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# Guess What? Brain Training Edition: A 2D Mobile Game Application for Android

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***Abstract:*** **The study entitled "Guess What? Brain Training Edition" A 2D Mobile Game Application for Android is intended for brain challenging entertainment to challenge the mind of the users in the form of a game. The game application can assess the user's ability to think through challenging the brain using different training games available such as guess the operator, rock, paper, scissors, bird watching, follow the marks, past, present, future, pants, guess the result and notice me; each training games has a corresponding cognitive skill incorporated namely accuracy, speed, memory, logic, focus, and judgment The game application lets the user experience a thrilling and exciting way of comprehension and self-evaluation. The application designed with promoting common Filipino themed object and places by using these objects in the game as a form of questions. The application developed using Unity 3D game engine and coded by C# for graphics and Adobe Photoshop for user interface design. To test the game application, the researchers used test cases such as conformance and functionality testing. The test conducted to specify the errors and bugs in the application and able to address it for improvement of the overall quality of the application. The evaluation instrument used was based on the criteria for mobile application using MARS (Mobile Application Rating Scale) with the following criteria of Engagement, Functionality, Aesthetics, and Information. The overall outcome of the result of evaluation gathered a mean of "3.70" with a standard deviation of "0.48" which is interpreted as "Highly Acceptable", this proves that the game application achieved its main purpose to challenge the mind of the users in the form of a game and will also have fun at the same time.**

***Keywords:*** **Filipino Culture, Elementary Pupils, Araling Panlipunan, and Mobile Application.**

## I. INTRODUCTION

Cognition is how a person understands situations and acts in it. As explained by Michelon (2006), cognitive abilities are brain-based skills we need to carry out any task from the simplest to the most complex. They have more to do with the mechanisms of how we learn, remember, problem-solve, and pay attention, rather than with any actual knowledge. For instance, answering the telephone involves perception (hearing the ring tone), decision taking (answering or not), motor skill (lifting the receiver), language skills (talking and understanding language), social skills (interpreting the tone of voice and interacting properly with another human being).

According to edubloxtutor.com (n.d), as cited in oxfordlearning.com, when cognitive skills are strong, learning is fast and easy. When cognitive skills are weak, learning becomes a challenge. There are different techniques to enhance the cognitive skills of a person like a memory game, puzzle, and psychomotor activities. In a blog posted in ehe.health (2019), the objective of brain training or cognitive training is to improve inactive brain cells into healthy, active ones. Routine habits don't stimulate new cell activity; brain training encourages new experiences that require attentive thought instead of routine thinking patterns. Just like physical fitness, brain fitness requires targeted effort through repetition. New and stimulating experiences may occur as part of daily life, but many of us operate on autopilot more than we realize. Exercising the brain daily is central to great cognitive fitness. (ehe. health, 2019)

At present, the use of mobile application plays a significant role in exercising cognitive skills by providing activities for users to perform. Brain Training apps help the user improve memory, thinking skills, and intelligence. This could somehow make a person sharp and prevent mental disabilities. Like achieving a healthy physique, a healthy mind also demands to exercise mental muscles. There are studies that show playing puzzle games can help increase mental agility like improving problem-solving skills and boost IQ. (modellist-id.com, 2018)

***A. Objectives of the Project***

The project aims to develop "Guess What? Brain Training", a 2D mobile game application for Android to challenge the users. Specifically, the project aims to:

1. design an Android mobile game application that has the following features:

a. In Start Assessment, the user is not just obtaining scores but also identifying the weaknesses and strengths of the users' cognitive skills by playing the start assessment;

b. By playing in the training games in the training tab, the user allows to train on the cognitive skill where they are not excelling much at by playing on the specific game that assesses the said cognitive skill;

c. The overall design of the Guess What? uses a User-friendly interface with simple responsive buttons and simple interaction with the users for easy navigation;

d. Tutorial upon registration of the user and must have some instructions, trivia, and tips to provide the users all necessary information about the application;

e. Eight different training games with a random set of questions at each game namely Guess the Operator, Rock Paper Scissors, Bird Watching, Follow the Marks, Mix and Match, Past Present Future, Guess the Result and Notice Me;

f. Life feature called brains. This is the basis of the user to start an assessment;

g. Timer, use to give the users allotted time in answering questions for each game;

h. Performance Tab that tracks the user's progress by identifying the best scores and skills they got on different games;

i. Added Rank Name for example "superior" that would depend on the average of the averaged skills;

j. Connection to Facebook feature wherein users are able to retrieve their respective name and profile picture and at the same time, they are able to share/post their progress and invite their friends to play the application;

k. Push notification feature to frequently remind the user to come and play again the application.

2. create the project using Unity 3D Game Engine and Adobe Photoshop as frontend, and using C# programming language as backend. It will work on devices running Android OS with a version of 6.0 (Marshmallow) and up.

3. test and improve the developed mobile game application using conformance and functional testing.

4. evaluate the acceptability of the mobile game application based on the criteria for mobile application rating scale (MARS):

a. Engagement;

b. Functionality;

c. Aesthetics;

d. Information

***B. Scope and Limitation of the Project***

The project is focused on mobile games infused with different kinds of objects just like to the Philippine peso bill, traditional game bato-bato pick, and Philippine birds, Philippine famous landmarks and other things that are related to the Philippines. The application consists of eight training games like Guess the Operator, Rock Paper Scissors, Bird Watching, Follow the Marks, Mix and Match, Past Present Future, Guess the Result and Notice Me. Each game assesses different types of cognitive skills. The basis of the assessment is the scoring chart that is included in the app. It determines what rank name you will get based on the score that the user got on playing the start assessment. The project aims to track the performance of the users based on their stats and to exercise their minds while they are having fun. In accordance with

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this, the application can have multiple accounts that can be accessed locally and connect to the Facebook feature. The project is a 2D environment in Unity 3D Game Engine. The application has some features likes the push notification wherein this feature delivers a message from the app on the home screen of the user's device. The application has a connection to Facebook feature, that allows the user to login using their Facebook accounts that retrieve their full name and profile picture. The users will also be able to share/publish their progress or score on their profile. The application works best on devices run by Android operating system with a minimum version of 6.0 (Marshmallow) and up.

On the other hand, the assessment made in the game application should not be compared to other assessments that undergone thorough scientific research. This way of assessment is only valid in the application itself. The project can only be viewed as a portrait. The application will not require extra permissions and connection to the Internet while playing the game unless when users login into their Facebook accounts, sharing and inviting their Facebook friends. The project does not support Apple Devices such as the iPhone and iPads. Moreover, the application does not support multiplayer. The project is intended for Android user level only.

### *C. Significance of the Project*

This section shows the importance of the study, its potential benefits and its overall impact on how this project can be used. The project was done for the benefit of the following:

Android users. All android users may play this game. It serves as a source of entertainment and stress reliever for Android users at the same time knowing what type of cognitive skill/s they excel the most.

Future Researchers. This project may provide references and new ideas to future researchers that can help them in their studies.

## II. METHODOLOGY

### *A. Design*

This section provides an illustration or diagram that describes the processes in the study. This includes the Program flowchart of the study.

This section includes a graphical technique that describes the whole application that can easily understand through diagram and symbols.

Uses various symbols to show how the application through an information system but does not show program logic or processing steps. This diagram shows to represent the way data needs to flow and what the application does when executed.

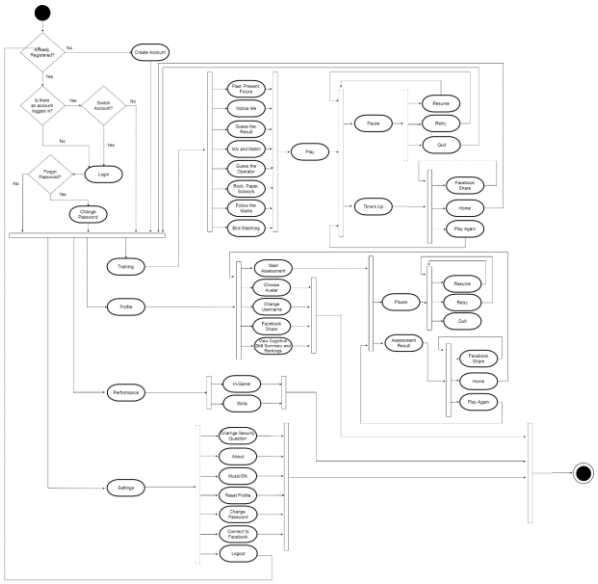

**Fig 1: Activity Diagram of Guess What? Brain Training Edition: A 2D Android Mobile Game Application**

Figure 1 illustrates the activities involved in the system. Once started, an action is stated which signifies the individual step within an activity. The action can possess input and output information just like in the figure once the user opens the application the user will have to either signup for an account if there is no existing yet or login to their accounts. If there is no logged in account, otherwise, a user must have to switch account in order to access the application then after logging in the user will see the home screen consists of profile tab, training tab, performance tab, and settings tab. In the Profile tab, the user can view his/her cognitive skill summary, choose among the pool of avatars available to make it as their profile picture. User has the option to change their username but only for once, also the Facebook Share feature in which, it will allow the user to share their cognitive skills progress into their Facebook profile accounts, lastly a start assessment which consists of the eight training games combined into one single assessment. This will be the basis for their cognitive skills and respective rank name.

In the start assessment gameplay, user can pause the game to retry playing the game, to quit the game and go back in the home screen or to just simply resume playing the game. When the game is done, an assessment result screen will show up which consists of a summary score on every game with an average score to it. It also consists of Facebook share, Home Button and Play Again. Under the training tab, the user will have a choice to pick from eight different types of training games. After choosing a specific training game, an instruction will appear on screen to help the users operate on how the game works then.

In the gameplay, user can pause the game to retry playing the game, to quit the game and to go back in the home screen or to just simply resume playing the game. Once the time is up it will show play again, Facebook share and home button. In the Performance tab, the user can track his/her performance in every single training game. It consists of fifteen data on the recent game made by the user and also fifteen data on the user's best scores achieve on every specific game. In the Settings tab, the user can view the game description and the developers of the app on the about button. Also in music/SFX wherein the user can adjust the background music and sound effects. A reset profile, wherein users can reset the progress that they have made. A change password wherein users can change their existing password and create a new one. A change security question, wherein users can change their current security question to update it. Another is connecting to Facebook, wherein users can connect their account into their respective Facebook account. And lastly, the log out, wherein user can have logged out their account.

### *B. Development*

This section discusses the process of development making of the project that takes place during the whole duration of the application made.

The software specifications used by the developers are Android OS version 6.0 (Marshmallow) as the main tool in testing the application. Unity Game Engine for creating the application possible and in terms of designing, the developers used Adobe Photoshop CS6. And lastly, the developers used C# programming language for developing and coding the application. This part of the chapter describes the hardware specifications used in developing the system and how it helps to support different software. The hardware specifications used by the developers in developing the project includes 4.00 GB RAM, Core i3 processor with 2.50 GHz speed and a 64-bit operating system. The developers used Asus and Acer laptops in creating the game. Aside from this, the developers also utilized smartphones in building, testing and deploying the game. The developed application has eight brain training games the guess the operator, rock, paper, scissors, bird watching, follow the marks, past, present, future, pants, guess the result and notice me. This part of Brain Training Application can assess their cognitive skills while playing. Here, the program provides a set of random questions for the users to answer and gain assessment after.

### *C. Test*

This section discusses the list of requirements, and functions on how the application will accomplish each test case. The initial testing was based on a test case criterion from developer.Android.com for a gradually testing of the application. Before proceeding to evaluation, the application software must succeded the test cases such as for the functionality and conformance to the Android core app standards from the developers, a technical critic, and five (5) Psychologist to assess if the mobile application performs accordingly.

During the testing period, the developers are required to find suitable evaluators to criticize the developed software application including here the IT Experts, Psychologists, and mobile users. In line with this, the respondents of the “Guess What? Brain Training Edition” application should validate the functionality and conformance in the provided test sheets. The test activity will be used to improve the application.

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### *D. Evaluation*

The evaluation phase was used to measure the user's acceptability level of the application. This was participated by forty-five (45) evaluators composed of ten (10) IT experts in the field of mobile application development, five (5) Psychologist, and thirty (30) mobile users are the reference point to which the test and evaluation results are measured.

Engagement Criteria are divided into five sub-criteria such as Entertainment, Interest, Customization, Interactivity and Target Group. Another Criteria is the Functionality which is divided into four parts namely Performance, Ease of use, Navigation and Gestural design. Next is Aesthetics with the sub-criteria of Layout, Graphics and Visual Appeal. Lastly, Information, which is separated into five parts, Accuracy of App Description (in App Store), Goals, Quality of Information, Quantity of Information and Visual Information.

**TABLE I: LIKERT SCALE**

| Range | Equivalent |
|---|---|
| 3.26 – 4.00 | Highly Acceptable |
| 2.51 – 3.25 | Acceptable |
| 1.76 – 2.50 | Fairly Acceptable |
| 1.00 – 1.75 | Unacceptable |

Table 1 shows the Likert scale as the basis of the interpretation from the raw scores gathered in the evaluation process. In able to get the highest user's acceptability assessment, the raw score should meet the range of "3.26" to "4.00" which is interpreted as "Highly Acceptable". For the application to pass the evaluation, the acceptability should be within "2.51" to "3.25" which is interpreted as "Acceptable". The project passes the assessment if the adjective equivalent is "Fairly Acceptable" with the range from 1.76 to 2.50, however, this can have major recommendations for the application to completely meet the user's preferences. The application should be thoroughly improved and be modified accordingly if the raw score garnered ranges from 1.00 to 1.75 with the interpretation of "Unacceptable".

**TABLE II: SCORING SYSTEM**

| Numerical Rating | Equivalent |
|---|---|
| 4 | Highly Acceptable |
| 3 | Acceptable |
| 2 | Fairly Acceptable |
| 1 | Unacceptable |

The table above shows the rating that the game application could receive from the evaluator which varies according to the acceptability of the application. Each numerical rating has a corresponding equivalent which is then used to classify the acceptability of the software in each criterion.

## III. RESULTS AND DISCUSSIONS

### *A. User Interface Design*

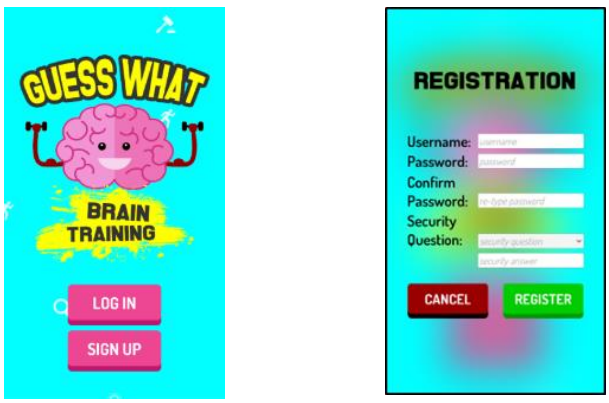


**Fig 2: Title and the Registration Screens**

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The Title screen of the game application as shown in Fig 2 appears after the splash screen. This has options for login and Sign Up after clicking the signup button in the title screen, the user should fill out the required fields is able to proceed with the app.

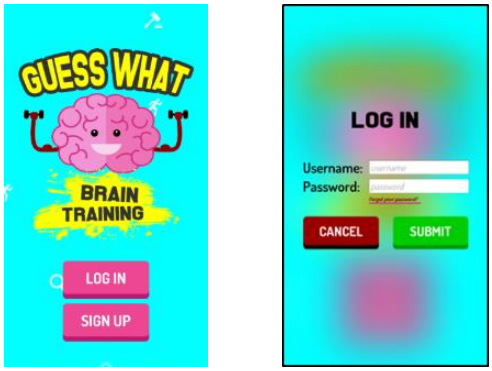


**Fig 3: Title and the Registration Screens**

Fig 3 shows the login screen after clicking the log in button in the title screen. The user must submit the correct username and password in order to continue. An option to retrieve the user's password in case forgot is also present.

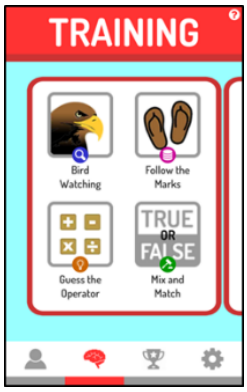


**Fig 4: Training Module**

Fig 4 shows the training tab of the game application. This tab contains all the available mini-games that the user can play. The categories are Bird Watching, the user needs to choose which Filipino bird picture is shown the most, this will test the ability to focus, Follow the Marks, memory of the user will be tested by repeating the sequence of the slippers that is shown, Guess the Operator, this will assess the user's logic through the guessing of the correct operator in the two numbers that will appear in the question, and Mix & Match, this is where the user's judgment will be tested by determining the object on the screen if matches to place, animal, name, or thing by choosing whether it is true or false.


**Fig 5: Assessment Result**

Fig 5 shows the assessment result of the user. It shows the scores and the interpreted skill computed by the application.

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**Fig 6: Profile**

Fig 6 shows the Profile that contains the summary of the user's basic information, the overall progress, and status throughout the game. This also has the Share button to display this on Facebook.

***B. Test Results***

The application went through a series of tests and evaluate by a numerous group of people such as IT experts, Psychologist, Psychology Students, and other mobile users. The testing instruments are the Conformance Test and Functionality test that was tested by a technical critic and with the participation of five (5) Psychologists.

In conformance testing, the developers used the Android Core App Quality criterion (android.developers.com.). It is explaining the basic aspect of quality of the developed application in terms with the installation, functionality and user interaction through sets of quality criteria and test. The application conforms on most of the criteria of the conformance testing unless it is not yet uploaded in Google Play for it is still in the finalizing stage but nevertheless, conformance testing in the application concluded a successful. This table shows the test results of conformance testing of "Guess What? Brain Training Edition". The criteria are based on the Android Core App Quality and out of twenty-nine (29) total criteria, twenty-four (24) is passed and five (5) failed which leads into 91.38% percentage.

Another test conducted is functionality testing. The criteria are based on the functionality of the Guess What? Application on how it works. All forty-three (43) criteria got a passing score of 100%. It is checking the whole function on how it works, if it performs what it is intended to in an acceptable manner, working correctly, conforms to its specifications including the menu functions, core application functions, inputs and if it truly gives the correct output. But just like any other applications, it is not an error-free application. Some bugs and errors seen in the application like the Game of the Follow the Marks gameplay, some logic errors in computation and averaging the scores of the users, in line with this are also the choices of some other games. The test results were used to improve the application to meet the needs and preferences of the users.

***C. Evaluation Results***

**TABLE III: EVALUATION RESULTS FROM FORTY-FIVE (45) RESPONDENTS**

| Criteria | Mean | SD | Interpretation | Rank |
|---|---|---|---|---|
| Engagement | 3.73 | 0.45 | Highly Acceptable | 1 |
| Functionality | 3.68 | 0.51 | Highly Acceptable | 3 |
| Aesthetics | 3.69 | 0.48 | Highly Acceptable | 2 |
| Information | 3.68 | 0.48 | Highly Acceptable | 4 |
| **Average Mean and SD** | **3.70** | **0.48** | **Highly Acceptable** | |

The overall evaluation from ten (10) IT Experts, five (5) Psychologist, and thirty (30) mobile users got an average mean of "3.70" and an average standard deviation of "0.48" which is interpreted as "Highly Acceptable." On the first criterion which is the "Engagement", which claimed the Highest score in the total evaluation as the overall average mean is "3.73" and the standard deviation is "0.45" and interpreted as "Highly Acceptable." For the second criterion which is the "Functionality" the overall average mean is "3.68" and the standard deviation is "0.51" which is interpreted as "Highly Acceptable". The "Aesthetics" criterion got an overall average of "3.69" and a standard deviation of "0.48" which is interpreted as "Highly Acceptable" and lastly for the "Information", the criterion got an overall average of "3.68" and a standard deviation of "0.48" although this criterion is not most likely the lowest score in separate respondents the overall interpreted as the lowest rank in the criteria but still gathered the interpretation of "Highly Acceptable."

The researcher computed the overall mean and standard deviation by summing all the gathered raw data of each set and divided it to the number of respondents which composed the total of forty-five (45) evaluators composed of ten (10) IT experts, five (5) Psychologist, and thirty (30) mobile users).

Overall, the evaluation from End Users got an average mean of "3.54" and an average standard deviation of "0.57" which is interpreted as "Highly Acceptable".

## IV. CONCLUSIONS AND RECOMMENDATIONS

### *A. Conclusions*

The project successfully developed an Android application entitled Guess What? Brain Training Edition: A 2D Mobile Game Application for Android. The application produces an assessment that identifies the weakness and strengths of the user's cognitive skill by playing the start assessment. It allows the user to train on the cognitive skill where they don't excel the most by playing on the specific game that assesses the said cognitive skill.

The application successfully builds eight different training games with a random set of questions at each game namely Guess the Operator, Rock Paper Scissors, Bird Watching, Follow the Marks, Mix and Match, Past Present Future, Guess the Result and Notice Me. The application was created using Unity3D Game Engine as frontend and using C# programming language as backend. The application was tested and improved using conformance testing which conforms to the standards of creating an Android mobile application and Functional testing verifies the performance of the application. The evaluation was participated by respondents like ten (10) IT Experts in the field of mobile game app design and development, five (5) Psychologists, and thirty (30) mobile-users with an average mean of "3.70" and a standard deviation of "0.48". The overall outcome of the result is interpreted as "Highly Acceptable" which proves that the game application achieved their main objective to challenge the mind of the users in the form of a game and have fun at the same time.

### *B. Recommendations*

For the future enhancement of the "Guess What?" application, the following are the recommendations that are advised.

1. Availability in other mobile platforms like iOS for Apple devices and others.
2. Multi-player mode for the start assessment in order to compare the user score to others.

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