PIT: Gamifying Personal Income Tax Learning

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Abstract

Submitting personal taxes is required annually in many countries, including Thailand, where Personal Income TAX (PIT) is mandatory. However, most people lack knowledge of PIT filing, which hinders the tax submission process for many individuals. To address this challenge, we propose a game-based approach to improve PIT knowledge. Developed using the ADDIE model, our Personal Income Tax (PIT) game integrates multiple puzzles and Role-Playing Game (RPG) elements to guide players through calculating income, allowances, and tax rates step by step. We evaluated the game by comparing average pre- and post-test scores (nine criteria) and by surveying expert and user satisfaction. The results show that the average test score improved from 4.60 before playing the game to 6.40 afterward, indicating better understanding of PIT filing. Satisfaction levels (on a 5-point scale) among both experts and general users ranged from "high" to "very high." Thus, this game-based learning tool appears effective for increasing basic tax-filing knowledge.

Keywords: ADDIE model, personal income tax (PIT), tax game, game-based learning

1. Introduction

In accordance with the law of Thailand, a person who is a citizen of Thailand is required to file the Personal Income Tax (PIT) on an annual basis. However, the majority of people lack adequate knowledge of how to do so correctly [1]. This knowledge gap often results in filing mistakes, which can lead to penalty fees [2]. Although official resources are available through websites such as the Revenue Department's portal, many individuals struggle to understand the principles behind correct tax calculation and submission.

Given that only a limited number of Thai individuals possess knowledge about personal income tax and are capable of completing the tax form independently [2], we propose developing a game — since game-based learning has proven effective in various educational contexts [3] — that teaches fundamental aspects of PIT. Our approach aims to help people learn how to calculate net income, apply allowances, and determine tax rates, all within an RPG-style environment. The ADDIE model [4], which has a process of analysis (A), design (D), development (D), implementation (I), and evaluation (E), is utilized to develop an entire game. We measure both users' pre- and post-game knowledge and also assess user satisfaction.

The remainder of this paper is organized as follows. Research objectives are presented in Section 2. Section 3 is the Literature Survey, summarizing related research on educational games and tax-learning applications. Section 4 describes our Methodology and framework, including details of design, development, and implementation. Section 5 presents the Results of our testing with both experts and end users. Finally, Section 6 concludes the paper and outlines future work.

2. Related Works

Digital technology has been progressively introduced to improve educational systems in various aspects, including improving using active learning methods or student participation [5,6,7,8,9,10,11]. Game-based learning (GBL) has been successfully applied to various subjects—mathematics [5], reading for dyslexic children [6], and even advanced topics like genetic algorithms [7]. The ADDIE framework often underpins these educational games because it provides a structured approach to analysis, design, and iterative improvement [3].

Arimansyah et al. implemented a Game-Based Learning (GBL) program for Kindergarten Level B [4]. Arimansyah et al. used the ADDIE model to design and develop the Game-Based Learning (GBL). The GBL was satisfied with a score equal to 93%. Sarah et al. proposed designing the 2D digital game-based learning application for children who were between 7 and 12 years old [6]. They developed the game and learning tool using the ADDIE model. The 2D digital game-based learning application helps reading be easier to learn, especially for children. Nuntawisuttiwong et al. developed and implemented a digital educational game for genetic algorithm learning, using the ADDIE model [7].

Kamarulzaman et al. developed a mathematical education game using the ADDIE model [5]. A mathematical education game application is specifically designed for slow learners. Feedback on the game was positive; it helped the slow learners understand mathematical subjects. The game includes challenges, simulations and quizzes to produce study environment. Satisfaction and testing were evaluated via students. Moreover, Putra et al. developed a dynamic number card game using the ADDIE model. The results of this project

were positive when the students used the dynamic number card game [12].

Overall, most of the previous educational games that used the ADDIE concept comprise an analysis step to investigate the need of game content to cover all learning materials, a design step to arrange the game story, a development step to create the contents, an implementation step to compile all contents into a complete game, and, finally, an evaluation step to measure the various perspectives of the game and outcomes from playing the game.

In the context of e-government services, research suggests that user acceptance hinges on clarity and perceived ease-of-use [2]. Although Thailand's Revenue Department provides official manuals [13], many users still find the process confusing. By integrating core tax concepts into an RPG, we aim to elevate engagement and understanding. Recent studies on digital-game-based learning have shown that well-designed mechanics—such as puzzles, immersive storylines, and frequent feedback—can significantly improve knowledge retention [4], [6], [12].

To fill this gap, our PIT game adapts puzzle elements—like "net income" mines, "allowance" statues, and "progressive tax" battles—into a storyline that incorporates basic principles from the Thailand Revenue Code [1]. The remainder of this paper demonstrates how these elements were designed and tested, culminating in user and expert evaluation of both educational effectiveness and system usability.

3. Methodology

We employed the ADDIE model [3], which consists of five main phases visualized in Fig. 1, to implement game following the Thai Revenue Department guideline [13].

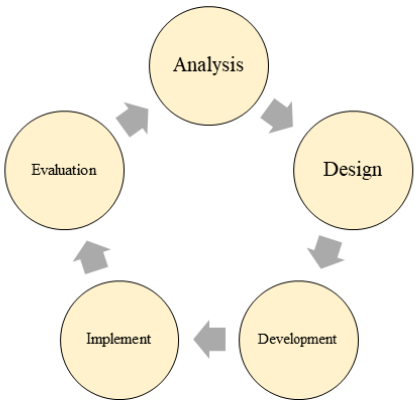

Fig. 1 ADDIE Model

The ADDIE model is a framework of Agile principles based on rapid application development (RAD). Thus, the ADDIE model is a suitable technique for developing which needs to effective and cost conservative. This experiment, the ADDIE model is integrated with the Software Development Life Cycle (SDLC) is shown in Fig.2.

3.1 Analysis process (A):

Requirement analysis is a Specification of the target group: the target group comprises individuals aged between 15 and 29 years old. Moreover, the people in the group are required to have revenue such as position fees, earnings from the organization shown under section 40(1) of the Revenue Code (RC), and have less than 2 years of experience, or someone who is interested in tax planning.

Using checkpoint as a milestone: materials from the personal tax manual (P.N.D. 91/90) were analyzed and organized by researchers. The manual was downloaded from the revenue department website [13].

The content of personal income tax (PIT) contains four fundamental components: personal income, tax allowances, progressive tax rate and calculation of personal income tax. To create checkpoints, the contents were distributed and organized, which were then verified by experts. Sufficient revisions were made according to feedbacks from the experts. The content organization was repeated until the experts satisfy in terms of contents and game environment.

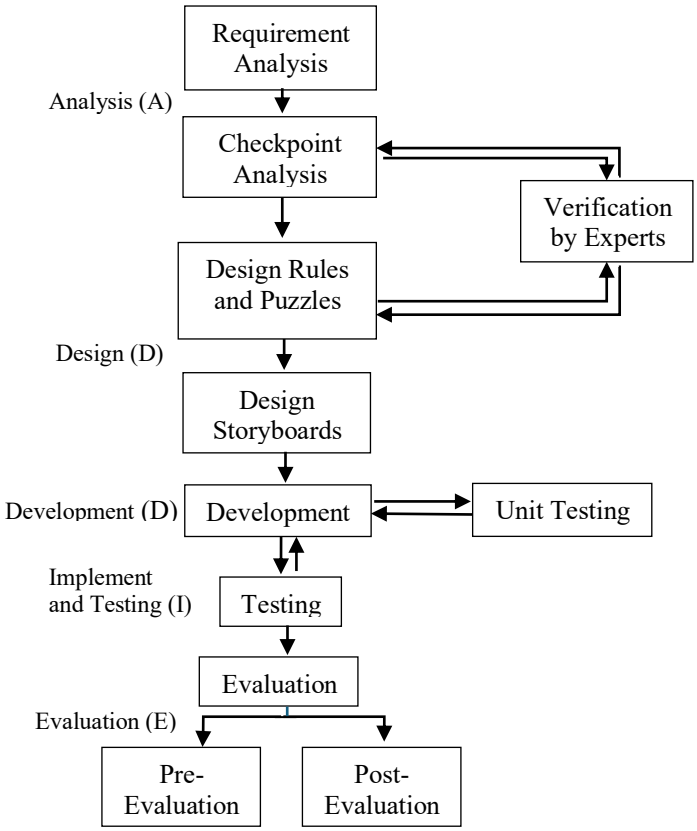

Fig.2 Framework of ADDIE Model is applied to SDLC

3.2 Design process (D):

The PIT integrates technical elements such as branching narrative structures, game-state checkpoints, interactive feedback mechanisms, and puzzle-based gameplay to enhance learning engagement. The design process is divided into two parts: Designing rules and puzzles, and Designing the storyboard.

Designing rules and puzzles: the rules and puzzles in the game were carefully designed to match the learning objectives. Each puzzle was designed for all main checkpoints and organized based on the four fundamental PIT components, identified during the analysis phase. These puzzles are directly linked to the actions of the players, which improves players' experiences throughout the game.

Designing Storyboard: The storyboards were designed to deliver accurate content in an appropriate order using various game components. The benefit of RPG is the check point where the users can save their own progress throughout the game, which is part of the game's story. Each action performed by the player is through the questions or puzzles that are embedded into the game. Points are given from correctly solving the puzzles about PIT before each check point. The game steps are as follows.

Players need to take a quiz before the game begins and after the game ends. Both quizzes have 8 questions. Scores before playing the game were compared with those after playing the game. An example of a quiz is presented in Fig. 3. An example of question is "Where to file taxes?". The player has to select the correct answer from "Counter service", "Tesco lotus", "Online" and "All answers are correct" to continue.

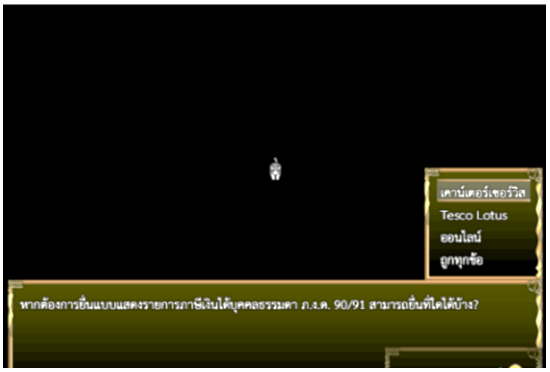

Fig. 3 An example of a quiz before and after playing the game

Fig. 4 Net income checkpoint

Fig. 4 shows the checkpoint after the net income session. Before proceeding to the checkpoint, the players need to search for red stones that required for opening an exit door to the checkpoint. Furthermore, the players also have a choice to open the secret room by solving the puzzle. The secret room stores the document about the basics of personal income tax. Players must find the answers in the secret room and respond to them when they use red stones. If players answer all questions correctly, the red stone reveals the exit path. Then, players may go to the door that led to the net income checkpoint. After that, the players will get a question from the non-player character (NPC). Then, the players need to calculate the net income and choose the door that has the correct answer. The question shown in Fig. 3 is "How to calculate annual salary?". The choices are monthly salary divide by 12, multiply by 12 and minus by 12.

(a)

(b)

Fig. 5 (a) The allowance checkpoint. Players have to trace the 6 stone slabs. (b) The allowance bridge has a 2—choice question that players have to correctly answer.

Fig. 5 (a) and (b) indicates the allowance checkpoint. The players have to trace stone slabs that represent 6 allowances. When they have already traced the 6 stone slabs, the stone slabs will be filled correctly in each statue. Allowance bridge will appear. Each point of the allowance bridge has 2 choices. The players have to correctly answer all questions to go to the next checkpoint, a progressive tax checkpoint. The question in Figure 4 (b) is "How much is the allowance for antenatal care and assist in childbirth?" The multiple choices include not more than 60,000 per pregnancy and not more than 30,000 per pregnancy.

(a)

(b)

Fig. 6 (a) The players go to the progressive tax door.
(b) Calculating the progressive tax.

(a)

(b)

Fig. 7 (a) The players have to look for all the gold bars. (b) The three gold bars need to be put on a scale for tax payable calculation.

Progressive tax checkpoint is shown in Fig. 6 (a) and (b). The players have to learn progressive tax knowledge, which is progressive tax memo. The players gain the knowledge from the progressive tax memo to solve puzzles. The puzzle is solved by attack slime which has a percentage like a net income from the stone slab in the center of a map. After the players solve each problem, they will receive a marble that can be used to pass the progressive tax door, as shown in Fig. 6 (a). Then, the players have to precisely calculate the progressive tax, visualized in Fig. 6 (b). The tax memo in Fig. 6 (a) is "What is the maximum income that can be used in tax calculate at the third tax rate?"

Next checkpoint is the tax calculation checkpoint, which is shown in Fig. 7 (a) and (b). Players have to collect all the gold bars on the map and place them correctly on the scale. Only three gold bars can be put on a scale for tax payable calculation. If the players put the three gold bars correctly, the correct tax will be calculated, and the player will enter the final phase of the game.

3.3 Development process (D):

Development: The PIT game was developed by following the guidelines of the Design phase (D). RPG Maker MV was used as the primary platform for constructing the game environment and implementing scripting logic. As shown in Fig. 8, the architecture contains of several consistent modules. The core of the system is the Logic Controller, which communicates with the UI Interface and Puzzle Module to handle user interactions and game mechanics.

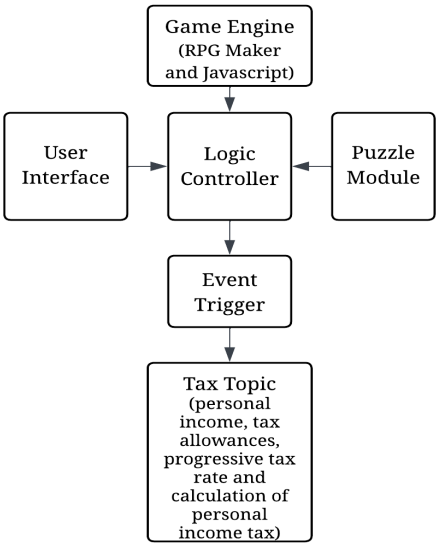

Fig. 8 The PIT game component Diagram

In addition to the default event-based system, custom JavaScript code was implemented within RPG Maker MV to extend the engine's core capabilities. These enhancements include user-defined UI behaviors, conditional puzzle logic, and dynamic feedback responses. The Logic Controller connects descending to Event Triggers, which activate educational content

related to Personal Income Tax (PIT), such as personal income, tax allowances, progressive tax rate, and calculation of personal income tax. This modular design supports better control over gameplay flow and ensures a structured learning experience.

Asperity was employed for pixel-based graphic design, particularly for developing character sprites and visual elements. Planning and content flow were managed using Google Sheets, allowing the team to track learning checkpoints and storyline progression efficiently.

Unit testing: After the development phase, a comprehensive testing process, including functional testing, gameplay testing, and user experience, was performed. Feedbacks from testing process were used to iteratively refine the game mechanics, which are correcting inconsistencies across learning lessons, improving overall engagement and evaluating educational outcomes from the game.

3.4 Implementation process (I):

The PIT game was developed to operate on Microsoft Windows operation system. The PIT was compiled into an executable format (.exe file) where players have to install the PIT game before playing. Following the development phase, comprehensive system-level testing was conducted to ensure functional integrity. If errors or malfunctions were detected during the testing process, the testing process was repeated to improve the effectiveness of final version.

Testing: After iterations of the PIT game improvements with the experts, the developer team verifies the performance twice using 1) one-by-one evaluations from 3 subjects and 2) group cases constructed using 5 subjects per group. These two groups were selected at random. The purpose of this process is to find the defects of the final version before the final evaluation of the PIT game on the different sets of subjects.

3.5 Evaluation process (E):

Evaluation was performed using a quiz to test PIT knowledge before and after playing the game. A group of ten subjects, consisting of five students in the undergraduate program and five people who were working in industry, undergone the same quiz of nine questions. The average score is reported.

The evaluation of the experiment was performed using average scores. Samples are 10 people recruited at random, comprising 5 students who were pursuing bachelor's degree in business administration program at Rajamangala University of Technology Krungthep and 5 employees who were working in the industry. The randomization was performed to create the evaluation group, which was used for both satisfaction and pre- and post-test evaluations.

4. Results and Discussions

4.1 Satisfaction Evaluation

We evaluated satisfaction in two groups: expert reviewers (3 in total) and end users (10 in total). The questionnaire is divided into two sections: (1) Design and (2) Functionality. Each criterion is measured on a 5-point scale. Expert satisfaction in both two groups is reported in Table 1. Overall design and overall functionality have scores of 3.87 and 4.42, which can be interpreted as that the experts have high satisfaction with game design and very high satisfaction with game functionality. Experts have compliments, particularly on the game's stability, visual appeal, and menu design. The key improvement areas are language clarity, game difficulty and game storyline.

Table 1 Expert Satisfaction (n=3)

Item	Mean	S.D.	Interpretation
Design Satisfaction			
1. Suitability and visual appeal of scenes	4.33	0.58	Very High
2. Correctness and clarity of language usage	3.33	1.15	Moderate
3. Orderliness of menus	4.00	0.00	High
4. Appropriateness of background music	4.00	0.00	High
5. Level of difficulty in each puzzle/level	3.67	0.58	High
Overall Design	3.87	0.48	High
Functionality			
1. Stability while playing the game	5.00	0.00	Very High
2. Speed of rendering graphics and text	4.33	0.58	Very High
3. Orderliness of menus	4.67	0.58	Very High
4. Clarity of the game's storyline	3.67	0.58	High
Overall Functionality	4.42	0.29	Very High

Table 2 User Satisfaction (n=10)

Item	Mean	S.D.	Interpretation
Design Satisfaction			
1. Suitability and visual appeal of scenes	4.40	0.52	Very High
2. Correctness and clarity of language usage	3.30	1.25	Moderate
3. Orderliness of menus	4.10	0.32	High
4. Appropriateness of background music	3.90	0.57	High
5. Level of difficulty in each puzzle/level	3.90	0.88	High
Overall Design	3.92	0.37	High
Functionality			
1. Stability while playing the game	4.80	0.42	Very High
2. Speed of rendering graphics and text	4.20	0.42	Very High
3. Orderliness of menus	4.40	0.52	Very High
4. Clarity of the game's storyline	3.80	0.63	High
Overall Functionality	4.30	0.10	Very High

User satisfaction is reported in Table 2. Overall design and overall functionality have scores of 3.92 and 4.30, which can be interpreted that the experts have high

satisfaction with game design and very high satisfaction with game functionality. A higher design satisfaction obtained from the user group may be interpreted as our simple game design is preferred by the user group where the expert group may expect a more advanced design. Overall, users found the game to be stable, visually engaging, and reasonably challenging. Some suggestions are to add more detailed instructions.

The evaluation suggests that the game design effectively imparts basic PIT knowledge. Both experts and end users scored the game “high” or “very high” in most aspects. The strongest rating is stability, while the weakest part is language clarity. Notably, participants demonstrate gains in knowledge, according to the post-test scores that surpass the pre-test scores. Nonetheless, the pilot sample size (10 users) limits the generalizability of these findings. Moreover, additional complexity—such as advanced tax deductions or specialized cases—remains outside the scope of the current game, which focuses on introductory PIT content.

4.2 Pre-Test Scores vs. Post-Test Scores

From the 10 participants (5 students, 5 employees), we measured their test scores on a 9-point scale. The pre-test average is 4.60, while the post-test average is improved to 6.40, as reported in Table 3. This improvement indicates that users have a better understanding of PIT concepts after playing the game. These results are consistent with the previous study that indicate most participants lacked sufficient knowledge of tax filing. The results confirm our hypothesis stated in Section 4.2.5 by demonstrating that users have a greater knowledge about tax after playing the PIT game. The average post-test score is higher than the average scores of pre-test, as observed in Table 3.

Table 3 Comparing the average value of before and after playing the PIT game

Actions (Playing the PIT game)	Average (9 scores)
Before	4.60
After	6.40

The higher average score after the gameplay may also indicate that the interactive puzzle approach effectively reinforced key tax-filing steps—such as calculating net income, selecting correct allowances, and applying progressive tax brackets. Although the absolute post-test score (6.40) is below a perfect score of 9, the improvement still demonstrates effective learning from participating in a short game session.

4.3 Discussion

The results suggest the game-based learning model can improve PIT knowledge among the target group of young adults and early-career earners. This is supported by the comparison of pre- and post-test scores, which showed an improvement in the average score from 4.60 to 6.40 after playing the game. This increase demonstrates that users have a better understanding of PIT concepts after playing and that the interactive puzzle approach can reinforce key tax-filing steps. The high to very high satisfaction levels reported by both experts and end users further indicate that the game is an engaging tool for tax education.

The study also demonstrates that the ADDIE model is an effective framework for the structured development of a tax-learning game. Through the model's evaluation process, specific feedback on the game's design and functionality was collected from three experts and ten users. The feedback identified clear strengths, such as game stability, which was rated "Very High" by both user groups. Visual appeal and menu orderliness were also received positively. However, the feedback also highlighted areas needing refinement. Language clarity was consistently rated as "Moderate”, and experts suggested improvements could be made to the game's storyline and overall difficulty.

5. Conclusion

This research investigates the game development as an educational tool to address the problem that Thai people lack knowledge about Tax filing. Therefore, the development of PIT game serves as an alternative approach that encourages interactions from the learner throughout the PIT. The PIT game was developed using the ADDIE model to facilitate the development process. The results show significant improvements in PIT knowledge, with an average score rising from 4.60 to 6.40 (out of 9). This improvement suggests that integrating game-based learning into tax education could be a promising approach. The PIT game confirm that game-based learning not only improves knowledge retention but also boosts user engagement, making it a suitable approach for tax education. The expert and user feedback confirms the value of the RPG format in explaining complex tax concepts.

Future works of this study are in the areas of evaluations, namely, a larger sampling size, a more comprehensive quiz, and baselines to include alternative methods. Additionally, the new version of PIT game can be further developed using results from this study.

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