



INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES



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To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v12-i2/12269>

DOI:10.6007/IJARBSS/v12-i2/12269

Received: 14 December 2021, **Revised:** 16 January 2022, **Accepted:** 30 January 2022

Published Online: 19 February 2022

In-Text Citation: (Jaapar et al., 2022)

To Cite this Article: Jaapar, A., Zain, W. Z. W. M., Mahdzar, M., Rahman, M. A., & Joremi, L. (2022). PPT Mobile based with Animated Agent Application for Gauging Students Motivation to Further Study in University. *International Journal of Academic Research in Business and Social Sciences*, 12(2), 276–287.

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Vol. 12, No. 2, 2022, Pg. 276 – 287

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INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES



www.hrmar.com

ISSN: 2222-6990

PPT Mobile based with Animated Agent Application for Gauging Students Motivation to Further Study in University

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Abstract

Program Pra Pengajian Tinggi (PPT), UiTM, is a corporate social responsibility that aims to provide an opportunity to the B40 children to pursue their studies in the higher institution through pre-diploma programmed. It is a unit that is actively involved in nationwide outreach by visiting schools and community centers. The main objective of this study is to develop animated pedagogical agents (APAs) and analyze motivational factors among youth perceptions through this application. This application is an animated on-screen character that assists learners in multimedia learning environments, and it is used in this to make the application more interactive by assisting the user throughout the questionnaires. Aside from APA, sound effects are also used as a form of feedback such as when users click on the choices of answers given. Some visual images related to the questions are also added to give further understanding of the questions to the respondent. In addition, the visual images are used to grab users' attention for more engagement. A software called Unity is used to develop this application from scratch, converting paper-based surveys into an application with interactive animations. This application is compatible with Android devices version 4 and up to the latest version but not compatible with the iOS version yet. Therefore, this study proposes an animated agent-based virtual instructor to be embedded in the survey apps. This will create a responsive environment in every survey session. The statistical analysis began with descriptive analysis and later continued with inferential analysis.

Keywords: Mobile Application, Animation, Agent-Based, Motivation, Higher Education, Inferential Analysis

Introduction

The different techniques used in collecting data give a different result. Studies of questionnaires mode and its effects have been conducted by many researchers. Different modes, including pen-and-paper, electronic, telephone, and face-to-face interviews demonstrated various relationships between questionnaire mode, content, type, and subjects' responses (Tourangeau et al., 2000). As a matter of fact, answering a question requires subjects to perform the following tasks: interpret the question and understand its meaning; generate an opinion or reflect on past behaviors (typically like memory recall); communicate and edit responses (Schwarz, Strack, Hippler, & Bishop, 1991; Tourangeau, 1984). It is found that the questionnaires mode often impacts efforts related to the tasks (Tourangeau et al., 2000).

Universiti Teknologi MARA (UiTM) has a special programmed called as The Program Pra Pendidikan Tinggi (formerly known as The Mengubah Destini Anak Bangsa), (MDAB) (or translated as *Office for Changing Destiny of Nations' Children Programme*) in June 2010 and renamed to Pejabat Programme Pra Pendidikan Tinggi (PPT) (or translated as *Office for Pre-Higher Education Programme*) in May 2019. The main objective of this office to help and provide a second chance to underprivileged Malays to enroll into institutions of higher learning through the pre-diploma and diploma courses. In the year 2021, the PPT conducted hundreds of visits and talks. In prior to the visits, the facilitators need to understand each group of teenagers that they are meeting up. It is important to understand their perceptions and motivation factors which can help to increase the effectiveness of the outreach program. This will also help PPT to conduct tracer studies of their students.

However, conducting survey using paper-based questionnaire can be costly. It involves data collection, data entry and analysis. Paper-based also limits the spectrum of motivation-related perceptions. Broader spectrum means more elements needs to be gauged. The questionnaires could be lengthy, and the session could turn up as a boring session. Another challenge is on the data entry. Data entry is also costly as longer time will be consumed and it also prone to errors.

This leads to the need of mobile web-based survey questionnaires. An automated and dynamic set of questionnaires is highly required. Apart from that, an interactive survey session must be created between the respondents and the survey apps. Therefore, this study proposes an animated agent-based virtual instructor to be embedded in the survey apps. This will create responsive environment in every survey session.

Literature Review

Animated Agent Animated agents with affective behaviour are already used in various application domains. They perform as virtual tutors in interactive learning environments (e.g., Johnson et al., 2000), as virtual presenters on the web (André et al., 2000; Ishizuka et al., 2000), and as virtual actors for entertainment (Rousseau and Hayes-Roth, 1998) and language conversation training (Prendinger and Ishizuka, 2001). Agent-based system create an environment where users able to get involved in interaction. They are being stimulate and gain courage to respond that like the ones in their daily. Animated agent should be generated with a consideration into the interaction between human beings and computers, and pedagogic elements. An animated pedagogical agent is an animated character that lives in

computer-based learning environments and helps students by guiding or instructing them (Choi & Clark, 2006). A graphical representation of animated agent are used to provide a more customized interaction between human beings and computers (Morton and Jack, 2005). These agents might play a role as a presenter (Granström & House, 2005), real estate agents (Granström & House, 2006) teaching guide (Morton & Jack, 2005), and a virtual reality assistant (Dehn & Van Mulken, 2000), sales representatives; (Morton & Jack, 2005) and many others. Web-based distance education environments with animated agents are representatives of such an approach. Research shows that human-like animated agents are more influential in attracting users' attention and enabling them to focus on active tasks than those that are not human-like (Dehn & VanMulken, 2000). One of the greatest advantages of animated pedagogical agents is that they can motivate and entertain students at a higher level than any other learning environment and that they can encourage them to make efforts to understand the learning material (Choi & Clark, 2006.), (Kim et al., 2007). Similarly, Moreno, Mayer, and Lester (2000) conducted a series of studies on the social roles of 4 animated agents in learners' motivation and performance. They discovered that animated agents had a positive influence on students' motivation and information recall levels.

Methodology

Application Development

The ADDIE model that consists of five phases : Analyze, Design, Develop, Implement and Evaluate as shown in Figure 1 below was used in this study. According to Serhat (2018), the ADDIE model was based on an earlier ID model, the Five-Step Approach, which had been developed by the U.S. Air Force but retained this five-step feature and included many sub-stages within each of the five broad phases (Serhat, 2018). Due to the hierarchical structure of the steps, one had to complete the process in a linear fashion, completing one phase before starting the next.

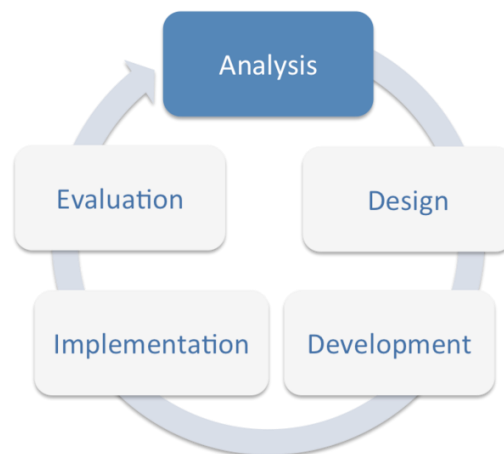


Figure 1: Process of Development of the Application

The first phase, Analysis Phase, is where all the brainstorming and planning takes place which can also be considered as the "Goal-Setting Stage". Ideas are drafted and created regarding what kind of application this project will develop, who are the target audience and what are the software and hardware requirements needed.

The second phase which is the Design Phase is where the designing takes place where storyline, storyboard, vector animation design, animating vector, and the duration of animation is designed and discussed, and choosing the best sound effects to be used to ensure the application is interesting and engaging. The question for the survey is also designed in this phase to determine what the most suitable questions and answers are to be directed to the target audience and how many sections will there be.

The development phase which is the third phase in this model is the major process that involves the creation of the application and the animation as well as insertion of voice for the APA used and sound effects. A software called Unity is used to develop this application from scratch, converting paper-based surveys into an application with interactivity. Unity is a cross-platform game engine and can be used to create 3D, 2D, virtual reality, and augmented reality games, as well as simulations and applications. The APA is also created in this phase inside Unity to increase student motivation and engagement.

There are a few types of APA used in multimedia learning environments nowadays such as navigational guidance and nonverbal feedback (Johnson et al., 2000) but in this project, Conversational Signals and Conveying and Eliciting Emotion are used. Conversational Signals produce speech output that reads the questions, provides feedback, and guides the students throughout the survey whereas Conveying and Eliciting Emotion provides emotions as feedback to convey excitement and thereby foster similar enthusiasm in the students to keep answering the questions. By carefully adapting facial expressions, animated pedagogical agents could give encouragement, convey empathy, and perhaps increase motivation for the students. For example, a happy expression is portrayed every time the student answers a question that could instill a form of achievement in them. According to Johnson, Rickel, and Lester in their research, engaging and lifelike pedagogical agents that are visually expressive could have a strong motivating effect on students thus making it more entertaining (Johnson et al., 2000). Aside from APA, sound effects that are used are a form of feedback to increase student's engagement and motivation (Ligthart et al., 2020). For example, when students click on the choices of answers given or when they have completed the survey. This form of feedback can also increase students' engagement and motivation to continue compared to using a static paper-based questionnaire.

The implementation stage reflects the continuous modification of the program to make sure maximum efficiency and positive results are obtained. After the application is developed and voice and sound effect is inserted, the application is tested, and video testing is done. If there are any bugs and errors or there is any need for an enhancement to the application, the phase will move back to the development phase to further enhance the application and do the fixing. And lastly, the video is processed and combined into one.

The last phase, which is evaluation, is where the data from the survey is collected and stored in an online database called Firebase. It is an easy-to-use real-time database that can be synced and used across all platforms whether on mobile or web (Stevenson, 2018). Once the user reaches the last question of the questionnaire and clicks on submit, all the data is directly synced and stored into the Firebase Realtime Database. The data collected can be viewed in Firebase or can also be downloaded and converted as an Excel file to make it easier for data analysis.

The installation of this application is quite easy for users to understand and install on their mobile phones but currently, the application is only available for Android devices and not yet available for iOS users. Users will be given the APK file of the application and can directly begin installing it. Users will be prompted with the question once they click to install the APK file. And once it is successfully installed, the user will be directed to the main page of the app directly and can start answering the survey.

Statistical Analysis

The purpose of the software application was to conduct online survey interactively and the collected survey data would then be interpreted to gain valuable information. The survey was distributed to 41 students from any school with the intention of doing a pilot study. They had to download the application and install it on their own devices before being able to use the app.

The analysis began with descriptive analysis and later continued with inferential analysis. The former one was purposely done to gain foundation information which provides summary statistics that can quantitatively describe the sample data. In addition, it can help in finding emerging patterns from the data. Meanwhile, the latter analysis can help in providing inference on underlying distributions of the data. With the smaller sample size, it can be used to infer a bigger population of the same properties.

The survey questionnaires have 3 parts, A, B, and C. The first one covers demographic aspects, followed by motivation aspects in part B and the last one includes respondents' opinions on the application's interactivity. Given that there are 3 parts in the survey questionnaires, parts A, B, and C, the descriptive analysis was conducted on every sample data available. For example, of part A, which focuses on respondents' demographics, the analysis can show the average age of students who have participated or the most number of students who came from families of lower-income category. For parts B and C (Table 1), which deals with a Likert scale of 1 to 5 items, the analysis can simply reveal the average score of each question.

Table 1: Elements of Questionnaires Given to Survey Respondents.

Part	Aspect	Question
B Aspirational and Motivational Factors for Students to Pursue their Studies at Higher Education Institution	Physiological Needs	To get a better job
		To buy food and clothes
		To improve family wellbeing
		Education and continuing study are important
		To get better pay
	Safety Needs	To secure a permanent job after completing studies
		To seek a better life in the future
		To be a good example for siblings
		To avoid being left out from friends whom continuously strive for success
		To avoid being a bother to others
	Social Needs	To avoid living a boring life
	To participate in association activities	

Part	Aspect	Question
		To meet more people and friends
		To be acknowledged by teachers
		To be acknowledged by other people and friends
	Self-esteem Needs	To increase self-confident
		To seek new knowledge
		To seek appreciation from others
		To seek respect from others
		To get academic recognition and award
	Self-Improvement Needs	To increase potential development
		To fulfil dreams and achieve personal goals
		To understand personal strengths and weaknesses
		To increase social status
		To build wealth in the future
C	Interactive Animation	Have you ever heard of interactive animation
		Have you ever used an animation application
		Do you think this animation application easy and interesting to use
		Do you feel that this animation application makes you want use and eager to answer the following questions?
		Do you think that this animation application interactive
		Do you think that this animation application suits your age
		Do you think that this animation application needs more graphics and illustrations?
		Do you think that this animation application gives a positive experience to your studies
		Do you think that this animation application increases your knowledge in information technology
		Do you recommend using this kind of this animation application to your friends?

Next, for inferential analysis (Figure 2), the sample data was tested with some statistical tests to find any differences between genders in a certain aspect of motivation. Due to the small sample size, the Mann-Whitney test was used to test for significant differences between genders. Furthermore, Wilcoxon-Signed Rank Test and Kruskal-Wallis test were also done to

deal with different sizes of comparison groups. All these inferential tests were conducted using IBM SPSS version 26.

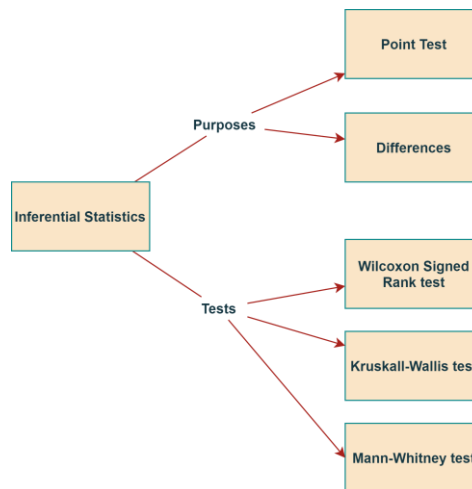


Figure 2: Inferential Statistics

Result and Discussion

Development of the Application

As mentioned previously in methodology, the last phase is where the evaluation is done, and the results and discussions are obtained. Once the application is fully developed, the users are asked to answer the survey using the application. The purpose of this evaluation is to determine whether students will be more engaged in answering the survey when using the application containing the APA that acts as a guide for them along the way.

After users have finished answering the survey, the results are stored in an online database called Firebase that is linked with the application. Firebase is an easy-to-use real-time database that can be synced and used across all platforms whether on mobile or web (Stevenson, 2018). Thus, since this application is being used in mobile, Firebase is the best choice. Once the user reaches the last question of the questionnaire and clicks on submit, all the data is directly synced and stored into the Firebase Realtime Database. The data collected can be viewed in Firebase or can also be downloaded and converted as an Excel file to make it easier for data analysis. Firebase also supports collaboration with other team members online with just an invitation so that it will be easier for team members to manage and analyze the data stored.

For member invitation, it is as simple as inviting team members through email. Team members can accept the invitation and will be directed to the project dashboard in Firebase. Each value beside the '+' symbol represents one user using the application and contains all the answers submitted by that particular user. Firebase users who have access to the project can view, edit or even delete the data submitted.

Once sufficient data is received, the user can export this data submitted into JSON format and convert it into Excel for better data analysis.

The installation of this application is quite easy for students to understand and install it in their mobile phones but currently, the application is only available for Android devices and

not yet available for iOS users. Users will be given the APK file of the application and can directly begin installing it. Users will be prompted with the question shown in the figure below once they click to install the APK file. And once it is successfully installed, the user will be directed to the main page of the application directly and can start answering the survey.

Statistical Analysis

Subsequent to the development of the software application, study analysis was done to demonstrate quantitative evaluation on the survey dataset.

Table 2: Summary Statistic

Aspect of Motivation	Count	Average	Standard Deviation
Physiological needs	30	4.00	1.08
Safety Needs	30	4.06	1.02
Social Needs	30	3.97	1.14
Self-Esteem Needs	30	3.92	1.20
Self-Improvement Needs	30	3.84	1.18
Interactive Animation	30	4.03	1.08

From the descriptive analysis that has been done (Table 2), the respondents can be observed to agree on every aspect of the questionnaires with acceptable response consistency, given that all of the standard deviations are below 1.25.

A Wilcoxon Sign-Ranked test (Table 3) was conducted to test for the significance of median for the questionnaire element “to secure a permanent job after completing studies”. Furthermore, it tested for a hypothesized median of 4.00.

Table 3: One-sample Wilcoxon Signed Rank Test Summary

Total sample size, N	30
Hypothesized median	4.00
Standardized	-0.876
p-value	0.381

The one-sample test’s result from Table 3 has a p-value of 0.381 which is greater than the critical value of 0.05 and this concludes that there is sufficient evidence to show that the responses regarding permanent job security after completion of studies has no significant difference against the median of 4.00.

A Mann-Whitney comparison test (Table 4) was performed to know the difference of opinions between genders for the questionnaire element “Do you think that this animation application gives positive experience to your studies”.

Table 4: Independent-samples Mann-Whitney test summary.

Total sample size, N	30
Standardized test statistic	2.71
p-value	0.007

The test's outcome as shown in Table 4 has a p-value of 0.007 which is lower than the critical value of 0.05 (5% significance level) and this indicates that there is a significant difference of opinion between genders regarding the positive experience impact of the software application to the studies.

A test was conducted (Table 5) to reveal a significant difference between groups of family income for the questionnaire element "to get better job" in the aspect of physiological needs. These small groups of respondents would be of different sizes and for being independent amongst them, the Kruskal-Wallis test was performed. Kruskal-Wallis test has come out with a result on the difference amongst the respondent groups regarding questionnaire element "to get better job" in the aspect of physiological needs with p-value = 0.39 which appears to be insignificant, setting a significance level of 5%.

Table 5: Result of Kruskal-Wallis test.

Total sample size, N	30
Test statistic	4.118
Degree of freedom	4
p-value	0.39

Table 6: Summary of survey distribution and response.

Questionnaires	Count
Distributed	41
Responded	30

From Table 6, it shows that the response rate is 73.17% and surpasses the 32.8% response rate using the web-push method (McMaster et al., 2017). The former one is considered as a quite high rate given that the application was distributed to target respondents, and they had a choice to proceed with the survey or leave it (Willott, 2019). This can be significant due to respondent relationships with the sender of the survey as with this application, teachers were the middle persons to distribute the application.

In a nutshell, the survey questions were all easily assessed and analyzed. Meanwhile, the respondents have shown solid agreement upon all given questions and most importantly, the survey, which was done through animated agent application has shown substantial success for having a high response rate.

Conclusion

In conclusion, the proposed animated pedagogical agent (APA) by the mean of software application was successfully developed using ADDIE (Analysis, Design, Development, Implementation and Evaluation) development model and it could be installed in any mobile device platform except iOS models. This could facilitate researchers to collect survey data from anywhere including remote areas where internet access was yet to exist.

Moreover, the data collected from a test run using the app has shown that the respondents were satisfied with their experience using the animated application. In addition, the acquisition of the data using the survey app was smooth and it could be transferred to and further analyzed statistically using other analysis tools. However, to allow for wider use, efforts need to be made to enable it to be adopted by iOS users.

Finally, the concept of developing the software application is recommended to be applied by researchers of various fields as it can be easily maintained by developers and can also be entertaining to respondents, thus increasing the survey response rate and data analysis will be at ease.

Acknowledgement

The present work was financially supported by the UiTM-SDG Pulau Tuba for the grant 600-RMC/LESTARI SDG-T 5/3 (117/2019)

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