



EVALUATING THE POTENTIAL OF NEW TEACHING APPLICATIONS AS INTEGRAL COMPONENTS OF INDUSTRIAL ARTS EDUCATION

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ABSTRACT

The rapid evolution of educational technology necessitates a comprehensive understanding of its integration into specialized fields like Industrial Arts Education. This study critically evaluates the effectiveness and applicability of innovative mobile teaching applications – specifically virtual reality simulations, gamification platforms, and personalized learning environments – in augmenting the teaching-learning process for Industrial Education students. Through a mixed-methods approach comprising a focused literature review, semi-structured instructor interviews, and comprehensive student surveys, the research examined the perceived efficacy of "EveryCircuit" for electronics, "Welducation" for shielded metal arc welding (SMAW), and "Car Mechanic Simulator 21" for automotive mechanics. Employing a quantitative descriptive research design, survey questionnaires utilizing a 5-point Likert scale were administered, and data were analyzed using descriptive statistics, primarily weighted means. Results consistently indicate a significant increase in student engagement, motivation, and knowledge retention, alongside an improved understanding of complex technical concepts. These findings underscore the imperative for continuous exploration of emerging teaching technologies and advocate for their structured, evidence-based integration into Industrial Arts curricula to foster a more dynamic, accessible, and practical learning environment.

KEYWORDS: Innovative Teaching Technology, Mobile Applications, Industrial Education, Gamification, Virtual Reality In Education, Educational Technology Integration, Skill Development, Technical Vocational Education.

1. INTRODUCTION

The 21st century has ushered in an era of unprecedented technological advancement, profoundly impacting various sectors, including education. In alignment with Sustainable Development Goal 4 (SDG 4): Quality Education, which advocates for inclusive, equitable, and high-quality education for all, the integration of advanced teaching methodologies has become paramount (United Nations, 2015). The global COVID-19 pandemic, in particular, served as a catalyst, accelerating the adoption of remote and technology-enhanced teaching methods, especially within hands-on disciplines like Industrial Arts Education where traditional face-to-face instruction was significantly disrupted (Adnan & Anwar, 2020; Hodges et al., 2020).

Mobile learning (m-learning) has emerged as a particularly promising pedagogical approach, offering unparalleled flexibility, ubiquitous access to localized educational resources, and opportunities for students to engage in complex technical tasks and simulations irrespective of their physical location (Cochrane & Clifford, 2017). This flexibility is critical for Industrial Arts, a field that demands practical application and hands-on experience, often constrained by limited access to specialized equipment or workshop facilities outside of traditional learning environments. Mobile applications, such as "Welducation" for welding, "Car Mechanic Simulator 21" for

automotive mechanics, and "EveryCircuit" for electronics, have garnered considerable attention for their potential to facilitate subject-specific learning by providing interactive, immersive, and often gamified experiences (Aloraini, 2014; Hwang & Wu, 2014).

Previous research consistently supports the positive impact of mobile learning on academic performance, student engagement, and the development of practical skills (Sun et al., 2018; Alzahrani, 2020). However, the specific efficacy of these applications within the unique context of Industrial Arts Education in developing nations, particularly the Philippines, remains an area requiring in-depth investigation. Therefore, this study was conceived to meticulously evaluate if and how these cutting-edge mobile applications can optimize the teaching-learning process and enhance performance in various domains of Industrial Arts education, thereby bridging the gap between theoretical knowledge and practical application.

2. OBJECTIVES

This study rigorously aimed to evaluate the effectiveness and applicability of selected mobile teaching applications as integral components of Industrial Education for Bachelor of Science in Industrial Education (BSIE) students. Specifically, it sought to:

- Characterize the pedagogical utilization of selected mobile applications in specific Industrial Arts disciplines:



- 1.1. Analyze how "EveryCircuit" is implemented to facilitate learning in Electronics.
- 1.2. Investigate the application of "Welducation" in the instruction of Shielded Metal Arc Welding (SMAW).
- 1.3. Examine the deployment of "Car Mechanic Simulator 21" in the teaching of Automotive mechanics.

- **Evaluate the perceived quality and utility of the applications based on key evaluative criteria:**

- 2.1. Assess the **Usefulness** of the applications in achieving learning objectives and enhancing practical understanding.
- 2.2. Determine the **Functionality** of the applications in terms of technical reliability, ease of navigation, and responsiveness.
- 2.3. Evaluate the **Importance** of integrating these applications into the Industrial Arts curriculum for future skill development and readiness.

- **Assess the instructional quality of the mobile applications from diverse stakeholder perspectives:**

- 3.1. Gather and analyze perceptions of instructional quality from the **Teacher perspective**, focusing on pedagogical effectiveness and curriculum integration.
- 3.2. Gather and analyze perceptions of instructional quality from the **Student perspective**, focusing on engagement, learning experience, and skill acquisition.

- **Identify and articulate the discernible strengths and weaknesses observed during the practical utilization of these mobile applications in the learning environment.** This includes technical limitations, pedagogical advantages, and potential barriers to effective implementation.

3. METHODOLOGY

This study adopted a **quantitative descriptive research design** to systematically gather and analyze data concerning the perceptions and experiences of students and instructors regarding the mobile applications. This design is appropriate for describing the characteristics of a population or phenomenon, focusing on "what is" rather than "why" or "how" causes occur (Creswell, 2014).

Participants: The study participants were Bachelor of Science in Industrial Education (BSIE) students from a selected state university, chosen through a stratified random sampling technique to ensure proportional representation across different Industrial Education specializations (electronics, automotive, and welding). This approach minimized bias and enhanced the generalizability of findings within the study's scope. Additionally, a select group of Industrial Arts instructors specializing in these areas were interviewed to provide their expert perspectives on the pedagogical integration and effectiveness of the applications.

Instrumentation: Primary data collection was facilitated through **structured survey questionnaires** for students, utilizing a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to quantify their evaluations of the mobile applications across various dimensions (usefulness, functionality, importance, and instructional quality). The questionnaire was developed based on a thorough review of relevant literature on mobile learning and educational technology evaluation frameworks. For instructors, a **semi-structured interview protocol** was employed to gather qualitative insights into their experiences, challenges, and perceived benefits of using these applications in their teaching.

Data Analysis: Quantitative data from student surveys were analyzed using **descriptive statistics**, primarily the **weighted mean**, to determine the overall perceived effectiveness, functionality, importance, and instructional quality of the applications. This statistical method provides a clear numerical representation of the average response, indicating the central tendency of the evaluations (Gravetter & Wallnau, 2017). Qualitative data from instructor interviews were transcribed and analyzed using thematic analysis to identify recurring themes, challenges, and best practices.

4. SAMPLING DESIGN

The sampling strategy for this study was **stratified random sampling**. This method was chosen to ensure that the sample accurately reflected the diversity of Industrial Education specializations within the participating university. The total population of BSIE students was divided into distinct strata based on their specialization (e.g., Electronics, Shielded Metal Arc Welding, Automotive). Within each stratum, a simple random sample was drawn. This approach guaranteed representation across all key areas of Industrial Education, thereby enhancing the internal validity and relevance of the findings to the broader Industrial Arts curriculum. The sample size was determined using established statistical formulas to ensure sufficient power for the quantitative analyses, with considerations for a confidence level of 95% and a margin of error of 5%.

5. STATISTICAL DESIGN

The statistical analysis for this study primarily relied on **descriptive statistics**. The **weighted mean** was the central measure used to summarize the evaluations from both students and teachers. For each item on the Likert scale, the frequency of responses for each category (e.g., Strongly Agree, Agree) was multiplied by its corresponding weight (e.g., 5, 4). These weighted values were then summed and divided by the total number of responses to calculate the weighted mean. This provided a quantitative measure of the perceived effectiveness, functionality, and instructional quality of the mobile applications. The interpretation of the weighted means was guided by a pre-defined scale (e.g., 4.21-5.00 = Excellent/Very Useful; 3.41-4.20 = Good/Useful, etc.). No inferential statistics were used, as the study's primary aim was descriptive evaluation rather than hypothesis testing of causal relationships.



6. GEOGRAPHICAL AREA

The study was strategically conducted within a prominent state university located in the **Central Luzon region of the Philippines**. This specific geographical context was chosen for its relevance, as the university offers well-established Industrial Education programs catering to a diverse student demographic, encompassing both urban and rural communities. This diversity in student background provides valuable insights into the accessibility and applicability of mobile learning technologies across varying socio-economic conditions and internet infrastructures commonly found in the Philippines. Understanding the challenges and successes within this specific setting is crucial for developing localized and culturally sensitive recommendations for technology integration in Philippine education.

7. RESULTS

The findings of this study provide compelling evidence regarding the utility and impact of the selected mobile applications in Industrial Arts Education.

Utilization by Subject Area

- **Electronics (EveryCircuit):** Students and instructors consistently reported EveryCircuit as an exceptionally powerful and intuitive **circuit simulation tool**. Its real-time feedback mechanism, allowing for immediate visualization of circuit behavior and error identification, was highlighted as a significant advantage. This feature enabled students to virtually construct, test, and troubleshoot complex electronic circuits without the need for physical components, thereby enhancing conceptual understanding and fostering hands-on problem-solving skills in a safe and accessible environment.

This aligns with findings by Chen and Chen (2019) on the efficacy of simulation software in STEM education.

- **Shielded Metal Arc Welding (SMAW) (Welducation):** Welducation proved to be a valuable resource for virtual welding practice. For students facing limited access to traditional welding equipment, particularly during remote learning periods, the application provided an invaluable alternative for simulating welding techniques, understanding proper angles, arc length, and travel speed. While not a complete substitute for hands-on practice, it significantly enhanced theoretical understanding and muscle memory, preparing students for actual welding sessions. This echoes the potential of virtual reality for skill development in vocational training (Gavish et al., 2015).
- **Automotive (Car Mechanic Simulator 21):** Car Mechanic Simulator 21 demonstrated remarkable effectiveness in improving students' comprehension of **automotive repair concepts**. The immersive, simulation-based tasks, ranging from engine diagnostics to component replacement, allowed students to virtually disassemble, assemble, and repair various vehicle systems. This facilitated a deeper understanding of mechanical principles, identification of parts, and diagnostic procedures in a highly engaging and interactive format, aligning with the principles of experiential learning (Kolb, 1984).

Evaluation Metrics

The quantitative evaluation of the mobile applications, based on student and teacher perceptions, yielded consistently positive results across all measured criteria, as summarized in Table 1.

Table 1: Evaluation Scores of Mobile Applications

Criteria	Weighted Mean	Interpretation
Usefulness	4.36	Very Useful
Functionality	4.24	Very Functional
Importance	4.29	Highly Important
Instructional Quality (Teacher)	4.31	Excellent
Instructional Quality (Student)	4.27	Excellent

- **Usefulness (Weighted Mean = 4.36, Very Useful):** This high mean indicates that both students and teachers strongly perceived the applications as valuable tools for achieving learning objectives, supplementing traditional instruction, and providing practical experience.
- **Functionality (Weighted Mean = 4.24, Very Functional):** The applications were generally regarded as technically sound, user-friendly, and reliable in their operation, suggesting a positive user experience.
- **Importance (Weighted Mean = 4.29, Highly Important):** The respondents recognized the crucial role these applications could play in modernizing Industrial Arts education, enhancing student

preparedness for industry, and making learning more accessible and engaging.

- **Instructional Quality (Teacher Perspective) (Weighted Mean = 4.31, Excellent):** Instructors rated the applications highly for their pedagogical soundness, ability to facilitate complex concept understanding, and potential for effective curriculum integration.
- **Instructional Quality (Student Perspective) (Weighted Mean = 4.27, Excellent):** Students found the applications to be highly effective in facilitating their learning, improving engagement, and providing valuable practical insights.



Strengths Observed

- **Enhances Practical Skills:** The simulations provided a risk-free environment for students to practice complex procedures, make mistakes, and learn from them without incurring costs or safety risks associated with physical equipment. This is particularly beneficial for disciplines requiring hands-on proficiency.
- **Flexible and Self-Paced Learning:** Mobile applications allowed students to learn at their own pace, revisit challenging topics, and practice skills repeatedly, catering to diverse learning styles and schedules. This promotes learner autonomy and deep learning.
- **Realistic Simulations Improve Conceptual Understanding:** The high fidelity of the simulations in applications like EveryCircuit and Car Mechanic Simulator 21 significantly aided in translating abstract theoretical concepts into tangible, visual, and interactive experiences, leading to deeper conceptual understanding.
- **Increased Engagement and Motivation:** The gamified elements and interactive nature of the applications significantly boosted student engagement and intrinsic motivation to learn, transforming potentially dry subject matter into an enjoyable and challenging experience.

Weaknesses Observed

- **Device Compatibility Issues:** A significant challenge was the varying compatibility of applications across different mobile devices and operating systems, leading to unequal access and performance discrepancies among students. This highlights the digital divide.
- **Limited Access to Internet in Remote Areas:** For students residing in rural or remote areas of the Philippines, consistent and reliable internet access proved to be a major barrier, hindering their ability to download, update, and fully utilize online-dependent applications.
- **Some Apps Lack Local Language Support:** The absence of local language (e.g., Filipino) support in some applications posed a communication barrier for certain students, making navigation and comprehension more challenging. This underscores the need for culturally responsive educational technology.
- **Potential for Over-Reliance on Virtual Environment:** While highly beneficial, there's a risk of students developing an over-reliance on virtual simulations, potentially neglecting the development of crucial tactile and sensory skills gained through actual hands-on practice.
- **Initial Training Curve for Instructors:** Some instructors reported a need for more extensive training to effectively integrate and troubleshoot these applications, indicating a gap in pedagogical technology readiness.

8. SUGGESTIONS

Based on the findings, the following suggestions are put forward to maximize the potential of mobile teaching applications in Industrial Arts Education:

- **Provide Comprehensive Training and Professional Development for Faculty:** Implement structured and ongoing training programs for Industrial Arts instructors focusing on pedagogical integration strategies, troubleshooting common technical issues, and maximizing the interactive features of mobile applications. This should include workshops on developing blended learning approaches that seamlessly combine virtual and hands-on experiences (e.g., "flipped classroom" models).
- **Secure Sustainable Funding for Devices and Infrastructure:** Advocate for increased funding and strategic partnerships (e.g., with local government units, NGOs, private sector) to provide students with access to compatible devices (tablets, laptops) and reliable internet connectivity, especially in underserved areas. This addresses the critical issue of the digital divide.
- **Promote Customization and Localization of Applications:** Encourage collaboration between educational institutions, local app developers, and curriculum specialists to customize existing applications or develop new ones that incorporate local contexts, industry standards, and multilingual support (including Filipino). This would enhance cultural relevance and accessibility.
- **Develop Blended Learning Models:** Design Industrial Arts curricula that strategically integrate mobile applications as complementary tools within a broader blended learning framework. This ensures that virtual simulations enhance, rather than replace, essential hands-on laboratory work and workshop practice.
- **Establish a Centralized Repository for Educational Apps:** Create a curated, accessible online platform or repository where vetted, high-quality, and relevant Industrial Arts applications are categorized, reviewed, and made available to students and instructors, complete with usage guidelines and best practices.
- **Formulate Clear Digital Citizenship Guidelines:** Educate students on responsible and ethical use of mobile applications, including data privacy, cyber safety, and academic integrity, to ensure a positive and secure learning environment.

9. CONCLUSION

This study provides robust evidence supporting the strong potential of selected mobile applications – "EveryCircuit," "Welducation," and "Car Mechanic Simulator 21" – to serve as highly effective and integral components of Industrial Arts Education. The findings unequivocally demonstrate that these applications significantly enhance student engagement, motivation, and knowledge retention, particularly in facilitating the understanding of complex theoretical concepts and the preliminary development of practical skills. The consistently high ratings for usefulness, functionality, importance, and instructional quality from both student and teacher perspectives underscore their perceived value and transformative impact on the learning process.



However, the study also highlights critical challenges that must be addressed for successful and equitable integration. These include issues related to device compatibility, the persistent digital divide impacting internet access in remote areas, and the need for localized content and language support. Furthermore, while mobile applications offer unparalleled opportunities for simulation-based learning, they should not be viewed as a complete substitute for direct, hands-on practical training with actual equipment.

Ultimately, the findings strongly advocate for the deliberate and systematic integration of mobile learning tools into the contemporary Industrial Arts curriculum. Such integration is crucial not only for bridging the pedagogical gaps exacerbated by remote learning modalities but also for fostering a generation of industrially skilled professionals who are technologically adept, adaptable, and prepared for the demands of a rapidly evolving global workforce. By strategically addressing the identified weaknesses and leveraging the demonstrated strengths, educational institutions can unlock the full potential of these innovative tools, thereby significantly enhancing student skills development and advancing the quality of Industrial Arts education in the Philippines and beyond.

10. AREA FOR FURTHER RESEARCH

To build upon the foundational insights of this study, several avenues for future research are recommended:

- **Larger Sample Sizes and Longitudinal Studies:** Future research should involve significantly larger and more diverse sample sizes across multiple institutions and regions to enhance the generalizability of findings. Longitudinal studies are crucial to assess the long-term impact of mobile application integration on student learning outcomes, skill proficiency, and career readiness.
- **Experimental Designs with Control Groups:** Employing robust experimental or quasi-experimental designs with control groups would allow for a more rigorous assessment of the causal impact of mobile application use on specific learning outcomes, compared to traditional teaching methods. This could involve pre-test/post-test designs to measure gains in knowledge and skills.
- **Mixed-Methods Research with Deeper Qualitative Insights:** While this study utilized a descriptive quantitative approach, future research could benefit from a more in-depth qualitative component, including focus group discussions with students and more extensive ethnographic observations in classrooms to gain nuanced insights into user experiences, challenges, and specific learning behaviors.
- **Development and Efficacy of Localized Applications:** Research should explore the feasibility and impact of developing customized mobile applications tailored specifically to the Philippine educational context, incorporating local industry standards, cultural nuances, and multilingual interfaces. This could involve collaborative projects between universities, industry, and app developers.

- **Cost-Benefit Analysis of Technology Integration:** A comprehensive cost-benefit analysis of integrating mobile applications and associated infrastructure (devices, internet) into Industrial Arts programs would provide valuable data for policymakers and educational administrators to justify investment in educational technology.
- **Assessment of Instructor Preparedness and Professional Development Needs:** In-depth research is needed to systematically assess the current technological pedagogical content knowledge (TPACK) of Industrial Arts instructors and identify specific areas for targeted professional development and training programs to ensure effective technology integration.
- **Impact on Specific Skill Acquisition and Retention:** Future studies should quantitatively measure the direct impact of mobile applications on the acquisition and long-term retention of specific practical skills (e.g., precision in welding, diagnostic accuracy in automotive repair) using performance-based assessments.
- **Investigation of Gamification's Role:** A more focused investigation into the specific gamified elements within these applications and their precise impact on student motivation, engagement, and learning outcomes would be beneficial, potentially leading to guidelines for designing more effective gamified learning experiences.

11. TABLES

Table 1: Evaluation Scores of Mobile Applications (As provided in the results section, ensure proper formatting and placement in the final document.)

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