Technology Integration through Computer-Aided Instruction (CAI) in Teaching TLE 11 Garments Concepts

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ABSTRACT

This study explored the integration of video tutorial-based Computer-Aided Instruction (CAI) in teaching garment concepts, specifically "Draft and Cut Pattern for Ladies' Trousers," to Grade 11 Technology and Livelihood Education (TLE) students. The research employed a developmental, descriptive design based on the ADDIE instructional design model. The study was conducted at Parang National High School in Surigao del Sur, involving purposively selected Grade 11 students. The students utilized the developed CAI material, and the data were gathered through pretests and posttests, as well as a validated Technology Acceptance Model (TAM)-based questionnaire assessing content, instructional, and technical quality. Findings showed that the developed CAI material was highly rated in all quality domains, with strong agreement on its effectiveness, user-friendliness, and relevance to the curriculum. Students perceived the material as valuable for enhancing learning, fostering confidence, and increasing engagement. A significant improvement in posttest scores was observed among students, affirming the material's effectiveness. Statistical analysis revealed a meaningful difference between pre- and posttest results, indicating the CAI's positive impact on learning outcomes. The study concludes that CAI is an effective and acceptable instructional approach for teaching garment concepts. It is recommended that learners maximize its use, teachers integrate it into pedagogy, administrators provide necessary support, DepEd explore policy integration, and future researchers expand on its long-term impacts in technical-vocational education.

Keywords: Computer-Aided Instruction (CAI), Technology and Livelihood Education (TLE), Garments Concepts, Pattern Drafting, Instructional Material Evaluation, Technology Integration, Technology Acceptance Model (TAM)

INTRODUCTION

Technology and Livelihood Education (TLE) equips students with vital technical and vocational skills under the Philippine K-12 Curriculum (DepEd, 2012). As a hands-on subject, TLE emphasizes practical learning for employment, entrepreneurship, or further study (Almazan & Pascual, 2020). In garment technology, students must master sewing techniques, fabric selection, and construction. Effective teaching strategies are essential to bridge theory and practice. Integrating Computer-Aided Instruction (CAI) through video tutorials offers a way to simplify complex garment-making concepts and enhance student engagement.

Instructional materials are key to boosting engagement and learning. While traditional methods remain useful, they often lack interactivity (Bautista & Pascual, 2021). CAI, mainly video tutorials, improves comprehension, motivation, and retention of skills (Mayer, 2021). These tools offer step-by-step visuals that learners can revisit at their own pace, reinforcing practice. Research by Ramel (2020) and De Guzman & Santos (2022) confirms that video-based learning enhances technical skill development in TLE. However, limited access to technology keeps many schools dependent on traditional instruction.

Despite CAI's potential, there is a lack of video-based materials tailored for TLE 11 garment instruction. While studies affirm CAI's value in broader technical subjects, few address garment technology specifically. Issues like limited class time, diverse learning speeds, and resource constraints remain unresolved. In Cantilan, the Mean Percentage Score for TLE 11 garments, particularly in "Draft and cut pattern for Ladies trousers," was just 34.35% in Q3 of SY 2023–2024, underscoring the need for innovative teaching methods.

This study addresses the gap by developing a Computer-Aided Instructional Material (CAI) for TLE 11 garments, guided by the ADDIE Model. It aims to evaluate the effectiveness of video tutorial-based instruction in enhancing students' understanding, skill acquisition, and overall learning experience. In particular, the study intends to address the following specific questions: (1) What is the evaluation rating of the developed material regarding content, instructional, and technical quality? (2) What is the acceptability level of the material based on the Technology Acceptance Model? (3) What are the students' pretest and posttest mean scores after using the material? and (4) Is there a significant difference in student performance after using the material? By leveraging digital tools, this research aspires to provide a sustainable and accessible instructional model that enhances student engagement and learning outcomes in garment technology.

Theoretical Framework

The ADDIE Model, a widely recognized instructional design framework, provides a structured, research-based approach to developing effective teaching materials through five phases: Analyze, Design, Develop, Implement, and Evaluate (Joseph et al., 2025). This study adopts the ADDIE model as its theoretical foundation for integrating video tutorial-based Computer-Aided Instruction (CAI) into teaching garment concepts in Technology and Livelihood Education (TLE). During the Analyze phase, instructional challenges such as limited teaching resources, difficulty in demonstrating sewing techniques, and students' low performance in garment-related topics were identified, with teacher and learner input guiding content development. In the Design phase, the study structured the video tutorials to align with curriculum standards, incorporating step-by-step demonstrations and multimedia elements to support visual learning. The development phase involved creating interactive tutorials covering essential garment construction techniques, including pattern drafting, fabric selection, and finishing. These materials were then implemented in actual TLE 11 classes to supplement traditional instruction, with observations focused on student engagement and skill acquisition. Finally, the Evaluate phase assessed the effectiveness of the CAI through pre- and posttests, feedback, and teacher input to determine its impact on learning outcomes and refine the materials accordingly. Anchoring the study on the ADDIE model ensured a systematic, student-centered approach that responds to learners' needs and supports continuous improvement, consistent with Joseph et al.'s (2025) assertion that ADDIE fosters the creation of meaningful and effective educational resources.

Another model used in this study is the Technology Acceptance Model (TAM). This widely used framework clarifies the processes by which users adopt and employ technology-driven innovations in education and other fields. Developed by Davis (1989), TAM identifies two key factors influencing technology adoption: Perceived Usefulness (PU), the degree to which a user believes the technology enhances performance, and Perceived Ease of Use (PEU), how effortless the technology is to use. In this study, TAM will be applied to assess the acceptability of video tutorial-based Computer-Aided Instruction (CAI) in teaching TLE 11 garments concepts. Students and teachers will evaluate the usefulness of video tutorials in improving learning and skill acquisition, as well as their ease of navigation and accessibility.

Additionally, factors such as attitude toward technology, behavioral intention to use, and actual system use will be analyzed to determine the overall effectiveness and adoption of CAI as a supplementary instructional tool. By incorporating TAM, the study ensures that the developed CAI is effective, widely accepted, and sustainable in enhancing garment technology education. As a result, a schematic diagram was made showing the study flow.

LITERATURE REVIEW

Integrating Computer-Aided Instruction (CAI) into technical and vocational education has gained momentum globally, especially in areas requiring procedural and hands-on learning, such as garment construction. International studies underscore CAI's effectiveness in promoting interactive, self-paced learning environments. UNESCO (2023) emphasized the role of CAI, particularly video tutorials, in enhancing accessibility and skill development across disciplines like dressmaking and electronics. The World Bank (2022) reported increased competency among students exposed to digital resources compared to those taught through traditional methods. Similarly, institutions such as Harvard and MIT found that learners who engaged with multimedia-based CAI performed better in practical assessments and showed improved motivation and retention. These findings are echoed by ISTE (2023), which supports the integration of visual and interactive

content to enhance vocational education. Locally, initiatives by DepEd (2021) and TESDA (2023) highlight CAI's value in overcoming instructional material shortages in rural schools, reinforcing its relevance in the Philippine context. Studies from CHED (2022) and universities such as UP Diliman and PNU (2023) further affirm that CAI fosters improved comprehension, engagement, and learner participation in TLE subjects like garments and dressmaking.

Emerging research continues to validate the benefits of CAI across global and local educational landscapes. Wu and Zhao (2024) emphasized the advantages of interactive CAI tools in vocational settings, while Okoye (2024) and Mazumdar (2024) found that learners using CAI retained procedural knowledge and demonstrated better practical performance. In the Philippines, Aguilar, Coloma, and Patacsil (2021) demonstrated CAI's effectiveness in enhancing comprehension in animation training, and Nicolas (2019) observed improved practical outcomes in TLE cookery classes using video-based instruction. Studies by Julian et al. (2023) and Mahawan & Celedonio (2023) confirmed CAI's role in increasing motivation and mastery of complex concepts, especially in resource-limited environments. These findings collectively support the implementation of CAI in TLE garment instruction as a way to improve learner outcomes through accessible and engaging instructional strategies.

Despite the robust support for CAI's effectiveness, specific gaps remain in the literature. Most existing studies focus on short-term performance gains, with limited exploration of long-term impacts on skill retention, learner autonomy, and employability. Furthermore, the cultural inclusivity and accessibility of CAI tools for diverse learners are areas requiring deeper investigation. Future research should consider interdisciplinary approaches that combine pedagogical, technological, and sociocultural perspectives to design more inclusive and scalable CAI models. Longitudinal studies assessing video-based instruction's sustainability and real-world applicability in garment education will also be crucial for developing evidence-based best practices in vocational teaching. These directions will help ensure that CAI continues to evolve as a dynamic tool for equity, engagement, and excellence in education.

METHODOLOGY

Design

This study employed a developmental, descriptive design, anchored on the ADDIE instructional design model. The research involved students exposed to video tutorial-based computer-aided instruction (CAI). The study followed the ADDIE framework (Analyze, Design, Develop, Implement, and Evaluate) to systematically create, refine, and assess the instructional material.

Respondents

This study involved Grade 11 students from Parang National High School who were carefully chosen to align with the study's objective of evaluating the efficacy of the video tutorial-based Computer-Aided Instruction (CAI) using the ADDIE model.

Since these students actively learn garment concepts in their TLE curriculum, they are the best fit for this research. By selecting them purposively, the study ensures that the participants have the right background to provide meaningful insights. This approach allows for a deeper understanding of how CAI influences student learning and engagement. The findings help improve TLE 11 garment education teaching strategies, making lessons more interactive, practical, and accessible for future learners.

Instruments

An adapted questionnaire was used to determine the acceptability rating of the developed material. The pretest and posttest have the same items.

The researcher adapted the Technology Acceptance Model (TAM) as the tool for the summative evaluation of the material. The checklist consists of 5 objective components with 20 items assessing the LM concerning the content, organization, structure, and its influence on motivation and learning.

The survey used a 5-point Likert scale to assess the effectiveness of the developed instructional material, with responses ranging from Strongly Agree (5) to Strongly Disagree (1). Scores were categorized as follows: 4.21–5.00 (Highly Effective), 3.41–4.20 (Effective), 2.61–3.40 (Moderately Effective), 1.81–2.60 (Less Effective), and 1.00–1.80 (Not Effective). This scaling method allows for a clear interpretation of the results, helping determine the instructional material's content, instructional, and technical quality, ensuring its suitability for TLE-Dressmaking students.

RESULTS

The results and discussion were organized following the phases of the ADDIE model to maintain a structured and methodical approach in the development, implementation, and assessment of the CAI.

Analysis Phase

During the analysis phase, the study identified several challenges in teaching garment concepts in TLE 11, particularly in the Draft and Cut Pattern for Ladies' Trousers topic. Data gathered from school reports in Cantilan revealed low Mean Percentage Scores (MPS), indicating a gap in student understanding. Teacher interviews also highlighted issues such as insufficient instructional time, outdated materials, and a lack of interactive learning resources. These findings emphasized the need for a structured, multimedia instructional tool to support independent and guided learning. The need to cater to diverse student learning paces further justified the development of CAI-based material to supplement traditional teaching methods.

Design Phase

Guided by the ADDIE model, the design phase focused on developing a comprehensive design for the CAI material, which was conceptualized as a website-based platform. This digital format was chosen to maximize accessibility, allowing students to easily access video tutorials anytime and on various devices, including smartphones, tablets, and laptops. The website was structured to align with the TLE curriculum standards, clearly sequencing lessons in drafting and cutting garments. It includes video demonstrations, step-by-step guides, downloadable resources, and built-in assessments. Special attention was given to the site to ensure a user-friendly interface and responsive design features that catered to diverse learning needs. By designing the CAI as a website, the material could support independent, self-paced learning and simulate an interactive, classroom-like experience in a digital environment.

Development Phase

Figure 1. Development of the Website
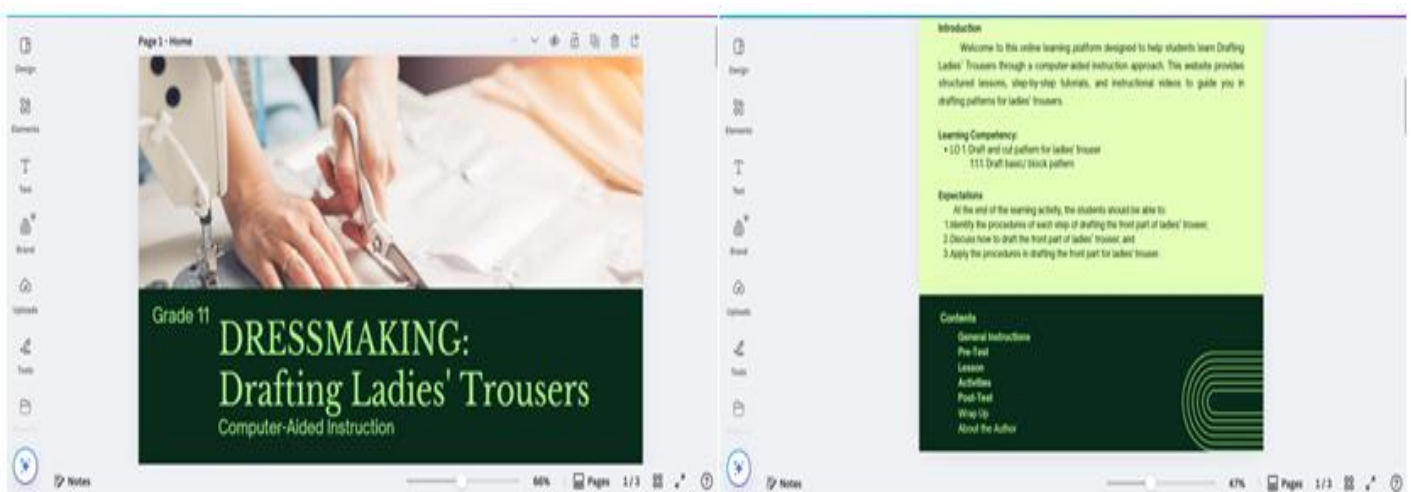
A fully functional website was developed in the development phase, integrating the structured video tutorials, downloadable learning resources, and self-assessment tools outlined during the design phase. The videos demonstrating key garment-making procedures, such as pattern drafting and fabric cutting techniques, were recorded, edited, and embedded into the website for seamless access. Interactive features like quizzes and tests

were incorporated to promote active learning and monitor student performance. This rigorous development ensured that cut CAI website provided an engaging, easy-to-use, and curriculum-aligned learning environment for TLE 11 garment students.

Implementation Phase

The implementation phase involved introducing the CAI website to the experimental group at Parang National High School, while the control group at Union National High School continued with traditional instruction. Students in the experimental group were given access to the website, where they independently navigated through video tutorials, step-by-step garment drafting guides, and built-in assessments. Teachers facilitated the sessions by providing initial orientations on website navigation and supporting learners as needed throughout the modules.

Figure 2. Implementation of the CAI as a Website

Evaluation Phase

Evaluation was conducted through both formative and summative assessments. Formative evaluation gathered feedback during the initial implementation phase, focusing on the website's usability, content clarity, technical functionality, and learner engagement.

Table 1 shows the evaluation of the developed Computer-Aided Instruction (CAI) material for teaching "Draft and Cut Pattern for Ladies' Trousers," which reveals highly positive feedback across all key dimensions: content, instructional, and technical quality. With an overall average weighted mean of 4.53 to 4.67, the results indicate that evaluators agree that the material is well-aligned with curriculum standards, effectively supports independent and collaborative learning, and demonstrates excellent technical usability. Notably, the Content Quality dimension scored an average of 4.63, highlighting the material's clarity, relevance, and logical flow. The Instructional Quality component, scoring 4.53, suggests that the video tutorials significantly aid student comprehension and engagement, primarily through step-by-step guidance and assessments. The highest score, 4.67, in Technical Quality, underscores the material's multimedia effectiveness, accessibility, and compatibility with various devices.

Table 1 The evaluation rating of the developed material

Statement	Weighted Mean	Interpretation
Content Quality		
The instructional material covers all essential learning objectives for *"Draft and Cut Pattern for Ladies' Trousers."*	4.50	Strongly Agree
The content is aligned with the TLE Dressmaking curriculum and industry standards.	4.83	Strongly Agree

The material provides clear and detailed explanations of garment construction techniques.	4.83	Strongly Agree
The content is presented in a logical sequence, making it easy to follow.	4.67	Strongly Agree
The material includes real-world applications of pattern drafting and cutting techniques.	4.33	Agree
Average Weighted Mean	4.63	Strongly Agree
Instructional Quality		
The instructional material effectively supports self-paced learning.	4.33	Agree
The step-by-step guidance in the material enhances learning comprehension.	4.67	Strongly Agree
The material encourages active student engagement in garment construction activities.	4.33	Agree
The assessments and activities effectively measure students' understanding and skills.	4.83	Strongly Agree
The material supports collaborative learning, allowing students to apply skills in group tasks.	4.50	Strongly Agree
Average Weighted Mean	4.53	Strongly Agree
Technical Quality		
The video tutorials are clear and visually engaging, making it easier to follow the lessons.	4.67	Strongly Agree
The interface and format of the instructional material are user-friendly.	4.50	Strongly Agree
The material integrates multimedia elements effectively (e.g., video, graphics, and text).	4.83	Strongly Agree
The technical aspects of the material (e.g., video playback, accessibility) function properly.	4.67	Strongly Agree
The material is compatible with different devices (e.g., mobile phones, tablets, laptops).	4.67	Strongly Agree
Average Weighted Mean	4.67	Strongly Agree
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	

Summative evaluation, shown in Table 2, involved analyzing pretest and posttest scores, which showed significant improvement among students who used the CAI website. Statistical results (t-value = 11.23, $p < 0.0001$) confirmed the positive impact of the website on students' learning outcomes.

Table 2 Significant difference in the performance of the students after using the developed material

t-value	p-value	Interpretation
11.23	< 0.0001	There is a significant difference

Table 3 shows the acceptability ratings based on the Technology Acceptance Model (TAM). The acceptability data of the developed CAI material reveals high levels of student satisfaction and positive perception across multiple domains. Regarding Perceived Usefulness, the instructional material garnered an average weighted mean of 4.53 (Strongly Agree), indicating that students recognize its effectiveness in enhancing their skills in garment construction, particularly in drafting and cutting ladies' trousers. Similarly, the dimension of Perceived Ease of Use received an average of 4.50, reflecting that learners found the material easy to navigate and comprehend, which is crucial for fostering independent learning.

Table 3 The acceptability level of the developed material

Statements	Weighted Mean	Interpretation
Perceived Usefulness		
The instructional material enhances my learning of garment construction techniques.	4.31	Agree
Using this material allows me to complete garment pattern drafting tasks more efficiently.	4.38	Agree
The material improves my ability to draft and cut patterns for ladies' trousers.	4.44	Agree
I feel more confident in applying what I learned using this material.	4.69	Strongly Agree
The instructional material is a valuable resource for learning dressmaking skills.	4.81	Strongly Agree
Average Weighted Mean	4.53	Strongly Agree
Perceived Ease of Use		
The instructional material is easy to navigate and understand.	4.38	Agree
The video tutorial provides clear step-by-step instructions.	4.50	Strongly Agree
I can easily follow the drafting and cutting process demonstrated in the material.	4.69	Strongly Agree
The interface and layout of the material are user-friendly.	4.75	Strongly Agree
Learning with this material requires minimal effort.	4.19	Agree
Average Weighted Mean	4.50	Strongly Agree
Attitude Toward Use		
I enjoy using this material for learning garment construction.	4.31	Agree
This instructional material makes learning more enjoyable.	4.44	Agree
Average Weighted Mean	4.38	Agree
Behavioral Intention to Use		
I would like to continue using similar CAI materials in the future.	4.50	Strongly Agree
I would recommend this material to my classmates.	4.62	Strongly Agree
I plan to use this instructional material for future reference.	4.75	Strongly Agree
Average Weighted Mean	4.62	Strongly Agree
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	

DISCUSSION

Evaluation of Material

The evaluation results for the developed Computer-Aided Instruction (CAI) material demonstrated strong positive feedback across content, instructional, and technical quality dimensions. Reviewers strongly agreed that the material aligned with the TLE Dressmaking curriculum standards, facilitated independent and collaborative learning, and maintained excellent multimedia usability. Content quality ratings emphasized information clarity, relevance, and logical sequencing, which are critical for procedural subjects such as garment construction. These findings are consistent with Bahri et al. (2024), who reported that CAD-based instructional resources in fashion education significantly enhance content clarity and technical usability. Moreover, the CAI material's strong technical performance supports the 4A Framework proposed by the U.S. Department of Education (2021), which stresses the importance of accessibility, active engagement, and structured content delivery in evaluating digital instructional materials. Thus, the high evaluation scores affirm that the CAI website effectively meets the educational needs of TLE students learning garment-making concepts.

Impact on Student Performance

The statistical findings revealed a significant improvement in students' learning outcomes after engaging with the CAI material. The paired-samples t-test indicated a significant difference between pretest and posttest scores, confirming that exposure to the CAI website substantially enhanced students' technical skills in drafting and cutting garments. These results reflect the direct relationship between instructional material quality and academic achievement, as Bahri et al. (2024) observed, where students using digital learning tools demonstrated improved competency in fashion courses. Furthermore, Alshurideh et al. (2022) emphasized that perceived ease of use and usefulness of educational technologies are crucial predictors of enhanced learning outcomes, suggesting that the CAI material's user-centered design, interactive features, and multimedia integration contributed to the significant academic improvements observed. The results imply that structured, evidence-based CAI materials can transform traditional TLE instruction by fostering better comprehension, skill mastery, and student engagement.

Acceptability of Material

Student feedback on the acceptability of the CAI website indicated high levels of satisfaction and positive perceptions across all measured domains, particularly in perceived usefulness, ease of use, and behavioral intention to continue using the material. Students acknowledged that the CAI resource enhanced their skills, made learning more accessible, and allowed for flexible, self-paced engagement with the content. Although the Attitude Toward Use dimension scored slightly lower, it reflected favorable experiences. In contrast, the high behavioral intention scores suggest strong future adoption and recommendation of the material among learners. These outcomes align with Bahri et al. (2024), who found that students exhibited higher motivation and satisfaction when using digital instructional resources in technical education. Similarly, Alshurideh et al. (2022) concluded that perceived usefulness and ease of use are key determinants of technology acceptance and sustained educational impact. The overwhelmingly positive acceptability results reinforce that the CAI website is an effective instructional tool and a motivational platform for continued learning in TLE garment education.

CONCLUSIONS

This study demonstrated the effectiveness of a website-based Computer-Aided Instruction (CAI) material in enhancing student learning in TLE garments education, specifically in drafting and cutting patterns for ladies' trousers. Evaluation results showed that the material met high standards of content clarity, instructional design, and technical usability, aligning with best practices outlined in contemporary digital learning frameworks. Significant improvements in students' pretest and posttest scores further confirmed the CAI's positive impact on technical skill development and learning outcomes. High levels of student acceptance, particularly in perceived usefulness and ease of use, suggest that the CAI website addressed instructional gaps and fostered motivation and sustained engagement in learning garment construction concepts. These findings reinforce the value of integrating multimedia-enhanced instructional tools into vocational education and highlight the critical role of systematic design frameworks, such as the ADDIE model, in developing effective digital learning environments. Moving forward, this CAI approach offers a scalable and accessible strategy for modernizing TLE instruction and can serve as a model for future innovations in technical and vocational education.

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