A Mobile-Based Computer-Aided Pattern Crafting and Marker Making (CAPCAMM) Manual for Teaching TLE 12 Pattern Drafting

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ABSTRACT

This study created and assessed the Computer-Aided Pattern Crafting and Marker Making (CAPCAMM) manual, a mobile-based instructional tool designed to modernize the instruction of Pattern Drafting in Technology and Livelihood Education (TLE) 12. The CAPCAMM manual addresses the instructional gap between conventional manual drafting methods and the digital competencies the modern garment industry requires. Utilizing mobile applications, the manual provides students step-by-step exercises that enhance accuracy, efficiency, and industry alignment in pattern drafting. A quasi-experimental design was employed, involving Grade 12 Dressmaking students from two public high schools in Surigao del Sur. The experimental class, which used the CAPCAMM manual, demonstrated significantly improved posttest results compared to a control group that followed traditional methods. Evaluation tools adapted from DepEd standards and supported by evidence-based literature assessed the manual's usability, content quality, and technical effectiveness. Analysis of the data involved the use of descriptive statistical methods, weighted mean, and T-tests. Findings confirmed that the CAPCAMM manual enhanced student performance and engagement and offered teachers a practical and scalable digital resource. Despite infrastructure and training limitations, the study highlights the viability of mobile-based CAD instruction in vocational education settings. It recommends broader adoption of the CAPCAMM manual to align TLE instruction with current industry standards, ensuring learners are better prepared for technical careers in garment production.
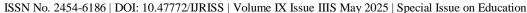
Keywords: Pattern Drafting, Computer-Aided (CAD), Technology and Livelihood Education (TLE), Mobile Learning, Instructional Design, Garment Industry

INTRODUCTION

Technology integration in Technology and Livelihood Education (TLE), particularly Pattern Drafting, has transformed teaching by equipping students with industry-relevant skills. Pattern drafting, essential for creating garment templates, is increasingly supported by computer-aided design (CAD) systems, offering greater precision and efficiency than traditional methods. As the garment industry adopts digital tools, incorporating these into TLE curricula is crucial to align education with professional standards (Bartolome, 2020).

Several studies have explored the use of computer-aided tools in garment education, demonstrating their potential to enhance learning outcomes. For instance, research by Elfizon, Mukhlidi, and Oriza (2020) found that technology-aided instructional devices improve students' ability to conceptualize and execute design tasks more accurately. Similarly, Widowati et al. (2024) highlighted that incorporating technology into instructional practices clarifies complex subject matter and boosts time efficiency and learner engagement. Furthermore, Merita et al. (2019) emphasized the effectiveness of developing tools to bridge theoretical knowledge and practical applications. Despite these advancements, the potential of mobile-based computer-aided pattern crafting and marker making, specifically through a structured manual like CAPCAMM (Computer-Aided Pattern Crafting and Marker Making), as a learning tool for TLE Pattern Drafting remains underexplored, leaving a significant gap in instructional innovation.

One of the biggest challenges in teaching Pattern Drafting in senior high school is the continued reliance on

traditional, manual methods that, while foundational, are time-consuming, prone to errors, and fail to meet the precision demanded by the modern garment industry. DepEd's TVL 12 Dressmaking curriculum's absence of updated instructional materials incorporating digital tools puts students at a disadvantage, leaving them ill-equipped for industry expectations. Studies have shown that integrating Computer-Aided Design (CAD) software, such as AutoCAD and specialized fashion applications, can significantly improve accuracy, efficiency, and overall learning outcomes (Liu et al. (2022); Jhanji (2020). However, despite its potential, transitioning from manual to digital drafting is challenging, especially in vocational education settings where structured instructional resources remain scarce (Cruz 2019; Reyes & Santos 2020). The situation in DepEd Surigao del Sur, particularly in Parang National High School and Union National High School, highlights this gap as these schools have yet to adopt CAD tools in fashion education due to limited access to technology, high software costs, and a lack of teacher training. These disadvantages prevent students from competing with industry professionals trained in modern patternmaking technologies (Ego 2023). Even in institutions where CAD software is available, adoption is slow due to the lack of teacher professional development programs and the absence of standardized curricula supporting digital drafting skills (Mupfumbati et al. 2021). Moreover, in many underfunded schools, acquiring licensed software is financially unfeasible, making it nearly impossible to integrate CAD-based instruction effectively. These barriers emphasize the pressing need for instructional manuals that provide a structured transition from manual to computer-aided drafting, ensuring that students and educators are adequately prepared to integrate technology into their learning and teaching processes.

This research aims to create and assess the CAPCAMM manual, a mobile-based tool used to bridge manual and digital drafting, enhance student skills, and support educators. It examines: (1) CAPCAMM's content, instructional, and technical quality; (2) the pretest and posttest results from the experimental and control groups; and (3) significant score differences.

LITERATURE REVIEW

Integrating digital tools, particularly Computer-Aided Design (CAD), into vocational education has transformed skill-based learning, aligning it with industry demands. Globally, CAD enhances precision and efficiency in pattern drafting, a critical skill in garment production (Johnson & Brookes, 2020; Tanaka, 2019). Locally, Bartolome (2020) and Lopez (2021) emphasize the need for digital tools in the Philippine TLE curriculum to modernize instruction and prepare students for professional standards. The CAPCAMM manual leverages these insights by introducing CAD-based pattern drafting to TLE, fostering competencies that bridge traditional methods with industry-relevant practices.
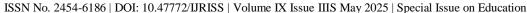
Studies underscore CAD's impact on improving learning outcomes. Foreign research by Ego (2023) and Ugwu et al. (2023) demonstrates that CAD and Computer-Aided Instruction enhance design accuracy and student engagement, while Jhanji (2019) and Mupfumbati et al. (2021) highlight its role in streamlining tasks and fostering creativity. Locally, Merita et al. (2019) and Cruz (2019, 2020) note that CAD addresses the limitations of manual drafting, such as errors and inefficiency, though challenges like limited teacher training persist. CAPCAMM aligns with these findings by providing interactive tutorials and educator-friendly resources to improve skill acquisition and teaching efficacy.

Despite CAD's benefits, gaps remain in its adoption in Philippine TLE education. Reyes and Santos (2020) and Anderson and Lee (2019) advocate for digital manuals to enhance engagement, yet barriers like high costs and inadequate training hinder implementation (Cruz, 2019; Bartolome, 2020). CAPCAMM addresses these by offering cost-effective, accessible tools and structured guides, ensuring equitable access and alignment with industry needs. By integrating CAD into TLE Pattern Drafting, CAPCAMM aims to modernize instruction, enhance student employability, and bridge the gap between education and the garment industry's technological demands.

METHODOLOGY

Design

This study utilized a developmental quasi-experimental research design with a non-equivalent control group

pretest-posttest. The researchers developed the CAPCAMM manual and evaluated its effectiveness in teaching Pattern Drafting in TLE. An experimental group was introduced to the manual; a control group carried on with conventional drafting. A pretest was administered to both groups to assess their initial skills, serving as a baseline for comparison. After the experimental group engaged with the CAPCAMM manual, a posttest measured improvements in their learning outcomes. Since this was a quasi-experimental study, the students remained in their naturally existing classroom settings rather than being randomly assigned. The final Evaluation phase examined the effectiveness of the manual, ensuring it not only enhanced students' pattern drafting skills but also made learning more engaging, practical, and aligned with modern industry standards.

Respondents

The study's respondents were 40 Grade 12 senior high school students taking the Dressmaking specialization under the TLE track at Parang National High School and Union National High School. The respondents in this study were students who were divided into two groups. Twenty students were assigned to the experimental group from Parang National High School, who utilized the CAPCAMM manual. Twenty students were assigned to the control group, taken from Union National High School, who continued with the traditional manual drafting. In addition to the students, TLE teachers specializing in Dressmaking from both schools also participated, providing valuable insights into the manual's usability, effectiveness, and practical integration into classroom instruction. The selection of these respondents ensured a well-rounded evaluation of the CAPCAMM manual's impact, assessing both student learning outcomes and teacher facilitation practices to determine its potential for broader implementation in TLE Pattern Drafting education.

RESULTS AND DISCUSSION

The Evaluation of the Developed CAPCAMM

The evaluation results of the CAPCAMM manual reveal a consistently high level of approval across all assessed areas— Instructional Quality (M = 4.68), Content Quality (M = 4.80), and Technical Quality (M = 4.80), with nearly all statements receiving a "Strongly Agree" interpretation. These findings indicate that the manual effectively meets essential learning objectives, aligns with the TLE 12 Dressmaking curriculum, and delivers engaging, user-friendly content through mobile technology. The strong ratings suggest that CAPCAMM is a well-designed instructional tool that enhances teaching and learning experiences in pattern drafting and marker making. This implies that integrating mobile-based CAD instruction into vocational education can increase accessibility, enrich content delivery, and more effectively equip students for digitally based methods of the garment industry. This aligns with findings by Widowati et al. (2024), who showed that CAD-based instructional design significantly enhances vocational education outcomes, particularly in fashion and garment-related fields. Similarly, Penuela et al. (2023) emphasized the usability and effectiveness of mobile-based educational apps in creating more accessible and engaging learning environments for industrial technology students.

Table 1 Evaluation Rating of the Developed CAPCAMM

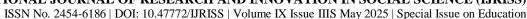| Statements	Weighted Mean	Interpretation
Content Quality		
1. The CAPCAMM manual covers all essential learning objectives for "Pattern drafting and marker making techniques."	4.60	Strongly Agree
2. The content is aligned with the TLE 12 Dressmaking curriculum and current garment industry standards.	5.00	Strongly Agree
3. The manual provides clear and detailed explanations of digital pattern drafting and marker-making techniques.	5.00	Strongly Agree

4. The content follows a logical sequence that supports structured learning progression.	4.80	Strongly Agree
5. The manual integrates real-world applications of mobile-based pattern crafting relevant to industry practices.	4.60	Strongly Agree
Average Weighted Mean	**4.80**	**Strongly Agree**
Instructional Quality		
6. The CAPCAMM manual supports self-paced learning and independent exploration of concepts.	4.60	Strongly Agree
7. The step-by-step digital instructions enhance student comprehension of the pattern drafting process.	4.80	Strongly Agree
8. The manual promotes active student engagement through interactive and practical tasks.	4.40	Agree
9. The learning activities and assessments accurately measure understanding and patternmaking skills.	5.00	Strongly Agree
10. The manual encourages collaborative learning experiences, especially in group garment construction tasks.	4.60	Strongly Agree
Average Weighted Mean	**4.68**	**Strongly Agree**
Technical Quality		
11. The video demonstrations are clear, engaging, and easy to follow.	4.80	Strongly Agree
12. The mobile app interface and manual format are user-friendly and accessible.	4.60	Strongly Agree
13. Multimedia elements (videos, visuals, text) are integrated effectively to support the lessons.	5.00	Strongly Agree
14. The technical features of the material (e.g., app compatibility, video playback) function smoothly and without issues.	4.80	Strongly Agree
15. The CAPCAMM manual is accessible across multiple devices, including mobile phones, tablets, and laptops.	4.80	Strongly Agree
Average Weighted Mean	**4.80**	**Strongly Agree**

Legend:

4.50-5.00 -Strongly Agree	3.50-4.49 -Agree	2.50-3.49 -Neutral	1.50-2.49 - Disagree	1.00-1.49 - Strongly Disagree

Pretest and Posttest Mean Scores

Table 2 provides an overview of the mean pretest and posttest scores of the experimental and control groups. This information emphasizes the variations in academic achievement observed before and after the experimental treatment. The experimental group, which used the mobile-based Computer-Aided Pattern Crafting and Marker Making (CAPCAMM) manual for teaching TLE 12 Pattern Drafting, improved markedly from a pretest mean

of 10.95 to a posttest mean of 18.45. In contrast, the control group, which did not use the CAPCAMM manual, showed a more minor increase from 11.30 to 16.60. The experimental group's higher posttest mean and lower standard deviation suggest that the CAPCAMM manual effectively enhanced student learning, leading to more consistent and substantial academic gains. These findings imply that integrating mobile-based instructional tools like CAPCAMM into the TLE curriculum can significantly improve learners' understanding and performance in pattern drafting. Recent studies corroborate the effectiveness of mobile-based instructional tools like the CAPCAMM manual in enhancing student performance in TLE Pattern Drafting. Nonato (2024) demonstrated that a redesigned interactive learning material significantly improved Grade 8 students' posttest scores compared to traditional manuals, indicating the potential of technology-integrated instruction in TLE education. Similarly, Temple (2022) found that recorded video lessons notably enhanced BTLEd students' competencies in garment construction, with a significant increase in posttest scores, underscoring the value of multimedia resources in skill-based subjects. Additionally, Isla (2023) reported that a virtual learning packet in pattern drafting received high evaluations from faculty and students for its content and instructional design, suggesting that well-structured digital materials can effectively support learning in fashion and design courses.

Table 2 The Control and Experimental Groups' Pretest and Posttest Mean Scores

Statistic	Experimental - Pretest	Experimental - Posttest	Control - Pretest	Control - Posttest
Mean	10.95	18.45	11.3	16.6
Median	11	19	11.5	17.5
Standard Deviation	2.72	1.43	2.89	3.19
Minimum	7	15	7	9
Maximum	17	20	17	20
Sample Size (n)	20	20	20	20

The Differences in Pretest and Posttest Mean Scores Between Control and Experimental Groups

Table 3 presents the data from independent samples t-tests, which were carried out to determine whether or not pretest and posttest means differ significantly between control and experimental groups. As seen from the pretest results, the t-value = -0.39 and the p-value is 0.695, which shows there is no statistically substantial difference between the two groups before the treatment, thus both groups are on an equal level. The posttest outcome, which has a t-value of about 2.32 and a p-value of 0.025, indicates that there is a substantial difference in favor of the experimental group.

As a result, the null hypothesis is rejected, and it indicates that the use of the mobile-based CAPCAMM Manual in TLE 12 Pattern Drafting is an effective means of instruction in improving students' performance. The findings support the integration of mobile-based instructional materials like CAPCAMM in enhancing technical skills and academic achievement in vocational education. Recent studies reinforce the significant impact of mobile-based instructional tools like the CAPCAMM manual in enhancing vocational education outcomes. A study by Aves and Te-Sasing (2022) demonstrated that technology-mediated learning manuals significantly improved students' practical mathematics skills in technical vocational education, as evidenced by higher posttest scores using the Mann-Whitney test. Similarly, research by Nonato (2024) found that interactive learning materials led to substantial gains in students' posttest scores in TLE subjects, highlighting the efficacy of digital tools in vocational training. Furthermore, Temple (2022) reported that recorded video lessons notably enhanced BTLEd students' competencies in garment construction, with a significant increase in posttest scores, underscoring the value of multimedia resources in skill-based subjects.
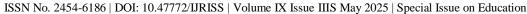
Table 3 There is a significant difference between the control and experimental groups' pretest and posttest mean scores.

Test Group Comparison	t-value	p-value	Decision on Hypothesis	Interpretation
Pretest (Control vs. Experimental)	$\approx$ -0.39	0.695	**Fail to Reject**	No significant difference
Posttest (Control vs. Experimental)	$\approx$ 2.32	0.025	**Reject**	There is a significant difference

CONCLUSIONS

The results indicate that incorporating the Computer-Aided Pattern Crafting and Marker Making (CAPCAMM) manual as a mobile-based instructional tool significantly enhanced students' learning outcomes in TLE 12 Pattern Drafting. The consistently high evaluation ratings affirm its quality and usability, while the substantial improvement in the experimental group's posttest scores confirms its effectiveness in promoting academic achievement. The positive impact of CAPCAMM underscores the importance of adopting mobile-assisted and CAD-based instructional strategies in vocational education to foster deeper understanding, skill development, and alignment with industry-relevant technologies.

RECOMMENDATIONS

To enhance TLE 12 Pattern Drafting education, students should actively engage with mobile-based tools like the CAPCAMM manual to boost technical skills and motivation. At the same time, teachers integrate such resources to modernize instruction and support diverse learning needs. School administrators are urged to invest in digital infrastructure and training to facilitate CAPCAMM adoption, aligning with 21st-century learning demands. The Department of Education should endorse CAPCAMM as a standardized K–12 TLE resource to ensure consistent, technology-driven instruction nationwide. Future researchers should investigate CAPCAMM's long-term impact, applicability across TLE strands, and effectiveness compared to other digital tools to advance vocational education

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