

SaveYourGrades! A 3D Mobile Educational-Entertainment Game Using Ant Colony Algorithm

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Abstract

Learning in this generation can be different nowadays, with the help of educational games learning are designed to be fun and interactive than the common way of teaching. The games are designed in a way to help people learn particular topics, that involves expanded concepts which develop skills as they learn while playing. Problem-solving is a process which playing games gives through a constant observation. The development of the game encountered problems on Artificial Intelligence. The problem needed a new way of implementing AIs into the game while optimizing the amount of time spent on each AI that were being implemented. The study utilized path finding algorithms for the Artificial Intelligence to determine or predict the exact location of the player. The use of Ant Colony Optimization Algorithm for path finding, helped the authors design Artificial Intelligence that would take the shortest path in searching of the player. This study optimizes each AI to find the player in shortest route. In addition, this study concluded that integrating educational-entertainment games would help students in improving their intelligence.

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I. INTRODUCTION

According to a study by NPD (formerly known as National Purchase Diary Panel Inc.), children from the U.S aging 2 to 17 are involve on playing video games. This shows that schools can drive deeper engagements with their students inside the classroom. Based on a recent survey by The Joan Ganz Cooney Center, teachers can establish video games as a learning material inside the classroom at least once a week and shows that 47% of these teachers believes that students who benefits from the given activity are low-performing students and special education students [1].

In most outstanding educational games, problem situations are initialized from the start of the game. Then, the games stimulate students' motivation to analyze and figure out the solution. From these games, they provide large amount of resources to the game's problemsolving at the same time. Thus, students can establish the habits of observing, analyzing and dealing with problems in depth unconsciously. They can also workout with students' logical reasoning ability. In this process, students' cognitive skills can be enhanced [2].

Pathfinding is the most common algorithm in computer games. Pathfinding is a game artificial intelligence (AI) problem in the game industry that has been the most popular but the most frustrating.

To further solve this problem, search algorithms such as Dijkstra's, depth first and breadth first search algorithm, emerged to solve the shortest path problem in extent for an optimal solution for pathfinding until the emergence of A* algorithm. From its creation, thousands of researchers were successfully attracted to the algorithm. Thus, decided to put effort into it. Numerous amounts of A*-based algorithms and techniques were developed [3]. The use of the Ant Colony Optimization Algorithm is another way on providing optimal solution for pathfinding.

Ant Colony Optimization (ACO) is an algorithm which simulates ant foraging behavior. The algorithm functions by randomly sending out artificial ants from a hub into a search space. Each ant finds a solution and then leaves an artificial pheromone trail along its path. The amount of pheromones depends on the success of the solution, i.e., a better solution leaves a stronger pheromone trail. The next iteration of ants takes the pheromones into account when choosing a direction to travel. Pheromones also weaken over time so less-optimal paths are abandoned for more-optimal paths [4].

Motivated by gaming technology and its importance on helping teachers achieve student engagement, the researchers developed a game that utilize the use of Ant Colony Optimization Algorithm. (ACO), the process starts by generating m random ants (solution). An ant represents a solution string, with a selected value for each variable. An ant gauge accordingly to an objective function. This is used for the AI that the player is encountering. [5].

Save Your Grades is an educational games that provides players a chance for them to enjoy their game while learning. The researchers' inspiration built a game that would develop players to enhance their decision-making skills, reasoning, logical skills and help players to be familiar with Math and Logic.

II. RELATED LITERATURE

An approach that uses game-based learning has been applied to school subjects that are science-related, through this approach it was discovered that it enhances the learning effectiveness and attitude of students more effectively than the usual PowerPoint instruction mechanics. Through game-based learning, it enabled participants to create various ways for learning more actively while giving the participants with greater interest from the learned contents that would eventually be use for conventional methods [6].

Games are believed to be an enjoyable activity that participants try to pursue from a challenging goal agreed-upon rules which makes games immersive and voluntary. The NMC Horizon Report 2013 Higher Education Edition reported that age of an average gamer from the gamer culture are lowering each passing year from a growing substantial sector from the world's population. Specifically, this goal considers results from the following steps which involves preference survey on a conducted game, educational gamed based that are evaluated from the result and implementing to the target user [7].

There is a study that evaluates the procedural approach of teaching cellular biology as well assessing student satisfaction from their learning outcomes and retention of knowledge from the use of role-playing games (RPGs). Two Brazilian public universities shows that first-year undergraduate medical students attended RPG-based class and lectures related to topics on cellular biology, pre- and post-RPG-based class questionnaires were used to compare scores from an announced test one year later to show the effects of student's attitudes and learning by the given approach [8].

Most role-playing games are not built to end in a "win" or a "loss" situation, role playing games also require teamwork to solve different scenarios in the game. This events depends on the player's

action, working with other players could guarantee a fun-time for both players rather than failure to work with other players to complete the game. Role-playing games tends to be cooperative with other players to make it fun to play that doesn't require a winner or a loser, cooperation helps players to further assess the competitiveness of the game from a refreshing change of pace. Additionally, learning to be a team player is a skills that is highly important in the professional word. By having roles from a game, it helps you do things that you've been trained to do in a workplace. By fulfilling a role on a diverse-team the participant developer particular skillset. If you don't do your role to a team, the team can suffer for it just like at work [9].

The implementation of algorithm in games are important to help certain situations of the game to operate. An example of it would be the pathfinding process which returns efficiently the optimal path to users. It was the first algorithm to use a heuristic function to travel a search graph in a best first manner, the search growing from the start node until the goal node is found. inspired many modified and improved algorithms. To evaluate the efficiency of such algorithms, the execution time, memory overhead, and whether the environment of the search system is static, dynamic, or real-time "deterministic" should be taken into account [10].

Ant colony optimization (ACO) is a relatively new heuristic combinatorial optimization algorithm that follows a stochastic procedure incorporating positive feedback of accumulated information. The positive feedback facility is a feature of ACO which gives an emergent search procedure such that the (common) problem of algorithm termination at local optima may be avoided and search for a global optimum is possible [11].

Ant Colony Optimization is a metaheuristic algorithm used for solving complex combinatorial optimization problems. With inspiring the

algorithm implementation by the biological behavior of ants, multiple solutions were proposed in literature to provide solutions for many problems. Based on the behavior of real ants, it represented good results to several well-known complex problems, such as the travelling salesman problem. The main objective of travelling salesman problem is established to find the shortest visit through a given number of locations, taking into consideration that every city is visited only once [12].

Another article furthered ant colony vinas, the field of ACO algorithms is very lively. From the theory, the relationship between ACO algorithms and stochastic optimization technique approaches are the most interesting study. It has been shown that, searching methods in the space of pheromones are interpreted from the ACO algorithm, then AS can be interpreted from a well-known algorithm as an approximate form of stochastic gradient descent that are extensively used in machine learning [13].

According to J.A. Bland in his research entitled "Optimal Structural Design by Ant Colony Optimization", Thisis considered to be motived by analogy with natural phenomena, in which a colony of ants performs their collective endeavours that requires them to 'optimize'. The particular implementation of ACO gives a computationally enhanced algorithm (ACOTS) which make use of a tabu search (TS) local improvement phase [14].

In another article predicting faults for the software are being assess from a software-reliability models. With the vast amount of soft computing methods that were developed, it is still very difficult to determine the most suitable models that can be used globally [8].In another study, applied to the coordination of mobile robots considering the energy consumption where it used a heuristic combinatorial optimization technique called the ant system algorithm. The algorithm was inspired by the collective performance of ants whose structured behaviour as a colony has been

modelled and adapted for use in a problem solving context. Their study concluded that in solving large-scale facilities layout problems, the ant system approach is a useful and viable optimization technique[15].

Based on the literatures cited above, the Ant Colony Optimization Algorithm can be applied in pattern recognitions and path optimization of AI's in the game. Most of the studies in ant colony system shows how solutions are being made with optimization of each artificial ants. With this, the researchers are eager to discover if applying the concepts of ant colony system would be effective in the way of developing an RPG Educational Entertainment Game.

Further the researchers wants to create the game and developed into a more strategically approach on improving the playability and reliability of the game for the users to begin with. The researchers want to create a more schematic approach on the game for the added depth of learning and immersion on embodying the characters personalities.

III. METHODS

The researchers aim to create and cater an enticing yet very user-friendly and warm to the eyes of the user. Specifically to design a remarkable set of designs that will highly benefit and increase the enjoyment of the user playing game. Thus, this game will be played and evaluated by various users.

The main goal of the study is to help/guide his character or student to solve problems and avoid any objects that will block him for moving on to another stage. Beating the game is possible because the game is a finite game whereas the game will only end when the player succeeds on finishing the final level/stage. In this way, players which are students were able to develop their logical thinking and cognitive skills, allowing them

to use their brain mechanisms on planning and solving problems.

A wide range of different users were chosen to be the respondents of the study. The respondents were given questionnaires in order to collect information for the betterment of the study and to assess the android game's capabilities and limitations for improvement. The researchers conducted an evaluation of fifty (50) respondents. Thirty-one (31) were gamers who frequently play games and are knowledgeable in this specific field and sixteen (16) were non-gamers who are not familiar with games. The respondents were asked to identify themselves as gamers or non-gamers by writing yes or no on the questionnaire. The respondents' feedback with regards to the game's effectiveness, efficiency, safety, flexibility and overall satisfaction for the game were gained.

The data gathered through the surveying of respondents was used by the researchers. They ensured the questionnaire was created in an organized and systematized manner. It consisted of criteria for validation of answers that are needed to be pointed out in the study such as functionality, reliability, user interface, user experience, and efficiency.

The questionnaire utilized Likert Scale to fully determine the respondent's level of satisfaction. Likert Scale is a five-point scale which allows the participants to accurately show their contentment. The scale was also used in determining the respondent's point of view in the topic involved. Thus, through the usage of Likert Scale, the researchers were able to verify the respondent's overall satisfaction after playing the game.

$$x = \frac{\sum_{i=1}^n (x_i * w_i)}{\sum_{i=1}^n w_i}$$

Eq(1). Average Mean Formula

The researchers tallied the convened ratings of the respondents. Arithmetic mean was used in

this study. In order to solve for the weighted mean, the formula indicated above should be used. The w represents the weights while the x represents the values gathered from each category; Functionality, Reliability, User Interface / User Experience, and Efficiency, from the questionnaires answered by the respondents. The Σ means “the sum of”. To follow the formula, simply calculate the sum of each values from the categories and then multiply it with the weights. After getting this, divide it by the sum of the over-all weights. The formula, in simpler terms, can be written as:

$$\text{Weighted mean} = \Sigma wx / \Sigma w.$$

Eq(2). Weighted Mean Formula

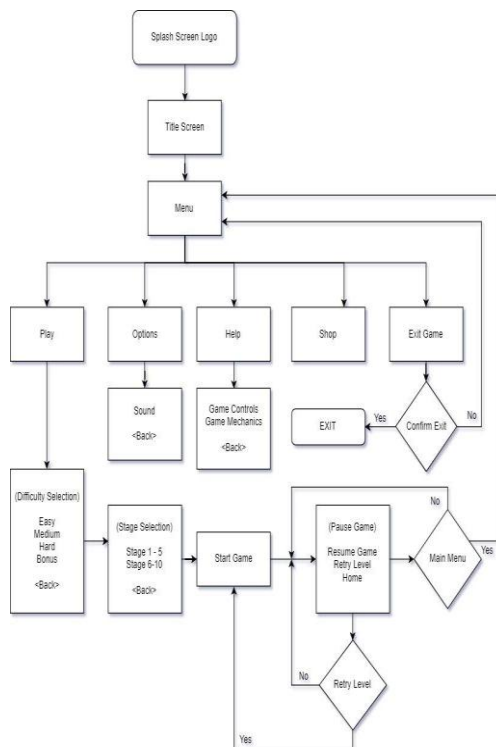


Figure 1. Game Architecture Flow Chart

Figure 1 shows the architecture of the game. Upon starting the game, the splash screen logo will pop out followed by the title screen. The title screen will then proceed to the main menu of the game. The menu contains the following: Start, Shop, Options and Help. Start will let the player start the game. The player may choose to create a new game or load a game if he already has an existing game data. The shop contains purchasable power ups and

boost that will help the player finish the game quicker and easier. The options will show the volume settings for the sounds (Music and Sound Effects). Lastly the help menu will show a short tutorial on how to play the game.

The game is a 3D Mobile Educational-Entertainment Game deployed in the Android platform. It is a role-playing game that is heavily story-driven. The game also utilizes the Ant Colony Algorithm which is vital to the game’s gameplay. Since role-playing games (RPGs) place huge emphasis on the story and character development, players could use the chance to immerse themselves into imaginary worlds with their imaginary characters. By controlling a character and following a series of events and obstacles leading to complex and continuous narration of the story, they realize the importance of roles. By controlling a hero with good moral principles and acting upon it, they developed a way to fulfill their promises and set the conclusion of the story.

Puzzle games focus on logical challenges and critical thinking. By receiving only limited bits information and critically analyzing the problem or situation, the researchers acted upon what the researchers think was the most logical answer. Using these puzzles to strengthen the mind and improve cognitive thinking the researchers acquired means of assessing and upgrading our logic and ability to judge well.

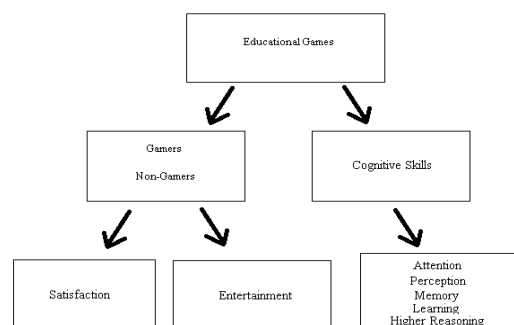


Figure 2. Conceptual Framework of Playing Educational Related Games

Figure 2 shows the Conceptual Framework of this study. This figure shows how Educational Games apply. Educational games when played by gamers or non-gamers gives satisfaction and entertainment. Yet, the most significant of it is regardless of the type of users, using educational games can help enhance cognitive skills of its user. Cognitive skills that were enhanced are the attention, perception, memory and higher reasoning.

IV. RESULTS AND DISCUSSION

The research was initiated with the analysis and interpretation of data gathered. It is then presented for the evaluation of the effectiveness of the developed mobile game Save Your Grades. The following scale is used for the interpretation of the mean of the evaluation: A scale of 1 to 5 with ranges intervals of 0.5 each. (for scales 1 and 5) and intervals of 1 for scales 2 to 4. Each scale (1 – 5) is interpreted as Strongly Agree, Disagree, Slightly Agree, Agree and Strongly Agree respectively.

The game was evaluated by a total of 50 individuals which consisted of gamers and non-gamers. The researchers surveyed 31 gamers and 19 non-gamers played and evaluated the game. Non-gamer individuals were included for data gathering in order to make sure that the game was effective enough for both gamers and non-gamers. Non-gamers were taken into consideration to show that the game can be played without prior knowledge on how gaming platforms works.

The method used for data gathering was by giving survey forms that serves as inputs from the respondents that will critique the game's effectiveness, efficiency, safety, flexibility and satisfaction. The results gathered would be later on used for the development of the game. The game was evaluated from 1 as the lowest and 5 as the highest to get its mean average.

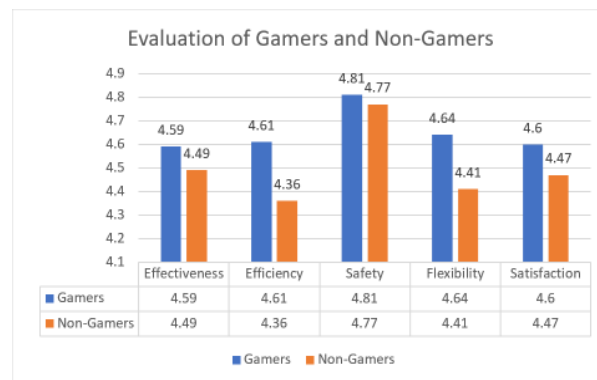


Figure 3. Evaluation of 31 Gamer and 19 Non-Gamer Respondents

The results for the evaluation of 31 Gamer and 19 Non-Gamer Respondents seen in the arranged “Evaluation of Gamers and Non-Gamers” results at Table 2.0, the gamer respondents rated effectiveness an average of 4.59 while the non-gamers rated 4.49. It means the game was easy to use or understand instructions and other necessary elements was effective. An average rating of 4.61 was given by the gamers and 4.36 for non-gamers on the efficiency of the game, an average rating of 4.81 was given by the gamer respondents on the safety of the game and 4.77 by non-gamers, the safety criteria of the game receives the highest amount of average to the users. The flexibility of the game was given 4.64 by gamers and 4.41 by non-gamers, meaning the flexibility of the game is quite high and can adapt to certain instances. Lastly an average of 4.6 for gamers and 4.47 for non-gamers were rated for their satisfaction while playing the game. The satisfaction of the game is high enough for players to enjoy the game.

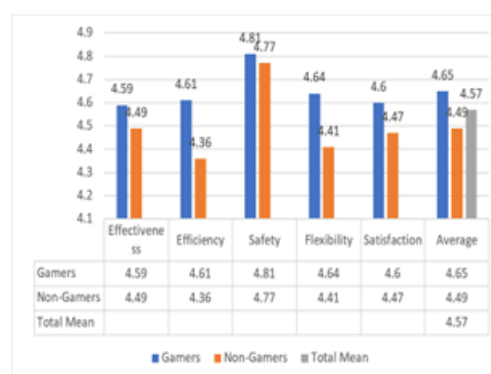


Figure 4. Overall Mean of Respondents

As seen in the arranged “Overall Mean of Respondents” results in Figure 4, the gamer respondents has an average of 4.65 meanwhile the non-gamers gathered an average of 4.49. Overall, the total mean of all of the respondents was 4.57. This means the respondents experienced a well-designed game as an Educational Entertainment for gamers and non-gamers.

V. CONCLUSION

The main goal of the study is to develop / create an educational-entertainment game that would create a new way of entertainment and educational approach for the users. The RPG game was made to be played on smart phones running on Android 4.0 OS and later. The stages that were in the game challenges the players to improve their knowledge skills on a given topic. The difficulties that were set on the game allows the users to be familiarize with the topic before moving over on to the new set of stages with the game. This helps the users to increase their approach with certain obstacles in the game. With this difficulty, the users educate themselves for some important skills that they would acquire.

The game was made in a mobile platform which allowed the researchers to provide comfort and ease for the users to play with. Mobile platforms helped the players to give a new style of entertainment and education while being at almost anywhere you can while playing the game.

The game’s interest triggers the users to think and to react to a given situation. This leads to the development of their brain mechanisms on handling situations on hand and a part of planning on visualizing the game’s aspect.

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