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Development of the DASHY-25M Teaching Aid Design at the Department of Mechanical Engineering, Politeknik Kuching Sarawak

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Abstract

Introduction/Main Objectives: This research details the development and evaluation of the DASHY-25M, a physical teaching aid designed to enhance the efficacy of teaching and learning (T&L) methodologies in mechanical engineering education, specifically in design-focused courses such as Computer-Aided Design (CAD).

Background Problems: Conventional pedagogical approaches in mechanical engineering often struggle to bridge the gap between digital simulation and physical reality. Instruction that relies exclusively on theoretical lectures and software-based exercises can constrain student comprehension by lacking a tangible, hands-on component.

Novelty: The novelty of this study lies in the DASHY-25M itself—a physical teaching aid developed to provide a complementary, hands-on learning modality aimed at enhancing students' understanding of complex design principles and their real-world manufacturing and assembly applications.

Research Methods: This study employs a quantitative, descriptive-correlational approach. Data will be collected via a questionnaire distributed to approximately 200 mechanical engineering diploma students at Politeknik Kuching Sarawak and analyzed using descriptive and inferential statistics to assess the aid's impact on student comprehension and perception.

Finding/Results: As the study is presented in a proposal format, specific empirical findings are not yet available. The hypothesis states that the integration of the physical aid is expected to show a significant positive correlation with students' conceptual understanding and practical skills.

Conclusion: It is anticipated that the integration of the DASHY-25M will address a critical gap in current pedagogical practice by strengthening the link between digital design theory and physical application, thereby enhancing learning outcomes in mechanical engineering education.

Keywords: Teaching and Learning (T&L), Teaching Aid, Mechanical Engineering, CAD, Hands-on Learning, TVET

Introduction

Technical and Vocational Education and Training (TVET) institutions face the persistent challenge of producing graduates who are not only theoretically knowledgeable but also practically competent (Alias & Rahman, 2017). In the field of mechanical engineering, the proliferation of sophisticated Computer-Aided Design (CAD) software has revolutionized the design process. However, this has also introduced a distinct pedagogical challenge: a potential disconnect between virtual design and physical application.

Students may become proficient in operating the software—creating complex models and assemblies in a digital environment—yet lack a fundamental understanding of the physical implications of their designs. This includes concepts of manufacturability, material selection, tolerance, and the tactile reality of component assembly. This "virtual-only" proficiency is insufficient for the demands of the industry, which requires engineers who can seamlessly navigate both the digital and physical realms (Ye et al., 2004).

The Department of Mechanical Engineering at Politeknik Kuching Sarawak has observed this challenge among its diploma students. Reliance on lecture notes and software drills, while necessary, appears to be an incomplete strategy. Students often struggle to visualize and internalize abstract design concepts when they lack a tangible object of reference.

To address this gap, we have developed the DASHY-25M, a physical teaching aid. This aid is a specialized, interactive model designed to supplement the existing CAD curriculum. It provides a "two-way" learning street: students can manipulate the physical aid to understand a concept, which clarifies their work in the digital environment, and vice-versa.

This study aims to formally evaluate the effectiveness of the DASHY-25M. The primary objectives are:

1. To assess the perceived effectiveness of the DASHY-25M in enhancing student understanding of core mechanical design principles.
2. To identify the correlation between the use of the DASHY-25M and students' self-reported comprehension and engagement.
3. To gather quantitative feedback for the future refinement and integration of the teaching aid into the curriculum.

Figure 1: DASHY-25M

Source : Authors Data, 2025

The theoretical foundation for this study rests on the proven efficacy of experiential and tangible learning in technical education. Kolb's (1984) theory of experiential learning posits that concrete experience is a critical component of a learning cycle. For engineering students, this

"concrete experience" often involves tactile, hands-on interaction with physical objects (Shy, 2010).

In the specific context of CAD education, Ye et al. (2004) noted that "today's students" require a blend of industrial perspective and foundational theory, which software alone cannot provide. Other researchers have explored the gap between virtual and physical prototyping, concluding that physical models—even simple ones—serve as crucial "cognitive bridges" for students (Bunt & D-V, 2008). They allow students to test assumptions, discover physical constraints, and develop the spatial reasoning skills that are foundational to engineering.

The use of targeted teaching aids is a well-established practice in TVET to improve learning outcomes. Studies on custom-built aids, such as welding simulators or mathematical models, consistently show positive impacts on student engagement and skill acquisition (Ismail & Abdul-Aziz, 2019; Rashid & Abdullah, 2018). These aids provide a focused, low-risk environment for students to explore complex topics.

This study extends this body of research by developing and evaluating a bespoke teaching aid (the DASHY-25M) specifically for the mechanical design curriculum, linking the abstract digital environment of CAD with the tangible world of mechanical components.

Research Methods

This research employs a quantitative, descriptive-correlational design.

Population and Sample

The study's population comprises all diploma students in the Department of Mechanical Engineering at Politeknik Kuching Sarawak who have completed the relevant CAD and mechanical design courses. A purposive sampling technique will be used to select a sample of approximately 200 student respondents.

Instrumentation

The primary instrument for data collection is a structured questionnaire. This instrument will be developed by the research team and validated by subject matter experts within the department. The questionnaire will consist of several sections:

1. **Section A: Demographic Information:** (e.g., program, semester).
2. **Section B: Experience with Traditional T&L Methods:** (e.g., lecture, software-only labs).
3. **Section C: Perception of the DASHY-25M Teaching Aid:** This section will use a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree) to measure variables such as:
    - Perceived Ease of Use
    - Effectiveness in Clarifying Complex Concepts
    - Impact on Understanding of Physical Assembly
    - Level of Engagement

- Perceived Advantage over Software-Only Learning

Procedure

The DASHY-25M will be introduced to the target student groups through supplementary workshops and dedicated lab sessions. Following these sessions, where students will have had hands-on interaction with the aid, the questionnaire will be distributed. Students will be briefed on the study's objectives and assured of the anonymity and confidentiality of their responses.

Data Analysis

The collected data will be analyzed using Statistical Package for the Social Sciences (SPSS).

- **Descriptive Statistics:** Mean, median, standard deviation, and frequency distributions will be calculated for all variables to describe the students' perceptions and experiences.
- **Inferential Statistics:** Pearson correlation coefficients (r) will be used to analyze the relationship between the perceived effectiveness of the DASHY-25M and students' self-reported understanding of design principles.

Result

This study is a proposal, and data collection is forthcoming. However, based on the literature review and preliminary informal feedback, we hypothesize the following outcomes:

1. **High Perceived Effectiveness:** It is expected that the descriptive statistics will show high mean scores ($M > 4.0$ on a 5-point scale) for the DASHY-25M's effectiveness, particularly in "clarifying complex concepts" and "impact on understanding of physical assembly."
2. **Positive Correlation:** We anticipate a moderate to strong positive correlation ($r > 0.5$) between students' rating of the teaching aid and their self-assessed confidence and comprehension in the course.
3. **Superiority to Traditional Methods:** We expect students to rate the blended approach (software + physical aid) as significantly more effective than the software-only approach.

Discussion

A discussion of these expected findings would suggest that the DASHY-25M successfully functions as a "cognitive bridge," as described by Bunt & D-V (2008). By providing a tangible, manipulable object, the aid helps students internalize abstract spatial and mechanical relationships that are often difficult to grasp from a 2D screen or 3D virtual model. This aligns with the Ministry of Higher Education's push for more dynamic, hands-on, and industry-relevant learning experiences (Ministry of Higher Education Malaysia, 2015).

Conclusion

This research addresses a persistent and practical challenge in modern mechanical engineering education: the gap between digital design and physical reality. The development of the DASHY-25M teaching aid represents a targeted, resource-efficient intervention to supplement existing CAD instruction.

This study's quantitative evaluation is expected to provide empirical evidence for the value of integrating physical teaching aids into technology-heavy curricula. The DASHY-25M is not intended to replace powerful CAD software but to augment it, ensuring that students develop a robust and holistic understanding of design. The findings are anticipated to guide the refinement of the aid and its formal integration into the curriculum at Politeknik Kuching Sarawak, with potential for wider adoption at other TVET institutions.

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