EMERGING TECHNOLOGIES, EMERGING MINDS: MOBILE-BASED EDUCATION APPLICATIONS IN THE EFL CLASSROOM

CÁC ỨNG DỤNG GIÁO DỤC TRÊN ĐIỆN THOẠI DI ĐỘNG TRONG LỚP HỌC NGOẠI NGỮ

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Abstract - In 2017, over 20 million students regularly used Google apps for educational purposes, marking a 100% increase in their use within this sector over just two years (https://www.edsys.in). The rapid and transformative advancements in technology in recent years have significantly altered the way students are educated. This paper offers a critical examination of the role of cell phones in education, particularly within the EFL classroom. Additionally, the article formally presents several beneficial applications for teaching and learning English. Lastly, it provides practical advice on how to effectively use educational apps on smartphones to enhance students' language skills beyond the classroom setting.

Keywords - M-Learning; SAMR model; smartphone applications

Tóm tắt - Trong năm 2017, đã có hơn 20 triệu sinh viên sử dụng các ứng dụng Google trong lĩnh vực giáo dục và việc sử dụng các ứng dụng của Google trong lĩnh vực này đã tăng 100% chỉ sau 2 năm (https://www.edsys.in). Những thay đổi nhanh chóng và liên tục trong lĩnh vực công nghệ những năm gần đây góp phần tạo dẫn liệu sinh động lý giải những thay đổi quan trọng và tất yếu của quá trình dạy và học ngoại ngữ. Bài viết này thảo luận về tầm quan trọng của việc sử dụng điện thoại di động trong giáo dục, đặc biệt là trong lớp học ngoại ngữ. Bên cạnh đó, chúng tôi đồng thời giới thiệu một số ứng dụng hữu ích trong dạy-học tiếng Anh. Cuối cùng, chúng tôi đưa ra một số gợi ý hữu ích để việc khai thác các ứng dụng giáo dục trên điện thoại thông minh đạt hiệu quả tối đa trong việc phát triển các kỹ năng ngôn ngữ của sinh viên trong và ngoài môi trường lớp học.

Từ khóa - Học dựa trên các thiết bị di động; mô hình SAMR; các ứng dụng trên điện thoại thông minh

1. Introduction

During the first quarter of 2020, the Apple App Store saw 470 million downloads of educational apps, while Google Play users downloaded 466 million educational apps. This period marked the peak for educational app downloads on both platforms [1]. By the first quarter of 2021, Android users had access to 3.48 million apps, making Google Play the largest app store by app count. The Apple App Store followed with around 2.22 million iOS apps. On May 20, 2021, Duolingo, created by Flora Medve, emerged as the top-grossing mobile educational app in Hungary, with earnings nearing 23 thousand US dollars, according to a survey conducted in May 2021. EWA: Learn English Language came in second, earning 9 thousand dollars in the same month [1]. The rapid growth of the mobile app market, particularly in education, has intensified competition among app platforms. This prompts an inquiry into the factors that have propelled apps like Duolingo and EWA: Learn English Language to such notable success in this expansive market. Opting for Google applications for educational purposes can help educational institutions save up to 1.5 million dollars annually. As reported by Education Systems and Solutions, 72 of the top 100 universities in the United States utilize Google applications, 73% of teachers access digital content via their mobile devices, and over 90% of the global population can connect to mobile networks [2].

The phrase “There is an app for that” quickly became the most popular tech saying of the decade as the app revolution spread worldwide. Beyond the convenience of having an app for everything - from work tools, communication, entertainment, and art to research- another key driver of the app phenomenon, particularly in educational technology, is the accessibility inherent in app design and development.

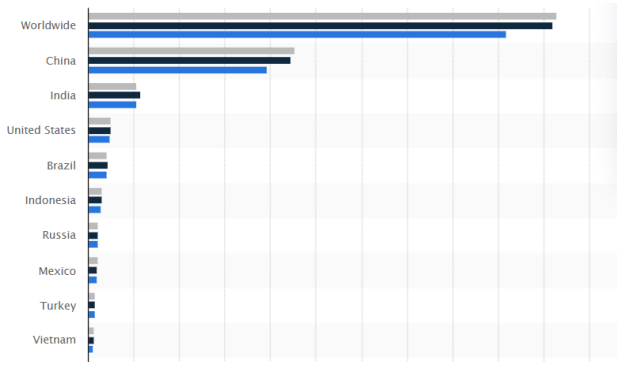

Figure 1. *Number of mobile app downloads worldwide from 2021 to 2023, by country [3]*

Vietnam, known for its large number of smartphone users, is also a leading nation in app downloads. By the end of the second quarter of 2019, Vietnam was ranked seventh globally for app downloads on both the Apple Store and Google Play, with a total of 750 million downloads [4]. At

the 7th National Digital Transformation Conference, Deputy Minister of Information and Communications Nguyen Huy Dung shared a report from the National Committee on Digital Transformation, highlighting that Vietnam was among the top 10 countries for new mobile app downloads in both 2022 and 2023 [5].

2. Applications and Operating Systems

2.1. Applications

In 2010, the American Dialect Society chose "app" as the word of the year [6]. An "app," short for "application software," is defined as a software program for a computer or mobile operating system [6]. Mobile apps are specifically designed to function on mobile devices like smartphones and tablets, including iPads. The apps discussed here are mobile applications, which are software programs created to operate on smartphones, tablets, and other mobile devices across various fields such as languages, arts, music, science, mathematics, and statistics. According to Merriam-Webster, mobile apps run on mobile operating systems (OS), which are described as software that manages a computer's operations and directs program processing by allocating memory storage and controlling input and output functions. Most smartphone and tablet manufacturers are licensed to use specific operating systems, such as Windows Phone OS, Symbian OS, Google's Android OS, or Palm OS from Microsoft. Research on BlackBerry by Motion and the iPhone by Apple Inc. shows these devices have proprietary systems (cited from Britannica). Applications are distributed to the market by providers through app stores tailored to specific devices. For instance, the Apple App Store, Google Play, BlackBerry App World, and Windows Phone Hub are compatible with iPhone, Android phones, BlackBerry, and Windows Phone, respectively. According to ABI's research on the mobile app market, there were 81 billion applications for smartphones and tablets by the end of September 2012, with 89% of them downloaded from native stores associated with the device's operating system. The two primary app stores are Google Play for Android and Apple App Store for iOS. Google Play, previously known as Android Market, is a global online software store developed by Google for Android devices. The Apple App Store was the first app marketplace to establish standards for app distribution services for iOS.

2.2. iOS Operating System

Introduced in 2007, Apple's iPhone transformed the smartphone industry with its multi-touch interface and the App Store, a controlled platform for app distribution [7], [8]. The App Store created opportunities for developers to design both native and web applications, including numerous apps for foreign language learning, enabling users to access and engage with educational content anytime and anywhere [9].

2.3. Android Operating System

Android is an open-source operating system developed by Google since 2007, allowing third-party developers to create and distribute apps via Google Play or as APK files [10]. This flexibility has driven the development of diverse language learning apps, from vocabulary learning and listening practice to interactive games, providing users with a rich learning experience.

2.4. Windows Operating System

Windows Phone and Windows Mobile support third-party applications through their dedicated SDKs and synchronize well with the Microsoft Office environment [10]. This facilitates the integration of documents, exercises, and learning tools in language learning apps on mobile devices, especially for users familiar with the Microsoft ecosystem.

3. Development of Language Learning Applications: Native, Web, or Hybrid Apps

3.1. Native Applications

Native applications require developers to "create apps by exclusively accessing the programming environment of the most suitable device if they want to fully leverage the hardware and operating system capabilities of that device" [8]. For this reason, iApps operate smoothly only within the Objective-C programming environment and the dedicated XCode developer tools from Apple. However, such applications will not run on other smartphone environments or on different programming platforms, as "all are certainly incompatible with each other" [8].

3.2. Web Applications

Godwin-Jones [8] suggests developing web applications as an alternative to native apps because they "use familiar and easier-to-learn scripting languages such as HTML, JavaScript, and CSS rather than programming languages". However, a web app should not be confused with a website. While web apps are intended for performing tasks, websites are for consuming information. From a technical perspective, Hird [11] identified two advantages of web apps over native apps. First, web apps run in the phone's browser, and the same codebase can support all devices including iPhone, Android, Blackberry, and Microsoft phones. Secondly, web apps can function on all devices and ensure "cross-platform compatibility" [11]. Furthermore, Godwin-Jones [8] points out that web apps allow students to use the app "from both desktop browsers and other mobile devices," which is impossible with native apps. Alongside these advantages, both authors noted some drawbacks of these app types. According to Godwin-Jones [8], native app users may encounter issues such as slow execution speed and low-quality user interfaces (UI). The limitation of web apps is restricted access to device hardware. Hird [11] notes that web apps require users to have an internet connection, while native apps do not need any connection during operation. Finally, web apps cannot be purchased from app stores. In contrast to native apps, web apps can only be downloaded via a web server [8].

3.2.1. Hybrid Applications

For hybrid app development, Godwin-Jones [8] suggests utilizing jQuery Mobile to enhance web applications with features like navigation, forms, and page transitions without the need for JavaScript coding. From a marketing standpoint, Castledine et al. [12] contend that a "hybrid web-native app offers undeniable marketing advantages". The advantages and disadvantages of creating native, web, and hybrid apps are outlined in Table 1.

Table 1. *Advantages and disadvantages of different types of language learning applications [13]*

Application Type	Advantages	Disadvantages
Native App.	- High performance and smooth user experience. - Deep integration with the operating system and device hardware features. - Can operate offline and use device hardware features.	- Requires cross-platform programming skills and high development costs. - Needs separate updates for different platforms, which can be time-consuming and labor-intensive. - Requires approval and time to publish the app on app stores.
Hybrid App.	- Easy to develop once and deploy on multiple platforms. - Saves time and development costs. - Partially integrates with the operating system and device hardware features, but not as much as native apps.	- Lower performance compared to native apps. - Requires a web browser to display the interface, providing a user experience not as good as native apps. - Difficult to access advanced device hardware features like cameras, sensors, etc.
Web App.	- Easy to deploy and access from any device with a web browser. - No approval needed from app stores. - Easy to update without needing to reinstall the app on the device when a new update is available.	- Performance is lower than both native and hybrid apps. - Difficult to integrate hardware features and offline functionality of the device. - Depends on Internet connection to access and use the app; does not work offline like native and hybrid apps.

Furthermore, emerging cross-platform tools might provide a middle ground between native and web apps. Jones notes that these tools could develop into platform-independent application development tools (AD) that "significantly reduce the cost of maintaining multiple platform versions of the same app" [8]. However, the market for these tools is still "immature and volatile," making "write once, run anywhere" a significant challenge for complex apps [8]. For instance, while native apps deliver the best user experience, they come with high costs and longer time to market, whereas web apps, though cheaper and quicker to market, may compromise on user experience quality. Thus, Castledine et al. [12] rightly describe the integration of native and web apps as "a delicate balancing act".

4. Application Classification

4.1. By Application Type and User Interface

Language learning applications can be categorized in various ways. From a programming or design perspective, Sweeney et al. classify them into three categories [14]. The first is "utility applications," which serve a single function, primarily for quick reference, like dictionary apps. The second, "productivity applications," assist learners in "practicing comprehensively" and offer "a range of preset functions enabling learners to quickly achieve their goals" [14]. The third, "immersive applications," are used for playing games, accessing media, and performing specialized tasks in a full-screen environment, featuring rich images, vivid graphics, and creative interactions.

4.2. Specialized and Non-specialized Language Learning Applications

Sweeney and Moore [14] categorize applications into two main types: non-specialized and specialized apps. The first category includes apps like mind mapping, note-taking, and word processing, which, while not specifically designed for language learning, offer potential benefits in this area. The second category focuses on apps specifically for English language learning (EFL), which Sweeney and Moore [14] further divide into subcategories such as dictionaries, skills, vocabulary, EAP, test preparation, and teacher resources.

4.2.1. Available and Self-created Applications

We concur with Wilden's classification, which splits applications into two groups: (1) apps available for automatic language practice and (2) self-created apps that enable users to generate content with flexible presentation using existing apps [15]. In the first group, users engage with interactive activities to study grammar or vocabulary, receiving feedback on their performance. The second group allows users to create ebooks, flipbooks, videos, and audio content on the app platform. Although these two types serve different functions in language learning, overuse of the first type might lead to learner fatigue.

4.2.2. Criteria for Designing Learning Applications

Sweeney and Moore [14] emphasize that any application design framework should account for "the diversity of contexts and opportunities in mobile language learning". To support this, they suggest two checklists. The first is a straightforward feature checklist to help teachers and developers create "pedagogically viable language learning apps" [14], consisting of seven requirements outlined in Table 2.

Table 2. *Criteria for developing language learning applications [14]*

	Requirements language learning app
1.	☑ Allows for personalisation;
2.	☑ provides visible progress indicators;
3.	☑ covers relevant language;
4.	☑ covers more than one skill;
5.	☑ maximises exposure to target language (i.e. minimal translation);
6.	☑ appropriate for the device in terms of content, activity and user interface;
7.	☑ encourages learning behaviours which correspond to what we know about general mobile-enabled behavior patterns, including social and gamification aspects.

From a mobile learning standpoint, Sweeney and Moore [14] offer a second checklist to ensure apps are developed to "facilitate several known benefits of mobile learning cited by Traxler in the JISC Mobile Learning Infokit (JISC 2010)". They argue that an app should meet at least one-third, or 4 out of 12, of the criteria/benefits listed in Table 3.

Table 3. Criteria for developing language learning applications for mobile devices [14]

	Requirements language learning app from a mobile learning perspective
1.	☑ Fits into the lives of learners (allow for productive 'dead' time);
2.	☑ is portable to allow anywhere, anytime learning;
3.	☑ allows for immediate communication (including speech and data-sharing);
4.	☑ allows access to learning by those in dispersed communities and isolated situations;
5.	☑ offers contextualisation through location-aware features, such as GPS;
6.	☑ allows for the delivery of bite-sized e-learning resources;
7.	☑ takes advantage of peer-to-peer networks making learning more student-centred;
8.	☑ promotes active learning;
9.	☑ enables new learning environments;
10.	☑ increases accessibility for learners with special educational needs;
11.	☑ encourages reflection in close proximity to the learning event;
12.	☑ reduces technical barriers to e-learning.

5. Advantages and Disadvantages of Applications as Learning and Teaching Tools

According to eCycle's evaluation, smartphone applications enable students to access information swiftly, thereby indirectly enhancing their academic performance [16]. eCycle notes that smartphones can assist students in creating flashcards, preparing presentations, receiving immediate feedback on questions, recording video and audio, and transferring recordings to their computers [16]. The drawbacks identified by eCycle include cost, device size, battery life, and usability issues (such as small keyboards making typing challenging) [16]. eCycle suggests that administrators reconsider allowing phone use in class, as laptops are bulkier, more expensive, and less portable [16]. Moreover, mobile phones can serve as effective teaching tools. For instance, instructors can use Dropbox to share files in class, distribute materials more quickly, and reduce paper usage. Another example is Evernote, which students can use to review lecture notes after class.

6. Some English Learning Applications

The debut of the iTunes App Store in 2008 signalled the onset of a surge in mobile applications. Initially, these apps were crafted for the iPhone, encompassing a range from "games and utilities to messaging and word processing" [10]. However, as noted in Godwin Jones's research at the time, only a limited number of apps were created specifically for language learning [10]. The majority were reference and language practice apps, presented in a straightforward manner. Besides apps explicitly designed for educational purposes, Godwin-Jones [8] identifies a unique category of language learning apps termed "alternative apps," which refers to "general-purpose apps that can be utilized for language learning, such as voice search, voice email, postcard creation, recording, and games". Nowadays, with technological progress, numerous apps have been developed to significantly aid the teaching and learning of foreign languages.

6.1. Suggestions for Some Language Learning Applications

6.1.1. Grammar Learning Apps

Hello English (iOS/Android): This well-known grammar learning app incorporates speech recognition software, audio dictionaries, and interactive games. Research by Oktaverani et al. [17] suggests that learning grammar through apps enhances learners' awareness and application of grammatical structures in real-life communication scenarios.

Grammar Up (iOS, Android): Featuring over 1800 multiple-choice questions, Grammar Up assists learners in improving grammar and vocabulary. Research by Kuzmina [18] confirms that quizzes rapidly reinforce grammatical knowledge and enhance accurate grammar use in communication.

6.1.2. Vocabulary Learning Apps

StudyStack: This app aids students in building vocabulary through games and flashcards. Research by Poláková and Poláková [19] indicates that using electronic flashcards (like StudyStack) is highly effective for vocabulary retention compared to traditional learning methods.

Memrise (iOS/Android): Memrise helps learners develop vocabulary through game-based lessons. According to Hou [20], game-based learning apps like Memrise boost learner engagement and motivation, as well as long-term vocabulary retention.

6.1.3. Speaking Skills Apps

HelloTalk (iOS/Android): This app connects learners with native speakers for speaking practice. Research by Basir et al. [21] suggests that communicating with native speakers via apps like HelloTalk enhances pronunciation and increases confidence in communication.

Italki: This app enables learners to participate in online lessons with native teachers. Research by Pivač and Kerla [22] shows that online classes with native teachers positively influence the improvement of speaking and listening skills and help learners develop natural language reflexes.

6.1.4. Reading Skills Apps

Readlang: This app assists learners in translating vocabulary and sentences directly on websites, supporting reading and vocabulary learning. Research by Topal [23] indicates that reading texts in real-life contexts helps learners improve reading comprehension and use vocabulary naturally.

Beelingu: This app allows learners to read bilingual texts, including literary works and articles. Research by Herminingsih et al. [24] demonstrates that bilingual reading helps learners gain a deeper understanding of word meanings and improve reading skills, particularly in understanding vocabulary usage contexts.

6.1.5. Writing Skills Apps

Grammarly Keyboard (iOS/Android): Grammarly provides grammar, spelling, and style checking tools. Research by Prasetya and Raharjo [25] shows that automated grammar checking tools help learners write more accurately and confidently in using correct grammar.

ProWriting Aid (iOS/Android): Similar to Grammarly, ProWriting Aid offers powerful editing capabilities and enhances academic writing skills. Research by Tobing [26] indicates that using grammar editing tools helps learners improve writing skills and minimize grammatical errors in their writing.

6.2. Suggested Activities Using Apps in Language Teaching

- **Activity 1**: **Combining Padlet and Ed Puzzle**

+ Step 1: Require students to complete a discussion related to their prior knowledge of the topic;

+ Step 2: Students complete an Ed Puzzle exercise related to the topic in step 1;

+ Step 3: Students return to Padlet and record what they have learned after completing step 2;

- **Activity 2**: **Parlay (Online/Live roundtable discussion)**

+ Step 1: Students watch a selected video on Parlay related to the discussion topic;

+ Step 2: Students answer discussion questions and post responses in Parlay's feedback section;

+ Step 3: Students perform Peer Feedback;

@ After submitting their responses, read at least two classmates' posts;

@ Answer two questions and post responses in Parlay:

1. What did you find interesting or appealing about this post?

2. Do you agree or disagree? Why or why not?

+ Step 4: Complete the discussion and submit responses to the instructor.

- **Activity 3**: **Combining Jamboard and Flipgrid**

+ Step 1: Read materials related to the topic;

+ Step 2: Use Jamboard to record answers (write name, create response page, add relevant images to illustrate answers);

+ Step 3: Review classmates' answers on Jamboard;

+ Step 4: Create a one-minute video response on Flipgrid about what was learned after completing steps 1 to 3;

+ Step 5: Read and respond to two classmates' posts.

6.3. Recommendations

6.3.1. Selecting Suitable Applications

Most instructors share concerns when required to select suitable apps for students. Among millions of apps, this task is certainly not easy. The top criterion when choosing an app is that it must be easy to use, not require much time to install, register an account, username, or verification information. The leading criterion is "less is more." Each teacher needs to clearly define the purpose before deciding to download an app and answer whether using the app will help students learn better compared to traditional methods.

6.3.2. The SAMR Model

Ruben Puentedura's SAMR model offers a practical approach for teachers to choose suitable apps [27]. Puentedura [27] advises educators who are new to technology to begin with basic substitution activities. For instance, students might be asked to use e-books in place of traditional paper books or employ fill-in-the-blank apps for these substitution tasks. Instead of writing directly in printed books, students will input their answers on mobile apps.

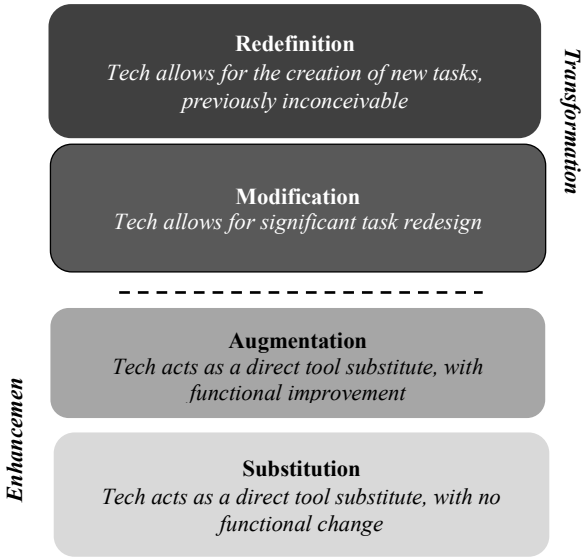

Figure 2. *SAMR Model [27]*

Augmentation is utilized when educators or students wish to modify or enhance features. For example, vocabulary learning applications can be used to capture and replay pronunciations. Students may document words in written form or export annotations from e-books as a consolidated file, offering a coherent summary of notes for essay writing. These changes significantly boost learning (Enhancement) but do not necessitate altering or transforming tasks. For instance, students can share these integrated notes and incorporate them into essays published on personal pages for peer review, thereby enhancing their writing and achieving better learning outcomes through task redefinition. According to Puentedura [27], transformation fundamentally involves a move towards social constructivism, where learners actively co-create understanding while acquiring vital 21st-century skills.

6.3.3. Free Applications

Some applications operate on a freemium model, allowing users to download a basic version at no cost, but requiring payment to access more advanced features. Free apps frequently include advertisements, so it's important to review the types of ads shown to determine their suitability for classroom use. Additionally, if an app asks for an email address, it could lead to students receiving unwanted spam. To enhance the utility of free apps, users might consider using app evaluation forms. Unlike content from books, newspapers, or television, the information on mobile apps is not specifically regulated for quality or accuracy. The widespread availability and easy access to mobile apps mean that students are increasingly relying on online resources for learning. Consequently, it is crucial for each student to be self-aware when selecting, evaluating, and choosing appropriate learning resources in the absence of instructor guidance.

7. Conclusion

In educational settings, a notable disconnect has been observed between developers of language learning apps, who often lack pedagogical insight, and language educators, who possess pedagogical expertise but are not well-versed in mobile learning and app development [14]. It is suggested by the authors that collaboration among developers, entrepreneurs, educators, and linguists is essential to ensure that mobile learning applications are created that are not only commercially viable and technically sound but also educationally effective. Additionally, educators should familiarize themselves with app specifics, read user reviews, and check app ratings. It is important to review privacy policies, terms, and conditions before agreeing to them. While smartphones can be a source of distraction, this should not deter their use in educational settings. Teachers need to establish clear guidelines and rules for phone usage in the classroom. By defining when students are allowed to use phones and separating device time from other activities, educators can ensure that students remain focused on language learning. In essence, mobile technology has become the tool of choice for most students today, with BBC News referring to this era as the "golden age of language learning." To conclude, it is important to highlight that no matter how sophisticated mobile apps become, they cannot replace the essential role of real-life educators: "*Technology will never replace great teachers, but technology in the hands of great teachers can create magical transformations*" [28].

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