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Bar Master: A Gamified Interactive Learning Application for Bartending Qualification Tems

Cristy Moreno Cañas[1], April Rose Ballos Flores, PhD[2]
[1]*Graduate Student, Master of Technology Education (MTE), University of Southern Mindanao, Kidapawan City Campus, Sudapin Kidapawan City, Philippines*
[2]*Faculty, University of Southern Mindanao, Kidapawan City Campus, Sudapin Kidapawan City, Philippines*

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Email of Corresponding Author: cristycanas0121@gmail.com

Abstract

This study designed, developed, and evaluated Bar Master, an Android-based gamified learning application intended to strengthen bartending students' knowledge, skills, and competency in tools, equipment, materials, supplies, and bar setup procedures aligned with TESDA standards. The study was anchored in Self-Determination Theory, Flow Theory, and Mobile Learning Frameworks and followed a developmental research design using the Agile System Development Life Cycle. The application was developed through MIT App Inventor and integrated Firebase Realtime Database and TinyDB for online and offline storage. Forty respondents participated, comprising 30 bartending students and 10 instructors from Colegio de Kidapawan and North Valley College Foundation Inc. Fifteen students formed the experimental group and 15 formed the control group. Data were gathered through validated pretest-posttest evaluations and a Unified Evaluation Form assessing usability, functionality, and acceptability. Weighted mean, standard deviation, paired-samples t-test, and independent-samples t-test were applied. Both groups improved, but the experimental group achieved a greater gain, with a very large effect, and significantly outperformed the control group in the posttest. Students rated the application usable, functional, and acceptable, while instructors rated it highly usable, highly functional, and highly acceptable. Challenges concerned interactive features and limited instructional time for familiarizing learners with bartending resources. The study concluded that Bar Master is an effective supplementary tool and recommended instructional integration, content improvement, controlled user access, and distribution through the Google Play Store. The study supports SDG 4 through accessible, technology-enhanced vocational education and contributes to sustainable institutional practice through reusable, self-paced learning and digital performance monitoring.

Keywords: Bartending Education, Bartending Qualification, Gamified Learning Application, Interactive Learning, Mobile Learning, TEMS, TESDA Competencies

1. Introduction

Although TESDA's Bartending curriculum is well-structured, Moreno (2010) found varying employability outcomes among TESDA-certified Food and Beverage Services NC II passers in Western Visayas, indicating broader concerns regarding the transition from competency-based hospitality training to employment. This gap is partly attributed to reliance on traditional, memorization-based instruction rather than hands-on, performance-oriented learning. Interactive multimedia approaches have since emerged as effective alternatives. Mulyati et al. (2024) found that multimedia-based learning increases motivation and mastery of practical tasks in vocational education, while Santhosh et al. (2024) demonstrated that spaced-repetition learning delivered through a mobile flashcard application improved students' learning outcomes. These findings support the rationale for embedding game-based and simulation features—allowing learners to interact with virtual bar tools and setups—alongside a real-time instructor dashboard that supports TESDA's competency-based assessment approach.

Related literature converges on several recurring themes. On game-based and simulation learning, Dahalan et al. (2023) established that gamification enhances engagement, skill development, and retention in vocational and technical education (VET), provided game mechanics are aligned with competency standards, a view supported by Plass et al. (2015) regarding active knowledge construction through feedback-driven challenges. In hospitality-specific contexts, Ismail et al. (2024) showed that VR and gamified simulations at the hotel front desk improve engagement and real-world service understanding, validating simulation-based activities such as a virtual bar setup exercise. On mobile flashcards and retention, Santhosh et al. (2024) found that mobile flashcards with spaced repetition improve post-test performance over traditional memorization, consistent with Kang (2016) on the durability of spaced retrieval practice for procedural and factual knowledge.

On learning analytics and dashboards, De Vreugd et al. (2024) reported that instructor dashboards strengthen formative assessment and progress monitoring, while Papamitsiou and Economides (2023) linked learning analytics dashboards to self-regulated learning and targeted instructional intervention—both supporting the inclusion of a dashboard aligned with TESDA's competency-based evaluation. Regarding competency alignment, the Bartending NC II training regulations of the Technical Education and Skills Development Authority (TESDA, 2015, 2019) define the competencies that structure the application's content and learning activities. On mobile learning platforms, Johannsen et al. (2023) identified system quality, user satisfaction, and accessibility as determinants of mobile learning effectiveness, while Adijaya et al. (2021) demonstrated the value of mobile learning frameworks in competency-based technical education. Within app features specifically, Xodabande (2022) and Zarrati (2024) found that digital flashcards outperform traditional study methods through spaced repetition and active recall, consistent with dual-coding theory regarding integrated verbal-visual processing (Boroughani et al., 2023). Gamified quizzes similarly strengthen motivation and engagement (Almusharraf, 2023; Khoshnoodifar et al., 2023), while matching-based activities support associative memory formation (Mourgues, 2016).

On usability, Johannsen et al. (2023) and Johnson et al. (2022) linked clear navigation and user-centered interface design to reduced cognitive load and improved learning outcomes, a position reinforced by Alghamdi (2022), Du Plooy et al. (2024) on personalized/adaptive learning, and Armour (2025) on the value of interactive multimedia and real-time feedback in bridging theory and practice. Finally, Nyman (2020) developed Barkeep, a serious online card game addressing gaps in formal bartending education by improving recall of cocktail recipes, illustrating the broader feasibility of gamified tools for vocational skill-building, though further testing was recommended.

Despite this established national competency framework, employability outcomes remain uneven across hospitality training institutions (Moreno, 2010). At the global level, prior technological developments demonstrate parallel efforts, including an interactive bartender kiosk that integrates customer interaction and automated beverage dispensing (Kalkshtein et al., 2024), an interactive game-based learning system designed for different academic subject areas (Minotti, 2009), and an online education platform incorporating an instructor dashboard for managing and monitoring learner activity (Aleahmad et al., 2019). A comparative review of these and related applications indicates that none simultaneously combine game-based learning, TESDA-aligned competency mapping, real-time skill tracking, and physical/practical bar-setup simulation specifically for bartending education—positioning this study's application as a locally grounded response to a gap evident in both national training outcomes and the broader global landscape of interactive learning technologies.

This study is anchored in Self-Determination Theory (SDT) by Deci and Ryan (1985), which holds that learner engagement is strongest when autonomy, competence, and relatedness are fulfilled; Tzuo et al. (2024) extended SDT to gamification, emphasizing that meaningful engagement arises when rewards, feedback, and choice are intentionally aligned with these psychological needs. Flow Theory (Csikszentmihalyi, 1990) further explains optimal learning as a state of immersion achieved when challenge and skill are balanced, a principle operationalized by Chalco Challco et al. (2023) in the GamiFlow Framework linking incremental task difficulty to sustained motivation. Mobile learning frameworks complete the theoretical basis: Kumar and Chan (2024) found that digital flashcards using retrieval practice and spaced repetition improve engagement and retention, and Lampropoulos and Sidiropoulos (2024) found gamified instruction yields the greatest gains in theoretical and applied performance compared to traditional and online-only methods. Sulaiman and Mahmud (2024) additionally noted that instructor readiness affects gamified teaching outcomes, informing the design of an Instructor Dashboard to support real-time feedback within TESDA's competency-based framework. Together, these theories inform a conceptual framework comprising inputs (competency standards, concepts, and references), processes (planning, designing, developing, testing, revising, and evaluating), and output (the Bar Master application).

Despite growing evidence supporting gamification, simulation, mobile flashcards, and instructor dashboards individually, existing applications and patented systems address these elements in isolation rather than as an integrated, TESDA-aligned solution for bartending competency training. A comparative analysis of existing interactive and educational systems found no application that combines interactive/game-based learning, bartending-specific skill focus, TESDA-aligned competency mapping, real-time accuracy/speed tracking, instructor monitoring, and physical bar-setup simulation within a single tool intended for hospitality or vocational education. This gap, combined with documented disparities in graduate employability (Moreno, 2010) and continued reliance on memorization-based instruction, provides the rationale for developing and evaluating Bar Master as an integrated, competency-aligned, gamified learning application for TESDA Bartending NC II training.

This study aligns with several SDGs. SDG 4 (Quality Education) is addressed directly through the development of an interactive, competency-based learning tool that strengthens vocational instruction and self-paced mastery of bartending skills. SDG 8 (Decent Work and Economic Growth) is supported by the study's focus on improving graduate employability

and industry readiness within the hospitality sector (Moreno, 2010). SDG 9 (Industry, Innovation and Infrastructure) is reflected in the application of mobile technology, gamification, and cloud-based data infrastructure (Firebase) to modernize vocational training delivery. SDG 17 (Partnerships for the Goals) is evident in the alignment between the application's design and TESDA's national competency standards, reflecting a partnership between technological innovation and an established government training framework.

The study contributes to educational sustainability by embedding gamified, self-paced, and instructor-supported learning mechanisms that can be reused and adapted across training cohorts without continuous dependence on physical materials. It supports socio-economic sustainability by aiming to close the gap between classroom learning and workplace competency, thereby improving graduate employability and workforce readiness for the hospitality industry. It advances technological and innovation sustainability by demonstrating how accessible, block-based development platforms (MIT App Inventor) and cloud synchronization tools can be leveraged to create scalable digital learning solutions for technical-vocational education. Finally, it contributes to institutional sustainability by offering training institutions a supplementary, standardized instructional tool that can strengthen compliance with TESDA's competency-based assessment system while reducing resource dependency over time.

2. Material and methods

2.1 Research Design

The study employed a Developmental Research Design, focused on the systematic design, creation, and evaluation of educational tools and learning innovations. The application's construction followed the Agile System Development Life Cycle (SDLC), comprising Initiation, Planning, Development, Release, and Retirement stages, chosen for its emphasis on continuous improvement, flexibility, and iterative testing. During Initiation, the researchers identified the need for a technology-based bartending learning tool given the limited classroom time allotted for tool familiarization under the TESDA Bartending NC II program. Planning involved consultation with advisers and instructors to define the application's scope, features (Tool Match, Timed Quiz, Flashcard Learning Mode, Bar Setup Challenge, and Instructor Dashboard), and required software and hardware. Development was carried out using MIT App Inventor for block-based coding, with Firebase Realtime Database for online synchronization and TinyDB for offline storage; modules were built individually, integrated, and tested for functional accuracy. During Release, the completed application was deployed to bartending students and instructors at Colegio de Kidapawan and North Valley College Foundation Inc., where pre-tests, post-tests, and user evaluations were administered and used to refine the system. Retirement marked the finalization of the application and its documentation, with future enhancements left to the discretion of the institutions and subsequent researchers. This developmental process was further supported by an evaluation phase consisting of Planning and Design, Software Setup, Application Development, Integration and Testing, Evaluation and Revision, and Finalization and Documentation.

2.2 Locale of the Study

The study was conducted in two schools in Kidapawan City offering Bartending programs: Colegio de Kidapawan and North Valley College Foundation Inc. These institutions were selected because they provide hands-on, competency-based bartending training and have active student and instructor participation in the program, allowing the researchers to evaluate the application's acceptability, usability, and functionality across different classroom settings.

2.3 Respondents of the Study

The respondents consisted of thirty (30) students from Colegio de Kidapawan and ten (10) instructors, five (5) each from Colegio de Kidapawan and North Valley College Foundation Inc. The thirty student respondents were divided into an experimental group of fifteen (15), who used the developed application, and a control group of fifteen (15), who did not, enabling comparison of learning outcomes between the two groups. All student respondents underwent pre-test and post-test evaluations of their knowledge of bar tools, equipment, materials, and functions, while both students and instructors served as evaluators of the application's functionality, usability, and acceptability.

2.4 Sample and Sampling Procedure

A purposive sampling technique was used to select respondents with direct involvement in bartending education who could provide relevant and reliable feedback on the application. A total of forty (40) respondents participated: thirty (30) students from Colegio de Kidapawan, split into fifteen (15) in the experimental group and fifteen (15) in the control group, and ten (10) instructors, five (5) from each participating institution. Both student groups completed the pre-test and post-test, while the fifteen (15) students in the experimental group and all ten (10) instructors additionally evaluated the application's acceptability, usability, and functionality.

2.5 Research Instrument

Two main instruments were used. The first, a Pre-test and Post-test Evaluation, measured students' knowledge and competency in identifying bar tools, equipment, and setup procedures based on bartending competency standards,

administered before and after use of the application to determine learning improvement. The second, a Unified Evaluation Form completed by both students and instructors, assessed the application's usability (ease of navigation, clarity of instructions, system responsiveness), functionality (performance of features such as Tool Match, Quiz Mode, Bar Setup Challenge, and Instructor Dashboard), and acceptability (engagement, visual design, content relevance, and overall satisfaction) using a five-point Likert scale ranging from 5 ("Highly Usable") to 1 ("Not Usable"). Both respondent groups answered the same core items with minor wording adjustments to reflect their respective roles, and the instrument underwent expert validation for content validity, clarity, and appropriateness.

2.6 Data Gathering Procedure

Data gathering proceeded through three phases: Preparation, Implementation, and Evaluation, aligned with TESDA Bartending competencies and the limited instructional time allotted for tool familiarization. In the Preparation Phase, the researchers secured approval from the research adviser and participating institutions, coordinated with instructors for scheduling and orientation, validated the research instruments, and reviewed key references including the TESDA Bartending Training Regulations (TR No. WTR 2015) and the Competency-Based Curriculum. In the Implementation Phase, data collection occurred through orientation and pre-testing, followed by application utilization—during which students engaged with Tool Match, Timed Quiz, Bar Setup Challenge, Flashcard Learning Mode, and the Instructor Dashboard under supervision—and concluded with post-testing and completion of the Unified Evaluation Form, alongside qualitative feedback from instructors. In the Evaluation Phase, the researchers tabulated, summarized, and statistically analyzed the pre-test and post-test scores and evaluation responses to assess the application's effectiveness, usability, functionality, and acceptability, with confidentiality, voluntary participation, and ethical standards observed throughout.

2.7 Data Analysis Techniques

Data were analyzed using statistical tools appropriate to each research objective. For the first and second objectives, concerning application development and student performance, pre-test and post-test scores were analyzed using descriptive statistics (mean and standard deviation) to measure students' knowledge and competency before and after using the application, and a paired sample t-test was used to determine whether performance improved significantly following exposure to the application. For the third objective, concerning the application's acceptability, usability, and functionality as perceived by students and instructors, responses were analyzed to ensure the results accurately reflected user satisfaction and system performance.

3. Results and Discussion

3.1 Design and Development of the Application

3.1.1 System Architecture and User Interaction

The application's architecture centers on interaction between students, instructors, and a database. Students provide inputs such as answers, selections, and bar setup actions across the learning modules, receiving scores, results, progress updates, and learning hints in return, while instructors access a dashboard that generates reports on student scores, progress, and performance. Both online storage through Firebase Realtime Database and offline storage through TinyDB support continuous data retrieval and performance monitoring. Within the system, students log in and engage with flashcards, timed quizzes, a tool-matching activity, and a bar setup challenge, and can view their own scores and feedback, while instructors log in through the dashboard to monitor performance, review quiz and game results, and provide assessment. Underlying system processes validate quiz and matching responses, automatically generate scores, and synchronize offline and online data to ensure accurate reporting to both user types. This architecture reflects a learner-centered, performance-driven design that integrates educational content with automated assessment, allowing students to learn through gamified activities while giving instructors an efficient means of monitoring competency development. The dual-actor structure and real-time feedback loop are consistent with the broader rationale for gamified, competency-based systems described earlier in this study, wherein interactive digital tools support both learner engagement and instructor-led evaluation.

3.1.2 Software and Hardware Requirements

The application was built to run on Android OS version 7.0 and above, developed through MIT App Inventor using block-based programming, with Google Chrome and Microsoft Edge used to access development tools, Firebase Realtime Database for online storage and synchronization, and TinyDB for offline storage. On the hardware side, an Android smartphone or tablet with at least 2GB RAM was required to run and test the application, a laptop or desktop computer was necessary for development and debugging, a minimum of 100MB of storage supported installation and offline functionality, and an internet connection enabled real-time synchronization with Firebase.

These requirements indicate that the application was designed for accessibility and practicality, relying on widely available and low-cost tools rather than specialized infrastructure. This supports the feasibility of deploying similar gamified learning systems in resource-limited vocational training settings, where affordable, dual-mode (online/offline) functionality can reduce dependency on constant internet access.

3.2 Evaluation of Students' Performance

3.2.1 Within-Group Pretest-Posttest Differences

Both the experimental group, which used the Bar Master application, and the control group, which did not, showed significant gains from pretest to posttest. However, the experimental group demonstrated a substantially larger improvement ($p < .001$, mean difference = -4.93, very large effect size) than the control group ($p = 0.026$, mean difference = -1.93, moderate effect). This indicates that while conventional instruction also produced learning gains, the gamified application had a considerably stronger impact on student performance. This finding supports Plass et al. (2015), who explained that game-based learning helps students understand better because they actively engage with lessons through interaction and feedback, and aligns with Dahalan et al. (2023), who found that gamification improves skill learning in vocational education.

3.2.2 Between-Group Performance Comparison

Both groups performed at a comparable level at pretest ($p = 0.051$, not significant), indicating equivalent baseline knowledge. After the intervention, however, the experimental group performed significantly better than the control group ($p = 0.026$, mean difference = 7.00). This confirms that the observed difference in posttest performance was attributable to use of the application rather than pre-existing differences between groups. This result supports Johannsen et al. (2023), who stated that mobile learning improves outcomes when it is accessible and relevant, and Almusharraf (2023), who found that gamified learning increases student engagement and performance. Overall, students who used Bar Master learned more effectively than those who received traditional instruction alone, indicating that the gamified approach was more effective than conventional teaching methods.

3.3 Usability of the Application

Both students and instructors rated the application positively in terms of usability, with students rating it "Usable" (weighted mean = 4.45) and instructors rating it "Highly Usable" (weighted mean = 4.68). Both groups gave particularly high ratings to the app's navigation, layout, and ease of feature access, while both groups gave comparatively lower ratings to the interactive features such as Tool Match, Timed Quiz, and Bar Setup Challenge. The strong ratings for navigation and organization support Johannsen et al. (2023), who noted that mobile learning applications are more effective when simple and well-designed, while the lower ratings for interactive features align with Alghamdi (2022), who explained that interactive learning tools often require further refinement to improve user-friendliness. The higher overall rating from instructors may reflect their appreciation of the system's instructional and monitoring value, consistent with De Vreugd et al. (2024), who noted that instructors tend to favor systems that support instruction and feedback, whereas students' relatively more critical view of the interactive features aligns with Johnson et al. (2022), who observed that students are more sensitive to interface complexity. Overall, the application was found usable and effective for both groups, though refinement of its interactive components could further enhance the learning experience.

3.4 Functionality of the Application

Both students and instructors perceived the application as functional overall, with instructors giving a higher rating ($M = 4.67$, $SD = 0.211$, Highly Functional) than students ($M = 4.49$, $SD = 0.323$, Functional). Instructors gave particularly high ratings to the Instructor Dashboard, the automatic scoring feedback system, the Timed Quiz, and the provision of information on bar tools and procedures. Students rated most features within the Functional range, including Tool Match and Bar Setup Challenge, while giving comparatively higher ratings to automatic scoring feedback and offline-online functionality. Both groups rated the Flashcard Learning Mode and the application's data storage and accessibility features favorably. The stronger instructor ratings for dashboard and feedback features support De Vreugd et al. (2024), who explained that learning analytics dashboards enhance instructors' ability to track learner progress and provide targeted, real-time feedback. Favorable ratings of gamified and review-based features are consistent with Khoshnoodifar et al. (2023), who found that gamification increases motivation and engagement, and with Santhosh et al. (2024), who emphasized that flashcard tools improve retention through repeated, self-paced learning. The strong ratings for system accessibility and data storage align with Johannsen et al. (2023), who noted that mobile learning effectiveness depends heavily on system quality, usability, and accessibility. Overall, the difference between student and instructor ratings suggests that students prioritize ease of use and interaction, while instructors place greater value on the application's instructional alignment and assessment capabilities.

3.5 Acceptability of the Application

Both students and instructors responded positively to the application's acceptability, with instructors rating it higher ($M = 4.70$, $SD = 0.216$, Highly Acceptable) than students ($M = 4.33$, $SD = 0.307$, Acceptable). Students gave their highest ratings to items concerning content alignment with bartending competencies, preparation for practical bartending, and use as a supplementary learning tool, while rating engagement and motivation somewhat lower. Instructors rated all acceptability indicators as Highly Acceptable, with the highest ratings given to the app's support for practical bartending preparation, content relevance, and usefulness as a teaching tool. These findings support Almusharraf (2023), who stated that gamified learning improves student engagement by making lessons more interactive, and Khoshnoodifar et al. (2023), who found

that gamification increases motivation and helps students learn more effectively. The high ratings for content usefulness and practical relevance further support Johannsen et al. (2023), who explained that mobile learning is most effective when relevant and easy to access. Overall, the application was well accepted by both groups, with students emphasizing their learning experience and instructors emphasizing its teaching effectiveness.

4. Conclusion & Recommendations

The study concludes that Bar Master: A Gamified Interactive Learning Application for Bartending Qualification (TEMS) is an effective supplementary tool for bartending education. Students who used the application achieved significantly greater improvement in posttest performance than those who received traditional instruction, demonstrating that its gamified and interactive features enhanced their understanding of bar tools, equipment, and procedures. The application was also positively evaluated by students and instructors in terms of usability, functionality, and acceptability, indicating its suitability for supporting engaging and technology-based bartending instruction.

Teachers should integrate the application as a supplementary tool for classroom discussions and practical bartending activities, while schools should support the use of mobile learning applications in vocational training. Students should use the application for continued practice and self-study, and future researchers and developers should update its questions, activities, and learning content to maintain their relevance and accuracy. The application should also incorporate an authentication or verification feature to restrict access to authorized users and be uploaded to the Google Play Store to provide safer and more convenient installation.

Compliance with ethical standards

The authors declare no conflict of interest. This study complied with recognized ethical standards for human-participant research by ensuring voluntary participation with informed consent, the right to withdraw without penalty, and strict confidentiality through anonymous, secure, and aggregated data handling. Given the focus on psychological well-being, procedures were non-invasive, and safeguards were observed to minimize discomfort, with guidance to appropriate support services when needed, and required institutional permissions were secured for instrument use and access to academic records.

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