risking the efficacy of Project-Based Learning (PjBL). This descriptive qualitative case study explores this phenomenon among 23 visual communication design (VCD) students at a vocational high school. Through participant observation and artifact evaluation, project originality was measured using a four-level analytical rubric assessing AI detection indices, visual anatomy defects, source files, and ideation logs. The availability of only a single sublimation press unit created substantial physical production bottlenecks, inducing severe frustration. Consequently, most students responded to this operational pressure by exploiting automatic vector-tracing shortcuts. This behavior manifests as fake engagement, triggered by deficient technological literacy, and caused significant delays extending across eight classroom sessions. Rubric scores confirmed a dominance of low-originality levels resulting from instant software manipulation devoid of manual sketching. Grounded in Self-Determination Theory (SDT), findings prove infrastructure deficits systematically hinder student learning autonomy and intrinsic motivation. Evaluating the facility-to-student ratio emerges as a critical imperative for institutional management. Furthermore, developing cross-teacher integrated instructional modules is vital to sustain pedagogical momentum, while policymakers must recalibrate AI utilization guidelines to prioritize reinforcing fundamental psychomotor skills.

1. Introduction

The massive wave of artificial intelligence (AI) technology sweeping through the creative industry forces the vocational education ecosystem to adapt rapidly. Mastery of mechanical instructions within software applications is no longer sufficient. Vocational education is currently mandated to integrate intelligent learning systems to equip graduates with comprehensive professional competencies. However, the omnipresence of automation carries the risk of manual skill atrophy and the systematic dematerialization of the graphic designer's role (Matthews et al., 2023). Graduates of vocational institutions, particularly within design disciplines, must possess not only adaptive digital literacy but also the professional instinct to solve visual problems through original and morally accountable design workflows.

This ideal curricular target relies heavily on the Project-Based Learning (PjBL) framework, which centers on direct, experiential learning. According to the Cone of Experience hierarchy, student retention and engagement reach their peak at 90% when learners engage in "Doing the Real Thing" through direct simulation and physical manufacturing (Wyatt & Looper, 1999). Within the Visual Communication Design (VCD) specialization, this real-world experience spans the entire continuum from pre-production conceptualization and symbol processing to the actual physical production of transferring digital artwork onto tangible media. However, field realities frequently expose a profound pedagogical dissonance between these experiential targets and the acute lack of infrastructure readiness within school workshops.

Prior studies have highlighted this educational mismatch, particularly concerning poor student literacy when confronting disruptive technologies. (Lee & Kwon, 2024) identified a fundamental absence of core AI literacy across K-12 and vocational streams, causing advanced technological functions to be severely reduced within classrooms. Easy access to generative AI induces a highly pragmatic disposition, displacing the technology's potential role as a collaborative partner for creative innovation (Giannakos et al., 2025). Consequently, students lean heavily toward digital shortcuts such as automatic vector conversion which curtails critical thinking and reduces the complex craft of design to mere instant image manipulation.

Other literatures examine how the workshop ecosystem psychologically impacts student learning motivation. The deployment of PjBL should ideally cultivate student autonomy and responsibility in utilizing digital tools (De Barros et al., 2023). This aligns with Self-Determination Theory (SDT), which posits that autonomy, competence, and relatedness are absolute prerequisites for fostering intrinsic motivation in educational environments (Ryan & Deci, 2000). Unfortunately, this intrinsic drive is easily eroded by structural deficits. Mismatches between institutional bureaucracy and sluggish workshop upgrades have been proven to trigger systematic resistance to innovation, thereby disrupting classroom instructional rhythms (Yu et al., 2022).

Failures in adapting physical facilities do not merely hinder technical operations; they actively incentivize students to adopt maladaptive workflows. The absence of adequate facilities for authentic practical execution drives students to generate *fake engagement* a state where tasks are completed purely to satisfy administrative requirements without any substantive transfer of knowledge occurring (Ng et al., 2024). Students lose their personal signature and artistic touch when the learning environment normalizes a culture of convenience (Huo & Wang, 2022). Their self-regulated learning profiles undergo severe degradation due to a heavy reliance on automated engines (H. Liu et al., 2025). This reality confirms that structural facility bottlenecks systematically stunt the development of foundational competencies in vocational education.

While prior research has separately addressed AI adoption challenges and the necessity of facilities in PjBL, empirical explorations regarding the direct link between physical infrastructure scarcity, sub-optimal instructional scheduling, and the resultant student tendency to adopt AI-driven shortcuts remain critically scarce. This empirical gap represents the core novelty and urgency of this study. This article aims to critically analyze how workshop equipment scarcity disrupts design brief compliance and learning mastery among VCD students at SMK Negeri 1 Cipatat. The findings are expected to offer evaluative prescriptions for educational management. Educational stakeholders must urgently update AI implementation rubrics and rebalance physical facility allocations relative to student population sizes.

2. Method

This field investigation employed a descriptive qualitative approach utilizing a case study design to explore phenomena deeply within real-world contexts (Creswell & Poth, 2018; Yin, 2018).

The research objective centers on identifying the extent to which digital shortcut practices circumvent the vital stages of symbol processing and student design brief comprehension. In parallel, this inquiry examines the systemic correlation between minimal workshop infrastructure and the disruption of institutional learning mastery timelines.

Fieldwork was situated entirely inside the production workshop of SMK Negeri 1 Cipatat. The unit of observation comprised 23 students from class XI DKV 1. Due to severe spatial and equipment limitations, practical scheduling had to be fragmented; 15 students conducted practical sessions on Mondays, while the remaining cohort gained workshop access on Tuesdays. Within this ecosystem, the researcher operated fully as a participant-observer, directly guiding the logo design project in the classroom.

The data collection phase integrated participant observation methods with formal design artifact documentation. The researcher systematically extracted field notes across three progressive project execution cycles. A four-level analytical rubric was deployed to evaluate the design outcomes of the 23 participants (Appendix A). Level 1 (Very Low) represents the instant adoption of automated generators entirely devoid of manual sketching. Level 2 (Low) denotes manual layout adjustments wherein the core graphic elements rigidly retain their native AI distortions. Level 3 (Moderate) reflects a balanced human-machine collaboration. Level 4 (High) represents pure manual design originality characterized by natural stroke consistencies. Data trustworthiness was anchored on source triangulation techniques by cross-verifying observational field logs against the physical digital track records of the students' project files. Formal peer-debriefing sessions conducted with a panel of fellow vocational instructors served to eliminate single-observer interpretive bias.

3. Results

Field data revealed a tightly locked, bidirectional relationship between technical constraints and student behavior throughout the project. These learning barriers emerged progressively and were tracked across three distinct project execution cycles.

3.1 Pre-Production and Symbol Processing Phase

The initial phase captured profound challenges as students attempted to translate client desires into an operational design brief. Difficulties in aligning visual perceptions triggered massive fluctuations in students' emotional and cognitive engagement during this live-client project (Chang et al., 2024). Consequently, the utilization of auto-tracing tools and web-based AI imagery became the dominant classroom practice due to a lack of independent ideation exploration. This pervasive reliance on digital shortcuts is systematically summarized through the lens of student artwork originality levels (Table 1).

Table 1. Distribution of Artwork Originality Levels among Students (n=23)

Originality Level	Frequency	Percent
Level 1 (Very Low)	12	52,2
Level 2 (Low)	6	26,1
Level 3 (Moderate)	4	17,4
Level 4 (High)	1	4,3
Total	23	100.0

Student dependence on artificial intelligence was exceptionally massive during this symbol processing stage. A severe concentration of the majority of the classroom population (78.3%) was recorded within the lowest two hierarchical levels, as visually represented in the distribution chart (Figure 1).

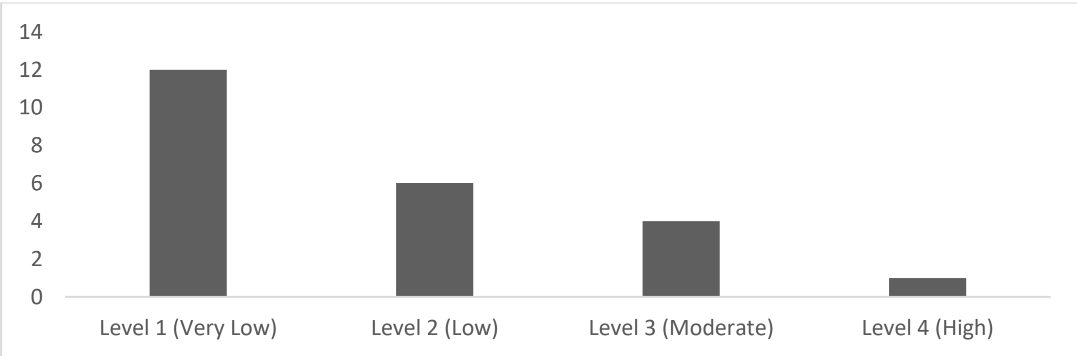

Figure 1. Student originality level distribution

Visual analysis concretely confirmed these metrics by identifying native AI design anomalies within student outputs. Field findings revealed distorted vector anchor paths due to rapid tracing, uneven line weights, and unnatural curvature warping within the geometric logo structures. This instant utilization of digital tools effectively erases the designer's personal identity right from the pre-production stage. A screenshot of the digital workspace (Figure 2) exposes these shortcut practices clearly through the presence of digital watermarks from internet reference images duplicated raw onto the canvas.

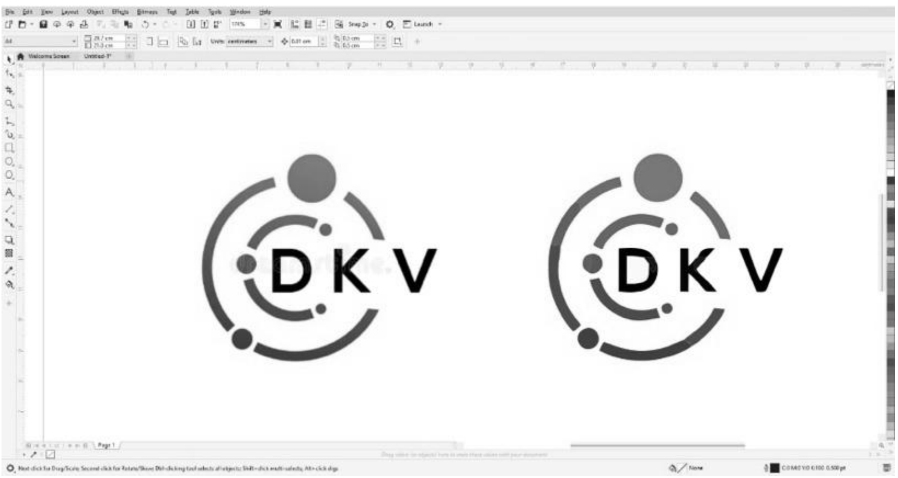

Figure 2. Visual comparison of original reference material (left) and raw auto-traced output (right)

Other student submissions similarly exhibited fragmented path boundaries from instant auto-tracing and irrational object proportions. This heavy reliance on instant AI features is a direct structural implication of practical infrastructure limitations. The heavy data weighting toward Level 1 and Level 2 reflects a fundamental shift in student learning orientations: moving away from psychomotor skill exploration toward fake engagement strategies executed solely to meet administrative quotas.

3.2 Physical Material Processing Phase

The transition from digital design execution to physical material manufacturing exposed significant operational bottlenecks for the workshop's workflow rhythm. The highly restricted student-to-equipment ratio stood in stark contrast to the large student enrollment, instantly triggering massive crowds around a single workstation. Field observation photography during this critical phase captures a learning environment severely bottlenecked around a single manufacturing asset (Figure 3).

Figure 3. Student queuing dense congestion around the single heat press unit in the workshop

The dense crowd packed around the press machine serves as a literal visual representation of the compressed space available for independent student exploration. This minimal infrastructure configuration forced the majority of students to transform into passive observers. The total lack of ergonomic workstations further degraded the classroom's operational time efficiency. This cascade of spatial constraints generated deep psychological fatigue long before projects reached final execution. Consequently, the tolerance for manufacturing margins of error dropped to near-zero as deadlines approached.

3.3 Final Printing and Execution Phase

The final phase of this design project accumulated the compound operational bottlenecks from the preceding two cycles. Looming project deadlines collided directly with structural technical unreadiness. This chronological shift in project workflows was itemized to highlight the severe disparities between the intended curriculum and field realities (Table 2).

Table 2. Project Completion Delay Timeline Matrix

Session / Day	Intended Competency Target	Field Realization Status	Core Root Cause
Sessions 1-2 (Mon & Tue)	Vector design finalized and prepped for manufacturing.	The majority of students only reached basic reference harvesting and raw auto-tracing.	Deficient AI literacy incentivizes an instant plagiarism culture.
Sessions 3-4 (Mon & Tue)	Transfer printing to sublimation media fully completed.	Only a small fraction of students successfully manufactured physical outputs.	Severe queuing at 1 press unit consumed the entire 3-hour practical block.
Sessions 5 (Thu)	Manufacturing wrap-up and quality evaluation.	Project execution halted entirely; students shifted to a completely different subject.	Instructor turnover without integrated module handovers fractured instructional continuity.
Sessions 6-8 (Mon & Tue)	Final artifact collection and project closure.	The remaining student cohort finally completed physical print manufacturing.	Compounded delays stemming from facility deficits and instructional disorientation.

The distribution of project delays highlights the severe domino effect caused by early-stage infrastructure blockages. The failure to hit vector design targets during the first two sessions triggered a massive, compounding workflow bottleneck during the printing phase. Prolonged queues to access the single printing unit completely consumed the entire three-hour practical block. The root causes of these operational manufacturing delays were formally validated via structured interviews conducted with 1 Workshop Head and 4 representative student participants. The vast majority of the students (3 out of 4 respondents) confirmed that resorting to automated AI tracing features was a purely pragmatic survival mechanism to fulfill assignment criteria under highly irrational equipment waiting times. This operational reality was directly confirmed by the Workshop Head:
"The core issue is the sublimation press machine. The ratio of equipment to our 23 students is wildly unbalanced, as we possess only 1 unit. This serves as our primary operational bottleneck, fundamentally forcing students to pivot away from active designing toward passive queuing."

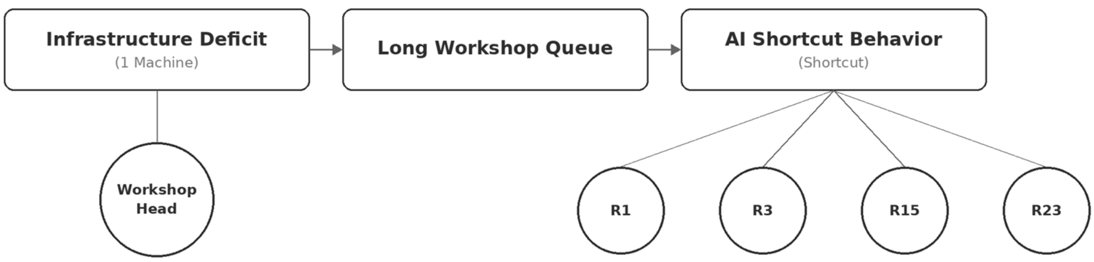

Figure 4. Conceptual model of infrastructure deficits and student AI shortcuts

The qualitative coding network architecture explicitly maps the conceptual relationships between institutional structural variables and student behavioral responses (Figure 4). Acute infrastructure deficits act as the primary structural upstream issue that linearly degrades workshop efficiency through dense queuing. This irrational operational time pressure serves as the primary environmental stressor driving the escalation of pragmatic digital shortcut behaviors among students. This phenomenon aligns with global observations where vague institutional frameworks often fail to mitigate premature and unguided generative AI reliance within educational settings (Jin et al., 2025). Cross-verifying these code segments demonstrates that learning autonomy failures do not stem from individual student negligence; rather, they are structural byproducts of severe facility restrictions that systematically cultivate fake engagement to survive institutional administrative deadlines.

This operational crisis was further exacerbated by sudden instructor turnover midway through the project without an integrated module handover. This instructional disorientation completely halted classroom printing operations during the fifth session, forcing students to abandon their project timeline to attend to other academic subjects. The combination of severe equipment deficits, prolonged queue times, and fragmented instructional coordination culminated in massive, compounded project delays. The remaining student cohort was only able to complete physical manufacturing during the final extended sessions. Consequently, the absence of stabilized digital-to-physical integration directly disrupts the ideal visual communication teaching system framework (X. Liu & Yao, 2023). This terminal delay completely erased the vital quality evaluation phase from the educational cycle. Ultimately, the physical design artifacts represented nothing more than a rushed compromise dictated by strict administrative deadlines, stripping this extended creative process of its core visual communication design competencies.

4. Discussion

Field realities establish physical infrastructure as the literal lifeblood of Project-Based Learning. The scarcity of a single sublimation press machine transcends basic technical friction; it functions as a psychological stressor that actively conditions students to adopt hyper-pragmatic behaviors. Desperation born from enduring prolonged, unproductive queues systematically drives students to exploit instant vector-tracing shortcuts on a massive scale. Furthermore, instructional time fragmentation caused by fragmented scheduling split-shifts severely disrupts design brief comprehension continuity. Students lose creative momentum when inter-session gaps are excessively wide, empirically proving that visual symbol processing mastery rates are heavily constrained by physical workshop facility support.

This inquiry expands the application of Deci and Ryan's Self-Determination Theory (SDT) to vocational education ecosystems operating under severe structural resource constraints (Deci & Ryan, 1985). Theoretically, PjBL frameworks are engineered to cultivate learner intrinsic motivation by satisfying three basic psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2000). However, empirical field data exposes a systematic collapse across all three foundational pillars. The need for autonomy is shattered when students are subjected to highly irrational equipment queuing constraints. Learners lose all meaningful control over their time allocation, causing a profound degradation of their broader self-regulated learning profiles (H. Liu et al., 2025). This independent drive is displaced by externalized, highly pragmatic regulatory motivations focused exclusively on deploying rapid AI shortcut behaviors to bypass authentic creative labor (Annamalai et al., 2025).

Similarly, the need for competence fails to crystallize due to deficient base-level AI literacy. The absence of an structured literacy framework stunts both psychomotor and academic development (Vieriu & Petrea, 2025; Wang et al., 2025). Students convert automated AI-tracing features into an operational bypass, generating *fake engagement* to fulfill administrative criteria while completely evading cognitive effort (Ng et al., 2024). This ease of generating and editing instant visual content via automated tracing triggers a plagiarism loops that eliminates personal artistic identity (Huo & Wang, 2022). This phenomenon is further compounded by permissive or ambiguous institutional policies, which passively allow these premature AI shortcut adoptions to normalize within practical spaces (Polyportis & Pahos, 2025). Lastly, the psychological need for relatedness is severely fractured by instructional alignment gaps among vocational educators. The total absence of co-authored, collaborative instructional modules isolates student workflows. This lack of integrated, continuous teacher support fatally undermines student emotional investment and fundamentally diminishes overall learning satisfaction metrics (Li & Chiu, 2025).

5. Conclusion

The systemic breakdown of Project-Based Learning within Visual Communication Design specializations stems directly from the collision between physical infrastructure deficits and premature digital technology adoptions. Scarcity of essential workshop facilities is empirically proven to paralyze learning autonomy and systematically extinguish student intrinsic motivation under the Self-Determination Theory framework. The widespread emergence of digital shortcut behaviors via automated vector tracing serves as an explicit indicator of competency-acquisition failure within the vocational ecosystem. This study is naturally bounded by its focus on a single institution suffering from severe facility deficits, meaning the insights cannot be generalized to vocational environments possessing ideal equipment-to-student ratios. The researcher strongly recommends future empirical inquiries expanding into multi-site, large-scale population sizes. Additionally, experimental testing of integrated cross-teacher instructional modules is highly necessary to successfully mitigate instant AI dependency behaviors within vocational practical environments.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of the paper.

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Appendix A. Analytical Evaluation Rubric for Artwork Design Originality Levels

Originality Level	Evaluation Criteria
Level 1 (Very Low)	Instant adoption of automated generators without manual sketching workflows. Presence of classic AI structural defects: fragmented vector paths from rapid tracing, melted ornamental lines, or overlapping object anatomy. Project files are blank or contain only raw bitmap inserts.
Level 2 (Low)	Manual layout and basic composition adjustments are present, but core graphic elements rigidly retain native AI distortions. Digital work layers merely isolate raw images without manual path smoothing or node refinement.
Level 3 (Moderate)	Balanced human-machine collaboration. AI technology is strictly confined to color palette exploration or asset reference harvesting. Vector geometry is re-drawn from scratch based on manual hand sketches, supported by digital moodboard evidence and sequential vector path build logs.
Level 4 (High)	Pure manual design originality. Stroke consistencies, perspectives, and typographic elements display natural rendering. Vector anchor node placement is executed with maximum efficiency and precision, backed by complete design ideation track records.