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Using Technology to Overcome Challenges in Physics Education: Insights From a Quiz App Study

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Abstract

Physics has often been perceived as a challenging subject due to its abstract concepts and rigorous mathematical demands. This complexity can lead to a lack of motivation and poor performance among many aspiring physicists and science enthusiasts. Technology offers an innovative solution to these challenges through quiz apps, such as the Researcher-Designed App used in this study. Four research objectives were pursued and achieved by randomly selecting 50 respondents for an online survey and conducting interviews with an additional 10 stratified respondents to gain insights into their experiences with the app and its effect on their learning motivation and improvement. The quantitative data were analyzed using descriptive and inferential statistics. The findings showed that the quiz app positively influenced students' motivation, and they enjoyed using the app, appreciating its easy and simple interface, recognizing academic benefits, and feeling more motivated to study. The gamification elements in the app increased students' enthusiasm and engagement, making it easier for them to understand difficult concepts. Based on the findings, several recommendations were made: the app should be widely adopted in educational settings, similar apps should be developed for other subjects, and necessary stakeholders should provide training for teachers and students to maximize the benefits of such tools in learning environments. It was concluded that the quiz app significantly impacted physics students' motivation and there was a high level of student engagement with the app as a supplementary learning tool.

Keywords: *physics education, Quiz app, Challenges, Technology and learning improvement*

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1. Introduction

Education serves as a social institution that provides its members with essential knowledge, including fundamental facts, professional skills, cultural norms, and values. It enhances personal lives and contributes to the smooth operation of society by maximizing individuals' inherent potential, Abulibdeh *et al.* (2024). According to Ogungbesan (2012), science education and learning in Nigerian schools began in 1878. Science was first taught in secondary schools as general science to classes one and two in the secondary schools, then biology, chemistry, and physics to upper classes

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three, four, and five. This comprehensive science, however, lasted until 1970, when Integrated Science, now known as Basic Science, was created as a foundation to express the underlying unity of scientific thought Alhashem and Agha (2020); Vázquez (2006).

Physics is a subject that most students find difficult, therefore having a positive attitude toward learning is crucial to success (Ayasrah *et al.* 2024; Oladejo *et al.*, 2023). The results of their studies demonstrated that students react favorably or positively to learning physics through motivation. However, the students' performance in physics is found to be lacking. According to the Pearson correlation study, there is a significant and unfavorable link between students' attitudes toward learning and their performance in physics. It demonstrates unequivocally that physics achievement and physics attitude are unrelated. It is possible for students to receive good grades in physics without having a favorable or positive attitude toward learning physics, and vice versa (Kohl and Finkelstein, 2006; Kessels *et al.*, 2006).

Together with the shifting conditions of the outside world, physics education is continuously evolving. Therefore, for the lectures to be effectively learned, new learning media must be developed in educational programs that are always improving, and students' attitudes toward physics lessons and physical experiments must be determined in the choice of learning materials and methodologies. Attitudes are crucial in shaping how people behave because they relate to managing the emotions that arise during the learning process. Whether attitudes are good or negative when they are part of a system of values and beliefs, they directly affect learning and have an impact on how people will live in the future (Basarkod *et al.*, 2024).

Assem *et al.* (2023), Students' attitudes toward physics, their perceptions and beliefs about the subject, and their study habits, including tendencies to procrastinate, significantly impact their performance. A student's attitude towards a subject can greatly influence their academic success or failure in that area. Musasia *et al.* (2012) conducted experiments aimed at altering students' attitudes towards studying physics. For students to adopt more optimistic attitudes, activities must be structured, planned, and carried out. To assess students' attitudes toward the natural sciences, a variety of attitude scales have been devised. Hewitt, Oliver and Simpson, and others have discussed these scales. Several authors have created attitude scales for physics courses, physics labs, and science lessons, including Vlachos *et al.* (2024); Madsen *et al.* (2015); Zacharia (2003).

Physics has a significant impact on all aspects of our lives, from technology to industrial development, job creation, and enhanced health (Davarcioğlu, 2018; Kaku, 2012). The benefits of physics research to society are numerous and are not all covered in this essay. There may be more potential to create helpful technology as our capacity to alter physics grows. It is crucial for both the Federal Government of Nigeria and private industry to invest in fundamental research in physics. This investment will enable physicists to make discoveries and inventions as significant as those achieved in the past; Babalola (2017). The low level of industrial development in Nigeria today is not unconnected to the poor funding of research in physics and other branches of science. The benefits of research funding are not always within sight, new discoveries often have far-reaching consequences that can affect everyone, and their potential impact is unpredictable. Take, for example, J.J. Thomson's discovery of the electron in 1897. At the time, it might have seemed like a waste of money to conduct experiments on such an imperceptible particle. However, today, our civilization heavily relies on electronics, illustrating how crucial that seemingly insignificant discovery has become. We must start making improvements to our funding of science research, especially in physics if we hope to become a developed country. Failure or delay is risky since it will become increasingly difficult for the nation to provide the population's most fundamental demands. The ability to read and write, ideally in Latin, was the key to success in medieval times. A scientific education is now very important, and physics is a crucial subject; Bao and Koenig (2019).

In Science, Technology, and Society, Our lives are increasingly dependent on science and technology, with rapid advancements occurring in these fields. While science and technology may not provide all the answers, they are essential in driving social and economic progress, thereby improving our quality of life. According to the National Research Council (2020), Center for Science, Mathematics, Engineering Education, and Committee on Development of an Addendum to the National Science Education Standards on Scientific Inquiry, these advancements play a critical role in our society; everyone agrees that scientific education and awareness need to be improved. The dissemination of science, advances in the classroom, and accurate scientific information are all crucial concerns. Outreach efforts should target decision-makers and politicians as well. Physics Education - A Bedrock of Healthy Society and Sustainable Development (Amusa, 2015). It is an undeniable fact that without relying on the use of technologies created as a result of the principle of physics and knowledge of physics education as the driving force, all medical and paramedical practitioners described in this paper may not be able to record significant and landmark achievements in modern medicine, which is the bane of modern-healthy society. Any health professional must have developed a very strong and

necessary interaction with physics at some point throughout their high school years or their early university years, at least at the Credit level. If this is the actual state of affairs, then the Federal Government of Nigeria must reinvest substantially in the sciences, of which physics is a component, in order to preserve a healthy society and achieve sustainable development. Therefore, a healthy population will result in a healthy workforce, which will immediately spark the desired development, helping to achieve sustainable development.

It is impossible to overstate the larger influence of physics on a country's development Evans *et al.* (2012). Physics is the foundation for progress in many fields, including technology development, industrial expansion, job creation, and better healthcare. Governments and commercial businesses, including those in Nigeria, must make major investments in fundamental physics research in order to realize this potential. Even when the immediate benefits are not always obvious, the history of scientific breakthroughs, such as J.J. Thompson's discovery of the electron, reveals the revolutionary impact of physics research on society. Finally, scientific education and understanding become crucial in a world where science and technology are at the forefront of social and economic progress. Prioritize outreach initiatives aimed at policymakers, the general public, and politicians. The advancement of scientific literacy, the encouragement of evidence-based decision-making, and the maintenance of societal advancement depend on this concentrated effort.

A quiz app is an application that allows users to participate in interactive quizzes or knowledge-based games. Users can answer questions on various topics, test their knowledge, and receive scores or feedback based on their responses. Quiz apps are commonly used for educational purposes, entertainment, or as a fun way to engage with content; Junior (2020). For students to succeed, it is crucial to cultivate positive attitudes toward physics education. This project includes not only pedagogical tactics but also an appreciation of physics' wider societal effects. We pave the way for a future marked by innovation, sustainability, and societal prosperity by fostering positive attitudes, funding research, and improving scientific education.

1.2. Statement of the Problem

Due to its abstract concepts and rigorous mathematical demands, physics has often been perceived as a challenging subject for students. Aspiring physicists and scientific enthusiasts frequently struggle to grasp the intricacies of this field, leading to decreased motivation and subpar performance. The creative solution to the problems learners have learning physics is provided by technology in the form of quiz apps. The difficulties that university-level physics students face are examined in this essay, along with the possible advantages of using a quiz app as an effective study aid to improve understanding and performance. Complex ideas and mathematical principles form the basis of physics. Abstract topics like quantum mechanics or relativity, which can be difficult to visualize and apply to real-world events, are frequently difficult for university students to understand. Additionally, individuals who lack confidence in their mathematical ability may be discouraged by the requirement for advanced math skills, such as calculus and linear algebra. Finding efficient strategies to engage and support students in their learning journey is crucial because the intricacy of the subject matter can cause a lack of motivation.

Consistent practice and concept reinforcement are important in learning physics. Traditional lecture-based teaching techniques, however, might not always give students enough chances to put what they have learned into practice. Without consistent practice, students can find it challenging to successfully retain and apply their knowledge, which could cause issues with problem-solving and analytical thinking. Their comprehension and confidence in handling physics tasks may be further hampered by the absence of prompt feedback on their progress.

Due to the demands of juggling several classes, assignments, and extracurricular activities, university students frequently struggle with time management. As a result, individuals could struggle to set aside enough time to study physics effectively. Additionally, without the right study techniques and direction, students could struggle to keep up with the massive amount of information in physics textbooks and lecture materials. Effective study methods are essential for simplifying complicated ideas into manageable chunks and promoting a greater comprehension of the subject.

1.3. Purpose of the Study

The main purpose of this study is to investigate how the creation and implementation of a quiz app can enhance motivation for studying among physics students.

And specifically to

1. Investigate the impact of a quiz app on students' motivation to study (physics);
2. Examine the relationship between quiz app usage and active learning among students;
3. Find out the level of student engagement with the quiz app as a supplementary learning tool; and

4. Find out the eagerness of the students in using the Quiz App to study other courses

1.4. Research Questions

This study seeks to achieve the following research question:

1. What is the impact of a quiz app on students' motivation to study (physics)?
2. What is the relationship between quiz app usage and active learning among students?
3. What is the level of student engagement with the quiz app as a supplementary learning tool?
4. Does the students want to continue using the Quiz App to study other courses?

1.5. Scope of the Study

All Physics education students in the Department of Science Education, University of Ilorin, Ilorin, Nigeria were the population scope of this study. The population scope was all Physic Education students from 100 Level to 400 Level and 50 students were randomly selected as sample scope. The content Scope was all Education and Physics courses offered by Physics Education students in the University of Ilorin and course were stratified. The Instrument scope was a survey type (descriptive), questionnaires were presented to the students as a form of survey in the Quiz App at the end of their Quiz session online. And the statistics scope was that their responses were automatically saved into a database for further access and data analysis.

2. Methodology

2.1. App Development

A quiz application was develop purpose for learning among physics education students so as to bring about motivation for the subject as a result of its gamification nature, this innovative application was built on a comprehensive design strategy that cover question formats, in the form of multiple-choice, true/false, and open-ended inquiries. This thoughtful inclusivity was aimed at accommodating the varied learning styles and preferences of its users, thereby ensuring a holistic and engaging educational experience. The app includes captivating features such as leaderboards and rewards. These strategic elements was harnessed not only to stimulate a spirit of friendly competition among users but also to kindle and sustain their motivation to actively participate in the learning process. Below are some images of few screens from the app

In addition to its rich features, it's worth noting that this quiz application will be developed utilizing the versatile Flutter framework, known for its cross-platform compatibility. By harnessing the capabilities of Flutter, the app will be readily accessible across various devices and operating systems, ensuring a wide reach and usability for its users. Furthermore, the application will leverage the robust and scalable Firebase database infrastructure to ensure seamless performance even as it scales to accommodate a growing user base. In line with a user-centric design philosophy, special attention will be devoted to creating an interface that is not only compatible with diverse devices but also inherently user-friendly, ensuring a smooth and intuitive user experience for all.

The Quiz app was built using the Flutter Framework and Firebase was used as the Backend (Server And Database) for the quiz app. Flutter is a Google-developed open-source UI framework designed for building cross-platform applications, including mobile, web, and desktop, using a single codebase. Key features include a single codebase for multiple platforms, rapid development with a hot-reload feature, a wide range of customizable widgets for rich UIs, high performance due to direct compilation, support for expressive UIs with animations, an active open-source community, use of the Dart programming language, a growing ecosystem of plugins, adaptability to various screen sizes, and strong community support. It's a popular choice for mobile app development, but its versatility extends to other platforms as well.

Firebase, developed by Google, is a comprehensive platform for mobile and web application development. It provides a range of cloud-based services and tools that streamline the app development process, including real-time databases, user authentication, cloud storage, hosting, and additional features. Firebase, a Backend-as-a-Service (BaaS) platform owned by Google, equips developers with a suite of tools and services for building, deploying, and scaling web and mobile applications. Its features include real-time databases, authentication, cloud storage, hosting, push notifications, analytics, and more. In summary, Firebase streamlines app development, making it faster, more secure, and easier to manage across Android, iOS, web, and Unity platforms.

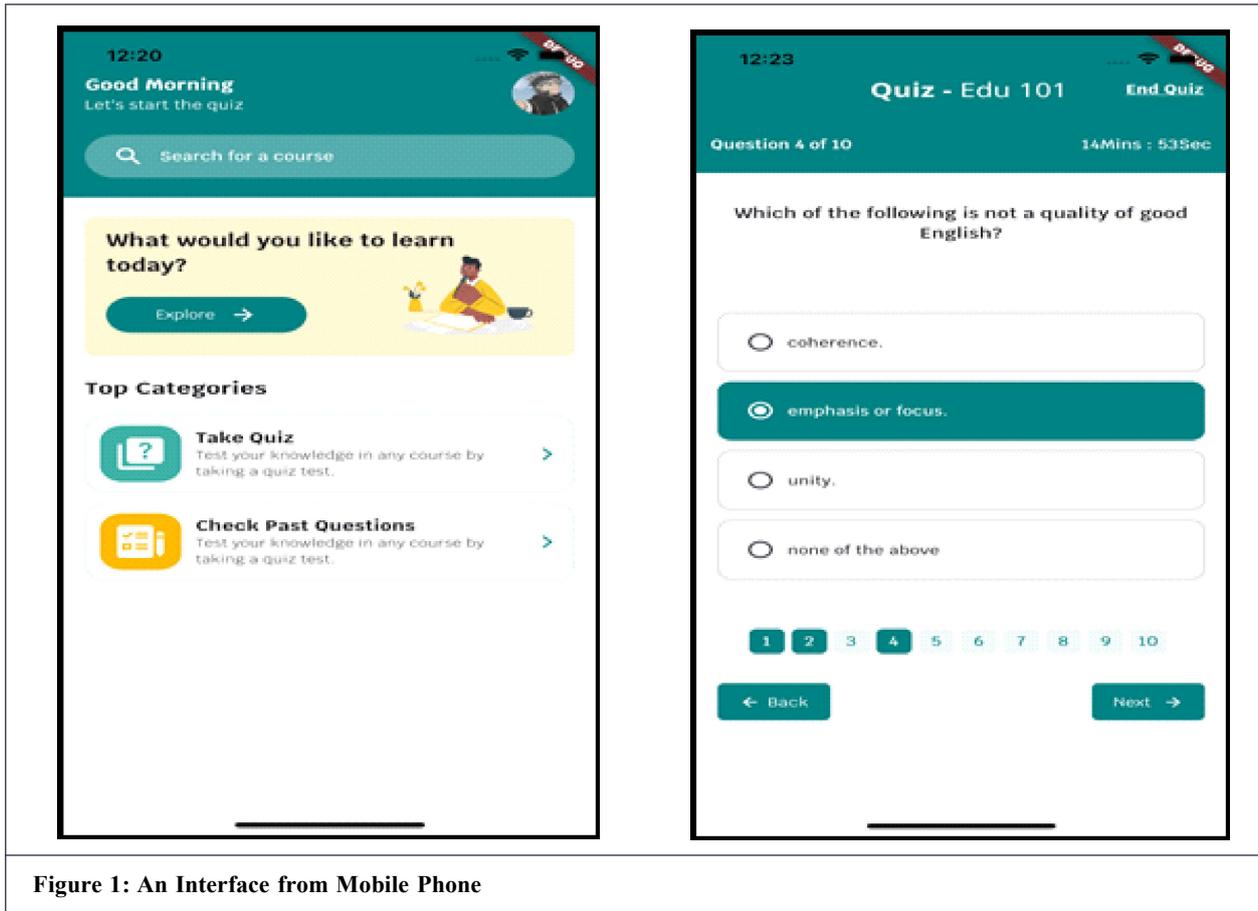


Figure 1: An Interface from Mobile Phone

The research type employed was descriptive survey type in which the students were subjected to fill a questionnaire in Google form after they have explored the app. The population of this study was all undergraduate students of University of Ilorin. The target population were all Physics Education students and purposive sampling techniques was employed to select 50 students from 100L to 400L that is, those who had downloaded the app and installed on their phone during the time of survey were able to part take in the quiz.

The questionnaire was divided into two section; Section A (Quiz App Usage and Past Experience) that contain five items based on their previous experience on apps usage and Section B (Student Experience Using the Researchers-Designed Quiz App for Learning) that is basically on this new app which contain 11 items. The instruments (The App and the Questionnaire) were validated by an experts and ten Mathematics education students were used in the reliability test, and the reliability coefficient was 0.77 using Cronbach Alpha. This coefficient suggests that the outcomes were fairly consistent or stable. Since the app and questionnaires are online base, it was therefore easy to gather for onward analysis. The data collected in this study will be analysed using descriptive statistics, which involves analysing and summarizing the data to provide meaningful insights

3. Data Analysis and Results

The Table 1 shows the demographic profile of the respondents. As shown above, 11 (22.0%) of the respondents were female and 39 (78.0%) of the respondents sampled in the study were male. This implies that majority of the respondents sampled in this study were Male.

Gender	Frequency	Percentage (%)
Male	39	78.0
Female	11	22.0
Total	50	100.0

Source: Field Work (2023)

3.1. Answers to Research Questions

The research questions were answered through the use of mean rating and standard deviation.

Research Question 1: What is the impact of a quiz app on students’ motivation to study physics?

The result in the Table 2 reveals the impact of quiz App on Physics Education students’ Motivation. The benchmark for accepting an item is 2.5 and any item with mean value of 2.5 and above would be accepted, otherwise it would be rejected. Collectively, the result of the study quiz App has impact on students’ motivation to study Physics with a mean score of 3.07 and standard deviation of 1.00. Specifically, all the items were accepted as the impact of quiz App on Physics Education students’ motivation as they have mean scores above the benchmark of 2.5. The App interface is easy and simple, the quiz App provides academic benefits, the quiz App motivates them to study and the App is an effective way to study for exams. Overall, it has positive impact on learning and study and so on. This means that the quiz App has positive impact on students’ motivation to study Physics and others courses for Physics education students.

S. No.	Items	Mean	SD	Remarks
1	I have used and interacted with quiz app before	3.41	0.96	Accepted
2	I enjoyed the experience of using a quiz app for learning and studying.	3.16	1.02	Accepted
3	I regularly use quiz app for learning	2.83	0.98	Accepted
4	Quiz app had a positive impact on my learning and studying	2.94	1.04	Accepted
5	I would like to use it more often if it was readily available and well made.	3.25	0.99	Accepted
6	Do you feel that the usage of a quiz app has (and will) provide you with any academic benefits	2.65	0.97	Accepted
7	This app interface was easy and simple to use	3.08	1.17	Accepted
8	I feel more confident in my knowledge after studying the quiz app	3.21	0.94	Accepted
9	I feel motivated to study more using the quiz app	3.22	0.81	Accepted
10	I would continue using the app if it is available for more courses	2.91	1.04	Accepted
11	I think that quiz app is an effective way to study for exams	3.15	1.04	Accepted
	Average	3.07	1.00	
<i>Source: Field Work (2023)</i>				

Research Question Two: What is the relationship between quiz app usage and active learning among students?

The result of Table 3 shows the relationship between quiz App usage and active learning among students. As shown above, the calculated significance value of 0.000 is less than the chosen alpha value of 0.05, indicating a relationship between quiz App and active learning. Thus, there is a relationship between quiz App usage and active learning among students. This means that quiz App usage influences active learning among the students.

Table 3: Relationship between Quiz App Usage and Active Learning	
	Relationship Between Quiz App and Active Learning
Chi-Square	50.839 ^a
Df	7
Asymp. Sig.	.000
Note: $p < 0.05$	

Research Question Three: What is the level of student engagement with the quiz app as a supplementary learning tool?

The result of Table 4 shows the level of students’ engagement with the quiz App as a supplementary learning tool. As shown above, the calculated significance value of 0.000 is less than the chosen alpha value of 0.05, indicating high level of engagement. Thus, there is a high level of students’ engagement with quiz App as a supplementary learning tool. This means that quiz App is highly used by students to supplement their learning.

Table 4: Level of Students’ Engagement with Quiz App as Learning Tool	
	Level of Students’ Engagement with Quiz App as a Supplementary Tool
Chi-Square	37.129 ^a
Df	8
Asymp. Sig.	.000
Note: $p < 0.05$	

Research Question Four: Does the students want to continue using the Quiz App to study other courses?

The result of table 5 shows the continuous usage of quiz App to study other courses. As shown above, the calculated significance value of 0.000 is less than the chosen alpha value of 0.05, signifying continuous usage of the App for other courses. Thus, there is a willingness among the students to continue to use the quiz App to study other courses. This means that students want to continue to explore other courses using the quiz App.

Table 5: Usage of Quiz App to Study other Courses	
	Continuous Usage of Quiz App for other Courses
Chi-Square	33.161 ^a
Df	11
Asymp. Sig.	.000
Note: $p < 0.05$	

3.2. Summary of Findings

1. The result of the study showed that quiz App had impact on students’ motivation to study Physics.
2. The outcome of the study also revealed that there was a relationship between quiz App usage and active learning among students.
3. The outcome of the study indicated that there was a high level of students’ engagement with quiz App as a supplementary learning tool.
4. The study discovered that a willingness among the students to continue to use the quiz App to study other courses.

Discussion of Findings

The findings of the study revealed that quiz App has positive impact on students' motivation to study Physics as the respondents affirmed that they enjoyed the experience of using quiz App, the App interface is easy and simple, the quiz App provides academic benefits, the quiz App motivates them to study, the App is an effective way to study for exams, it has positive impact on learning and study, and so on. This finding is in line with the result of Musasia *et al.* (2012) who used experiments to change the attitude of students towards the study of physics. This finding may be true because Quiz App is a learning tool experimented to help students learn better in Physics and other subjects.

Also, the outcome of the study revealed that there was a relationship between quiz App usage and active learning among students. This means that quiz App usage influences active learning among the students. This result may however be true because using an App to learn subject like Physics brings fun and makes the subject more real to the students.

Similarly, it was discovered that there was a high level of students' engagement with quiz App as a supplementary learning tool. This means that quiz App is highly used by students to supplement their learning. This result lends credence to Deterding *et al.* (2011) who demonstrated that adding gamification components to quiz apps can increase student enthusiasm and engagement. The likely reason for the high level of engagement by the students is because the App could be leveraged on to understand some concepts which had been found difficult to comprehend.

The study further revealed the willingness among the students to continue to use the quiz App to study other courses. This means that students want to continue to explore other courses using the quiz App. This finding agrees with Zuhriyah and Pratolo (2020) who discovered positive perspectives of the students toward using Quiz as an online assessment tool for English teaching and learning, especially on a formative level. Students express willingness to continue to use the quiz App may be due to the fact it is beneficial to their studies and make them to be actively engaged in their own learning.

4. Conclusion

The study emphasizes the critical role of science education, particularly physics, in fostering sustainable development and a healthy society. It underscores the importance of adequate funding for research in physics and other scientific disciplines to drive technological advancements and societal progress. The findings reveal that the implementation of a quiz app as a supplementary learning tool has a positive impact on students' motivation, active learning, and engagement in studying physics. Despite the challenges students face in learning physics, such as lack of motivation and time management issues, effective study methods and tools like the quiz app can enhance their comprehension and confidence in the subject. Moving forward, it is essential for educators and policymakers to prioritize science education, invest in research funding, and provide innovative learning resources to support students in their academic journey and contribute to the development of a knowledgeable and skilled workforce for the future.

5. Recommendations

Based on the findings of this study, it is recommended that more quiz Apps should be employed for the teaching and learning of Physics in higher institutions and even secondary schools and below. The use of quiz App will afford students the opportunity to interact better with their learning and participate actively in the class.

Also, quiz App and other Apps should be developed and used in teaching and learning of Physics and other subjects to supplement the conventional methods of teaching and learning. The use of App can help students to develop more interest in learning, motivate them to study and make them to learn at their own pace. This is because quiz App and other Apps can promote self-learning among the students.

Similarly, there should be training for teachers/lecturers and students on the use of quiz App and other Apps for learning. Such training will serve as eye opener for the teachers/lecturers as well as the students on the available Apps that can complement their efforts in teaching and learning. There should be workshops and training organized to gain more insight into the uses, benefits, applications and possibly the weaknesses of the quiz Apps for learning.

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