PalArch's Journal of Archaeology of Egypt / Egyptology

# INTERACTIVE GAME "POW-POW" TO PROMOTE ENGLISH VOCABULARY LEARNING FOR ELEMENTARY LEARNERS

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**Bibhuti B Pradhan: Interactive Game "Pow-Pow" To Promote English Vocabulary Learning For Elementary Learners -- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(6). ISSN 1567-214x**

**Keywords: Digital Game-Based Learning, Game, English Vocabulary and Elementary Students**

## ABSTRACT

Player's experience in the game was considered to be one of the main keys to the game's success. There are several strategies available to improve the interactions of the player in the games. A complex control system is among the unexplored methods using recognition of facial speech. The face expression of the player is captured in real time as the player is playing the game, and the dynamic control system can automatically change the difficulty of the game depending on the facial expressions of the player. This work aims to investigate empirically the application of Facial Expression Recognition to a complex balancing framework increase player experience in the game. Developed and tested two action games (2D and 3D), with 60 respondents in two categories. Both groups played the game twice, one with recognition system of facial expression activated as dynamic balancing, and one without. The findings indicate that there are statistically relevant differences (i.e. improvement) between the baseline and enhanced $p < 0.01$ games.

## 1. Introduction

Games became known as the world's best entertainment tool. The fascinating thing about the game is that in the game people (i.e. players) will volunteer to make unfair challenges. They don't mind engaging in a situation of negative

emotions (e.g. frustration, fear, sadness) when they face unnecessary challenges in the game. In the games both negative and positive emotions create game experience. In addition, the emotions of the player play an important part in affecting the experiences of the player in the game. Typically, emotional perceptions are created when the player communicates with the objects of the game (e.g. game environment, physics, etc.) through game feedback (e.g. keyboard, mouse, joystick, etc.). Therefore, it could be done in manipulating the game objects and/or inputs to improve the player's experience throughout the game. One of the renowned strategies for improving the enjoyment and perceptions of the player while playing a game is to exploit the game balance. Game balance plays a part in deciding whether or not the game is too hard, too fast, balanced for the player. Too hard game would bring annoyance to the player while playing too easy would bring boredom to player. The emotions (e.g. anger, boredom, etc.) are normally ex-pressed willingly through the facial expressions of the player during the action. Providing this complexity and the functionality of an automated Facial Expression Recognition (FER) [1]program, the balancing program may change the game difficulties dynamically based on the player's reaction to the current game difficulties.

For many works of literature the use of the FER of player to dynamically balance the game difficulties has been suggested. However, there were only a few empirical experiments made to prove the concepts. Moniaga et al are proposing a complex balancing method in a Hack and Slash Game using FER[2]. Although the dynamic balancing system caused the player's interactions to increase throughout the game, it is not entirely sure whether the dynamic balancing system will yield the same results in the other game genres. Different game styles will generate contrasting player experiences. Hence, in the most common game genre this paper proposes a dynamic game balancing system with FER: This work aims to apply dynamic game balancing framework to two unity-based action games, one is a 2D action game and the other is a 3D action game. Hopefully, this will provide more analytical insights into the research in this field. Five out of seven perceptions variable groups of players typically have statistically relevant discrepancies (i.e. improvement) between the baseline and enhanced games ($p<0.01$). In addition, there are no statistically important variations in the category of Negative Influence in both classes as well.

Recent years have seen an increase in studies on the efficacy of Digital game-based learning (DGBL)[3]. Throughout the learning process, educational games concentrate on organized and enjoyable game programming assist players until the stated teaching target is achieved. The researchers are investigating how an immersive game promotes elementary student English vocabulary learning in this context. In addition, students need more engaging English-language learning media to escape the frustration they feel when taught using traditional methods. A study was carried out among the third graders in Salatiga and it concluded that the competency of the students in vocabulary learning is influenced by internal and external factors, some of

which are the motivation of the students, the level of focus, the level of complexity of the words, the number of students in the classroom and the use of educational teaching tools. Additionally, another study has examined the impact of the elementary students playing the game. The result notes that the interest of the students rises because they felt the game was beneficial and enjoyable, which in effect makes them more knowledgeable.

The success of Digital Games Based Learning is often measured by testing the game by conducting a pre- and post-test to students. It is concluded that the study comparison results show the game used as a learning tool will increase the interest and motivation of the students. The previous work also indicates that the approach to the game motivates students to learn more than the approach to the non-game. In addition, gaming achievement motivation and outcomes between men and women are also comparable. This shows that gaming isn't restricted just to guys. The present work, focused on the above circumstances, suggests an alternative approach to learning using interactive game. It is built based on the unique needs of the consumers as elementary students[4].

## 2. Related Work

### 1. Dynamic Game Balancing:

The attempt to improve the experience of players when playing a game has progressed from enhancing the feel and look (i.e. the aesthetic aspect of the game) to enhancing the agents' intellect (e.g., non-player character, and the Enemies). In addition, several researchers have suggested a system for seamlessly integrating game reality into player reality using Augmented / Virtual / Mixed Reality and/or sensors (GPS, Camera, Accelerometer, Gyroscope, Microphone, etc.). Both of those approaches empirically increased the immersiveness of the player as well as their contributions to other players or objects within the game[5]. This result is also consistent with the other statement that one of the important elements for creating game experience and introducing it to the player is through dedication and immersivity. Improving the player’s experience using the aesthetics of the game is fairly easy to do, but this approach typically requires the resources of ex-pensive graphics. The game's feel and look is generally determined by the graphics (e.g. animation, and appearance) and sounds of the game (e.g., sound effect, voice, and background music). Meanwhile, improving player interaction using virtual / mixed / augmented reality during the game and sensors empirically provide players with the best game interaction. The players should be able to communicate with their physical (i.e. real) as well as the virtual game environment with those methods. Playing the game with virtual / mixed / augmented reality and sensors, however, still has many drawbacks: restricting technology, being inflexible and being very expensive to implement[6].

The most common methods of improving player interaction in the game are to improve the agents' intelligence (e.g. Non-Player Character, and the Enemies). Several strategies have suggested playing around with the intellect of the game agents. Scripting Artificial Intelligence (AI)[7] actions for the character of the game or non-player character (NPC)[8] is the most classic and effective

technique for supplying game agents with intelligence. Some AI methods, such as findings of the path, were mostly solved and remained in use to this day. Some approaches such as dynamic balancing, however, are still subject to intensive analysis as there are no general rules or approaches in a game to create a dynamic balancing system. A dynamic balancing method typically adjusts certain predefined variables in the game to dynamically adjust the game's difficulty. Generally, the predefined variables are modified in real-time based on the output of the player during the match. This approach helps players to assume that the game's difficulty is correct regardless of the players' type / profile (e.g. a game expert or a casual gamer). This caused the player's experience in the game to increase (Table 1).

**Table 1.** Baseline of the Characters HP and AP in both 2D and 3D Games

| **Character** | **Health Point** | **Attack Point** |
|---|---|---|
| Player | 900 | 20 |
| Enemy | $280 + (40 * level)$ | $5 + (3 * level)$ |
| Boss | $2000 + (800 * level)$ | $8 + (3 * level)$ |

## 2. Affective Game Design:

The term Affective Gaming was possibly first coined by Eva Hudlicka, who originated from the gaming-implemented Affective Computing. Rosalind Picard coined the term of Affective Computing itself first to categorize a study of the recognition, processing, interpretation, and simulation of human effects (i.e. emotional and emotional experiences). Accordingly, Affective Game can be used to describe the gaming experience of understanding, manipulating, interpreting and simulating the emotions and feelings. Implementing affects element within the game empirically enhances the experiences of the player while playing in the game. Several approaches suggested for developing an affective game are incorporating the ability to perceive, process, interpret, and simulate the perceptions of the agents' emotions and feelings (i.e., NPCs, and Enemies). Sensors such as camera or microphone may be used to record the effects of players (e.g. facial expressions, speech prosody) and then process them for the agents to interpret. The computational models of emotions in the agents can represent the emotions for the agents based on the internal thoughts, emotions, and the perceived emotions of the agents. Finally, through their actions, the agents will show the simulated emotions e.g. words, voice-prosody, and facial expressions). To dynamically change the game difficulty, the method to capture the results of the player can be implemented. For example: If the player shows a face of tension or anxiety, the game difficulty variables can be lowered until the player shows a calm face. This can be accomplished with game-installed Facial Expression Recognition (FER)[9]. During the game the FER system automatically interprets the facial indications of the player. Just a few empirical tests were carried out to prove FER's principles for dynamic balancing in the game.

Some research have been performed on the effects of using games in vocabulary learning, some of which claim that games support language learning. A research on the effects of using a digital computer game among Iranian children has proven that the game has improved vocabulary learning. There were 40 girls aged six to seven who had no English knowledge were divided into experimental and control groups. The experimental group was using SHAIEx digital game while the control group used traditional method. The study results show that the mean score of the children in the experimental group was higher than that of the control group, meaning that the positive effect of digital games used in vocabulary teaching is on the children. Therefore they conclude that "the use of games in the class of young leaners smoothest their learning because games capture their attention and motivate them"[10].

A similar study between Iranian kindergarten students was conducted in 2013. The research aims at finding ways to help the students repair the novel words in their heads. The students were divided into control and experimental groups; the control was taught using traditional teaching method while an online language game is used by the experimental community. The result reflected the fact that the students in the experimental group are more inspired than the control group and enjoy the learning.

Another study investigated the impact of video games on vocabulary learning among Iranian students. The study included 40 learners, and they were chosen via a TOEFL proficiency test. They were divided into two groups, each comprising 10 learners, a control group and an experimental group. The control group typically studied vocabulary in the classroom while the experimental group used a video game called "Runaway: A Road Trip" to research the same vocabulary. The study has found a powerful way to learn vocabulary through video games.

Game-based learning has a positive effect on learning for the students. Game-based learning also improves the skill of the school students. The game-based learning approach has been successful in promoting the creation of student skills from study outcomes. Game designers and educators are supposed to be in a position to develop games that meet students ' needs and typically incorporate educational games. Education will inspire students to be involved by mixing mobile games, and feel excited to learn and acquire information. Students who learn through games get more insight from the outcomes of studies performed than those who do not learn through games. Digital game-based learning is highly recommended for schools through game-based learning in classroom teaching. The game elements need to be considered and the built game performance also needs to be checked. In addition to game play in the classroom, the usefulness of Interactive Based Game Learning must be measured, and can be implemented flexibly across a number of different contexts.

## 3. Methodology

Some moves are in the conduct of the study. The present paper, however, limits itself to purely the perception of the PowPow game elementary students. It

does not encompass the game design technical aspect. First, a questionnaire set is distributed to 112 elementary students from three Kemanggisan-area schools. The questionnaire result is used as the input for developing game PowPow. Then, 35 elementary students, ages 7 to 12, play the game. Finally, some questions are given to the students to find out how they interpret the PowPow game. While there have been some digital English learning games, especially vocabulary games, PowPow game in research is different from previous ones because PowPow game was developed based on user needs, in this case elementary students (Table 2). The overview of the user's needs survey is:

- 36 % of respondents play video games under an hour.
- The game image is the most commonly liked feature of the game (29% of respondents)
- The three topics are the most popular: 19% choose outdoor room, 18% choose restaurant and 13% like home.
- 66 % of respondents opt for level game
- 55 % of respondents prefer using mouse when playing the game

As summarise, the users' desires are:

- The game kind is puzzle
- The game will consist of a few mini-games to offer a lot of different playing styles
- The game makes use of 2D graphics
- Background music and sound effect are required for the choice of stage and the correct identification of the wrong answer
- Trophy room and stars are the important feature of the game

The following is the difference of the digital learning games:

**Table 2.** The Characteristics of English Vocabulary Learning Games

| **Name** | **Funland** | **Monkey Puzzles World Tour** | **Cambridge English FC** | **PowPow** |
|---|---|---|---|---|
| Platform<br>Genre<br>Gameplay | Android, iOS, Web<br>Puzzle<br>Answering available questions | IOS, Web<br>Puzzle<br>Answering available questions, picture matching, coloring picture as requested | Android, Web<br>Puzzle<br>Answering available questions | Android<br>Puzzle<br>Answering available questions, picture matchin coloring picture as requested |
| Graphic<br>Sound | 2D<br>Background music | 2D<br>Background Music | 2D No background music | 2D<br>Background music when stage and mini-game are chosen; sound effect |

| | | | | |
|---|---|---|---|---|
| | | | | to show the right and wrong answers. |
| Feature | Achievement in the trophy room when users can finish certain number of tasks of the game or do some | Achievement in the form of stars, three is the maximum number users can get; a star is gained based on the score | Two additional mini-game | Achievement in the form of trophy room and stars gained by completing a variety of 9 sets of |

## 4. Result And Discussion

### 1. Game design:

PowPow is composed of three themes and nine game packs. Increasing game begins with the basic subject knowledge. Until applying the knowledge in game play, the users are given some time to study the knowledge. This way, players can learn the experience so they can reach the game's goal and get the stars. Users can select the theme and play the game within a limited time span. Game users can replay the game to find out if progress is being made in completing the game by noting the time record involved in each game. The following is the Pow-Pow interactive vocabulary game sample-that is animal knowledge.

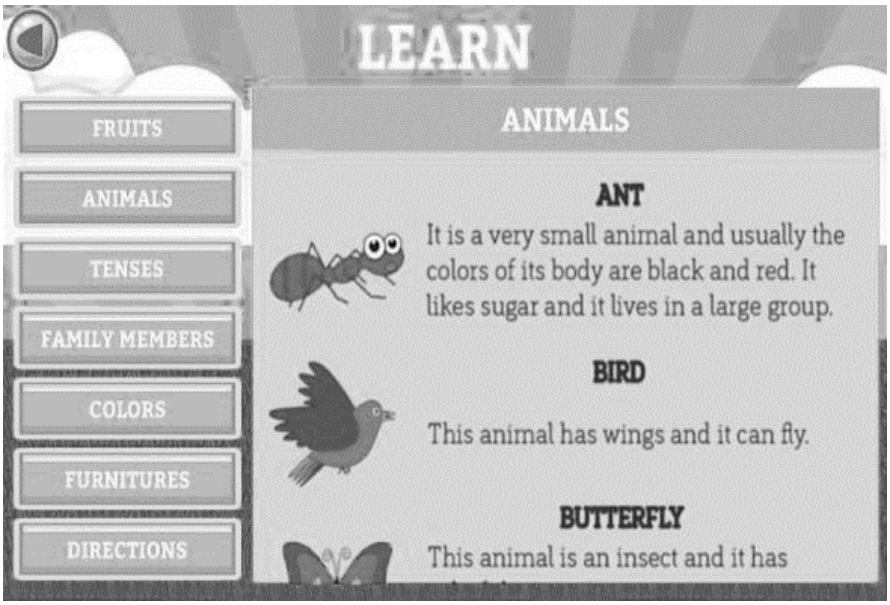


**Fig 1.** Knowledge of Animals in the Mini Game

Fig 1 displays a section of the game where the users select the theme. This section includes the knowledge to guide users to learn the English vocabulary. Thereafter, users are given some tutorial (Fig 2) that allows users to work on the information intended. The game tutorial serves as a guide for equipping users with a few required terms. This must be done to ensure that the game is played properly. In addition, game user interface asks users to apply their developed thematic awareness. Ultimately, after completion of the three stages, users will be accommodated with the materials intended.


**Fig 2.** Game Tutorial of Animals

*Users' perception of the game:*

The interpretation of the users of the game is based on the results of the questionnaire that was filled in after users completed the match (Table 3).

**Table 3.** The Result of the Questionnaire

| No | Key Indicator | Percentage |
|---|---|---|
| 1 | Users' evaluation on the mini games | 83% |
| | The theme "house" is easy to be played | 83% |
| | The theme "restaurant" is easy to be played | 86% |
| | The theme "outer space" is easy to be played | 80% |
| 2 | The game provides an interesting way of learning | 91% |
| 3 | The game causes users to like English more | 86% |

## 5. Conclusion

The Pow Pow game is thought to have succeeded in gaining interest from students in learning English and inspiring students to learn the Language. Moreover, this smartphone application will develop the English vocabulary skills of the students. Conventional learning approaches, in particular for elementary school students, are not in line with technology development.

One aspect that needs change is to increase the time needed to allow more time to practice. This illustrates the need for progress in designing the application that is relevant to the needs of the users. It is recommended that this immersive

game be extended in addition to English, to other learning topics. Will it be history, for example? It shows the need for change in designing the framework that is relevant to the needs of the users. It is recommended that this immersive game be extended in addition to English, to other learning topics. History, for example, might be the next lesson that will use interactive games to explain historical people, places or locations.

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