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A Mobile Application for Learning Enterprise Resource Planning

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Abstract

With the growing demand for Enterprise Resource Planning (ERP) literate graduates in the professional world, ERP education is an imperative aspect that has been integrated into universities. However, for many higher education institutions, the affordability of a commercial ERP system for courses is not practical. On the other hand, students struggle to grasp the concept of business processes and enterprise systems. They have difficulties in fully understanding the interrelationship of various ERP modules, especially new ERP features such as Business Intelligence (BI) and Business Analytics (BA), in meeting the holistic organisational objectives. This struggle was reinforced by the COVID -19 pandemic, which forced courses to be moved from face-to-face to online platforms. In this paper, a gamified mobile learning approach for ERP learning has been proposed and implemented to enhance ERP knowledge retention, improve the availability of ERP learning material, and expose new ERP features. The mobile application, named LearnES, consists of the application of gamification and adapted learning components based on various learning models. A research model with hypotheses was developed to test the outcomes of the solution, and the application was evaluated through a mixed survey-based approach. Following the evaluation, participants manifested a favourable attitude towards learning ERP through the mobile application.

I. INTRODUCTION

ERP systems pave the way for business excellence, and the organisation highly seeks ERP literates since they will be the primary users of these systems and having adequate competency caters for economic and competitive benefits [1]. Consequently, education on these systems and their operations has become equally significant [2]. However, for many Higher Education Institutes (HEI), purchasing commercial ERP systems for ERP learning is impractical, especially when they are included in a limited number of courses and finite time [2]. Additionally, as stated by [3], the traditional teaching techniques do not provide students with a thorough understanding of business processes, how they are integrated and how the processes are carried out in real-time. It is noted that the ERP learning process is challenging to learners since the provided ERP systems to institutions are not designed for educational purposes [4].

Additionally, millennials have grown more technologically aware, technology-savvy, and adaptable than any preceding generation, yet they have acquired a short attention span [5]. Due to the Covid-19 outbreak, traditional teaching methods have become archaic, and many institutions have shifted their priority to e-learning[6]. Furthermore, exposure to emerging ERP features such as ERP BI and BA are offered only in simulations by commercial ERP vendors. Offering up-to-date ERP courses is challenging since HEI cannot afford to acquire ERP systems at the exact cost of ERP implementers [7]. With a constraint exposure on ERP, working with an actual modern ERP system would be problematic for graduates. This research aims to enhance ERP education in Higher Education Institutes (HEI) by making the ERP learning experience easily accessible, more engaging, motivating, and fun using gamification while exposing learners to Business Intelligence and Business Analytics in ERP.

The research question for the paper was set as follows:

RQ1: How can students ERP learning experience be enhanced while also exposing them to Business Intelligence and Business Analytics in ERP systems?

The remaining sections of this paper have been organised as follows. Section II presents the related works about our study. Sections III presents the proposed solution, while Section IV presents the development of the solution. Section V focuses on the evaluation and the discussion of the results obtained, and finally, Section VI concludes the paper.

II. RELATED WORKS

This section documents the different findings of the Systematic Literature Review (SLR) conducted on selected studies.

A. ERP Teaching Challenges

Various ERP teaching challenges have been discovered due to the literature analysis. The challenges can be presented in student, teaching and simulation challenges [8]. Student challenges consist of students' lack of learning motivation and the inefficiency of the teaching syllabus to influence the

various types of learning styles [9]. The teaching challenges consist of the need for qualified lecturers with a high degree of knowledge and familiarity with ERP to deliver hands-on training on these systems. The structure of the courses, the installation of ERP systems, and the maintenance depend heavily on the professors' knowledge, and the training of the staff can be costly [10]. Simulation challenges can be summarised with the inability of HEI to afford updated ERP resources at a similar cost as ERP adopters, thus resulting in the incapability to deliver relevant and up to date courses [4]. It is not practical for many institutions to acquire commercial ERP systems such as SAP ERPsim when the system will be only used in specific courses for a limited period [2]. Furthermore, as stated by [11], during a post-pandemic crisis of the COVID-19, faculties were forced to relocate from the traditional face-to-face classes to online classes to avoid the spread of the COVID-19 virus.

B. ERP Learning Simulation Game

Based on the analysis, several ERP simulations or ERP software have supplemented traditional ERP learning and provided hands-on experience. SAP ERPsim was the most widely embraced simulation tool to aid ERP teaching and hands-on practice. Over 500 universities globally were claimed to have included SAP into their teaching curricula [8]; however, access to the solution is subject to certain conditions, including the institution being a full member of the SAP University Alliance. Another approach identified for exposing students to ERP concepts was using real ERP software such as Odoo open-source software and Microsoft Dynamics software.

Additionally, it was found that simulations are increasingly becoming accepted as a pedagogical tool by business institutions, universities, and companies worldwide [12]. Figure 1 indicates that simulation games are the most popular learning technique, accounting for 39% out of 21 selected studies, with role-play (7%), project-based (9%), lectures (11%), teamwork (15%) and case study (11%). Compared to traditional methodologies, the simulation learning method prioritises a hands-on approach, which improves ERP teaching [13]. According to [14], learners exposed to an ERP simulation have justified that simulation is the most effective way to learn and master ERP by establishing a favourable attitude towards the concepts.

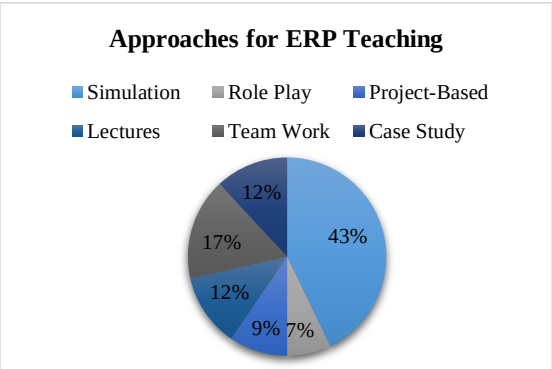

Figure 1: Approaches for ERP Teaching

C. Consideration of Learning Styles and Model

The selected studies mentioned the use of learning models and learning styles to produce the highest learning result. Kolb's experiential learning model was utilised to develop ERPsim to obtain the greatest possible learning outcome and encourage learners' active involvement [15]. From a study by [16], the consideration of distinct learning styles from the Felder-Silverman Learning Style model (FSLSM) proved to have a favourable effect on students' academic performance. The FSLSM categorises the different types of learning styles in four dimensions: Input, Processing, Perception and Understanding. Furthermore, the revised Bloom taxonomy learning model is a model that was implemented in designing an ERP simulation game [8]. Furthermore, the revised Bloom's taxonomy forms a common language to facilitate communication to attain learning outcomes[17]. As a result, it was established that structuring educational courses concerning the various learning styles positively influences students and that it should be considered in the development of any potential learning system.

D. M-Learning Approach for ERP Learning

Only a limited number of research and implementations have been undergone to produce an open-source ERP mobile-learning simulation. Pertaining to ERP teaching, larger commercial ERP vendors offer ERP m-learning applications [18]. An example is the SAP Learn Now mobile app developed by SAP Education to aid their busy users in accessing the content [19].

E. Gamification in ERP Learning Simulation

Based on the review of research, it was found that gamification resulted in improved information retention, motivation and student engagement [20]. Gamification was integrated into an ERP training system from a study conducted by [21] to enhance user satisfaction during ERP training. It was determined that gamification had a favourable effect on the established ERP training and showed higher learning and satisfaction[11]. Due to societal crises, people's lives have been altered in perceptible and imperceptible ways [16]. Hence, it was deduced that integration of gamification into the learning of a complex subject resulted in a greater motivation to learn and higher skills development [20]. Moreover, the main goal of gamification is to motivate users to get engaged in some specific situation and also gamification changes the participant's attitude or behaviour which can affect the learning outcomes [22]. However, from the findings, there is not much research on the usage of gamification, especially in ERP learning simulation.

F. Integration of BI and BA in ERP Learning Simulation

According to analysis and findings, just one simulation game, ERPsim, was accessible to educate students about Business Intelligence and Business Analytics. To expose learners to these concepts, ERPsim employs SAP Lumira, which allows students to generate visualisations of a given dataset provided by SAP [23]. On the other hand, Odoo open-source software just had BI integrated, and it is still under development [8].

G. Conclusion

In this section, a range of approaches for ERP teaching and their challenges, pedagogical aspect, learning model, ERP simulation and M-learning has been examined. After analysing the integration of BI and BA in ERP Learning simulation, it was observed that ERPsim contain both BI and BA features while Odoo open-source software lack BA features. Moreover, the gamification concept is crucial to

enhance and ease the ERP implementation lifecycle since many ERP systems fail during implementation [24].

III. PROPOSAL

From the previous section, various issues have been identified and discussed. The main problems regarding ERP learning can be summarised as:

1. Unaffordability of ERP simulations.
2. Lack of student's learning motivation.
3. Different types of students' learning styles.
4. Little exposure to new ERP features such as BI and BA.

In order to develop a solution to the various issues, a methodology, as shown in Figure 2, has been adopted. The methodology consists of the various aspects that have been taken into consideration towards building the proposed solution.

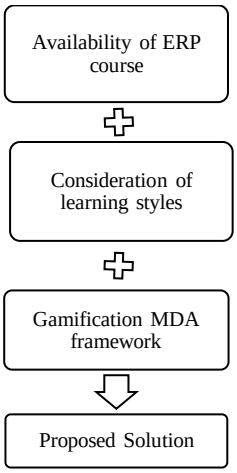

Figure 2. Aspects considered for Solution Development

A. Availability of ERP Course

A non-traditional approach to mobile learning has been proposed to address the unavailability and unaffordability of ERP courses and ERP simulations to students. This approach would allow learners to access the ERP learning resources easily. The recommendations by [18] for embracing mobile learning for ERP teaching were taken into account while developing a satisfactory mobile learning application. According to the recommendation, m-learning is a distinct learning environment where learning materials should be presented easily and simply for comprehension.

B. Analysis of Learning Styles and Learning Models

In order to influence the various types of learners and learning styles, the Felder-Silverman Learning Style Model (FSLSM) has been used to identify students' learning styles and propose corresponding learning methods. This model was selected since the FSLSM combines major learning models such as Kolb, Myers-Briggs and Pask [25]. Several adapted learning components have been proposed and documented in Table 1 to satisfy each learning style. Another pedagogical model that has been utilised is Revised Bloom's Taxonomy. According to [26], the revised Bloom's Taxonomy allows setting clear objectives and building more concrete lesson plans with concise content to allow the student to ascend up the pyramid of learning from the lower level of knowledge and attain a higher level of knowledge.

Moreover, the user is assessed with the Revised Bloom's Taxonomy framework to encourage and reflect on their progress. It can be indicated that learning occurs at multiple levels in the simulated mobile application with the integration of the revised Bloom taxonomy. Table 2 illustrates the integration and usage of the Revised Bloom's Taxonomy and demonstrates how learning occurs in LearnES at multiple levels with the specific games and components that will be deployed.

Table 1
Proposed Adapted Learning Components according to FSLSM

Dimension	Style	Characteristics	Proposed Components
Processing: Determines a learner's preferred method to process information.	Active	Preference to try and have better assimilation though active practice.	Simulation
	Reflective	Preference to learn new information by thinking and working alone in a calm environment	Case study, Lectures quiz
Input Determines a learner's preferred method for information to be delivered.	Visual	Preference for pictures and graphics.	Animated lectures
	Verbal	Preference for words in written or oral form for better assimilation of educational materials.	Lecture Audio
Perception Determines a learner's preferred method of perceiving or absorbing information.	Sensing	Preference for learning facts and details and conducting experiments	Lectures, Case Study, simulation game, quiz
	Intuitive	Preference for learning through abstract ideas and through innovative approaches.	Simulation, Role game, Case study
Understanding Determined how learners choose to organise and progress through the learning process.	Sequential	Preference for step-by-step and for the perception of information to be gradual and continuous.	Lectures, quiz
	Global	Preference for learning at a quick pace and understanding the full picture.	Role game, Case study, Simulations

Table 2
Application of the Revised Bloom's Taxonomy

<table>
<tr><td rowspan="2">Knowledge Process Dimension</td><td colspan="6">Cognitive Process Dimension</td></tr>
<tr><td>Remember</td><td>Understand</td><td>Apply</td><td>Analyse</td><td>Evaluate</td><td>Create</td></tr>
<tr><td>Factual Knowledge</td><td colspan="2">Short Videos</td><td colspan="2">Scenario-based quiz (Summative Assessments)</td><td></td><td></td></tr>
<tr><td>Conceptual Knowledge</td><td colspan="2" rowspan="3">1. Quiz (Summative Assessment)
2. Scenario-Based Quiz (Summative Assessment)</td><td colspan="3" rowspan="2">1. Simulation Game (Formative Assessment)
2. Integration of BI and BA</td><td></td></tr>
<tr><td>Procedural Knowledge</td><td></td></tr>
<tr><td>Meta-cognitive Knowledge</td><td></td><td colspan="3"></td><td></td></tr>
</table>

C. Gamification with the Mechanics, Dynamics and Aesthetics (MDA) Framework

Knowledge retention is directly related to the learner's involvement with the subject and learning materials [8]. Hence, the gamification concept has been utilised to capture the learner's attention. According to the literature study, gamification is an effective approach for motivating, engaging, and enhancing learners' information retention. MDA gamification framework was used to develop and build successful gamification. Table 3 summarises the selected gaming elements and how they have been used in the ERP learning process.

Table 3
Gamification MDA Gaming Elements

Component	Elements	Details of Usage
Mechanics	Progress Bar	Presenting student's progression.
	Rules/Guidance	Instructions to fulfill objectives.
	Time Limit pressure	Challenging element to promote engagement.
	Multiple choice Questions	
	Points	Used to evaluate and visualise learners' performance.
	Animations	Constant easy-to-perceive interactions to help explain complex processes in a simpler way.
Dynamics	Completion of tasks	Presenting student progression as they complete designed tasks.
	Choice of business processes	Exposure to different ERP business processes.
	Constraints	The students will have to face time constraint while doing the quizzes.
	Achievements	Users will receive achievements upon the completion of the activities.
Aesthetics	Challenge	The users will have the following challenges to overcome: (1) Learn about the fundamentals of ERP systems, (2) Learn the business configuration (Procurement and Sales Configurations), (4) Learn about the BI and BA in business, (5) Analyse BI visualisations and perform analytics.
	Enjoyment	Fun in learning about ERP.
	Cognisance	Develop an understanding of ERP and business process.
	Discovery	Learning new ERP concepts.

D. Integration of ERP BI and BA

Business Intelligence and Business analytics allow organisations to comprehensively understand their operations and make fact-based decisions by employing statistical techniques or computer-based models [2]. Furthermore, ERPsim and Microsoft Dynamics AX are both not accessible and outrageously expensive. Tableau software has been employed as a Business Intelligence platform and for advanced analytics in the BA integration so that users can make informed decisions. The learner will gain knowledge about the many possibilities of Tableau software by using LearnES. Moreover, this integration aims to familiarise the students with descriptive, predictive and prescriptive analytics used in businesses.

E. Proposed Solution

The eventual proposed solution is a mobile game application that can be further categorised into two learning components: 1) Lectures and 2) Hands-on practice.

Table 4 illustrates the various elements and the application of gamification. The lectures will be delivered through animated videos with audio. Following the completing of the lectures, students can take a quiz to assess their comprehension of the material covered. A real-life Mauritian problem-based case study of a hardware store was proposed for learners to better comprehend the concepts and for hands-on practice. Based on the case study, students have to complete various simulated tasks. The simulation tasks allow the students to have hands-on practice and an easy exposure to the ERP concepts. The gamified mobile application was called, LearnES. The mobile app's name reflects the aim of the study conducted, that is, to improve Enterprise System (ES) learning. Figure 3 shows the final proposed solution.

Table 4
Application of Gaming Elements in Learning Components

Learning Component	Learning Features	Description of Learning Feature	Gamification elements
ERP Lecture	Video	Video of lecture material	• Animations
	Audio	Audio of lecture text	
	Quiz	MCQ about the lectures	• Time Limit pressure • Points • Multiple choice Questions
ERP Hands-On Practice	Case study	Real-life case study of a business	• Animations
	Simulation	The ERP simulation of the business processes of the business case study	• Progress Bar • Completion of tasks • Choice of business processes
	Tasks	The tasks to be carried out and completed	• Rules/Guidance • Animations

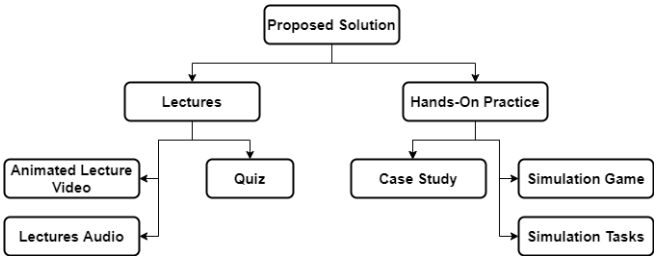

Figure 3. Proposed Solution

F. Hypothesis Development

With consideration of learning styles and usage of gamification for designing the solution, four hypotheses have been derived about the learning outcomes of the solution.

H1: Consideration of the various learning styles to design learning components has a positive impact on the ERP learning experience.
The learners' learning experience will improve by taking into account the various learning styles of individuals to develop adapted learning components for LearnES.

H2: The gaming elements have a positive impact on the ERP learning experience of the various types of learners.
The use of the gamification concept and the gaming elements will improve the learning experience of all types of learners.

H3: The mobile simulation application increases learners' understanding of ERP concepts.
The use of LearnES as a tool for learning ERP will improve learners' knowledge and comprehension of ERP concepts.

H4: The mobile simulated application increases students' confidence level in explaining the various concepts to other students.
The usage of LearnES mobile application will increase students' confidence in discussing the various aspect of ERP with their classmates and others. The usage of LearnES will boost the prior confidence level of students already familiar with ERP.

The four hypotheses are demonstrated in the research model in Figure 4. The model was adapted from behavioural research for learning outcomes [27]. The initial model demonstrated that the enjoyment and cognitive appraisal on using ERPsim would result in the behavioural intention to use ERPsim and thus resulting in positive perceived learning results. The connections and equation-like logic were used to design the model for this study.

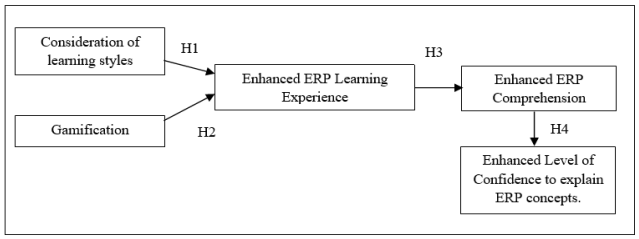

Figure 4. Research Model for Learning Outcomes

IV. DEVELOPMENT OF PROPOSED SOLUTION

This section presents the various steps undertaken in the realisation of LearnES mobile application.

A. Analysis and Design

The initial step towards developing the solution consisted of the analysis and design phase, which was accomplished using Unified Modeling Language (UML) diagrams. The use case diagram for students' interaction with LearnES is presented in Figure 5. Figure 5 describes the user's interaction with only the Sales and BI modules.

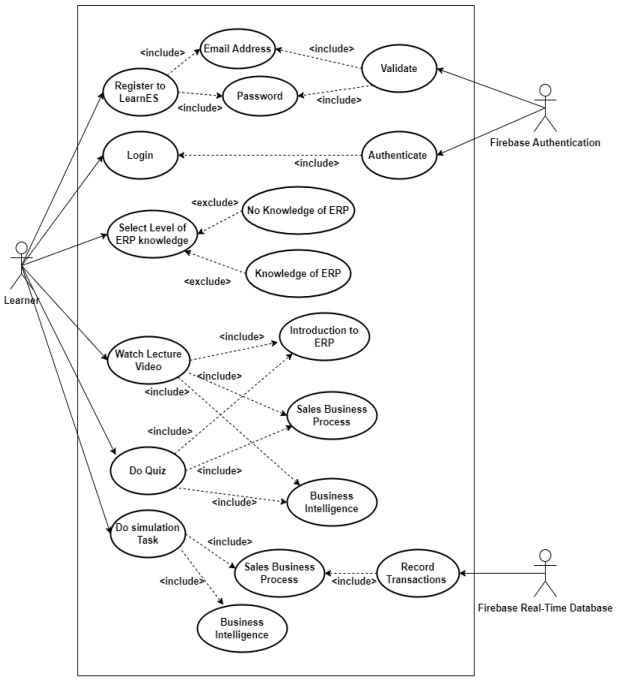

Figure 5 Application Use case for Sales and BI

Figure 6 represents the flowchart of the overall LearnES mobile application.

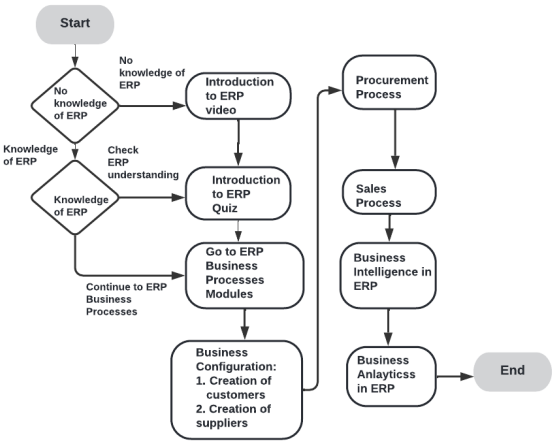

Figure 6. Application Flowchart

B. *Implementation*

For the implementation of LearnES, several software has been used. Android studio was utilised for the mobile application development, while Firebase was employed as the system's backend. Powtoon online platform was used to produce animated videos with audio for the lectures. To expose students to BI and BA, visualisations and charts for the Business Intelligence and Business Analytics Modules were produced through Tableau Software. The system architecture for LearnES is shown in Figure 7.

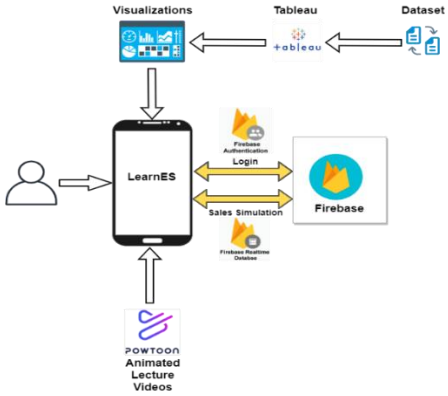

Figure 7. System Architecture

The various components and interfaces that have been developed are presented in Figure 8, Figure 9, Figure 10 and Figure 11, respectively.

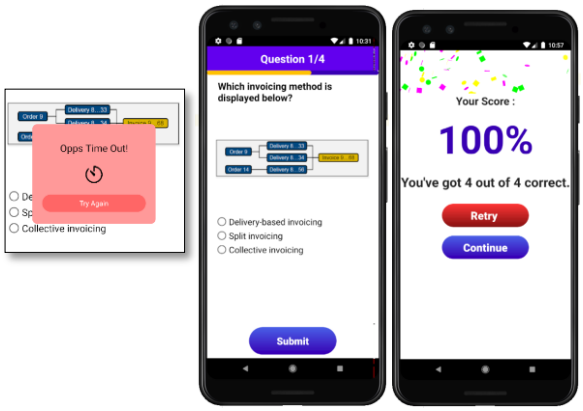

Figure 8. Quiz with Timer Interface

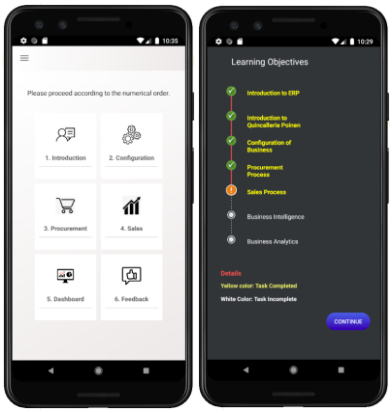

Figure 9. Modules Dashboard

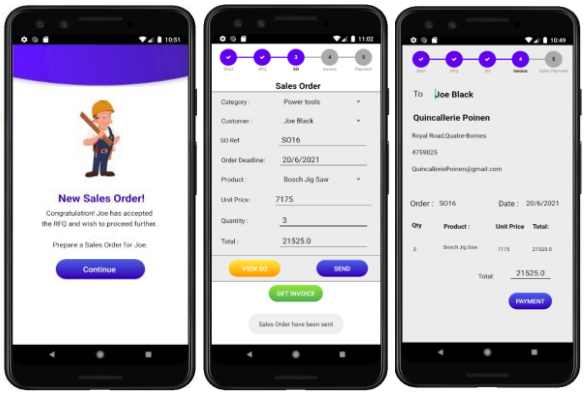

Figure 10. Sales Process Simulation Interfaces

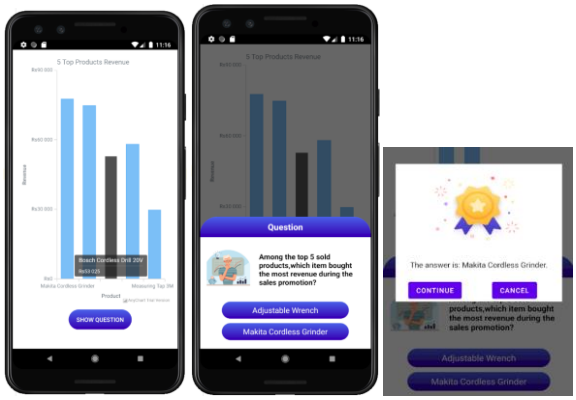

Figure 11. BI and BA Implementation

V. TESTING AND EVALUATION

This section focuses on the evaluation of the proposed solution.

A. *Approaches for Testing*

The testing of the solution was conducted by following two testing approaches; initial pilot testing and final testing. The pilot testing is to ensure that the mobile application can be used easily, detect any flaws in the implementation, ensure that the layout and content of the questionnaire were clear, and data can be gathered effectively. The final testing is the main testing of the study being conducted.

Data was collected using a mixed methodology of quantitative and qualitative data. The evaluation session began with all learners completing a pre-test questionnaire; afterwards, the learners were given a presentation of the LearnES Mobile application's different features. Following

that, learners were granted access to download LearnES. Subsequently, they were prompted to fill in a post-test questionnaire after using the mobile application.

B. Participants Profile

The users of the gamified mobile application were divided into two distinct groups: users with no exposure to ERP concepts (Group A) and users already having exposure to ERP concepts (Group B).

Users were categorised to conduct a better evaluation of the learning objectives. Table 5 shows the various demographic details of participants.

Table 5
Demographic Details of Participants

Group		n		Percentage %	
		A	B	A	B
Gender	Male	6	14	40	56
	Female	9	11	60	44
Age	18-25	12	25	80	100
	26-30	3	0	20	20
Occupation	Working	4	24	26.7	96
	Student	6	1	40	4
	Unemployed	5	0	33.3	0

A. Identification of Participant's Learning Styles

For both groups of participants, the distribution of the various learning styles can be seen in Figure 12. To identify the learning styles, eight top representative questions were derived from a previous study by [28], which ranked the top five representative questions of the four dimensions of the Felder-Silverman Index of Learning Styles (ILS). Out of the top five questions of the four dimensions, each dimension's top two relevant questions were selected, thus resulting in a final set of 8 questions for the ILS.

For Group A, 46.7% of participants were found to have a balanced preference in the Processing Dimension, 86.7 % of participants had a balanced preference in the Perception Dimension, 73.3% of participants had a visual preference in the Reception Dimension, and 53.3 % had a sequential preference in the Understanding Dimension.

For Group B, 60% of participants were found to have an active preference in the Processing Dimension, 64% of participants have a balanced preference in the Perception Dimension, 84% of participants have a visual preference in the Reception Dimension, and 48% have a sequential preference in the Understanding Dimension. From Figure 12, we can see the distributed learning styles across the participants from both groups. Hence, it was deduced that LearnES was further evaluated by the various types of learners from the FSLSM.

B. Quantitative Results

The initial step for the quantitative analysis consisted of using the Cronbach Alpha measure to conduct a reliability test on the results of the simulated mobile application. Furthermore, variable frequency analysis was conducted to have a visual frequency representation of responses obtained. A descriptive analysis and T-Test was further conducted and studied. IBM SPSS Statistical was used to conduct all the statistical evaluations. Figure 13 summarises the various analysis and tests conducted from data collected from the pre-test and post-test questionnaires.

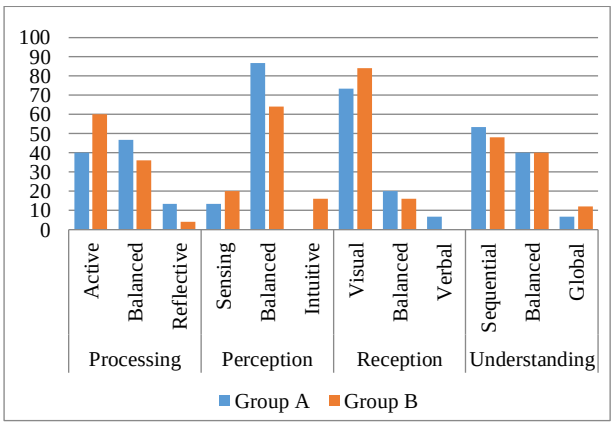

Figure 12: Learning Styles of participants

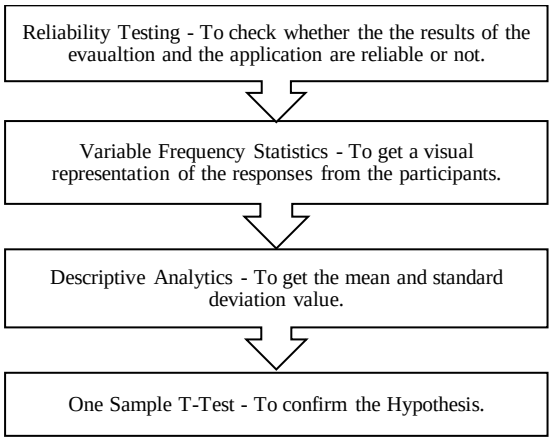

Figure 13: Data Analysis

1) Reliability Testing

Table 6 presents the results of the Cronbach Alpha test. After analysing the reliability test for both the participants with ERP knowledge and no ERP knowledge, we concluded that the simulated mobile application was reliable since nearly all their variables have an alpha value greater than 0.70.

Table 6
Results of Cronbach Alpha Test

Criteria	No. of Items	Cronbach's Alpha(α)	
		Group A(n=15)	Group B(n=25)
Use of Gamification Elements to enhance learning experience	7	0.908	0.896
Implementation of learning components based on learning styles	3	0.770	0.833
Understanding of ERP concepts after using LearnES	6	0.800	0.980
Perceived Intention	4	0.874	0.827
Level of confidence in explaining ERP concepts	5	0770	0.970
Perceived Learning	9	Close to 0.70	0.875

2) Variable Frequency Statistics

To examine the participants' overall opinions towards LearnES, they were asked to rate their opinions based on pre-defined statements. Table 7 represents the various questions asked in the questionnaire to evaluate students' attitudes towards LearnES mobile application.

Table 7
Examination of participants' opinions towards LearnES

Criteria	Question	Code
Accessibility	LearnES was easy to download from Playstore.	STMT1
Usefulness	LearnES was easy to use.	STMT2
Design	I found the various functions in LearnES well integrated.	STMT3
	I thought there was too much inconsistency in LearnES	STMT4
Knowledge Acquisition	LearnES would be easy to learn by any type of user.	STMT5
Learning Experience	LearnES was very awkward to use	STMT6
Confidence	I felt very confident using LearnES.	STMT7
Preparation	I need to learn a lot of things before I could get going with	STMT8
Motivation	LearnES motivated me to continue to learn ERP via gaming	STMT9

Figure 14 and Figure 15 shows the percentage results of the ratings of both groups after using LearnES. The results indicate a positive outcome for the various criteria, with participants responding positively to the mobile application.

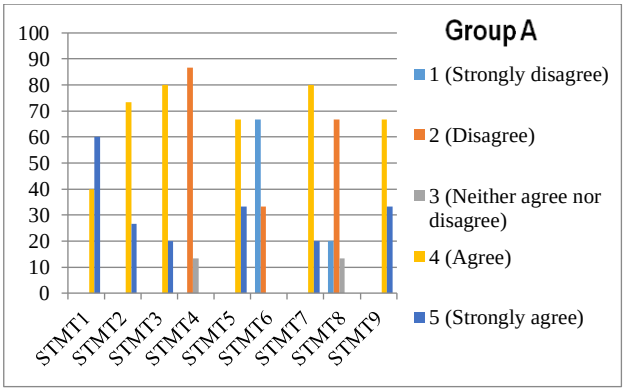

Figure 14. Statement ratings of Group A

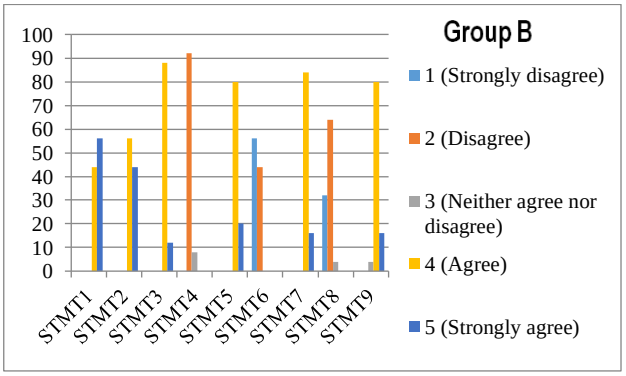

Figure 15. Statement ratings of Group B

3) Descriptive Analysis

Various descriptive analytics were conducted to obtain the means and standard deviation values for the various hypotheses. Table 8 presents the descriptive analysis of both groups in their confidence level in explaining ERP concepts after using LearnES. The mean value is greater than 3.50, indicating that both groups conveyed that they were confident explaining the various topics. Table 9 gives the results for the pre-test and post-test by Group B, which is the group already having knowledge on ERP. The results presented in Table 9 indicate that after the use of LearnES, Group B was more confident about explaining ERP concepts than before, thus deducing that the mobile application could make them better understand the ERP concepts.

Table 8
Confidence level in explaining about ERP Concepts

Code	Group A(N=15) Mean	GROUP B(N=25) Mean
CONF1	4.47	4.24
CONF2	4.27	4.20
CONF3	4.07	3.76

Table 9
Pre-Test and Post-Test Results for Confidence Level of Group B

GROUP B(N=25)	Pre-Test Results Mean	Post-Test Results Mean
CONF1	3.04	4.24
CONF2	3.08	4.20
CONF3	2.60	3.76

C. Qualitative Results

Qualitative results were recorded in terms of overall feedback after the use of LearnES. The various qualitative statements given by the participants are follows.

- *It helped me to understand the different concept throughout the whole application.*
- *Very user friendly and it make the different parts of the ERP very easy to learn and to understand the different steps of each module.*
- *It is much easier to understand than a normal lecture.*
- *Provide interesting practices and thus have a better understanding of the subject.*
- *LearnES is very different as compared to lectures, as it contain different levels in the game.*
- *Innovative application to help to learn ERP, business Intelligence and Business Analytics in a more organised and fun way.*
- *It was an innovative and easy app for learning about ERP and the other concepts.*
- *It was an interesting app that motivated and made me curious to learn more and continue. The fun game-like aspect was nice.*

D. Hypotheses Results

The quantitative and qualitative results support H1 that considering learning styles for designing adapted learning components will enhance ERP learning at a level of $p<0.001$ for both groups of learners. Hypothesis H2, which was that gaming elements would improve the ERP learning experience, is highly supported at the level of $p<0.001$ for the two groups. The enhancement in ERP learning experience through LearnES thus support H3, that an enhanced learning experience provided by LearnES mobile app will result in a better understanding of ERP concepts at a level of $p<0.001$. A better understanding of ERP concepts will increase the confidence level to explain the concept to others; hence H4 is supported at a level of $p<00.1$.

With all the hypotheses being supported at a level of $p<0.001$ or a significance level of 99.9%, the designed hypothesis model in Figure 4 can be proven to be valid and well-founded. Figure 6 shows the proven hypothesis model with the test results. In terms of the knowledge and cognitive dimension of the Revised Bloom's Taxonomy, it is noted that all the tasks and levels in LearnES, prompt the learner to develop and employ the aforementioned level of the Revised Bloom's Taxonomy.

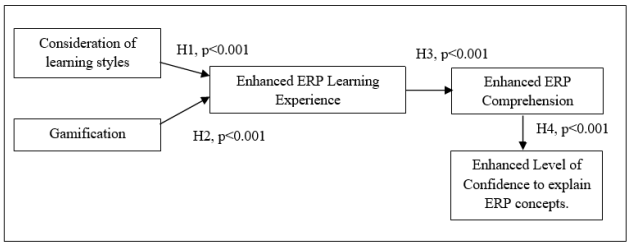

Figure 16. Hypotheses Model Testing Results

VI. DISCUSSION

The evidence from the study demonstrated that the developed gamified mobile application, LearnES supports the hypotheses pushed forward. The application of gamification proved to be effective in capturing learners' attention in learning about ERP systems. The usage of games and gaming mechanics emphasised the enjoyable aspect of education, which encouraged engagement and participation [11]. The ERP simulation game resulted in being a potentially beneficial strategy with learners demonstrating a favourable attitude about ERP and an enhanced ERP comprehension and skills [11][29][14][30]. Adapted learning components incorporated in LearnES were able to target all types of learners, allowing them to interact with the application fully and learn about ERP concepts. Participants mentioned that the open-sourced mobile application, LearnES, allowed them to quickly and better understand ERP concepts, especially during this post-pandemic situation of the COVID-19. They expressed their satisfaction with the structure and content of the m-learning application and highlighted that this untraditional method for learning could captivate their attention and further motivate them to continue learning.

VII. CONCLUSION

This paper aimed to carry out an in-depth systematic literature review to identify the various approaches for ERP teaching and techniques to enhance ERP education. Accordingly, a gamified mobile simulated application for learning ERP was proposed and implemented based on the different pedagogical aspects. The application, LearnES, intended to target all types of learners and increase the ERP learning experience, was further evaluated. As evidenced by the results, the mobile application positively impacted both ERP literates and non-literates. It was concluded that the use of gamification, the consideration of learning styles, and learning models effectively enhanced students' ERP learning experience.

A. Research Limitations

The focus of the study was primarily on the Procurement and Sales Business Process available in ERP systems, with other necessary ERP modules such as Inventory and Accounting excluded. First and foremost, the sample size obtained for the participants is not a genuine representative of the population size. This situation arose due to the COVID-19 pandemic, students' reluctance to participate in our research work, and a tight schedule. Additionally, a limited number of papers addressed a gamification approach for ERP learning. Furthermore, there was not enough paper relating Business Intelligence and Business Analytics to ERP simulations.

B. Future Research

As future works, other fundamentals ERP modules can be included to allow a better holistic view of ERP systems and better exposure to ERP management. The gamified mobile application can be used as an initial tool to expose students to ERP concepts before the actual lectures. It can also be used as a training tool to expose individuals with no ERP knowledge about the various underlying concepts. More gaming elements can be added to the application, e.g. leader boards can be added in the mobile app so students can compete with others. The application can be further improved in terms of the interactivity of the business processes. The transactions made in the business processes can produce real-time data for Business Intelligence. A multiplayer aspect could be further implemented to promote group work and managerial skills.

REFERENCES

[1] Zadeh, A. H., Zolbanin, H. M., Sengupta, A., & Schultz, T. (2020). Teaching Tip: Enhancing ERP Learning Outcomes through Microsoft Dynamics. Journal of Information Systems Education, 31(2), 83-95.

[2] Zagulova, D.,Boltunova, V.,Katalnikova, S.,Prokofyeva, N. and Synytsya, K. (2019) Personalized E-Learning: Relation Between Felder– Silverman Model and Academic Performance. Applied Computer Systems, Vol.24 (Issue 1), pp. 25-31. https://doi.org/10.2478/acss-2019-0004.

[3] Grabis J., Sandkuhl K., Stamer D., 2015, Collaborative teaching of ERP systems in international context, ICEIS 2015 - 17th International Conference on Enterprise Information Systems, Proceedings,1.

[4] K. M. Mahanga and L. F. Seymour, "Enterprise Resource Planning Teaching Challenges faced by Lecturers in Africa", Proceedings of the 9th IDIA conference, IDIA2015, Nungwi, Zanzibar, pp. 343-353, 2015.

[5] U. Ruhi, "An experiential learning pedagogical framework for enterprise systems education in business schools," The International Journal of Management Education, vol. 14, no. 2, pp. 198–211, Jul. 2016, doi: 10.1016/j.ijme.2016.04.006.

[6] Deznabi, Iman, et al. "Impact of the COVID-19 Pandemic on the Academic Community Results from a Survey Conducted at University of Massachusetts Amherst." *Digital Government: Research and Practice*, vol. 2, no. 2, 20 Jan. 2021, pp. 1–12, 10.1145/3436731.

[7] Davis, Charles H. and Comeau, Jana (2004) "Enterprise Integration in Business Education: Design and Outcomes of a Capstone ERP-based Undergraduate e-Business Management Course," Journal of Information Systems Education: Vol. 15 : Iss.3,287-300.

[8] Jheengut, Kaushal and Cauleechurn, Dinesha and Cadersaib, Zarine, Teaching Methods Used for ERP – Focus on Gamification (September 12, 2020). International Conference on Business Management, Innovation & Sustainability (ICBMIS)2020.

[9] Darban, M.; Kwak, D.H.A.; Deng, S.L.; Srite, M.; Lee, S. Antecedents and consequences of perceived knowledge update in the context of an ERP simulation game: A multi-level perspective. Comput. Educ. 2016, 103, 87–98.

[10] Tina Beranič & Marjan Heričko, 2019. "Introducing ERP Concepts to IT Students Using an Experiential Learning Approach with an Emphasis on Reflection," Sustainability, MDPI, Open Access Journal, vol. 11(18), pages 1-17, September.

[11] Jheengut, K., Cauleechurn, D. and Cadersaib, Z. (2021) Enterprise Resource Planning Teaching in Post-Pandemic using gamification, p. 252. doi:10.1109/ICoICT52021.2021.9527497.

[12] Tsuruta, A., 2020. The Average Millennial's Attention Span—Shorter Than Your Goldfish's. [Online] Repsly.com. Available at: <https://www.repsly.com/blog/consumer-goods/the-average-millennials-attention-span-shorter-than-your-goldfishs> [Accessed 7 November 2021].

[13] Knigge, M.; Prifti, L.; Kienegger, H.; Krcmar, H.(2017). Teaching enterprise organisation and enterprise resource planning systems in schools: Playing a serious game with pupils. s.l., s.n., pp. 486-495.

[14] Munogee, P., Moctaram, H., & Cadersaib, Z. (2019). Using a Gamification Approach to teach ERP in Higher Education. 2019 Conference on Next Generation Computing Applications (NextComp), 1-6.

[15] Tiwari, S. R., Nafees, L., & Krishnan, O. (2014). Simulation as a pedagogical tool: Measurement of impact on perceived effective learning. The International Journal of Management Education, 12(3), 260–270.
[16] Deznabi, Iman, et al. "Impact of the COVID-19 Pandemic on the Academic Community Results from a Survey Conducted at University of Massachusetts Amherst." *Digital Government: Research and Practice*, vol. 2, no. 2, 20 Jan. 2021, pp. 1–12, 10.1145/3436731.
[17] Zorluoğlu, S. L. & Güven, Ç., 2020. Analysis of 5th Grade Science Learning Outcomes and Exam Questions According to Revised Bloom Taxonomy. *Journal of Educational Issues*, 4 3, 6(1), p. 58.
[18] Schwade, F.; Schubert, P. The ERP Challenge: An Integrated E-learning Platform for the Teaching of Practical ERP Skills in Universities. Procedia Comput. Sci. 2016, 100, 147–155.
[19] Scholtz, B., Kapeso, M., & Villiers, R.D. (2017). The Usefulness and Ease of Use of a Mobile Simulation Application for Learning of ERP Systems. South Afr. Comput. J., 29.
[20] F. L. Khaleel, T. S. M. T. Wook, N. S. Ashaari, and A. Ismail, "Gamification Elements for Learning Applications," International Journal on Advanced Science, Engineering and Information Technology, in press, vol. 6, no. 6, pp. 868-874, 2016.
[21] Alcivar, Isabel and Andres G. Abad. "Design and evaluation of a gamified system for ERP training." Comput. Hum. Behav. 58 (2016): 109-118.
[22] Dreimane, S., 2018. Gamification for Education: Review of Current Publications. *Didactics of Smart Pedagogy*, pp. 453-46.
[23] Michon, J.-F. et al. (2016) Experience real-time analytics: Enabling business analytics competency with ERPsim for SAP HANA.
[24] El-Telbany , O. & Elragal, A., 2017. Gamification of Enterprise Systems: A Lifecycle Approach. *Procedia Computer Science*, Volume 121.
[25] N. Zaric, S. Scepanovic, U. Schroeder (2018) "Learning style gamification model: Gamification in E-Learning based on students's learning styles", ICERI2018 Proceedings, pp. 4654-4663.
[26] Persaud, C., 2018. Bloom's Taxonomy: The Ultimate Guide | Top Hat. [Online]
Available at: https://tophat.com/blog/blooms-taxonomy-ultimate-guide/ [Accessed 08 03 2022].
[27] Chen, L., Keys, A. and Gaber, D. (2015) 'How Does ERPsim Influence Students' Perceived Learning Outcomes in an Information Systems Course? An Empirical Study', 26, p. 13.
[28] Graf, Sabine, Silvia Rita Viola, and T. Leo Kinshuk. "Representative characteristics of Felder- Silverman learning styles: An empirical model." In Proceedings of the IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2006), Barcelona, Spain, pp. 235-242. 2006.
[29] M. Hwang and K. Cruthirds, "Impact of an ERP simulation game on online learning," The International Journal of Management Education, vol. 15, no. 1, pp. 60–66, Mar. 2017, doi: 10.1016/j.ijme.2017.01.004.
[30] Winkelmann, Axel and Leyh, Christian (2010) "Teaching ERP systems: A Multi-Perspective View on the ERP System Market," Journal of Information Systems Education: Vol. 21 : Iss. 2 , 233-240.