A Trend Analysis on Learning Apps Research

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Abstract—*Learning Apps (LAs) are computer software applications designed to run on mobile devices, computer systems, and other portable devices. Though not defined well yet, its de-facto standardization appears to be essentially characterized by the terms 'small and handy' at least for now. Looking into the context and spirit, we characterize it further in conformance with the well-accepted attention span of 20 minutes, limited focus on 7(±2) specific learning outcomes, individualization, and multimodal communication. In turn, an LA must conform to all the celebrated components of high-quality instructional ingredients, including interactivity, feedback, individualization, ergonomics, etc. LAs have come a long way recently but are still in infancy in terms of methodical research, development, standards, use and contextual evaluation. Consequently, it appeared mandatory to comprehend the trends in this regard. We undertook as an 'exploratory and methodical' trend review on learning apps related research publications; and report the Metadata analysis on Learning Apps – adhering to a debate on its significance and recent research works. The paper includes a contextual background, trend analysis methods, and results. Finally, it concludes with a few important broad research findings and upcoming directions related to LAs.*

Keywords: *Learning Apps, Mobile Apps, Modeling, Evaluation, eLearning, Research Trends, Metadata analysis, 21st-century Learners, Pedagogical issues.*

Introduction

There is a rapid expansion in the field of mobile technologies, especially in the field of hardware, software, and communication devices with high portability features. Such mobility, no doubt, requires a redefinition of instructional technology paradigms afresh. In the age of ICT, everyone wants to learn more informally without restrictions of both time and place. To access these types of learning environments, we need some special learning strategies and integration of current portable technologies with new educational modalities. The portable technologies broadly include iPhone, iPad, laptop, Smart-phone, watches, and some other portable devices as well.

Since most of the portable devices are web-enabled, the whole paradigm of their usage is changing fastly. In recent years, we witnessed huge growth in e-payment, e-business, and e-learning systems to accomplish the required tasks easily and effectively. Mobile Apps are one of the most popular delivery formats that offer the additional flexibility of offline viewing of the eLearning courses to the learners. These Mobile Apps are of several types but highly loaded eLearning systems needing an internet connection to download the application, and then we can use these m-Apps with or without internet connection [1].

Findings show that there are a billion number of devices available in the world now, but revolution came in 2014 when its magnitude increased dramatically to surpass stationary devices [2]. Because of some important advance features in the field of portable technologies such as Wi-Fi, email, music player and multimedia, these improvements have incited the instructors and specialists to take an academic view toward creating Mobile Apps including Learning Apps as well [3].Learning modules ought to be fit in the gadget-free delivery of learning context and learning management. But the serious issues are the reusability of educational contexts on various gadgets. As of today, Learning Applications are the best solution to overcome these technical issues. Quinn [4] reported that a portable learning model must work for a wide scope of gadgets, not only one but also a lot of gadgets. As of today, m-Apps (especially in educational fields) are providing the inevitable solution because of heavy use and an ever-increasing trend towards such devices.

Due to the uncountable unique features of Mobile Apps (m-Apps), now almost people are using these apps in their personal lives according to their individual needs. So, it is right to say that m-Apps are fastly changing the life of the 21st-century learners. The learners of the 21st era, support highly pervasive ways of learning, i.e. anytime and anywhere. As it is already known that, learners can enjoy their learning very well when a learning system provides lots of flexibility and informality. Traditional teaching and learning methods do not achieve these learning features. On the other side, m-Apps are still not fully explored and utilized, especially in academics domain.

Mobile Apps

There may be various classifications of Mobile Apps, depending on the selection of criterion. Here is a classification that is the most general and based on deployment-type. It is a primary classification that is not based on a too-specific criterion but a few prevalent general features. The types of

Apps are comparable to each other, however, they share several similarities. A comparative view of these typical mobile apps is briefly summarized from thinkmobiles.com[5], as follows.

Web Apps use a browser to run and ordinarily written in HTML5, JavaScript, or CSS. These applications divert a client to URL and give an introductory decision to guide the navigation. These require an insignificant amount of memory in general. As all non-open databases are saved on a server, clients can get access to from any contraption each time there is a connection. Some good examples of these types of apps are Medium, The Washington Post, etc.

Native Apps are largely developed for a single cell running device exclusively. Consequently, these are local for a stage or gadget. The application works for structures like iOS, Android, Windows Telephone, Symbian, and Blackberry can't be utilized on a stage other than their own. These are remarkably available from application stores of their structure and have the unmistakable propensity to achieve target clients. In contrast to advantages, some cons include higher cost, exclusive assistance, and a bit difficult upkeep for exclusive sorts of apps resulting in the better product price. Some good examples of these types of apps are Bloomberg, Airbnb, etc.

Hybrid Apps are created utilizing multi-stage web innovations, such as HTML5, CSS, and JavaScript. So, called hybrid because they are mainly developed for website applications and they are run inside a native browser. Some good examples of these types of apps are Ever note, Pacifica, Baskin Robins, Remote POS, etc.

Before the development of an application, it is mandatory to know about all the essential attributes or ingredients related to that particular app. A set of nine attributes list is selected for the m-Apps for comparison purpose. The list of apps attributes includes- development cost, performance, distribution, monetization, trends, device features, user interface, code recommended for, and portability. A comparative view of these apps attributes is briefly summarized from [2, 6], in Figure 1.

We can observe that the native apps are costlier as compared to other available apps because we require highly skilled persons for its development. The lowest cost in term of application development belongs to web apps. In the case of the second attribute, the best performance goes to the native apps, whereas worst to the web apps because these types of apps require a lot of browser work and network connection. Distribution is the third attribute of m-Apps; both the native and hybrid apps follow the same distribution process. Both the apps have their own limitations and requirements, but in the case of the web applications, there are no app store limitations.
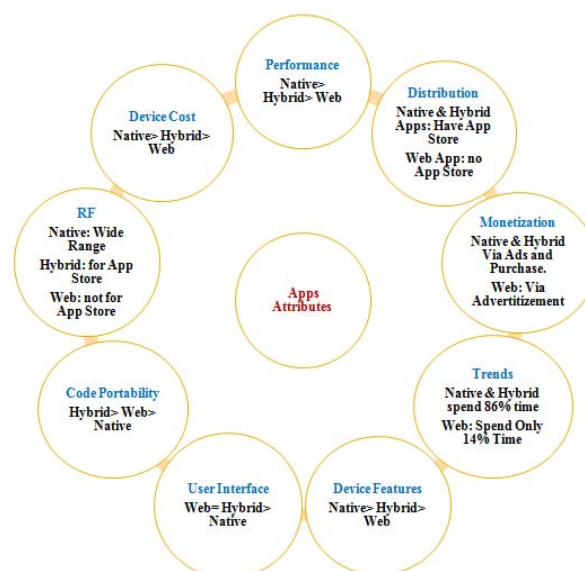

Figure 1: A Comparative Analysis on Mobile Apps Attributes

Next essential attribute is monetization; in the context of the native and hybrid applications, the app store takes approximately 30% fee through the purchase processes. On the other hand, the web Apps monetization attributes are achieved with the help of advertisements and subscriptions. In a survey, it was found that users of the native and hybrid apps are approximately 80%. On the other hand, users of the web apps are only 14%. In the case of device features attribute, the code of the native apps can access at a wide range. In the case of the hybrid apps, some API cannot work due to some limitations. With respect to the web application, only a few device application programming interfaces (API) works. On the user interface, the native apps are developed with the help of highly intimate native OS, but in case of both the hybrid and web apps, even desired applications cannot give fully native experience due to some platform limitations.

Code portability is not available in case of the native application, in the hybrid applications most of the code is portable and minimal portability exists in the web application. The native applications provide a wide range of development due to the capabilities of web or internet technologies, so these types of apps are mostly used, where optimization is a key component. If an app is to be developed for an app store, then the best option is the hybrid app development. For an application that does not require any app store, and then the best option is the web apps development. From the above concluding remarks, it appears that the above-mentioned features may be primary ones but do not suffice well for Learning Apps due to its specialty on inducing learning outcomes rather serving data processing requests.

By observing the above literature, we conclude that there are some desirable modifications needed on the available Learning Apps. These desirable modifications may provide some desirable learning outcomes by adding valuable instructional features. These unique features may include interactivity, ergonomics, profiling, customization, time spans, pace control, etc. Although, LAs have come a long way from but are still at the very early stage of development. A few examples of Learning Apps include the following[7][2]:

- Duolingo: Learn Languages for Free (Android & IOS)

- Photomath: Camera Calculator (Android & IOS)

- Quizlet: Flashcard & Language App to Study & Learn (Android & IOS)

- Lumosity: Brain Training (Android & IOS)

- BYJU'S: Multidisciplinary (Android & App Store)

- TED: (Android & IOS)

Typical Learning Apps

Learning Apps are critical software applications designed to run on a mobile device, computer systems, and other portable devices. These Learning Applications follow a limited time span, in conformance with the well-accepted attention span of 20 minutes. With these limits, a Learning App may focus on maximum three to seven specific learning points and provide multimodal learning opportunities for the learners based on their profile. They must be interactive and support individualized learning principles. With the help of Learning Apps, people are effectively utilizing their leisure time as productive time, because LAs extend and promise such desirables features. Learning Apps are used to provide the best virtual environment for learning to take place; this means that Learning Apps provide meaningful content with the help of depth experience. The current estimate shows that there are thousands of Learning Apps in use around. According to [1] all the LAs can be categorized in the seven categories such as playful learning apps, eBooks, workbooks or practice books, puzzles and traditional games, theme experience, interactive encyclopedia, and bring your own contents (BYOC). These are shown in summarized form in Table 1, with source data from (kindertown.com.)

Table 1: Categorization of Typical Learning Apps

LAs	Key Features	Benefits	Examples
Playful Learning	Learning by the performance of playful activities.	Open-ended; Encourages creativity, flexibility, and multisensory experience.	Toca-Boca App
eBooks	Learning by reading, listening, and observation.	Develops vocabulary of learners; Understanding of storylines.	Auryn HD-Teddys Day Goodnight Moon
Workbook	Generate the questions; Used to give homework and extra practice work for learners.	Develops fluency amongst the learners; Used to test preparation as well as it supports reinforcement learning.	Todo Math, Bluster-Deluxe
Puzzle and Traditional Games	Learning by puzzles and games; encourage reasoning skills through the various games.	Develop social and cognitive skills; Learning by fun.	Multi-player LA, Match Blitz, Futaba
Theme Experiences	Learning by creating themes. And applies these themes to learn available learning strategy.	Correlates the learner's interests, Assess the learners. And learning through a multitude tool, Support collaborative learning.	Barefoot World Atlas, Geography Drive
Interactive Encyclopedia	Learning through videos, images, and playing games.	Helps the learners in explore topics of interest; Provide connections between contents.	ABC Aquarium
BYOC	Learning through creating your own contents.	Flexibility to build, Virtual reality world.	Toca Builders

The present work focuses on issues and a critical review on metadata analysis with respect to LAs. This examination adequately outlines these issues and joins the important synthesis through a meta- examination [8] to give an unyieldingly complete examination of past examinations. We proposed the four research questions to cover metadata analysis on Learning Apps, as follows: (1) What are the major databases & journals that focus on Learning Apps Domain? (2) What is the state-of-the-art research on LAs evaluation? (3) What is the state-of-the-art research on LAs modeling? (4) What are the popular LAs and perception about them?

State of the art

Learning Apps have come a long way but are still at the very early stage of development. So, it is mandatory to comprehension a through sightedness of the trend to notice the direction of upcoming research in this area. Learning is one of the crucial areas of instructive applications for modern innovations. Learners of this era support portable learning at a very high rate due to rapid expansion in the field of portable technologies. According to [3], portable learning occurs when the student isn't at a fixed, predetermined location, or when the student exploits learning openings offered by portable devices. So, we can define portable learning as- learning via the internet or network with the help of individual portable devices such as Tablets, Smartphone, and other portable

devices. Learning Apps are supporting learning (either offline or online) through portable devices in the 21st- century.

Literature shows that the success of 21st-century learners depends on multiple factors such as technology and demographics. Learning Apps are also part of this success, but to design the successful Learning Applications (LAs) is still a major challenge. To design such successful LAs, we need to follow some formal strategies and guidelines such as technology supporting learning apps, based on lifelong learning strategies, based on self-control, and customization [9]. Some guidelines include self-paced learning, selection of appropriate learning styles, and integrating current learning strategies with digital skills.

After careful observation or investigation of previous literature, we found some important research gaps. Such as the learners of this century want to integrate with 21st- century skills as well as with digital skills to provide a better learning environment. It was also found that the pedagogical issue is still a major issue in app development systems [10]. This is necessary that 21st-century skills should fit in the current educational curricula to achieve better learning outcomes. This study also identifies the essential dimensions and key operational components that should be integrated into the current learning system. Finally, we identified the seven core skills and five contextual skills of 21st-century for an integrated purpose, briefed as follows.

In general, the core skills include collaboration, communication, digital literacy, citizenship, problem-solving, critical thinking, creativity, productivity, information management, and self-direction [11]. These skills-based on current social issues and current economic development that is why these skills are also known as 21st-century skills. According to [12] there are seven core skills of 21st-century such as (i) Information Management, (ii) Critical Thinking, (iii) Collaboration, (iv) Communication, (v) Problem Solving, (vi) Creativity and (vii) Technical. Also, there are five contextual skills defined by [12]these are listed as Cultural Awareness, Self-direction, Ethical Awareness, Lifelong Learning and Flexibility.

The findings reveal that the core skills and contextual skills of 21st-century are vaster than digital skills. According to [13] we considered the 21st-century skills as- master of ICT to solve the cognitive task. Some of the skills that are not delivered or supported by technology but can be supported by emerging skills of 21st- century. On the other hand, Learning Apps can easily support several types of 21st-century skills as well as all the technological skills. Learning Apps are continuously developed to fill the versatile needs of 21st-century learners. Because they are continuously provided learners centered instructions as opposed of traditional teaching or learning methods. With the help of Learning Apps, people are effectively utilizing their leisure time as a productive time because Learning Apps provide lots of flexibility and user-centered features to their learners. Some of

the features of LAs are- anytime & anywhere, collaboration, sharing & corporation. But still, it is one of the areas, which are not fully explored and utilized.

Learning Apps are computer programs and software applications designed to run on a mobile device or computer systems and other portable devices. These learning applications follow a limited time span, in conformance with a well-accepted attention span of 20 minutes. With these limits, a Learning App may focus on maximum three to seven specific learning points and provide multimodal learning opportunities for the learners based on their profile. Many Learning Apps has been proposed by the researchers in the last several years. Reviewing and getting state of the art in this field still a challenge.

Apps are frequently used for a specific purpose, they can add value to its users such as purchasing goods, and it enables customers to become better acquainted with the goods and product. It provides new trends of the facility to their users; they can enjoy these types of services with the help of Wi-Fi, LTE, Push Notification, and other types of services as well. These apps also support few additional advantages as well such as customization, user center approaches, and collaboration. With the help of these advantages, even new learners can be deeply engaged in their learning tasks whenever they want and wherever they want without the restriction of both time and place.

Learning Apps derive many educational advantages to their users or learners but here we are a few exclusive to support them. Communication & Collaboration, Sharing & Corporation, Dynamic & Creative, Engagement & Flexibility, Speed & Security, Simplicity, and learn Anywhere & Anytime. In short, Learning Apps supports 4 C's (Communication, Collaboration, Corporation, and Creativity) as well as 4 S's (Speed, Simplicity, Security, and Sharing). All the advantages mentioned above are shown in figure 4.
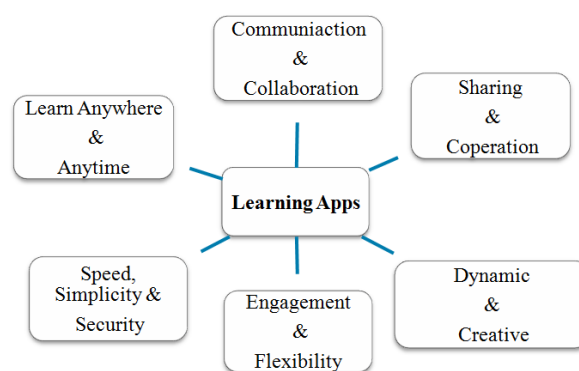

Figure 2: Skills Learn Via Learning Apps

On the other hand, the learning models also explained the importance of these learning applications in our daily life. In the past, many learning models were proposed by researchers but out of them, only a few learning models explained the

needs of Learning Apps in the current education system. We discuss only two learning models, the first one is "Cone of Learning Model" and the second one is "Seventy: Twenty: Ten" (70:20:10) learning model[14][15]. Dr. Edgar Dale proposed the Cone of Learning Model in the year 1960. Originally the Cone had been proposed in the year 1946 and the main aim of Cone development model was that "how the Cone represents the various learning experiences through the Cone." According to Dr. Edgar, the contribution of learning via Presentation & Learning Apps is 90%, contribution via discussion and participating is 70%, contribution via watching movie and demonstration is 50%, via seeing is 30%, via hearing words is 20%, and via reading texts is 10%.

The second model of learning is Seventy: Twenty: Ten (70:20:10) and it was developed at the Center for Creative Leadership (CCL) in the year 1980. In the context of the current model, Seventy percent of beneficial learning comes from an informal medium. For supporting this fact, Learning Apps are providing lots of learning contents by the informal medium. Twenty percent of learning comes through social expressions such as collaboration activity, assignment activity, group discussion, and sharing of information. Ten percent of learning comes from traditional mediums. As we know that different people learn different things in different ways. Some of them best learn when they see the problem in visual form, some of them best learn via writing, via speaking, via hearing, and body language.

According to Mayberry [16]all the instructional materials or learning materials should be fit into a single framework. He proposed some important guidelines to create such type of framework and recommended the various font styles for instructional material, suitable colors, and design principles. Wu et al. [17] have surveyed to study the relevant literature during (2003 to 2010). The focus of Wu et al., literature was on the distribution of research area in the field of mobile applications and utilization of mobile devices. The Wu et al., researchers concluded that most of the developers or designers mainly focused on the successfulness of Learning Apps followed by Learning Apps design. Bidin and Ziden[18] have conducted a literature review on instructional apps or learning apps. They found some key difference between eLearning and mLearning in their review. Finally, Bidin and Ziden literature found some emerging research issues such as- Usability Issues on available LAs, learning expectations from learners, and Pedagogical Issues.

In the same year, one more related literature was published by the Dionne [19]. Dionne used the survey method to conduct his research. According to him "the Learning Apps or Educational Apps should be integrated into school education to teach special students". Dionne Finally, done some experimental work on these apps and he found the effects of LAs were positive to teach the special students (students who have some learning disabilities). But his survey method covered only two learning dimensions (speaking dimension

and hearing dimension). Kucirkova et al.[20] have conducted research on 'How to Create Own Learning Apps' for an individual as well as for group learners. After creating the Learning Apps, the tests were conducted on the Forty-One students by the researchers. The tests were conducted in two ways- (i) test the learning app by the individual learner. (ii) Testing the learning app in groups. After qualitative as well as quantitative evaluation, it was found that the LAs affected the whole learning paradigm. Lee and Sloan[21] have conducted a research on the rating system. The focus was on 'how to propose a good rating system that can evaluate Learning Apps from all aspects. According to these researchers, there was only two literature published on the rating system before their literature, but those rating systems could not successfully evaluate the Learning Apps from all aspects. Finally, they proposed a rating system that covered twenty-four dimensions of pedagogy.

Ok et al [22] conducted literature on creating the special Learning Apps for special students (the students who have some learning disabilities). The main focused of this essay was on 'how to best utilize the digital technologies to achieve desired learning goals and what could be the selection criteria's for selecting effective Learning Apps'. According to Ok et al.[22], there should be special LAs for special learners (the students who have some learning disabilities). For evaluating these special LAs for special students, the researchers selected the thirteen rating criteria. The experiments were done by instructors and guardians. In the year 2016, the next literature was published by Chen [23]. The focus of that literature was on 'how to propose an evaluation system to evaluate language Learning Apps', especially for secondary and post-secondary learners. The researchers found that the proposed evaluation system got desirable learning outcomes both in secondary as well as in post-secondary students. The evaluation was conducted in three steps these are- step1) developing some rating mechanism, step2) selection of LA and step3) getting the result. Zydney and Warner [24] have proposed a review on Based on analyzing the science learning Apps from 2007 to 2014 based on theoretical approached. Researchers Zydney and Wamer observed that the science Learning Apps are also supporting the number of common features as other disciplined LAs supporting. But on the other hand, the examiner needs to test the individual science learning app feature to examine the app behavior. This process was very time-consuming.

There were approximately a billion number of Learning Apps available in the market till 2017. The selection of effective and efficient LAs is still a major challenge. With respect to this crucial issue, one of the important literatures was published by Liu et al.[26] that is apps mining literature. The researchers Liu et al., proposed some effective guidelines for developing successful Learning Apps. Such as, predict the learners' requirement in advanced, know your learners' interest, and what types of learning they want. After that, one of the new literatures was published by Papadakis,

Kalogiannakis, &Zaranis[25]. And the overall message of this literature was that 'the available Learning Apps are not providing quality education' for any stream of current education. The researchers analyzed that, most of the available Learning Apps are promoting rote learning, deeper knowledge is not provided by these apps, and the thinking level of these Learning Apps is very poor. Results demonstrated that a large number of literatures on Learning Apps had been enhanced from 2010 to 2019. And the well- known domain in the field of Learning Apps are ergonomics, feedback, effectiveness, assessment, personalized systems, informal communication, portable learning and skills of 21st-century.

Review Methodology

To conducting effective 'Metadata Analysis Review', we need at least six criteria as mentioned by the Field and Gillett [26]. Those criteria are- (1) Making the number of the possible search string. (2) Proposed some inclusion or exclusion criteria's (3) investigate the inclusive literature (4) Do Analysis (5) also does various analyses on published related work and (6) Prepare the results.

A) Making Search Strings

Although search strings are varied depending on the tools and technique we applied in our search. To address our research title "A Metadata Analysis of Learning Apps Research- A Trend Review" our searched strings including the various keywords combinations such as: (A metadata analysis on "learning apps" or "learning applications" or "learning app's") OR (A metadata analysis on "instructional apps" or "instructional applications" or "instructional app's" or "instructional program") OR (A metadata analysis on "educational apps" or "educational applications" or "educational app's") OR (A metadata analysis on "teaching apps" or "teaching applications" or "teaching app's") OR (Published literature on "learning apps" or "learning application" or "learning app's" or "educational app" or "educational app's" or "educational applications" or "instructive apps" or "instructive app's" or "instructive applications" or "teaching apps" or "teaching app's" or "teaching application") OR ("learning apps" or "educationalapps" or "instructional apps" or "teaching apps" based on "21st century" or "current trends" or "current generation").

Inclusion/ exclusion criteria, as custom protocols for inclusion as well as exclusion purpose. Inclusion Criteria includes: 'either Learning Apps or Mobile Apps as keywords, completeness, freely accessibility, 2007-19'. Exclusion Criteria includes 'no empirical basis, no relationship to our RQs and focused on general Mobile Apps'.

To address the research proposed, we selected 24 research papers from 163 research literature. Out of the 163 papers, 37 papers were founded as duplicate those were truncated from our desirable paper pool. Altogether, only 24 research papers met the consideration criteria and were utilized in investigations.

Results

To cover Metadata research, we framed four research questions as RQ1-RQ4, dealt separately as follows.

RQ1:What are the major databases & journals that are focusing on Learning Apps domain?

Some most important databases those are related to Learning Apps domain such as- Academia, j-Gate, Sci-hub, Google scholar, IJCSI, ERIC, Science Direct Onsite (SDOS), SAGE Journal Online, Pro-Quest, Wiley Inter-Science, ACM Digital Library, JSTOR, Elsevier Science (Elsevier)/SDOL, and Informa world. Note that we accessed the maximum number of domain-related papers from Academia database followed by j-Gate. We accessed most of the latest papers from the j-Gate database. On the other hand, the maximum number of duplicate papers received from Google Scholar. We also identified some good journals in the same domain (Learning Apps Domain) such as- Journal of Computer Assisted Learning, American Journal of Educational Research, Social and Behavioral Sciences, Computers & Education, Canadian Journal of Learning and Technology, Computer in Human Behavior, British Journal of Educational Technology, Journal of Educational Technology and Society, and The International Review of Research in Open and Distance Learning.

RQ2: What is the state-of-the-art research on Learning Apps Evaluation?

Evaluation is a key point in any type of teaching (either online or offline). To design better evaluation systems for available Learning Apps is still a major issue. By observing and investigating the previous literature, we conclude that a large number of literature was weak in developing the common evaluation system for all the available Learning Apps. A few previous literatures were focused on the apps evaluation domain, but they covered limited learning dimensions in their evaluation system. Researchers used the Linkert Scale, Rubric,Checklist, pretest and posttest as the evaluation tolls for apps evaluation. The Baran, Uygun and Altan[10], proposed an apps evaluation system based on some predefined protocols. That evaluation system was based on the 5 learning parameters such as- psychological, technological, usability, background, and content. It was found that the pedagogical issue is still a major issue in the field of instructional design. Recently, Vincent[27] proposed an apps evaluation system. He described the present evaluation system. He described that the present evaluation systems mainly focusing on customization, feedback, thinking skills, level of engagement. We conclude that the Vincent evaluation system covered the limited number of learning dimensions.

'TRIPLE E' apps evaluation system was proposed by the ("A very good visual on how to evaluate educational apps", 2019) [28]. TRIPLE E, evaluation system based on these 3 E's (Extended, Engage, and Enhance) for evaluating these three

E's, the researchers applied rating system (Zero, One, Two) based on the learner questions. The questions asked by the learners were related to engagement, teaching strategies, motivation factors, and accessibility. Based on the Checklist tool, the next evaluation system was proposed by the Tillander[29]. The evaluation was conducted based on some criteria's such as- learners' interest, instructional strategies, instructional strategies, and curriculum strategies. Finally, we can conclude that there is an urgent need to develop better evaluation tools or techniques for evaluating available Learning Apps.

RQ3: What is the state of art research on Learning Apps Modeling?

There appears a considerable good amount of research and developments on Learning Apps. However, we could not find single comprehensive framework (based on research findings) handling all the three dimensions- pedagogic, technological and ergonomics. Here we want to list out some previous proposed work on learning apps modeling in tabular form. This summarized work taken from (Dhiman,[30]; Aliannejadi [31]; Wang[24]). In view of this, it is highly pertinent to develop a framework for modeling effective learning apps and a comprehensive quality evaluation tool.

Table 2: Models on Learning Apps

Modeling	Features	Limitations
Modeling for learning scenarios.	Mainly focused on how to design learning scenarios. Test out development scenarios in advanced.	Not focused on LAs design.
iRPD	The learners, instructors, and developer view on the same plane while designing. Means it provides 3-way collaboration i.e. Learner, instructor, and developer.	Focused only on iPad Apps. Not focused on current issues.
UTAUT2 model	Focused on how to search for queries for jobs through m-Apps.	Not focused on LAs
Proof based Modeling	Proposed a technique for selecting desirable LAs based on eight predefined characteristics.	Focused only on mathematics apps
Validation Model	Focused on reuse learning behavior of 21st century learners. This model-based on seven parameters.	Focused only on paid language learning Apps.
Unified Modeling	Selecting desirable LAs based-on learner's questions. Focused on learning behavior and searching behavior of learners.	Focused only on learners' queries.

RQ4: What are the popular LAs and perception about them?

Up to the year 2019, almost a billions numbers of learning apps are available[6]. So, selecting a good quality LA is a very difficult job. Here some good Learning Apps based on some predefined apps attributes such as- exciting, exploratory, limited time span, and limited learning keywords. Here we aregoing to propose the answer for popular Learning Apps

research question. It is a general answer that is not based on a too-specific criterion. Based on the above apps attribute, we have created a provisional list of most popular Learning Apps and it is not necessary in the same order as written in the proposed table. This summarized data is taken from educational app store.com [7]as shown.

Table 3: Popular Learning Apps

Learning Apps	Purpose	Available on	Feedback
Byju's	It is the World largest LA, mainly designed for school students (4th to 12th) to teach multiple disciplines.	iOS	Yes
Curious World: Play Learn Grow	Based on distinct activities to fun and educate learners.	iOS / Web	No
Sentence Master Pro	To improve language abilities. Sentences are created via gamification.	Android, iOS	No
Edmodo	It is multidisciplinary LA, mainly used to reduce the workload of instructor	Android, iOS	Yes
Kahoot	It is MCQ based LA. It supports images and YouTube videos as learning content.	Android, iOS	Yes
Khan Academy	Provide free worldwide education anywhere and anytime	Android, iOS	No
Socrative Student	Instructors ask questions and conduct evaluation to their learners.	Android, iOS	No
Nearpod	Used to create assessments, ppt, slides, and interactive lesson plan.	Android, iOS	No
News-o-Matic EDU	Provide newspaper content in multiple language	Android, iOS	No
Edu-blogs	Used to create blogs for instructors as well as for students	NA (Not Available)	No
Evernote	With the help of this app, we can take notes, capture images, and create.	Android, iOS	No
Reading Eggs- Learn to Read	Read via interactive games, via digital story notebooks, and via some fun activities.	iOS	Yes
Merit nation	Based on CBSE curriculum. It is providing free solution for all classes up to 10th.	Android, iOS	No

Conclusions

We believe that this paper might provide some benefits both for new researchers and practitioners those are working in this vast field. LAs have come a long way but selecting good quality LA is a very difficult job, especially when you have almost 500,000 Learning Apps in the apps market. There appears a considerable amount of research and development

on Learning Apps. However, we could not find single viable model or framework (based on research findings) handling all the three dimensions- pedagogic, technological and ergonomics. So, to create an effective & efficient model for Learning Apps is an urgent need. The contribution of Learning Apps in the Cone learning model is almost 90%. Currently, the learning technologies are based on 21st-century skills such as operational skills and contextual skills Laar, and Haan[32].

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