Developing a Gamified Mobile Learning Approach for Evaluating Student's Agricultural Accounting Education

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Abstract. This study aims to establish an innovative approach to teaching accounting, with a strong emphasis on a student-centred methodology. The curriculum is thoughtfully designed using an effective teaching framework, with the primary goal of helping students better understand accounting principles. It introduces a mobile learning environment with a focus on gaming, achieved through the development of an accounting mobile game integrated into a mobile learning system. The study selected a group of 60 accounting students to participate. The curriculum development followed a quasi-experimental design, combining quantitative data gathered through questionnaires and qualitative data obtained through interviews. The results highlight the advantages of game-based mobile learning in improving teaching effectiveness. Moreover, a regression model indicates that information quality and service quality positively predict the intention to use such a learning approach, and this intention, along with user satisfaction, positively influences engagement in the learning process. Notably, user satisfaction serves as a mediating factor within this relationship. In conclusion, this study offers valuable recommendations for educators and researchers in the field of accounting, shedding light on the benefits of incorporating game-based mobile learning into accounting education.

Keywords: Accounting, agricultural, education, game, mobile

INTRODUCTION

In the midst of the current era characterized by rapid technological advancements, mobile networks have garnered extensive popularity, and the functionalities of mobile devices are in a state of continual evolution, aimed at augmenting the user-experience and accessibility of cellular communication [1]. Beyond the foundational attributes encompassing auditory communication, visual documentation, and videography, modern smartphones exhibit a diverse spectrum of auxiliary capabilities. These encompass real-time textual communication, facilitation of educational endeavors, consumption of visual media, auditory content reproduction, and engagement in mobile gaming activities, among a multitude of additional potentialities. With the continuous development of new functions and applications for mobile phones, they have evolved into indispensable tools for daily life. As more and more novel features and applications for mobile phones are being created, they have become a vital tool in our everyday lives. The Central Agency on Statistics conducted an analysis of how mobile phones are utilized by individuals in Indonesia. The report highlighted that daily usage of mobile phones was observed among 67,8% of individuals. If mobile phones were effectively integrated into the realm of education, they could transform into a potent tool for mobile learning. In fact, educators could merge online learning platforms with wireless communication devices within the context of online teaching and learning [2].

The advent of mobile learning has ushered in a profound shift in the teaching paradigm. This emerging form of education offers learners the potential for "wireless" and omnipresent learning prospects [3]. Those who have the inclination to learn can now enhance their personal knowledge efficiently by studying whenever and wherever they choose. Game-based instruction has seen significant growth recently. Numerous studies affirm its potential to enhance motivation and learning efficacy [4]. Despite this, its integration into accounting education remains limited. Prior research underscores the positive impact of game-based learning on accounting education [5] yet its implementation in higher accounting curricula remains constrained due to a dearth of suitable educational games. Challenges in data collection have further hindered game-based learning's application in accounting education [6], thereby impeding its broader adoption.

Agricultural accounting stands as an indispensable tool in the realm of farm management, offering a systematic approach to measure and record the consumption of agricultural resources and financial transactions. Its primary objective is to provide farmers with a comprehensive means of evaluating the income generated from their agricultural activities. The multifaceted role of agricultural accounting encompasses three key functions: registration, classification, and interpretation of financial procedures, making it an essential component in any agricultural undertaking [7].Similar to broader accounting domains, agricultural accounting is divided into distinct areas, including financial accounting, cost accounting, and management accounting. These branches cater to the specific needs and nuances of managing finances within the agricultural sector. The unique characteristics of economic production in agriculture contribute significantly to the development and specialization of accounting practices within this field.

Differences in economic production areas have led to the evolution of specific specializations in accounting. For example, we find specialized accounting systems for banking, insurance, building and road construction, industrial activities, hotels, taxation, and, notably, agricultural accounting. Each of these branches tailors its accounting practices to suit the unique demands and intricacies of the respective economic sector [8] . In essence, agricultural accounting not only facilitates financial record-keeping but also plays a pivotal role in strategic decision-making for farmers. By providing a systematic and specialized approach, it empowers agricultural businesses to navigate the complexities of their financial landscape and optimize their operations for sustainable and profitable outcomes.

This research initiative is dedicated to the integration of game-based mobile learning within the realm of accounting courses, delivered through mobile platforms. The primary objective is to establish innovative curriculum frameworks that transcend traditional teaching methods. The central focus of this endeavor is to enhance students' academic achievements, particularly in the complex domain of proficient accounting knowledge. To achieve this, the study adopts the BOPPPS pedagogical model, a comprehensive approach encompassing Bridge In, Outcomes, Pre-assessment, Participatory learning, Post-assessment, and Summary. This model strategically combines game-based instruction and mobile learning to create an immersive educational environment.

Throughout the implementation of this integrated approach, meticulous attention is given to various elements, including curriculum design, pedagogical techniques, learning assessment, curriculum reflection, and a recursive review mechanism. The study is characterized by a commitment to adapt and refine pedagogical strategies in response to complexities encountered during instructional processes. This iterative approach aims to achieve pedagogical excellence and favorable training outcomes. By addressing challenges and refining the integration of game-based mobile learning, the research endeavors to contribute to the advancement of effective and engaging educational practices in the field of agricultural accounting.

This research endeavors to integrate game-based mobile learning into the domain of accounting courses delivered through mobile platforms, thereby establishing inventive curriculum frameworks. The principal aim centers on elevating learners' scholastic accomplishments, particularly in the sphere of proficient accounting knowledge. To actualize this goal, the study employs the BOPPPS pedagogical model (comprising Bridge In, Outcomes, Pre-assessment, Participatory learning, Post-assessment, and Summary). This model synergistically merges game-based instruction and mobile learning, culminating in an immersive educational milieu. Throughout the course of implementation, meticulous attention is accorded to curriculum design, pedagogical techniques, learning evaluation, curriculum introspection, and a recursive review mechanism. Sustained adaptations are undertaken to address pedagogical intricacies encountered during instructional proceedings, thereby aspiring to attain pedagogical excellence and favorable training objectives.

Employing a quasi-experimental design, the study seeks to delineate the impact of game-based mobile learning upon scholarly accomplishments. Additionally, an exploration of the determinants influencing the efficaciousness of game-based mobile learning is pursued through the prism of the information system success model. Moreover, the study is underpinned by the subsequent objectives; (1) Grasp the existing scenario concerning impediments in accounting education, (2) Formulate a logical framework for an accounting learning game, (3) Evaluate the

educational achievements stemming from the game-centered learning program, (4) Create a valuable course for learning accounting through game-based approaches.

METHODS

Research Design

This study investigates the potential benefits of integrating accounting mobile games and mobile teaching platforms into accounting education, specifically examining the influence of game-based and mobile learning on college students' levels of engagement and the effectiveness of their learning experiences. The study spanned four weeks. The independent variable under investigation was game-based mobile learning, and it aimed to measure its influence on learning effectiveness. This included factor affecting the utilization of the accounting mobile game and its impact on learning engagement. The control variable ensured that all learners had the same teaching hours, learning objectives, and materials.

To collect data on learning effectiveness, the experimental group took a pre-test before the course, and a post-test was administered after incorporating game-based mobile learning. The pre-test and post-test results were analyzed and compared to assess the impact of game-based mobile learning on students' learning effectiveness. Upon completing the experimental teaching phase, students were provided with a questionnaire designed to uncover the factors influencing their motivation and outlook towards game-based learning. This questionnaire comprised six dimensions relating to information quality, including system quality, service quality, intention to use, user satisfaction, and learning engagement. Importantly, the questionnaire had been adapted from [9], specifically in the aspects of information quality, system quality, service quality, intention to use, and user satisfaction.

Regarding content, this research centers on accounting and outlines a curriculum that spans a series of topics, including fundamental accounting concepts, the entire accounting cycle, business accounting, and more. This curriculum is organized into five major subjects, as illustrated in Figure 1.

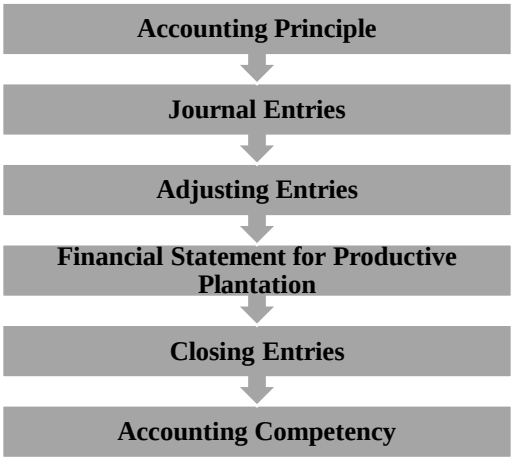

FIGURE 1. Five Major Subject

This study investigates the potential synergies between accounting mobile games and mobile teaching platforms, integrating game-based and mobile learning within accounting education. It aims to ascertain whether this integration yields a favorable influence on college students' level of engagement and effectiveness in learning. The research employed a quasi-experimental design, specifically the one-group pretest-post test design, to examine these dynamics.

This research project created a mobile game for accounting education, integrating it with the course's core concepts. The team devised narratives, scenarios, and characters inspired by various accounting themes, enriching the gameplay experience. Additionally, gamification elements like peer rivalry, feedback loops, and rewards were incorporated to stimulate learning motivation. These attributes generate excitement and anticipation among students, enhancing their commitment to the game. Through gamification, the study aimed to boost learning drive and foster active participation in the educational process [10].

The comprehensive accounting curriculum incorporated a game-based approach in the following manner: Initially, the instructor would elucidate and elucidate each accounting module. Subsequently, students would procure the app from the internet and enroll as participants in the tailored accounting game. This procedure would grant students access to the specific level aligned with the instructional segment, enabling them to commence the corresponding game stage. This instructional model aimed to facilitate students' acquaintanceship with and mastery of accounting concepts.

FIGURE 2. Intro Display

FIGURE 2. Material Display

FIGURE 4. Game Level Display

Designing The Curriculum

The implementation approach of the course was rooted in the online digital teaching platform, forming the bedrock of curriculum through accounting knowledge chapters. This foundational structure was then enhanced by the inclusion of an accounting mobile game tailored to the teaching content. The research methodology commenced with a pre-test before the course initiation, aimed at gauging students' prior knowledge and initial learning behaviors. Throughout the gameplay process, students were required to memorize and apply concepts to navigate knowledge-based challenges at varying game levels, ultimately accomplishing game tasks. This gaming approach fostered the development of students' competence in accounting learning units and knowledge points, nurturing their personal accounting knowledge construction.

Across the four-week experimental teaching period, each student devoted one hour per week in the classroom to engaging with the agricultural accounting mobile game as a medium of game-based learning. The researchers systematically gathered data on students' learning outcomes for rigorous statistical analysis and verification, to gain insights into their educational progress. By contrast, the control group received conventional lecture-based instruction, with teaching content, assessments, and hours kept identical to those of the experimental group.

The participants of the experimental group were sophomore students enrolled in taxation accounting department Politeknik Caltex Riau. A cohort of 41 students took part in the course, engaging in quizzes and responding to questionnaires. Among them, males constituted 21.9% of the group, while females made up 78.1%, with female majority.

RESULTS AND DISCUSSION

The Impact of Mobile Learning with Game-Based Apps on Academic Attainments

Students were initially assessed with a pre-test, followed by a post-test after implementing game-based mobile learning at the end of the semester. Subject-specific tests were also given before and after each course module. Analysis of the pre-test and post-test scores, conducted with paired-sample t-tests, indicated that post-test scores significantly exceeded the pre-test scores in all categories (see Table 2). This underscores the effectiveness of game-based mobile learning in improving learning outcomes.

TABLE 2. Agricultural accounting Topic

Subject	Week
W1	Pre- Test Quiz
W2	Input Transactions until providing financial statement
W3	Research Questionnaire
W4	Final Exam

The experimental group consisted of sophomore students enrolled in the agricultural accounting course within the Department of Taxation Accounting. A total of 60 students took part in the course, completing both a quiz and a questionnaire. Of these participants, 21.6% were male, while 78.4% were female, with a slightly higher proportion of females than males.

TABLE 3. Summary table of sample data

Variable	Item	Number	Percentage
Gender	Male	13	21.6
	Female	47	78.4
Do you enjoy playing games?	Do not like	8	13.3
	Ordinary	11	18.3
	Like	27	45
	Like very much	14	23.3
Do you partake in mobile gaming?	Yes	43	71.7
	No	17	28.3

In this study, we utilized confirmatory factor analysis to evaluate the measurement model. The factor loadings of individual observed variables for their respective latent variables ranged from 0.876 to 0.977, surpassing the recommended threshold of 0.45. As for average variance extraction, all six facets exhibited values exceeding 0.50. A higher AVE for a facet implies stronger convergent validity, indicating a significant level of convergent validity in the scale employed in this study. The values for compositional reliability, Cronbach's α, and rhea all exceeded 0.80, affirming the reliability of the dimensions under scrutiny.

The theoretical model's parameter estimates reveal that information quality ($\beta = 0.419$, $p < .01$) and service quality ($\beta = 0.509$, $p < .01$) significantly influence usage intention ($R2 = 0.901$). However, system quality ($\beta = 0.070$, $p > .05$) does not impact usage intent. Usage intention ($\beta = 0.864$, $p < .01$) correlates positively with user satisfaction ($R2 = 0.746$), and both influence learning engagement ($R2 = 0.946$). The study highlights the positive impact of information and service quality on usage intention, with user satisfaction mediating the relationship with learning engagement (Sobel Test = 2.788, $p < .01$).

TABLE 3. The influence of game-based learning on educational achievement assessed through both pre-test and post-test measures.

Project	Number	Average	Standar Deviation	T Value
Agricultural accounting pre test	60	38.45	27.503	
Agricultural accounting post-test	60	75.32	25.407	11.537**
Pre- Transaction Input process	60	35.12	21.003	
Post- Transaction Input process	60	64.27	28.429	14.720**
Full pre test	60	32.33	18.379	
Full post test	60	74.09	23.084	11.063**

*Note: ** p < 0.001*

TABLE 4. Summarizing statistics and probing correlations in the dataset.

Measurement	Week 1	Week 2	Week 3	Week 4
User complacence	0.824**	0.853**	0.871**	0.836**
Data Accuracy	0.825**	0.816**	0.874**	0.828**
System excellence	0.804**	0.827**	0.824**	0.840**
Desire to utilize	0.817**	0.792**	0.8028*	0.893**
Learning participation	0.853**	0.962**	0.860**	0.803**
Average	**4.301**	**4.407**	**4.428**	**4.319**

*Note: *p < 0.05, **p < 0.01*

Previous research conducted by Jamaluddin et al. in 2020 highlighted a prevalent perception among students that accounting is both dull and challenging. This perception was found to persist even among students with prior exposure to accounting, indicating a widespread difficulty in understanding the subject. The challenges students faced included the complexity of mathematical theories and exercises, leading to a tendency to avoid accounting coursework, as noted b [11]. To tackle these challenges, the current study introduces an innovative approach by incorporating an interactive accounting mobile game into the curriculum. This game, accessible on mobile devices, is designed to transform the learning experience in accounting by making it engaging and flexible. The goal is to encourage independent study and provide students with a more accessible and enjoyable method of grasping accounting concepts.

The researchers are motivated by the belief that addressing these challenges and enhancing students' enthusiasm for learning is crucial for improving academic performance. Previous research conducted by [12] supports the idea that increased enthusiasm for learning positively influences academic outcomes. The introduction of the mobile game into the curriculum is seen as a practical strategy to not only address current issues in accounting education but also contribute to filling gaps in accounting research. It represents an innovative and dynamic approach to engage students and potentially transforms the way accounting is taught and learned.

Results from both quantitative and qualitative analyses strongly support the positive influence of the gamified mobile learning model on students' outcomes in accounting education, aligning with prior studies, such as [13]. This innovative approach has demonstrated effectiveness in enhancing the overall learning experience. However, a notable exception is the rejected prediction regarding system quality's impact on users' intention, contrasting with other previous research findings. The study also establishes the existence of partial mediation between user satisfaction, users' intention, and learning engagement, shedding light on the complex interplay of factors in the mobile learning context. In line with findings from other studies, such as [10], the study highlights that system quality did not significantly influence students' intention to use the designed game. This lack of influence is attributed to curriculum constraints, suggesting that the structured nature of the curriculum may diminish the perceived impact of system quality on students' intentions. Despite this, the study underscores the broader recognition of mobile game-based learning as an effective strategy for enhancing students' performance, supported by insights from [14].

The study acknowledges that, in the context of accounting education, 'system quality' does not possess predictive power in influencing students' intention to use the accounting game. This finding raises questions about the specific role of system quality and suggests the need for further investigation. The curriculum's structure and requirements may play a significant role in students' decision-making processes, emphasizing the importance of tailoring interventions to the educational context. Additionally, the study reveals that user satisfaction plays a crucial mediating role between intention to use and learning engagement. This implies that the satisfaction derived from using the mobile game serves as a direct motivator for active engagement in accounting studies. These findings contribute to the development of a practical model for enhancing undergraduate accounting education with technological tools, as indicated by [15]. The integration of mobile game-based learning, despite the identified challenges, offers a promising avenue for addressing issues in accounting education and improving students' overall learning experiences.

CONCLUSIONS

This research developed a mobile accounting game combined with a teaching platform to create an engaging mobile learning environment for accounting education. They employed an effective teaching model and various classroom interactions to facilitate learning. Data analysis and ongoing curriculum improvements were carried out, addressing a gap in accounting education research. The study revealed that game-based mobile learning significantly improved students' learning outcomes. Additionally, questionnaire data indicated that most students had positive feedback about using mobile accounting games.

The study also explored the impact of game-based mobile learning on accounting education through an information systems model. The findings demonstrated that information quality and service quality positively influenced the intention to use the system, and there was a strong positive correlation between intention to use, user satisfaction, and learning engagement. Intention to use directly affected learning engagement, with user satisfaction playing a partial mediating role. In summary, the accounting mobile game effectively integrated accounting knowledge into a user-friendly and responsive system, enhancing students' intention to use, user satisfaction, and learning engagement.

The study focused on students from the division of continuing education, typically juggling work commitments with limited study time, and coming from diverse fields and backgrounds. These students faced the added challenge of engaging with accounting courses, which were often unfamiliar to them, and educational games that required prior understanding of accounting concepts for successful gameplay. The guidance of instructors and the collaboration among students played a pivotal role in this context. Adaptations and corrections were made during the course to suit the students' needs. Implementing modern technology and innovative teaching methods demanded patience in explaining and communicating with students, ensuring they could learn online while enjoying the learning experience.

Furthermore, instructors needed to provide support, guidance, and arrange teaching assistants to help students with any learning difficulties. The design of teaching activities needed to strike a balance between students' workload and maintaining their enthusiasm for learning, guiding them to acquire professional knowledge. Students were central to the classroom, and diverse course activities were used to increase their learning engagement. Cooperation among classmates was a key factor influencing the effectiveness of teaching. Given the diverse student composition, the course had to be adaptable to individual student needs. Additionally, the availability and functionality of hardware and software equipment were critical, as students encountered issues like game lag, platform unavailability, limited mobile phone capacity, and installation constraints. Timely problem resolution or alternative solutions, such as providing tablets, was necessary to ensure a smooth learning experience.

The practical insights gained from implementing this course could serve as a valuable reference for future efforts in game-based mobile learning, especially in the context of accounting education. It's worth noting that this study focused on introductory accounting, which may not be directly extrapolated to more advanced accounting subjects like intermediate accounting, management accounting, or auditing. Furthermore, the study's sample selection was deliberate and limited, which impacts on the generalizability and validity of the research results. Future research could benefit from expanding the study to include students from various universities or related institutions to enhance the appropriateness and validity of the findings.

REFERENCES

[1] N. Bado, “Game-based learning pedagogy: a review of the literature,” *Interact. Learn. Environ.*, vol. 30, no. 5, pp. 936–948, May 2022, doi: 10.1080/10494820.2019.1683587.

[2] H. Lei, M. M. Chiu, D. Wang, C. Wang, and T. Xie, “Effects of Game-Based Learning on Students’ Achievement in Science: A Meta-Analysis,” *J. Educ. Comput. Res.*, vol. 60, no. 6, pp. 1373–1398, Feb. 2022, doi: 10.1177/07356331211064543.

[3] J. Yu, A. R. Denham, and E. Searight, “A systematic review of augmented reality game-based Learning in STEM education,” *Educ. Technol. Res. Dev.*, vol. 70, no. 4, pp. 1169–1194, 2022, doi: 10.1007/s11423-022-10122-y.

[4] S. Akkerman, W. Admiraal, and J. Huizenga, “Storification in History education: A mobile game in and about medieval Amsterdam,” *Comput. Educ.*, vol. 52, no. 2, pp. 449–459, 2009, doi:

https://doi.org/10.1016/j.compedu.2008.09.014.
[5] P.-S. Seow and S.-P. Wong, "Using a mobile gaming app to enhance accounting education," *J. Educ. Bus.*, vol. 91, no. 8, pp. 434–439, Nov. 2016, doi: 10.1080/08832323.2016.1256264.
[6] J. E. Rebele and E. K. St. Pierre, "Stagnation in accounting education research," *J. Account. Educ.*, vol. 33, no. 2, pp. 128–137, 2015, doi: https://doi.org/10.1016/j.jaccedu.2015.04.003.
[7] Sevilengil, *Financial Accounting*. Ankara: GaziKitabevi, 2008.
[8] Z. Doğan, S. Arslan, and A. Köksal, "HISTORICAL DEVELOPMENT OF AGRICULTURAL ACCOUNTING AND DIFFICULTIES ENCOUNTERED IN THE IMPLEMENTATION OF AGRICULTURAL ACCOUNTING / Tarım Muhasebesinin Tarihsel Gelişimi ve Tarım Muhasebesinin Uygulanmasında Yaşanan Güçlükler," pp. 107–116, Jan. 2019.
[9] E. R. DeLone, W. H., & McLean, "The DeLone and McLean model of information systems success: a ten-year update," *J. Manag. Inf. Syst.*, vol. 19, no. 4, pp. 9–30, 2003.
[10] L. Pütz, *Strukturtarifverträge zur Organisation der betrieblichen Mitbestimmung: - Anwendungsmöglichkeiten und Reformbedarf des § 3 BetrVG unter besonderer Beachtung moderner Unternehmensstrukturen* -, 1st ed., vol. 84. Baden-Baden: Nomos Verlagsgesellschaft mbH & Co. KG, 2020.
[11] R. M. Carini, G. D. Kuh, and S. P. Klein, "Student Engagement and Student Learning: Testing the Linkages*," *Res. High. Educ.*, vol. 47, no. 1, pp. 1–32, 2006, doi: 10.1007/s11162-005-8150-9.
[12] Y. yang Chih huang, "Research on the Relationship Among Learning Motivation, learning engagement, and Learning Effectiveness," *Educ. Rev.*, vol. 5, no. 6, pp. 182–190, 2021.
[13] C.-J. Lee and C. Kim, "An implementation study of a TPACK-based instructional design model in a technology integration course," *Educ. Technol. Res. Dev.*, vol. 62, no. 4, pp. 437–460, 2014, doi: 10.1007/s11423-014-9335-8.
[14] P. Bitrián, I. Buil, and S. Catalán, "Enhancing user engagement: The role of gamification in mobile apps," *J. Bus. Res.*, vol. 132, pp. 170–185, 2021, doi: https://doi.org/10.1016/j.jbusres.2021.04.028.
[15] N. Tavares, "The use and impact of game-based learning on the learning experience and knowledge retention of nursing undergraduate students: A systematic literature review," *Nurse Educ. Today*, vol. 117, p. 105484, 2022, doi: https://doi.org/10.1016/j.nedt.2022.105484.