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CONTEXTUALIZING TECHNICAL DRAFTING WITH AutoCAD: BASIS FOR A LEARNING GUIDE

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ABSTRACT

This study evaluated the effectiveness of contextualizing Technical Drafting with Computer-Aided Design (CAD) — specifically AutoCAD Version 2013 — in enhancing student learning outcomes at Cebu Technological University – San Francisco Campus (CTU-SF). Employing a quantitative-descriptive research design, the study involved 247 second-year Bachelor of Industrial Technology students enrolled in Computer Technology and Electronics Technology programs during Academic Year 2025–2026. Data were gathered using an adapted survey questionnaire disseminated through Google Forms and analyzed using frequency, percentage, weighted mean, Pearson Product-Moment Correlation, t-test, and one-way ANOVA. Results indicated a moderate level of student learning across five CAD competencies: system features, design, usability, accuracy in creating technical drawings, and proper use of tools and commands. Students' perception of AutoCAD was likewise moderate, yet a significant positive relationship ($r = 0.779$, $p = 0.002$) was established between learning levels and perceptions. Significant differences in learning outcomes were found based on frequency of CAD practice, while age and sex showed no significant effect. Based on these findings, a contextualized and outcomes-based Learning Guide structured into six progressive modules was developed to bridge classroom instruction and professional industry practice.

KEYWORDS: *Technical Drafting, AutoCAD, contextualization, student learning, outcomes-based education, learning guide*

I. INTRODUCTION

Education in the twenty-first century demands that learners acquire practical, technology-driven competencies capable of sustaining them in a rapidly evolving global economy. Within technical and vocational education, drafting functions as the universal language of engineering, architecture, and industrial design. The advent of Computer-Aided Design (CAD) transformed this discipline by enabling greater precision, faster design revision cycles, and the capacity for sophisticated spatial visualization — advantages that manual drafting techniques could never efficiently replicate (Alonso & Anido, 2019). As industries increasingly depend on CAD-generated outputs, academic institutions bear the responsibility of embedding this technology into instruction so that graduates are genuinely prepared for industry demands.

In the Philippines, the Commission on Higher Education (CHED, 2014) mandated the adoption of Outcomes-Based Education (OBE) to align higher education programs with professional competency standards. OBE, as articulated by Spady (1994), privileges measurable learning outcomes over mere content coverage, ensuring instruction is purposeful, performance-anchored, and industry-relevant. Contextualization further strengthens this framework by situating abstract technical concepts within learners' real community environments and career aspirations (Adnan et al., 2024; CHED, 2020). In technical drafting with CAD, contextualization may take practical forms such as designing barangay facilities, community infrastructure, or locally inspired architectural layouts — tasks that simultaneously reinforce technical skill and professional identity.

Despite its recognized importance, CAD instruction at CTU–San Francisco Campus has historically relied on generic or foreign-based reference materials that lack local relevance and alignment with OBE standards. This instructional gap motivated the present study, which sought to assess the level of student learning in Technical Drafting with CAD, examine students' perceptions of AutoCAD as a learning tool, explore significant relationships and differences in outcomes across demographic variables, and ultimately propose a contextualized and outcomes-oriented Learning Guide to elevate competency development and industry readiness.

The study is theoretically grounded in Constructivist Learning Theory (Piaget, 1976; Vygotsky, 1978), Experiential Learning Theory (Kolb, 1984), and the Technology Acceptance Model (Davis, 1989). Constructivism underpins the use of hands-on, contextualized drafting tasks that allow students to actively build knowledge. Vygotsky's Zone of Proximal Development justifies the scaffolded, progressive structure of the learning guide — from foundational navigation skills to advanced blueprint reading. Kolb's experiential cycle reinforces iterative design practice, while TAM explains how students' perceptions of AutoCAD's usefulness and ease of use directly influence their learning engagement and performance outcomes. Legal foundations include Republic Act 7722 (Higher Education Act of 1994), RA 7796 (TESDA Act), RA 10533 (Enhanced Basic Education Act of 2013), and CHED's CMO No. 46 on OBE, collectively mandating that higher education deliver contextualized, outcomes-aligned, and industry-ready instruction.

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II. METHODS

Research Design

This study employed a quantitative-descriptive research design. The descriptive component profiled respondents by age, sex, and frequency of CAD-related activities, while the inferential component examined statistical relationships and differences through Pearson r, t-test, and one-way ANOVA.

Participants and Sampling

The respondents consisted of 247 second-year Bachelor of Industrial Technology (BIndTech) students enrolled in the Computer Technology (CT) and Electronics Technology (ET) programs at CTU–San Francisco Campus during the first semester of Academic Year 2025–2026. Simple random sampling was used to ensure representative coverage of varied CAD skill levels and demographic backgrounds.

Program	Frequency (f)	Percentage (%)
BIndTech – CT & ET	247	100.00
Total	247	100.00

Table 1. Distribution of Respondents

Instrument

Data were collected using an adapted survey questionnaire divided into three parts. Part I captured demographic profiles — age, sex, and frequency of CAD-related laboratory participation. Part II assessed level of student learning across five competencies. Part III evaluated students' perception of AutoCAD using the same five competency domains. All items employed a five-point Likert scale (1 = Very Low to 5 = Very High). The instrument was adapted from validated studies (Ali & Bukhari, 2021; Özcan & Toklu, 2022; Alarmi et al., 2023; Hamzah et al., 2023) and modified to fit the CTU-SF technical drafting context. The questionnaire was distributed electronically via Google Forms to facilitate wide-scale data collection while ensuring respondent anonymity and confidentiality.

Data Analysis

Statistical analyses were conducted as follows: frequency and percentage for respondent profiles; weighted mean and standard deviation for levels of learning and perception; Pearson Product-Moment Correlation to determine the relationship between learning and perception; independent-samples t-test for sex-based differences; and one-way ANOVA for age and activity frequency differences. The scoring rubric used the following verbal descriptors:

Weight	Range	Description
5	4.21 – 5.00	Very High
4	3.41 – 4.20	High
3	2.61 – 3.40	Moderate
2	1.81 – 2.60	Low
1	1.00 – 1.80	Very Low

Table 2. Scoring Rubric for Likert Scale Interpretation

III. RESULTS

Profile of Respondents

The majority of respondents (49.80%) were aged 21–23 years, followed by those aged 18–20 (27.13%), 24–26 (9.72%), and 27 and above (8.91%). Sex distribution was nearly balanced: 112 males (45.34%), 120 females (48.58%), and 4 who preferred not to disclose (1.62%). In terms of CAD activity frequency, 34.82% engaged twice a week, 29.15% only when required by the subject, and 23.48% once a week. Smaller proportions practiced three times a week (5.67%) or more (6.88%). This variation in engagement frequency is particularly relevant given its subsequent statistical association with learning outcomes.

Level of Student Learning in Technical Drafting with CAD

Student learning across all five CAD competency domains was rated as Moderate, with overall mean scores ranging from 3.35 to 3.45. The highest-rated competency was Proper Use of Tools and Commands (M = 3.45, SD = 0.68), followed by Accuracy in Creating Technical Drawings (M = 3.43, SD = 0.69), Usability (M = 3.41, SD = 0.70), Design (M = 3.39, SD = 0.70), and System Features (M = 3.35, SD = 0.72). These findings suggest that students possess foundational CAD knowledge but have not yet achieved the consistent, high-level proficiency required for professional drafting practice.

Competency Domain	Mean	SD	Description
System Features	3.35	0.72	Moderate
Design	3.39	0.70	Moderate
Usability	3.41	0.70	Moderate
Accuracy in Creating Technical Drawings	3.43	0.69	Moderate
Proper Use of Tools and Commands	3.45	0.68	Moderate

Table 3. Summary of Level of Student Learning in Technical Drafting with CAD

Level of Students' Perception Toward AutoCAD

Students' perception of AutoCAD as an instructional tool similarly reflected a Moderate level across all five competencies. Grand overall mean was 3.41 (SD = 0.70). Proper Use of Tools and Commands registered the highest perception mean (M = 3.45, SD = 0.68), while System Features recorded the lowest (M = 3.35, SD = 0.72). These results, interpreted through the Technology Acceptance Model (Davis, 1989), indicate that students moderately recognize AutoCAD's perceived usefulness and ease of use — factors that are foundational precursors to sustained technology adoption in learning environments.

Competency Domain	Overall Mean	SD	Description
System Features	3.35	0.72	Moderate
Design	3.40	0.70	Moderate
Usability	3.41	0.70	Moderate
Accuracy in Creating Technical Drawings	3.43	0.69	Moderate
Proper Use of Tools and Commands	3.45	0.68	Moderate
Grand Overall Mean	3.41	0.70	Moderate

Table 4. Summary of Perception Toward AutoCAD Software Application Tool

Significant Relationship: Student Learning and AutoCAD Perception

Pearson Product-Moment Correlation analysis revealed a statistically significant positive relationship between student learning levels and their perception of AutoCAD across all five competency domains. Pearson r values ranged from 0.754 (Usability, p = 0.003) to 0.812 (Accuracy in Creating Technical Drawings, p = 0.000), with a grand overall r = 0.779 (p = 0.002 < 0.05). Since all p-values were below the 0.05 significance threshold, the null hypothesis was rejected. This finding aligns with Feng et al. (2020), who demonstrated that technology acceptance positively mediates learning engagement, and with Hamzah et al. (2023), who linked CAD-based instructional materials to improved technical performance through increased software familiarity.

Competency	Pearson r	p-value	Interpretation
System Features	0.781	0.001	Significant
Design	0.754	0.003	Significant
Usability	0.754	0.003	Significant
Accuracy in Creating Technical Drawings	0.812	0.000	Significant
Proper Use of Tools and Commands	0.769	0.002	Significant
Grand Overall	0.779	0.002	Significant

Table 5. Significant Relationship Between Learning and Perception of AutoCAD

Significant Difference in Learning According to Profile

Analysis of variance and t-test results revealed that age (F = 0.12, p > 0.05) and sex (t = 0.00, p > 0.05) did not significantly influence students' level of learning in Technical Drafting with CAD. However, frequency of CAD-related activities produced statistically significant differences in learning outcomes (F = 4.85, p < 0.05). Students who engaged with CAD exercises more frequently — two to three times per week — demonstrated progressively higher mean learning scores (3.38 to 3.45) compared to those who practiced only once per week or as required. These results affirm that consistent, structured exposure to CAD practice is the most potent demographic predictor of improved competency, regardless of age or sex.

Profile Variable	Statistical Test	Result	Interpretation
Age	One-Way ANOVA	F = 0.12, p > 0.05	Not Significant
Sex	Independent t-test	t = 0.00, p > 0.05	Not Significant
Frequency of CAD Activities	One-Way ANOVA	F = 4.85, p < 0.05	Significant

Table 6. Significant Differences in Learning According to Profile Variables

IV. DISCUSSION

The finding that students demonstrated a uniformly Moderate level of learning across all five CAD competency domains reveals a critical instructional gap at CTU–San Francisco Campus. While students possess the foundational knowledge necessary to navigate AutoCAD's interface and execute basic drawing commands, they have not yet achieved the level of independent, precise, and efficient drafting performance that the industry expects. This pattern aligns with Liu (2020), who observed that CAD students often struggle to translate theoretical knowledge into practical performance without structured, scaffolded, and repeated practice opportunities.

The moderate perception of AutoCAD — particularly in System Features — suggests that familiarity barriers persist. Students who struggle to fully navigate the software interface are less likely to explore advanced features independently, perpetuating surface-level competency. This observation resonates with Davis's Technology Acceptance Model (1989): when perceived ease of use remains only moderate, the threshold for autonomous and exploratory engagement with the technology is not crossed. Instructional interventions that directly address interface familiarity through guided, contextualized exercises can meaningfully shift these perceptions and unlock deeper learning.

The strong positive correlation between learning levels and AutoCAD perceptions ($r = 0.779$) confirms what Feng et al. (2020) established: technology acceptance and learning performance are mutually reinforcing. Students who perceive AutoCAD as useful and manageable engage more actively, practice more independently, and consequently develop higher competency. This relationship has direct implications for instructional design — learning materials that build confidence and demonstrate the practical value of AutoCAD within localized, community-relevant contexts can simultaneously improve both perception and learning.

The significant effect of CAD activity frequency on learning outcomes ($F = 4.85$, $p < 0.05$) is perhaps the most actionable finding of this study. It confirms that repetition, scaffolded practice, and consistent exposure are the primary drivers of CAD skill development — not age or sex. This aligns with Mursid et al. (2020), who found that structured and repeated hands-on CAD practice in vocational settings significantly strengthens technical competencies. Curriculum designers and instructors at CTU-SF should therefore prioritize increasing the frequency and structure of laboratory sessions, particularly for students who currently engage with CAD only when required by the subject.

The absence of significant differences by age and sex indicates that the instructional environment — not demographic identity — is the decisive variable. Every student, regardless of background, is capable of achieving high CAD competency when given consistent access to structured practice and contextualized, outcomes-aligned instructional materials. This finding supports inclusive curriculum design that does not differentiate expectations based on demographic group, but instead ensures equitable quality of learning experiences for all.

Collectively, these results establish a compelling evidence base for the development of a Contextualized and Outcomes-Based Learning Guide tailored to the CTU-SF learning environment. The guide's effectiveness is expected to derive from three core design principles: situating all learning tasks within the familiar geographic and social context of Camotes Island (contextualization); structuring six sequential, competency-based modules from foundational interface navigation to advanced blueprint reading (scaffolding); and aligning every activity and assessment with clearly defined industry-relevant outcomes (OBE compliance). By embedding these principles into a coherent instructional resource, the Learning Guide addresses the core deficiencies identified in this study and positions students for measurably higher competency, engagement, and workforce readiness.

V. APPLICATION: THE CONTEXTUALIZED LEARNING GUIDE

In direct response to the study's findings, a Contextualized and Outcomes-Based Learning Guide in Technical Drafting with CAD (AutoCAD) was developed as the primary output of this research. The guide integrates the theoretical principles of Constructivism, Experiential Learning, and OBE, and reflects all applicable legal mandates under RA 7722, RA 10533, and CHED's CMO No. 46. Its design philosophy holds that technical skill development is most durable and transferable when grounded in familiar, community-meaningful contexts — in this case, the infrastructure, facilities, and landscape of Camotes Island, Cebu.

Structure: Six Progressive Modules

The guide is organized into six competency-based modules, each targeting one of the core skill areas assessed in this study and culminating in a locally relevant contextualized drawing task:

- Module 1 – System Features & Interface Navigation: Students configure professional templates using correct architectural units and layer settings, culminating in a Barangay Hall Layout Setup task.
- Module 2 – Basic Drawing & Editing Commands: Through guided command drills and sketch-to-CAD conversion exercises, students produce a Simple Community House Floor Plan reflecting residential designs common to Camotes Island.
- Module 3 – Design & Interpretation: Students analyze hand-drawn sketches and translate them into accurate CAD drawings, culminating in a Tricycle Terminal Layout Design — a community facility with direct local relevance.
- Module 4 – Usability & Workflow Optimization: Keyboard shortcut challenges and file organization tasks build efficiency, with a timed School Laboratory Layout Optimization as the capstone performance task.
- Module 5 – Accuracy & Dimensioning: Precision exercises in dimensioning, scaling, and alignment are anchored by a Water Tank Blueprint Design, reflecting real community water infrastructure in rural Cebu.
- Module 6 – Advanced Commands & Blueprint Reading: SCALE, MIRROR, ARRAY, BLOCK, and XREF commands are applied to a Small Resort Site Plan inspired by Camotes Island's growing tourism industry — integrating all previous competencies in a capstone professional output.

Assessment and Evaluation

Each module includes structured Quick Checks for Understanding — practical performance tasks assessed against clearly defined rubrics covering accuracy of command application, design quality, proper layer usage, dimensioning completeness, and adherence to industry-standard drafting conventions. The culminating Module 6 assessment incorporates an oral presentation component, requiring students to articulate their design decisions and demonstrate independent command of AutoCAD's advanced features.

Implementation Scheme

The Learning Guide is designed for implementation across three phases. The Preparation Phase involves faculty orientation and student pre-assessment of prior CAD knowledge. The Execution Phase delivers all six modules sequentially, with increasing student autonomy in hands-on activities. The Evaluation and Feedback Phase collects performance data, student reflections, and peer critiques to inform continuous guide improvement. An estimated budget of PHP 70,000 covers planning, pilot testing, and follow-up evaluation across one semester.

The expected outcomes of full guide implementation include student competency progression from Moderate to High across all five CAD domains, improved independent use of AutoCAD without instructor dependence, production of accurate and fully dimensioned industry-standard technical drawings, and demonstrable workforce readiness through localized professional design outputs aligned with CTU-SF's mission of producing highly skilled, community-oriented industrial technology graduates.

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