Students' Perception on Putra Fizik Mobile Application as A Complementary Teaching and Learning Tool for Physics Education

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Abstract- Mobile applications are increasingly being utilized as useful teaching and learning tools among educators and students. This paper discusses the student's perception of PutraFizik mobile application (Beta version) developed specifically for the first-year undergraduate students enrolled in the course ESC 3013: Environmental Physics. This web-based mobile app was written in IONIC framework and edited in GitHub Atom. The app contains mathematical problems, multiple choice questions and crossword puzzles to encourage students to learn and understand concepts in Physics. A survey was distributed among 64 students to assess their perception of the mobile app of which 37 students responded. Descriptive analysis reveals that the overall students' satisfactions are in the range of 4.11-4.43 (S.D. = 0.67 – 0.83) for all four factors, namely fun, ease of understanding, motivation and usefulness, This indicates that students are satisfied with the app as a complementary teaching and learning tool for Physics education.
Keywords: Mobile application, Teaching and learning tool, IONIC, Physics education.

Introduction

Mobile phones are becoming more affordable to the masses with greater functionality and connectivity [1]. A report by App Annie states that an estimated 194 billion mobile apps were downloaded in the year 2018 alone [2] highlighting the ubiquity and pervasiveness of mobile technology throughout the society. Mobile apps are increasingly seen as attractive and valuable teaching and learning (T&L) tools due to their connectivity, which can extend beyond classrooms, and breadth of functionality available to users [3]. Therefore, it is not uncommon for educators and students to utilize popular apps such as Facebook and WhatApp to enhance teaching and learning experiences as discussed in [4]. Recently, however, the proliferation of mobile apps development platforms and frameworks, such as XCode, React and Angular, has made it more appealing for people, even the ones with limited experiences and skills, to develop their own apps with unique functions and purpose.

Educators too are no exception to this trend. For instance, Zhalgasbekova [5] et al. created a simple app specifically for learning Physics and Mathematics using the Xcode integrated development environment (IDE). The app, however, contains only notes as it is meant as a reference and study guide only. On the other hand, Gonzalez et al. [6] developed several sophisticated apps meant for in-depth learning of fundamental concepts in Physics. Their apps allow students to simulate Helmholtz coils, electric circuits and capacitors, as well as to collect GPS data to study motions and trajectories. In contrast to Zhalgasbekova's contribution, Gonzales et al. carried out a survey among their students to gauge their perception of the apps created for them. Results from their study suggested that students are satisfied with using those apps to help them study concepts in Physics.

In line with the current enthusiasm among educators for customized education app, a mobile app called PutraFizik was created specifically for 64 first-year Bachelor of Environment Science and Technology (BEST) students enrolled in the course ESC 3013: Environmental Physics, in Semester 1, Session 2018/2019 academic calendar. The concept and design of this app will be discussed in great detail in section 2: Materials and Methods. Similar to other studies, a survey was conducted in order to assess students' satisfaction of this app which is the main objective of this paper. The survey is crucial to gauge how well the app is received by the students, who are the end user of the app.

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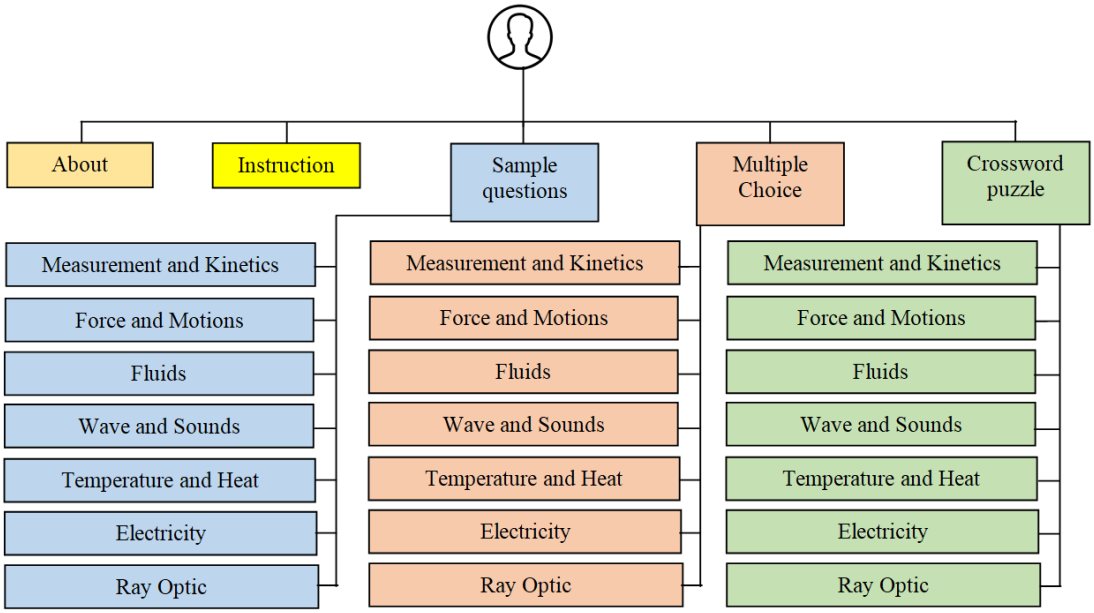


Figure 1. PutraFizik app version 1.0.1 user experience (UX) diagram.

Materials and Methods

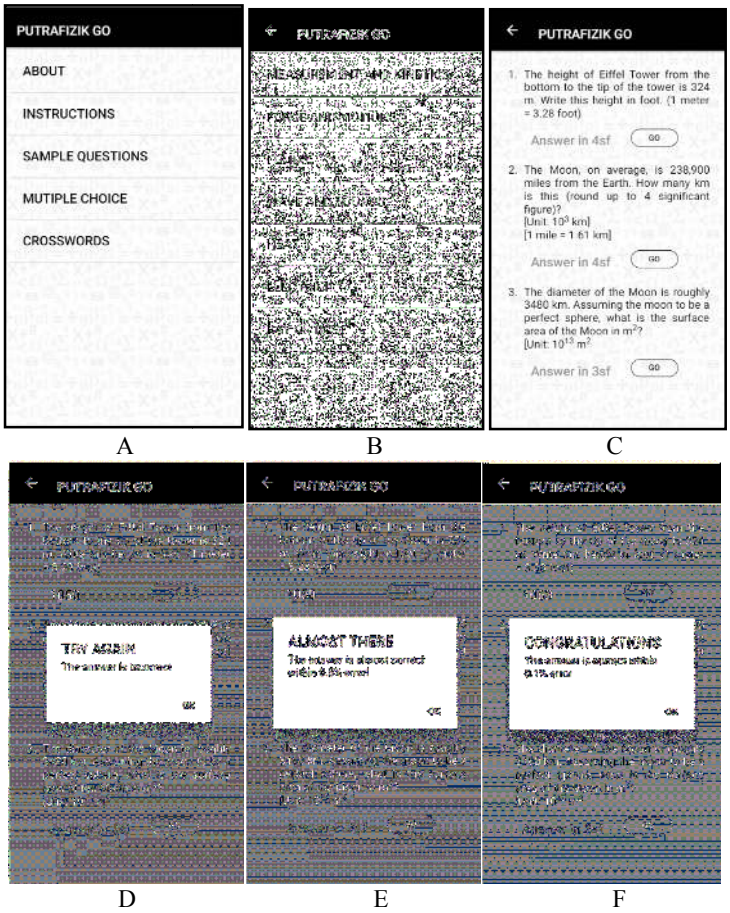
2.1. The concept of PutraFizik app

Solving mathematical problems is arguably one the most common methods of assessment in physics and engineering courses, whether given to the students as test questions or homework assignments. It is thought that this method of assessment is essential in developing students' problem-solving skill, which is widely regarded as highly important in the field of science, engineering and technology. However, this method of assessment is also identified as the one many students struggle with, as extensively reviewed by Ince [7]. Acknowledging the challenges and struggle faced by many students to solve mathematical problems, Reddy and Panacharoensawad [8] recommended Physics educators to give students adequate exercises in the form of homework assignments and mock tests. Therefore, PutraFizik app is created as an innovative and enjoyable approach to encourage students to solve mathematical problems in the Physics course.

2.2. Development and design

The app was developed in IONIC (HTML5) framework which is a widely-used, open-source, front-end focused user- interface (UI) toolkit with Angular integration [9]. Three standardized core web technologies namely HTML, CSS and Javascript (Typescript) were used to write the app. GitHub Atom was used as the text editor while Cordova was used for compiling. DevApp mobile app was used to test the app in mobile devices.

Figure 2. The splash screen of PutraFizik app.



A B C

D E F

Figure 3. Selected screenshots of PutraFizik app

The design of this app can be explained in terms of the UX diagram (Figure 1). On the "Home" page, a user (student) will find five options to choose from, namely, "About," "Instruction," "Sample questions," "Multiple Choice" and "Crossword puzzle." The "About" and "Instruction" pages give the user some information about the app and how to use the app, respectively. On the "Sample questions," "Multiple Choice" and "Crossword Puzzle" pages, a user will" find seven topics in Physics to choose from, which were the same topics covered during the lecture. Mathematical questions, multiple choice questions and crossword puzzles for each topic can be found on each respective page.

2.3. Appearances and features

Selected screenshots of this app are shown in Fig. 2 and 3. After launching the app, a user will find five options to choose from, as explained in the previous section (Figure 3A). If the user clicks either "Sample questions" or "Multiple Choice" or "Crossword Puzzle," the user will find seven topics to choose (Figure 3B). In a situation where a user wants to solve mathematic problems for "Measurement and Kinetics" for example, the user needs to click the text button which will allow the user to see mathematical problems prepared for the topic selected by the user (Figure 3C). In order to answer the question, the user needs to type the answer in the provided form and click the "GO" button to check for the correct answer. An alert dialog box will pop up to notify the user on whether the given answer is right or wrong. If the TRY AGAIN message appears, the app is notifying the user that the given answer is wrong (Figure 3D). If the AMOST THERE message appears, the app is notifying the user that the given answer is almost correct (Figure 3E). In this case, the given answer is within 0.5% deviation from the correct answer. If the CONGRATULATIONS message appears, the app is notifying the user that the given answer is correct within 0.1% deviation from the correct answer (Figure 3F).

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2.4. Assessment of students' perception

A survey is one the most preferred tools to assess students' perception on the use of a mobile app as a complementary T&L tools [5, 11]. There were four factors considered in the assessments, which were, fun, learnability, motivation, and usefulness. The survey instrument contained 10 questions as shown in Table 4 in the Appendix. Each question measures a specific factor; Question C1 and C5 (fun); Question C4 and C6 (ease of understanding), Question C7 and C8 (motivation); and Question C2, C3, C9 and C10 (usefulness). It is important to note that four questions were constructed to measure "usefulness" because this factor is considered the most important. These questions were not grouped according to their factors; instead, they were randomly placed on the page of the survey as recommended by [12]. The participants' perceptions were assessed with a 5-point Likert scale (strongly agree as 5; agree as 4; slightly agree as 3; disagree as 2; and, strongly disagree as 1).
This survey was conducted by using the convenient and purposive sampling techniques [13]. The target respondents were from the same first-year BEST students enrolled in course ESC 3013 in Semester 1, Session 2018/2019. Course ESC 3013 is one of the core courses in the BEST program. The survey instruments were delivered and self-administered by respondents on the last day of the semester to allow the students to use the app for the whole semester (14 weeks). The data obtained from this survey was analyzed using descriptive analysis. The results attained from the survey were interpreted based on the satisfaction scale shown in Table 1, which was adapted from [14] and [15].

Table 1. Satisfaction scale used for interpretation

Mean Score, M	**Level**
$1.00 \leq M \leq 1.50$	Extremely Dissatisfied
$1.51 \leq M \leq 2.50$	Dissatisfied
$2.51 \leq M \leq 3.50$	Slightly Satisfied
$3.51 \leq M \leq 4.50$	Satisfied
$4.51 \leq M \leq 5.00$	Extremely Satisfied

Results and Discussion

Out of the 64 students who enrolled in this course, 48 voluntarily participated in the survey. Eleven (11) responses were removed due to missing answers. Therefore, only the data received from 37 respondents was qualified to be analyzed which represented 57.81% of the whole class population. Among the 37 respondents, nine were male students, 27 were female students and one respondent did not reveal his or her gender.
Table 2 shows the results obtained from the survey. It can generally be observed that a significant number of the respondents answered "strongly agree" for every question in the survey. This is especially true for factors "fun," "motivation," and "usefulness." The highest number of respondents to choose "strongly agree" is noted for question C10 (usefulness) while the lowest is noted for question C4 (ease of understanding). In fact, for questions C2 (usefulness) and C4 (ease of understanding), the number of respondents that chose "strongly agree" are slightly higher to that of "agree." Besides this, ten number of respondents selected "slightly agree" for questions C4 and C6 (ease of understanding) which are higher than other questions. On the other hand, the lowest number of respondents that chose "slightly agree" is observed for question C1 (fun) even though at least one respondent chose "slightly disagree" for the same question.

Table 2. Results from the survey

Factor	**Ques.**	**Score**				
		1	**2**	**3**	**4**	**5**
Fun	C1	0	1	3	13	20
	C5	0	0	7	11	19
Ease of Understanding	C4	0	0	10	13	14
	C6	0	0	10	10	17
Motivation	C7	0	0	6	12	19
	C8	0	0	7	10	20
Usefulness	C2	0	0	4	15	18
	C3	0	1	4	11	21
	C9	0	0	5	11	21
	C10	0	0	6	9	22

A reliability test is needed to examine the internal consistency of all the measured items in the survey. Arguably, the most commonly used parameter to measure internal consistency is the Cronbach Alpha (α) [16], which is given by the following equation [17]:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{1}{S_T^2}\sum_{i=1}^{K} s_i^2\right) \quad (1)$$

where K is the number of items

s_i^2 is the variance of ith item

S_T^2 is the variance of total score

Based on the results obtained from the survey, the calculation above reveals a score of α = 0.962 which is within the satisfactory range of 0.58 – 0.97 suggested by [16].

Table 3. The mean score (M) and standard deviation (SD) for each factor and question

Factor	Ques.	M ± S.D	Satisfaction Level
Fun	C1	4.41 ± 0.75	Satisfied
	C5	4.32 ± 0.77	Satisfied
Ease of Understanding	C4	4.11 ± 0.80	Satisfied
	C6	4.19 ± 0.83	Satisfied
Motivation	C7	4.35 ± 0.74	Satisfied
	C8	4.35 ± 0.78	Satisfied
Usefulness	C2	4.38 ± 0.67	Satisfied
	C3	4.41 ± 0.79	Satisfied
	C9	4.43 ± 0.72	Satisfied
	C10	4.43 ± 0.75	Satisfied

Table 3 highlights the mean score received from the survey for each factor and question which was calculated based on results in table 2. As can be observed in the table, none of the questions scored less than 3.51 and greater than 4.50 which indicate that all scores are within the "satisfied" level. The results are consistent with the findings reported by Gonzalez et al [5] which suggested that students participating in their study generally agreed that mobile applications are useful teaching tools for helping university students to learn Physics. Besides, they also reported that students generally felt encouraged to learn more about physics after using the mobile applications. Interestingly, the satisfaction levels achieved in, which ranged between 2.4 to 3.8, were less than what were achieved in that study, which ranged between 4.11 and 4.41.

Closer inspection of the survey results reveals that the highest mean score is achieved for questions C9 and C10 (usefulness), while the lowest mean score is achieved for question C4 (ease of understanding). In general, questions C4 and C6 (ease of understanding) scored relatively lower than questions C2, C3, C9 and C10 (usefulness). This result could indicate that, while the majority of the respondents agreed that the app is useful to help them learn Physics, a small number of the respondents were less inclined to agree that the app made their learning process easier. The lowest mean score achieved for question C4 might suggest that the students may have considered other methods of teachings, such as reading Physics textbooks to be as equally important as using the app to help them learn Physics. These results are somewhat expected since the main intention of creating this app is to complement the main textbook used in this course. As described in the methodology, students can only find mathematical problems, multiple choice questions and crossword puzzles in the app. Much of the information presented in the textbook was not added in the app. Therefore, students still needed to refer to the textbook for definitions, formula, explanations and examples.

Furthermore, it could also be possible that some of the students might not be interested or comfortable with the idea of using an app to learn Physics. As discovered by Ismail et al. [18], among 551 students in 11 public universities in Malaysia who participated in their study, a significant number of the respondents reportedly were still "moderately ready" for mobile learning. Additionally, they also found that the respondents were "moderately aware" of the importance and benefit of mobile learning. However, they demonstrated an interest to learn or know more about mobile learning. Similar findings were also reported by Shuib et al. [19], among 68 students of English language learners in public universities in Malaysia, and Mahat et al [20], among 210 students in the Faculty of Education, who concluded that the mobile learning concept is still relatively new in Malaysia and students prefer to use mobile phones primarily as communication tools as opposed to educational tools. As cautioned by Cheon et al. [11], students' comfort level with technology and digital readiness must be taken seriously by educators who want to implement m-learning effectively in their teachings.

On the other hand, the high scores achieved for questions C1, C5 (fun), C7 and C8 (motivation) are not surprising. As noted in several studies, many students consider learning with mobile phones as enjoyable and something that further motivates them to study [21, 22]. This is especially true among young adults since they are avid users of smartphones and spend long hours with their smartphones as mentioned earlier [4]. The same

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sentiments are also shared by educators. For instance, Craciun and Bunoiu [23] reported that the participants in their studies, who were pre-service science teachers in Romania, agreed that mobile applications with augmented reality (AR) could stimulate and motivate students to explore and review their teaching materials. These results are also expected since the app is intended to be a fun and enjoyable tool to learn Physics as described earlier in Section 2.1 (Methodology). During the semester, several students verbally expressed their thought about the app as something they have not encountered or experienced in other courses. This uniqueness of the app compelled them to learn Physics by challenging themselves to find the correct answers for all the questions prepared in the app.

Finally, even though the results from the survey reveal that the Putra Fizik app has achieved satisfactory levels among the participating students, this does not mean that more further work will not be done is unnecessary to improve the quality of the app. Furthermore, the effectiveness of the app needs to be measured not just in terms of students' perception, but also in terms of usability, service quality, user satisfaction and performance. Adopting or developing a different set of instruments might be necessary to measure the quality of the app as an effective complementary T&L tool for learning Physics.

Conclusion

The Putra Fizik app was developed in this study as a complementary T&L tool for students to learn physics. This mobile app contains mathematical problems and multiple-choice questions with hidden answers which are aimed to help the users to polish their understanding of the Physics subject. The assessment conducted in this study reveals that the Putra Fizik app is fun, able to help students in understanding the topic better and is able to motivate students to become active learners who are engaged in the learning process. This app is flexible in the sense that the questions can be modified for other courses such as chemistry, biology and mathematics. Since the framework of the app is completed, the modification can be made without altering its main framework. It is hoped that the concept and design described and elaborated in this paper will help and inspire other researchers and education technologists to develop their own mobile apps for their respective teaching activities in class. For future work, a usability test will be conducted to assess other qualities of the PutraFizik app, such as usability and performance. In addition to that, developing instruments for assessing the effectiveness of such an app would also be necessary.

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Appendix

Table 4. Questions for measuring students' perception on the effective-ness of PutraFizik mobile application as a complementary T&L tool to learn environmental physics

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
No.	Question	1	2	3	4	5
C1	I enjoy using this app in this course					
C2	I wish this learning method can be incorporated in other course					
C3	This app is useful for this course					
C4	I understand this subject better with this app compared to other methods of teaching					
C5	The learning session is more enjoyable with this app					
C6	I can understand the subject more quickly with this app					
C7	I became more interested to learn in this course with this app					
C8	The app encourage active learning					
C9	The app helps me to retain my knowledge longer					
C10	The app enhances my knowledge in this course					