ORIGINAL ARTICLE

A Mixed-Methods Study of Secondary Student and Teacher Attitudes to Mobile Education Apps in Lagos, Nigeria

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***Abstract**: With the advent of smartphones, laptops, and other various portable devices, the ability to incorporate technology into the classroom has increased dramatically in the last few decades. This study evaluates the perceptions and attitudes of both students and teachers in relation to mobile apps that assist in classroom learning. The research used a mixed-methods approach that collected demographic information and conducted qualitative interviews to determine the perceptions of mobile apps to students and teachers. Cross-sectional data was collected from participants and analyzed for associations. 43 students and 6 teachers were recruited and interviewed. The participants were asked about their thoughts on mobile educational apps, and their interviews were audio recorded and transcribed. Inductive thematic analysis was used to analyze the data. For students, themes were centered on barriers to educational app adoption, barriers to continued use of education apps, tracking progress, credibility, and goal setting/reminders. For teachers, themes identified that influenced mobile app use, and criteria used for mobile app selection was identified. Future research should aim to assess quantitative improvements in mobile educational app use within the classroom.*

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Introduction

MOBILE learning, defined as using handheld technologies such as phones for educational use has progressed rapidly in the past decade (Bomhold, 2013; Mohtar et al., 2022; Sonal e al., 2013). An integration of mobile technology with classroom has allowed for a broadening of learning opportunities, allowing students to develop customized performance, enhance learning needs, and provide students with authentic learning practices when alternative teaching methods fail (Doucet et al., 2019; Ramirez-Donoso et al., 2017; Shokirovch, 2022; Voshaar et al., 2022; Wang, 2017). By extension, mobile learning by its nature offers a greater personalized experience, as individual profiles can be taken into account and miniature sized phones or laptops allows for more flexible studying (Criollo et al., 2021; Eppard et al., 2019; Uther, 2019). Educational apps are the most common method of mobile learning. These apps may include simple note apps, language learning apps, or apps intended to heavily integrate with the classroom. While there has been rapid growth in educational app development, research on the use of mobile apps for the purpose of education is scarce, despite schools, governments, and companies regularly using them to train and teach employees and students.

There are few studies that have evaluated the perceptions of educational mobile apps by those that use it. Previous researches on educational mobile apps have adopted a content analysis approach (Bagci & Akpinar, 2018; Kondracki et al., 2002). Although these approaches provide valuable insight on what parts of an app are being used, and the capabilities of such an app, there are very few that have examined the themes, perceptions, and accessibility of these apps. Thus, qualitative studies have been sparce in this area. It is important that research extends beyond just a content analysis stage, in order to not only examine the differences between apps but also the differences amongst users and consumers (Draper et al., 2014; Ok et al., 2016). By designing and examining the user experience of educational apps, researchers can better develop classroom tools to be effectively employed in a low cost setting in developing countries.

Research Questions

This research is aimed at answering the following questions:

1. *What are barriers and motivators for students to use mobile apps that enhance or augment learning in the classroom?*
2. *What are barriers and motivators for teachers to adopt new mobile apps that enhance or augment student's learning in the classroom?*

Literature Review

Learning is described as the ability to acquire or transform pre-existing knowledge, skills or behaviours, usually as a result from experience or training. For humans, the most common form of learning is learning through school education or self-education, in both implicit and explicit ways (Darling-Hammond et al., 2020). E-learning is learning that incorporates technology to enhance knowledge dissemination that began in the 1960s as a result of the Programmed Logic for Automated Teaching Operations (PLATO) project (Pereira & Rodrigues, 2013). In the 70s, the Time-shared, Interact, Computer-Controlled Information Television (TICCIT) increased the development of E-learning (Yan et al., 2010). By the late 80s and early 90s, E-learning encompassed all forms of teaching, and was an emerging and integral piece in workplace onboarding and post-secondary education (Svetlana & Yonglk-Yoon, 2009). E-learning can include virtual classrooms, computer-based education, language learning applications, and web-based learning. Content includes any form of media that can be displayed electronically, allowing the ability for video, animation, images, and audio to be used in the learning process.

In recent years, education has seen a rapid increase in mobile technology adoption (Al-Emran & Shaalan, 2015). The combination of E-learning with mobile solutions has led to "M-learning", emerging as a new research trend that addresses mobility in several dimensions: mobility of educators, learning, students, and technology (Peters, 2007). Thus, it is imperative M-learning technology is understood and investigated before it is applied to the learning process. M-learning devices can include smartphones, personal digital assistants, cell phones, laptops, tablets, consoles, E-book readers, and more. Notably, M-learning can provide all the advantages of E-learning with the additional ability to be portable and motile.

While the definition of M-learning is not exactly agreed on, it often encompasses mobility of the learner in combination with a learning device, with a degree of personalization to the learner. Hutchison, Beschorner, and Schmidt-Crowford have adopted Traxler's (2009) definition that is defined as any learning that is "supported or delivered by a handheld device". Other definitions include Melhuish and Falloon, which define it as "just-in-time, situated learning, mediated through digital technology in response to the needs of the user (2010). Still others, such as Quan et al., suggest a precise definition is impossible, but instead M-learning share a group of characteristics that "enables knowledge building by learners in different contexts, enables learners to construct understandings, and the mobile technology often changes the pattern of learning/work".

There are several pedagogical methods that relate to mobile learning. Behaviourist theories such as Pavlov and Skinner are relevant to mobile learning due to the nature of stimuli presented from the mobile device (Naismith et al., 2004). Constructivist methods as a result of immersive experi-

ences are analogous to those proposed by Bruner, Piaget, and Papert. Such use of interactive learning increases self-control of the learning process (Evagorou et al., 2008). Furthermore, collaborative learning through group discussions and online chat or video becomes possible over large distances with the advent of the internet, and has been shown to parallel the effects of in-person collaboration (Franklin et al., 2007). The primary advantage of M-learning is the ability to allow learning to be ubiquitous, with access to real-time data from others, content, or learning resources (Churchill & Hedberg, 2008; Naismith et al., 2004; Savill-Smith, 2005). Mobile devices may also be used to gather information, and has shown to be helpful in knowledge consolidation in science classrooms where students were required to learn particularly challenging content that required internet research (Evagorou et al., 2008). Equivalent progress in learning have been found when students are required to gather data on a mobile device compared to a paper and pencil control group. In another case study, students were able to solve a problem set sooner with a drawing tablet as opposed to pencil and paper due to speed and ability to retract changes on the tablet (Lai et al., 2008). Particularly in developing countries, mobile users often vastly outnumber users that are wired, and thus provide an effective means for knowledge translation in poor areas (Yu et al., 2007). Due to pervasive use of mobile phones in much of the developing world, M-learning often occurs without the pre-existence of E-learning (Motlik, 2008).

Even outside of developing countries, mobile use is extremely prevalent. *Project Tomorrow* released a "Speak Up" Report in 2013 that provide statistics on the prevalence of technology use by children and youth within the United States. They found that 65% of middle-school students and 80% of secondary students used a smartphone. The Horizon Report published by the New Media Consortium found similar results (2021). All available statistics agree that mobile device use throughout society, across all parts of the world, is increasing. Consequently, it is understood that this is the primary driver in increased mobile app use for learning.

Various constraints of mobile learning exist, however. Particularly, there is growing debate that mobile technology was not designed for the education industry in mind. Koszalka and Ntloedibe-Kuswani (2010) suggest that mobile phone usage growth is the primary driver for mobile learning growth. Other authors such as Terras believe the technology used for mobile apps were not optimize for "user psychology, habits, needs, behaviours, and socio-cultural habits" in relation to learning. Traxler (2010) has noted that "We can say only that the devices owned by students will be, at best, poorly suited to learning. They will all be different; they will be changing often for reasons that are not technical, not educational and probably not even rational or foreseeable". In general, there is an understanding that mobile devices, while effective in aiding learning, were not designed for educational pur-

poses. Thus, understanding mobile apps, which function as the vehicle that convert mobile devices into learning tools, is critical.

Research Methodology

Research Design

This study utilized a mixed-methods research design that contained both quantitative and qualitative components. The qualitative component used an explanatory design, where group interviewers were conducted with students and individual interviews were conducted by teachers to determine student and teacher perspectives respectively. The quantitative part of the study included administering a questionnaire to all participants for the purposes of collecting demographic information that supplemented findings from the qualitative part of the study.

Participants

Participants were either students or secondary school teachers from 4 local secondary schools located in Lagos, Nigeria. For teacher recruitment, teachers were recruited through a criterion-based sampling method. Inclusion criteria for teachers were defined as follows: teacher had to teach at a senior or junior secondary level, had to have at least implemented one classroom activity through the use of a classroom-educational mobile app, have had experience in using educational mobile apps in classroom contexts; have at least one kind of mobile device (Phone, Tablet, Computer); was a native English speaker. The participants included 6 full-time teachers (2 male, 4 female) that taught a combination of the following subjects: science, physics, chemistry, history, religion, and math. Three of the teachers had post-secondary degrees. 4 of the teachers were employed in schools that were in city centres, while the remaining two were part of country towns. All had indicated they had used educational mobile apps in some shape or form in their classroom to enhance learning. Self-reported time usage on mobile tools was approximately 2-4 hours per week. Teachers used a varying number of different technological devices, including smart phone (4), laptop (6), smart watch (1), and tablet (2). These devices served as dual-function products for personal use, as all participants stated that the device's primary purpose were for personal use.

Student recruitment was done by providing the university administration with an email list of interested teachers, and students in the classes of teachers that agreed to do the study were recruited. Student recruitment consisted of 43 individuals, with 15 randomly selected to be put within interview groups due to limitations required by participating secondary student

institutions. 3 groups were made in total with 5 participants each. All participants were provided with a demographic questionnaire to fill out. All the consented participants completed the study. Inclusion criteria were the ownership and regular use of a smartphone; enrolment in a secondary school in Lagos, Nigeria; between the ages of 14-18; had consistent access to internet; and spoke English as a native language. To get a well-rounded picture about why people used or did not use educational apps, both individuals with and without prior knowledge or usage of educational apps were included. All interview groups consisted entirely of Nigerian secondary school students.

Procedure

The institutional review board of Lagos State University approved this study. After obtaining consent from participants, each participant filled out a form on smartphone usage, mobile app usage, demographics, mobile app proficiency, and perceptions on learning and education. A total of three research assistants were in contact with participants. One research assistant served as a moderator, while another transcribed interviews verbatim. The third research assistant conducted interviews. All members of the study team involved in data collection were trained in qualitative analysis and were graduate students. Only the author and participant were ever present throughout the process of data collection. There was no prior relationship between moderators and interviewee. The authors had positive attitudes towards educational mobile apps, but remained neutral in conversation. Small group interviews were conducted at Lagos State University in a set meeting room, with sessions running lasting between 60-120 minutes long. All participants were provided a cash incentive of 8,000 Naira. All interviews were conducted in the same meeting room at Lagos State University Law Library. All interviews were audio recorded and transcribed.

Data Collection

Participants were given a brief summary on the purpose of the study, and asked questions about their knowledge of educational apps, their general app usage, the different kinds of educational apps they may use, and reasons for liking or disliking the apps. Participants were given the opportunity and encouraged to freely discuss own experiences. To facilitate and guide conversation, he interviewer and moderator adhered to a discussion guide.

A demographic information form was provided to both students and teachers. Each participant was asked to fill in said forms before interviews, and requested information with regards to gender, subject being taught/teaching, age, their school district, family income, city, degree, years of teaching experience (if applicable), school name, in addition to mobile educational app usage.

Participants who specified that they have no prior experience or knowledge in using educational apps were given a set of trigger materials to familiarize themselves. These materials were screen captures of several features of education app. These included: 1) tracking study time and information (progress visualization, behaviour monitoring and/or tracking, goal setting), 2) involving teachers and various educators (sending and receiving information to teachers, parents, or school district), 3) taking advantage of social networking, 4) increasing access to educational learning such as coaching, tutorials, etc., 5) the use of entertainment to keep students engaged (gamification), and 6) linguistic learning apps. Participants had the opportunity to explore these categories by accessing these apps on their devices or asking questions. Participants were then asked to discuss thoughts on them, going into as much detail as possible, elaborating on any dislikes they had with the particular apps, and whether or not they had used certain apps and reasons for continuing/discontinuing use.

Data Analysis

The verbatim transcripts were imported and coded with MAXQDA qualitative data analysis software. Inductive thematic analysis was adopted to analyze the data according to Nowell et al.'s 6 phase frameworks (2017). The interview transcriptions were analyzed as a whole. Each recording was coded separately by at least two authors who independently came up with labels to attach to text segments that appeared to indicate important user perspective. Then the team came together to compare their codes and revise the codes in an iterative fashion to develop a set of themes that captured the essence of the discussions or interviews. Finally, the raw data were compared with the emerging theme labels and definitions, and further refined by merging, adding, and removing redundant themes. Then, themes and sub-themes were identified. Demographic data was imported, organized, and aggregated using Microsoft Excel. Certain descriptive statistics including percentage, frequency, and mean values were applied to any relevant data.

Results

Demographic Data

Table 1 summarizes demographic information on app usage for participants. All 43 participants completed the demographic questionnaire. There was a roughly even split between student grades amongst our sample, with 14, 14, and 15 individuals in year 10, 11, and 12 respectively. The sample had an even split between gender (51.2% male) and the majority of users used iOS/Apple devices, while other operating systems included Ubuntu Touch

Table 1. Demographic and Participant Usage of Smartphones and App Usage.	
Grade	**Count (%) (43)**
10th	14 (32.5%)
11th	14 (32.5%)
12th	15 (34.9%)
Total	43 (100%)
Gender	
Male	22 (51.2%)
Mobile Device Operating System	
iOS	25 (58.1%)
Android	16 (37.2%)
Other	4 (9.3%)
App Usage/Proficiency	
Number of Apps on Smart Phone (mean)	32 (SD = 11)
Daily Smartphone Usage	4.2 hrs (SD = 2.9 hrs)
Total Mobile Device Usage	7.4 hrs (SD = 3.7 hrs)
Number of Education Apps Used Weekly	3.5 (SD = 3)
% Students that Personally Used Educational App	14 (32.5%)

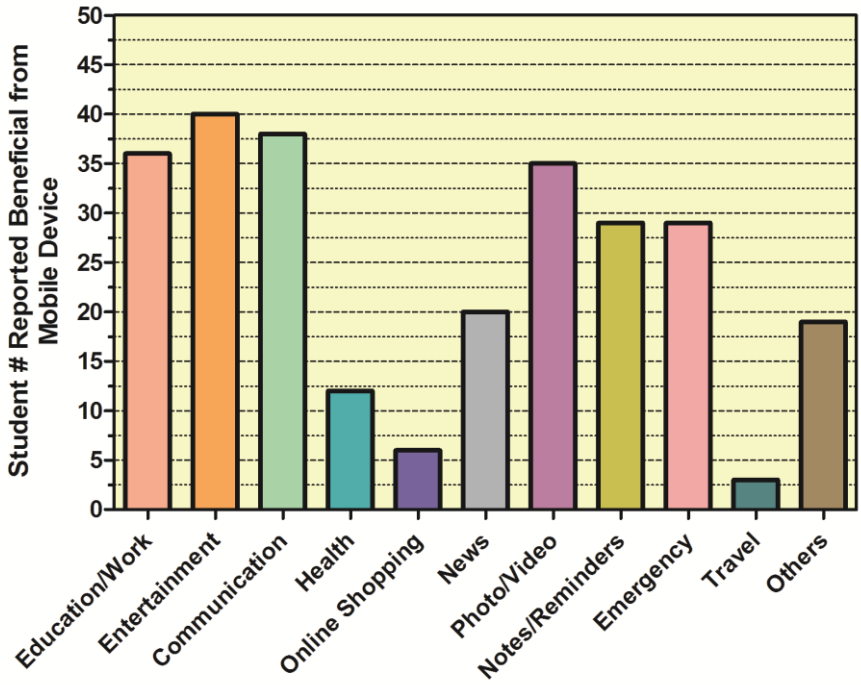


Figure 1. Reported Perceived Benefits of Having A Mobile Device (Students).

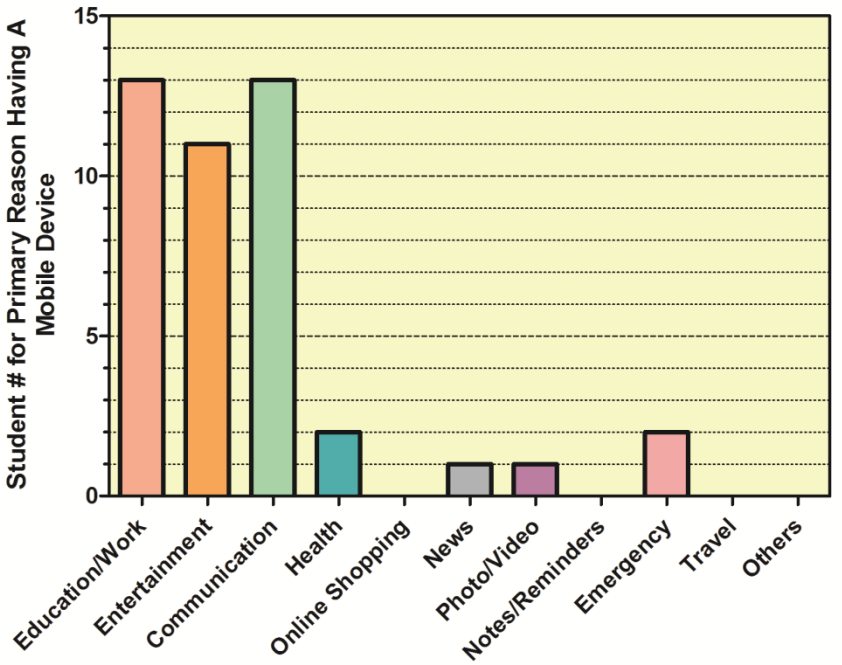


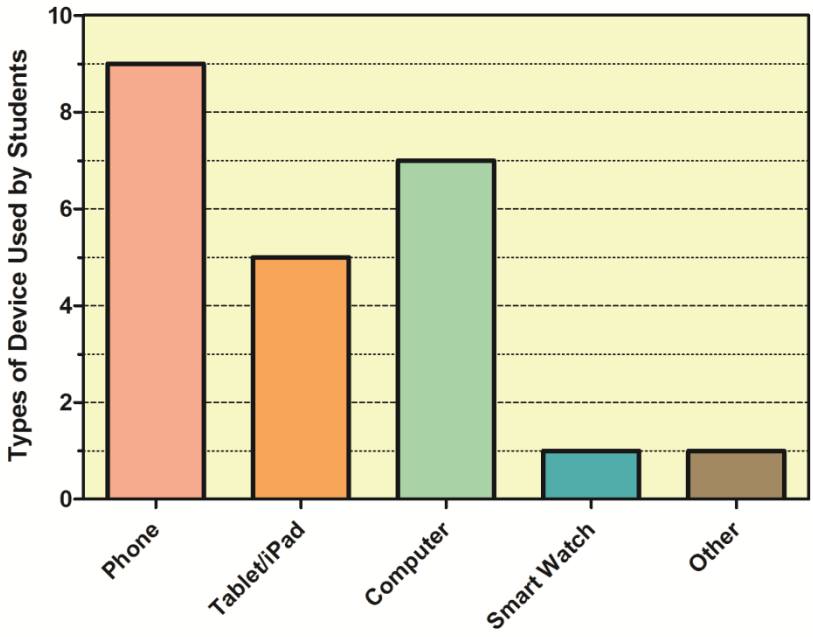
Figure 2. Primary Reason for Having a Mobile Device.

and Blackberry. Only two students had more than one mobile device. Average daily screen time for students was 4.2 hours, and average total screen time was 7.4 hours (**Table 1**). Although the students used an average of 3.5 education apps weekly, most were from the classroom and only 32.5% of students used a personal educational app on their mobile device.

Students were asked to check the boxes in which activities they felt that having or using a mobile device benefited them in (**Figure 1**). The most commonly cited benefits of using a mobile device from students was for the purposes of entertainment, followed by communication purposes defined as "any form of texting, calling, and social interaction facilitated with your mobile device". The least commonly reported reasons of having a mobile device was for travel planning and shopping, likely due to the fact that these activities can be done on a non-mobile device. "Other" reasons of using a mobile device included responses such as: "alarms", "calculator", "for camping", and specific mobile apps such as "Instagram" or "Strava".

In the next question, students were asked to select the benefit they believed was the single most important reason for having a mobile device. Education and communication were the top two most selected reasons, followed by entertainment (**Figure 2**). While students felt that photo/video,

A.



B.

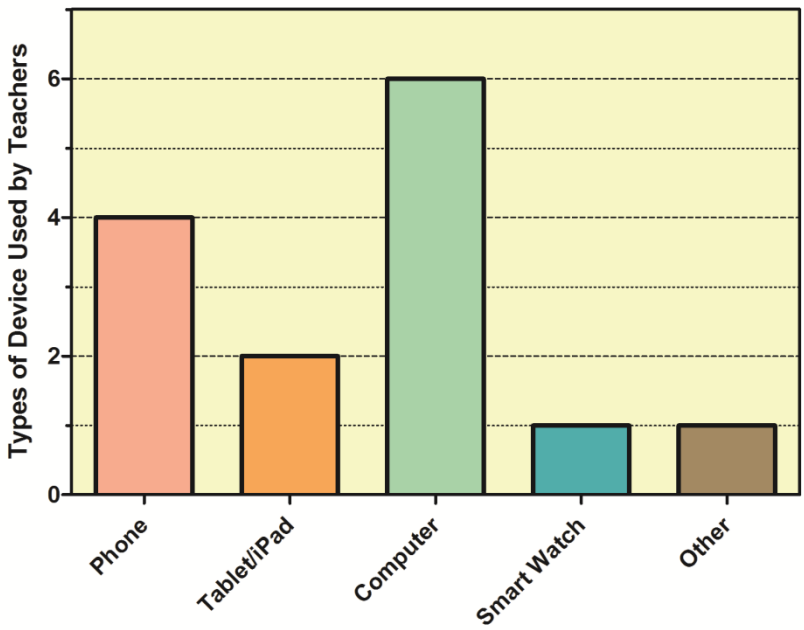


Figure 3. Types of Devices Used by Students and Teachers.

notes/reminders, and emergency use were positives of mobile device use, they were rarely the primary reasons for possessing the device.

Students and teachers who were interviewed were asked what kinds of mobile devices they used. Device usage patterns were similar across both teacher and student groups, with the biggest difference being that students used their phone more often relative to teachers (**Figure 3a**). Particularly, all 6 teachers stated they regularly used their computers during class for educational/work purposes (**Figure 3b**). For both groups, smart watches and other devices (i.e. recorder, audio player) were used the least.

Qualitative Interviews – Students

Motivators for Using Educational Apps

One commonly expressed external motivator was social competition, where students would be encouraged to engage when they saw peers in the classroom use the app. This would take the form of being motivated in beating a study streak or getting points on tutorials. However, participants expressed that it may be demotivating if individuals were too far behind others, and could create stress or urgency that was perceived negatively. A student explains in this following way:

> *I compete with my friends to see who can get the highest scores.*

Furthermore, students also reported that academic progress was a strong external motivator. When they saw time commitment improvements or grade improvements that could be logged on certain apps for each of their subjects, some students expressed feelings of confidence and happiness. A student describes it:

> *Last year I would only be scoring around a 60%, but after every test and exam I can log in and see the improvements I've made. It also helps let the teacher know that I've been trying, and now I'm around 83%, which is really just a big jump and has made me think that I can do other things in life, of that sort.*

Many participants site admission into university to be an important factor for using the apps, as a means to make academic progress, improve grades, or pursue a more economically prosperous career. One student put it:

> *I really want to go to Lagos State University one day, and you need at least a decent enough level of academic ability to have a shot at there. I think it will improve my chances and that is why I use the app. I hope to one day get a good job.*

Many educational apps provide users with intangible rewards such as progress meters and fake currency for unlocking certain perks or badges. Such progress markers are designed to incentivize users to learn more, and were effective for some students. A student stated:

> *Earning badges was helpful, it made it seem more fun and I treated it almost as a video game.*

However, some students were not interested in tangible rewards. Instead, many preferred it when a teacher associated an intangible reward built into the app with a tangible reward administered by the teacher or school. In this way, students could unlock achievements or milestones in the app and consequently be awarded various materialistic perks (i.e. candies, chocolates, pencils) at the teacher's discretion. An interviewed student describes:

> *I don't really care about the badges, but for me what I think was kind of helpful was that you could get some snacks and food with new progress. It would be like a treat, every day I could come into class and as long as I did the homework, I got a little chewing gum. It's not much but it's convenient.*

Most students agreed that in order to be successful in using an app to augment learning, one must have a certain level of internal motivation, since studying was generally seen as a mentally strenuous and time-consuming activity. Ultimately, an individual must be internally motivated to pursue educational attainment in order for serious behavior change and learning to occur. Accordingly, those who felt that they did not have the intrinsic motivation to study believed that a mobile app would not change or improve their learning habits. For instance, a student said:

> *Apps are helpful, but in order to stick with it I think I would have to want to study in the first place.*

Barriers to Adoption of Education Apps

Of the participants, 32.5% had presently used education apps (**Table 1**). Two main reasons were identified by the researchers for why adoption of education apps was not used. (i) No knowledge of the existence of education apps: more than half of the participants were largely unaware of or did not believe that educational apps are available. (ii) Lack of belief in education app effectiveness: students largely did not feel that there was any benefit in using a classroom assistance app for educational purposes, with most commonly cited reasons of preferring more traditional studying methods such as pen

and paper compared to using an online or mobile resource. One of the participants said:

> *I don't think it will help. It's just an app that I have to use mental focus on. I like having my stencil and sheets of paper, there is not much I need to do. And I don't have much to do outside the classroom either, I do most of my studying when I go to school, and we can't use phones in the classroom.*

Alternatively, one point brought up repeatedly was that students did not feel it was a necessity to use a mobile app if they had already developed strong study habits, or the participant did not have a belief that strong study habits could be developed from education apps for themselves specifically. However, the majority believed that an education app could be helpful for certain individuals, and generally had positive impressions on the utility of such apps. A skeptic participant said:

> *I don't think [a mobile educational app] can help me… I do well enough in school, I don't need to catch up or use a tutor.*

Barriers to Continued Use of Education Apps

Students who did have educational apps presented a number of barriers to their use. Specifically, a primary reason was that use of educational apps was too time consuming and a "hassle". One secondary school student said that you "must always put in every time you study, and I just prefer to study whenever I want, when I feel like it". Thus, students universally indicated that ease of use and simplicity are highly desired features. One student said:

> *If an app is too complicated, or it takes too long to learn, I think I'd delete it just because you don't really need it to study.*

Such sentiments were echoed by other participants:

> *I don't like a lot of apps these days that require you to sign up, or have ads, and stuff like that. I prefer something that I can open up and boom, there it is.*

Students interviewed felt that individuals who already had the motivation to use educational apps would have the sufficient motivation to do well in school, and therefore not require them in the first place. One described:

If someone can use a health app, I must ask, why they cannot just spend that time studying.

And another said:

I really feel that if someone was focused enough to log time in, or watch tutorials, couldn't they have enough time to talk to the teacher or stay after school?

Additional barriers mentioned included storage space, economic barriers of having a phone, and excessive screen time, either to the concern to the student or the teacher.

Tracking for Awareness and Progress

Most students, who used educational apps like Teach the Need, specified that having a built-in feature to track user progress was extremely important. For instance, users could include the different subjects they were taking, the grades they received, and even access online Canvas or Google Classroom pages via the app and import assignments. This way, there could be an easily accessible way to keep progress advantageous over more traditional methods of note keeping. Most students enjoyed having a tracking feature as it provided a self-monitoring technique that increased awareness. One student put it bluntly:

Helps me keep track of my progress.

And another said:

I love to see when my graph is trending upwards and see the grade changes over the years, I definitely build by confidence.

However, the tracking feature could be abused as a result of stressors in the form of social competition. Some students would lie in order to bolster to their classmates their commitment when the reality may be contrary. One student declared:

I had a friend who would keep the app on and just speed through the tutorials at 2x speed.

Tracking was generally perceived as a positive trait to students. However, others believed that tracking was only beneficial in the beginning. After a while some students felt that the tracking was redundant, as the habits and routine were already developed. Furthermore, it could become a negative aspect of the app, as some users felt they were obligated to keep on

tracking even when the usefulness was long gone. One apprehensive student said:

> *When I first started I would track it a lot, but after a while it got boring and I felt like I was supposed to do it even though I didn't really want to. After a while I just stopped using the app.*

Goal Setting and Reminders

Many participants enjoyed the goal setting features used in these education apps. In their eyes, they saw that goal setting, in particular with the use of small daily and weekly goals could allow them to discipline themselves. These included targeted grades and hourly study milestones. A student reflected:

> *Having an app that allows me to goal set is very beneficial.*

Furthermore, liked by most participants, having a notification system that could remind students for class or study times was incredibly beneficial. This feature was particularly helpful to individuals who described their day as busy or tended to forget things. The caveat was that reminders must be easily settable and well designed, with personalization features that allowed a quick and reliable way of putting in dates, which many classroom apps seemed to lack.

Important Characteristics

At the end of each interview, participants were asked to give a rating of 1-4 of which features they felt were the most important. A summary of features in hierarchical importance to students is presented in **Figure 4** with the most important traits at the bottom, increasing at 1-point increments.

The most important features students felt should be included in an educational mobile app were freeness and ease-of-use, reflecting the importance of adoption. Conversely, features related to rewards, credibility, and quality of tutorials were not viewed as comparatively important.

Qualitative Interviews – Teachers

Mobile App Use - Teachers

Teachers were invited to explain what kinds of mobile apps they used and for what purpose they were used for teaching. The most commonly described apps included Plickers, Kahoot, Anatomy4D, Elements4D, Quiver, and others. **Table 2** shows the different apps used and the frequency used by teach-

Figure 4. Hierarchical Triangle for Important App Features.

Table 2. Common Apps Recommended and Used by Teachers.

App Name	Frequency
Plickers	2
Kahoot	6
Anatomy4D	1
Elements4D	1
Quiver	2
Algoodo	3
Powtoon	2
App Inventor	4
Google Science Journal	2
Teach the Need	4
Google Classroom	6
Google Drive	6
Class Dojo	4
Codecademy	5

ers. Across the entire range, apps focused on pre-test/post-test, behavioural assessment, data storage, student tracking, and information presentation were the most common.

Criteria for Mobile App Selection

As teachers are the primary influencers in which educational apps students will choose to use, we asked what criteria they used to select for mobile apps for their students. We identified 4 categories that were used for selecting mobile app use: evidence-based teaching, ease of use, content/relevancy to existing course content, and the extent of community building.

Evidence-based teaching: teachers cared about how much an app supported traditional and proven learning methods. Particularly, the difficulty and speed of the app had to be aligned with the ability of the students, in combination with being stimulating enough to keep the attention of students. This included an apps ability to have multimedia design, several content representations, and an entertaining learning environment to invoke as much intrinsic rewards as possible. A teacher explains the following way:

> *For me, the most important thing is that whatever app I choose, that app I can actually use in the classroom. If the app can't be used in the classroom, why use it? For example there was this app I used that taught mathematics but the way they teach it is different and you couldn't change the order of videos around, so my students were moving back and forth from my curriculum to jump to some midway in the app's program. I don't like.*

Ease of use: most evaluations done by teachers were through the perspective of a student's lens. Essentially, a teacher's desire to introduce an app to a student was based on that teacher's belief of how accessible such an app would be to their own student. Furthermore, 3 teachers believed that an app's ability to contact the teacher were particularly important during selection. A teacher said:

> *Students like apps that are easy to use. It shouldn't take too much Wi-Fi or time to download. And I don't want to teach an app for that long.*

Another mentioned:

> *I want an app where I can learn easily. Things like icons and pictures, they are nice.*

Content relevancy: as teachers predominantly used apps to enhance the existing curriculum taught in class, content relevancy with relation to the in-person course was an important factor in 5 of the 6 teachers. This included how much the app's content and literature was relevant and could be understood by students. Particularly, tutorial videos from mobile apps were almost exclusively in either British or American accent, which teachers found could be difficult for younger students to understand at the pace of speech. Thus, many teachers emphasized that apps that allowed customization were important, even preferring apps that allowed an administrator to build a curriculum from the ground up as opposed to having a ready-made curricula. One of the science teachers stated:

> *The content can't be too hard or too easy. That can be difficult, sometimes it's in different languages, a lot of times the content is borrowed from other curriculums like IB. I have to spend a lot of times to go through the videos to make sure all of them align.*

Another teacher shared similar sentiments:

> *I really like Drive and Classroom, they allow me to customize as much as I want. If I want to add this, boom, I can add it. It is not the same with others. Some you just can't do that.*

Classroom Connection: finally, the ability for there to be classroom connection was interestingly an important factor as well. Apps like Google Classroom or Kahoot which allowed students to play with each other were generally seen as a positive.

Discussion

This mixed-methods study on educational app user perception was done with a pool of Nigerian secondary school students and teachers located in Lagos, Nigeria. Our findings suggest that user experience and perspective on mobile app education is understudied. We identified barriers to adoption and use of educational classroom apps within mobile devices. Through participant experience and display of common features amongst educational classroom apps, a summary of motivating features and factors of use were identified. Many of our themes that were identified were consistent with Dennison et al.'s findings related to mobile health app usage, which draws many parallels and can be considered a subcategory of "education" apps. In particular, Dennison et al. emphasized the use of using smartphones as information sources, tracking progress, importance for ease of use, and credibility (2013). A significant barrier in using or adopting educational apps stems from the required time commitment (Ali et al., 2020).

Due to our study targeting mainly lower-economic individuals who would benefit the most from such an educational app, we identified several risk factors. First, low app literacy and low app awareness were two factors related to non-adoption, suggesting that greater knowledge of educational app use or mobile use in general within Nigeria would improve acceptance. Students also emphasized the importance of having the option for customization, related to their courses, schedules, and even the interface of the apps. Students were generally not comfortable with revealing private information, but very few educational or classroom assistance apps required information beyond names and date of birth. Automatic detection or non-voluntary adjustment to user behaviours was a commonly stated feature that users felt these apps lacked. Finally, barriers to adoption such as cost of the app were identified, as well as motivators, such as money, intangible goals, and intrinsic motivation.

Previous studies have examined the effect of using mobile apps for ESL or language learners in the classroom (Ali et al., 2015; Heil et al., 2016; Steel, 2012). Similar to this study, most commonly cited advantages of using those apps over traditional study methods included the ability to track progress and extrinsic motivation in the form of gamified learning (Al-Jarf and Reima, 2020; Heil et al., 2016; Steel, 2013). Furthermore, classroom assistance apps focused on STEM education have found improvements in student grade and attitudes towards education after introduction of mobile education apps. However, the most significant barrier to mobile app adoption remains to be the cost associated with implementing mobile learning if students were unable to afford or have existing phones/tablets, particularly for low-income households or countries (Domingo & Gargante, 2016; Falloon, 2017; Grant & Barbour, 2013; Pan et al., 2021). Lack of curricula, lack of customizability, and steep user interface learning curves are also commonly cited reasons (Al-Kathiri, 2015; Chistensen & Knezek, 2018; Heil et al., 2016). An abundance of research related to mobile health app use corroborate these themes, and present significant overlap between user motivations for continued health and education app use, though differences exist in usage training. For instance, although Author et al. also conducted a qualitative assessment on user attitudes towards mobile apps in Nigerian, the focus on health apps lead to user-training to be one of the most important factors for app adoption, despite not being a concern for participants in this study (Kenny et al., 2017).

Overall, this study aims to expand the current research on user experience and perspectives on classroom assistance/educational mobile apps. Limitations included not having many participants from outside the research setting, with the majority of our participants being students. Furthermore, the participant pool came exclusively from four secondary schools. As research was done on a low-income area, participant experiences and attitudes may differ from individuals in more developed nations, and not all participants

had constant access to a personal mobile device. Furthermore, the apps we selected tended to be the most popular educational apps on the app stores, and did not sample the entire range of educational apps available. Purposeful sampling for student participants may lead to lack of data saturation. Furthermore, the teachers and students participating in this study were only concentrated within four schools, and therefore the research sample is relatively small. Future works should conduct studies with larger statistical power. Despite these limitations, this is the first kind of research with qualitative evidence on the field of educational apps and brings insight to the perceptions of young students in an area that may benefit the most from a low-cost and highly accessible form of education.

Conclusion

The advancement of new technologies related to mobile education creates new opportunities that students and teachers can use to augment learning processes. Thus, this study which uses a mixed-methods design in understanding the concerns and problems that users of such mobile educational apps have is particularly pertinent for the future development and optimization of new apps. Additionally, it serves to inform a more detailed understanding of the perceptions that individuals in developing nations such as Nigeria may have on mobile educational apps. The researchers recommend that future development of mobile educational apps should focus on integrating ease to use, ease of access, and customization. App selection for incorporation into the classroom from teachers should prioritize relevancy to course content and low-cost solutions to maximize student engagement. Future research should also aim at quantitatively assessing the magnitude of improvement associated with providing classrooms with mobile educational apps.

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