CHAPTER 7

Enhancing Learners' Engagement with Educational Apps

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Introduction

Technology-enabled learning environment provides increased opportunities for enhancing learners' engagement, interaction and collaboration. With the advent of technology, educational applications (apps) have become popular in learning, teaching, and research at all levels of education. Learning through the use of apps is therefore gaining momentum as it affords flexible learning opportunities, coupled with 21st century learning paradigm. The nature of educational apps is varied, be it an app downloadable on a mobile device or customized apps, designed to provide bite sized information or a learning activity based on learning design. The core function of these apps remain the same, which is to provide learners an engaging and meaningful interaction with content and interface such that it enhances not only the learning experience but also success in learning. In short, apps are designed to enhance learning efficiency and effectiveness. The use of apps, from early childhood education through to higher education, provides continuous opportunities to enhance learners' engagement with learning materials (Diliberto-Macaluso, & Hughes, 2016; Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015; Pechenkina, Laurence, Oates, Eldridge, & Hunter, 2017), however there is a need for more research in this area (Hirsh-Pasek *et al*, 2015; Pechenkina *et al*, 2017). Hamari, Koivisto, and Sarsa (2014) reported that integration of gamified elements into apps has the potential to engage students and motivate them in a way that it can in turn affect other factors, which influence the learning process.

The Pacific Island Countries (PICs) have also been influenced by this technological wave of apps. While the concept of using apps is emerging at a rapid pace, infrastructure is still catching up to support these technological innovations in the PICs. The growth of wireless technologies, internet connectivity and reliable electricity supply in urban and remote areas have made eLearning possible in the Pacific region (International Telecommunication Union, 2015). It is important to note that while the incremental growth in ICT development has resulted in technology-integrated learning environments, the internet connectivity, infrastructure, ICT skills, and competencies remain an issue (Lingam, Raturi & Finau, 2015). Despite these challenges, learners and educators in PICs are determined to engage with learning through eLearning and mLearning opportunities.

The use of educational apps in eLearning and mobile learning (mLearning) environments is deemed useful by students as well as the teachers. The ubiquity of mobile devices offers learners affordances to engage with educational apps anywhere anytime, thus mLearning is picking up the momentum. A study conducted at the University of the South Pacific (USP) on students' perceived use of mobile devices such as a tablet in their higher education learning, concluded that it was a good idea as they were able to share their work, generate discussions, assess their cognitive skills, and develop new knowledge (Reddy, Sharma, & Hussein, 2015). The authors further reported that approximately 40% of the students faced connectivity issues and 38% lacked ICT competency. Some of the connectivity issues can be eased by downloading educational apps on mobile device, depending on internet availability and then use them offline. Similarly, practical sessions for science courses, which were reported as an issue for distance education (Chandra & Sharma, 2018),

can also be tackled with the use of educational apps. The educational apps can be used to demonstrate the practical session performed by the learner in the presence of a suitable supervisor. These apps can also be used to engage learners in bite sized learning through a self-paced context and quiz package. So and Brush (2008) emphasise the need to raise students' critical thinking and engagement, which is possible through a variety of learning technologies. It is thus not surprising that both teachers and learners are moving away from pen-paper and textbooks towards using educational apps and tablets. This has led to the development of new educational models such as flipped and blended learning classrooms (Cherner & Fegely, 2017). Such educational models open up a whole new world of student-centred learning and teaching strategies available to the teachers at all levels.

This chapter focuses on the use of educational apps currently used in the different learning environments and presents a framework for developing app-based lessons in an inquiry- based learning environment.

What is an Educational App and Where to find It?

An application (hereafter referred to as app(s)) is an online program that can be downloaded to a computer or mobile device and can be used immediately. Alternatively, "Mobile applications (apps) are software programmes developed for use on personal wireless devices such as smartphones" (Pechenkina, 2017, p.134). According to Hirsh- Pasek *et al*, "Apps designed to promote active, engaged, meaningful and socially interactive learning – four "pillars" of learning – within the context of a supported learning goal, are considered educational" (2015, p.3). These apps have evolved over the years from early prototypes like mobile phone based arcade games and other practical tools (calculators and calendars) to more versatile combinations, where operating systems for smart phones (Windows Mobile, Symbian, RIM, Android, Mac iOS) open up to the development of third- party software unlike the traditional programming environment on standard cell phones (Clark, n.d.). The apps developers began to focus on purpose, use and cost, which meant more variety and convenience for the user.

The majority of the apps are designed to run on either Apple's iOS OS or on Google's Linux- based OS, or Android (Cherner, Dix, & Lee, 2014). Google launched *Apps for Educatio*n in 2006 while Apple launched its *App Store* in 2008. Google apps have several tools available such as classroom, Gmail, drive, docs, forms and talk/hangout to build teamwork and enhance learning. It should be noted that at the time of finalizing this chapter, the Google Hangout is being phased out, but there will be new app to replace it (Spadafora, 2019). These apps are free, collaborative, provide real time editing, and are secure. Teachers and students are able to save time with improved communication when giving assignments and feedbacks (Google for Education, 2014). Apple apps have a combination of free and paid apps with downloads increasing every year. It is interesting to see Google Earth and Google Mobile apps featured amongst Apple's top ten free apps. What started as a source of entertainment has now made its way into the education field. Mobile apps provide a learning process or data collection and analysis, through mobile devices such as mobile phones, tablets, handheld PCs and netbooks. These can involve solving multidimensional, complex problems that require a variety of tools such as customized calculators and simulation software (Educause, 2010). A report by Chiong and Shuler (2010) focused on how the advances in digital media are influencing young learners and their families in the United States and how these devices can be deployed to support the learning system for all. The implications and insights raised by the related studies show that these educational apps help shape innovations (Chiong & Shuler, 2010).

Introducing mobile devices in education is believed to provide opportunities for varied learning and teaching strategies at all levels. McManis and Gunnewig (2012, p. 23) highlight this assertion in "finding the education in educational technology and its importance in the development of early learners". Yell and Master (as cited in McManis & Gunnewig) highlighted the importance of affective, cognitive and technical scaffolding while using technology with children. Today, there are many educational apps for children aged 0 to 8 years and intuitive interactions provided by touch screens on mobile and tablets make this possible. As of March, 2019, App Trace[55] reported 905,644 free apps by iTunes (though iTune would be replaced from September 2019 as Apple will then release its new software *Catalina*[56]), 2,201,784 free apps by Google, whereas there were 394,513 paid apps by iTunes and 253,163 paid apps by Google (appendix 1). App Trace is a website that provides analytics for apps. The sheer volume of apps is overwhelming for a user. As of 9th January, 2019, analytics from App trace for four PICs namely Fiji, Palau, Papua New Guinea and Solomon Islands reveal the top apps downloaded stand at 191, 195, 193 and 198 respectively. However, the majority of the apps are social networking apps, language learning, music learning, and weather information apps but Fiji analytics indicate a Math learning app called Math learner: Easy Mathematics, as one of its top apps. It is, on one hand, surprising that the website only provides data for four of these Pacific Island Countries but, on the other hand, it is also encouraging to see that a number of learning apps feature among the top apps for each of these countries, especially language and vocabulary learning apps. Fiji is the only country among PIC where a Math learning app 'Math learner: Easy Mathematics' appears in its top 25 downloaded apps. Highfield and Goodwin (2013), in a study of educational apps in Australia, UK and USA, revealed Science and Literacy apps as most popular ones. However, parents and educators find it difficult to choose the appropriate apps for their children (Guernsey, Levine, Chiong, & Severns, 2014; Rideout, 2014). It is imperative that more awareness is created for the use of apps. A quick search for Education apps on App Store resulted in 4000 apps that one can choose from (Figure 1) while the Google Play store provided a variety of education apps (Figure 2).

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55 https://www.apptrace.com

56 https://www.independent.co.uk/life-style/gadgets-and-tech/news/itunes-end-apple-death-when- wwcd-podcasts-music-announcement-a8942736.html

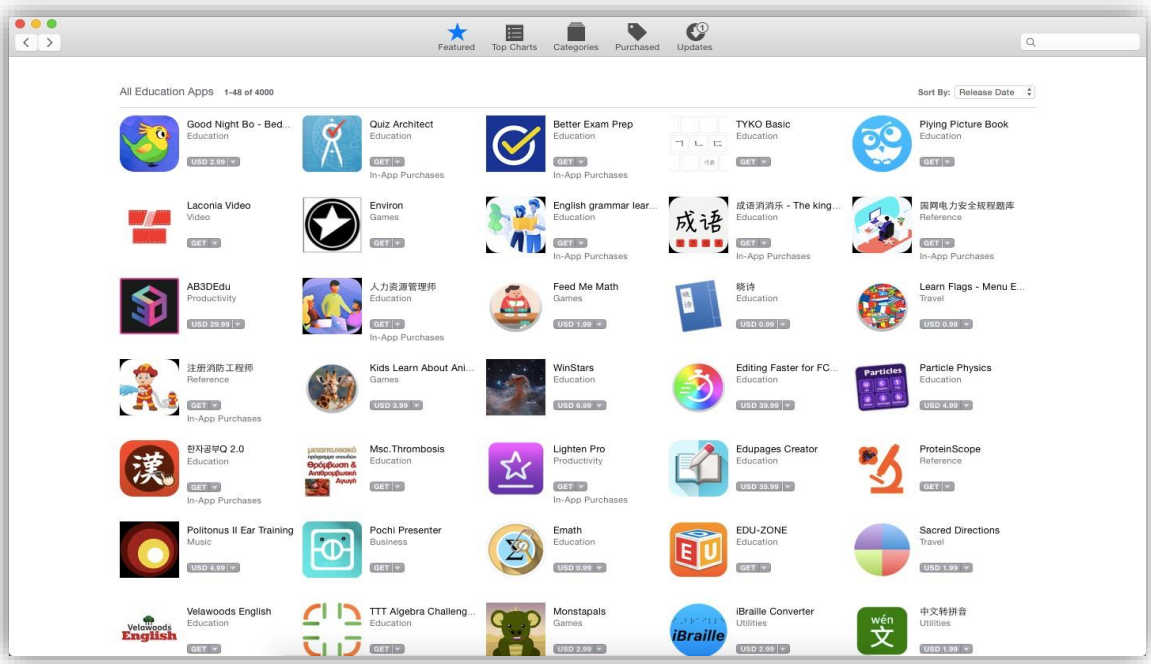


Figure 1. Screenshot of the App Store Education section, 31st March, 2019

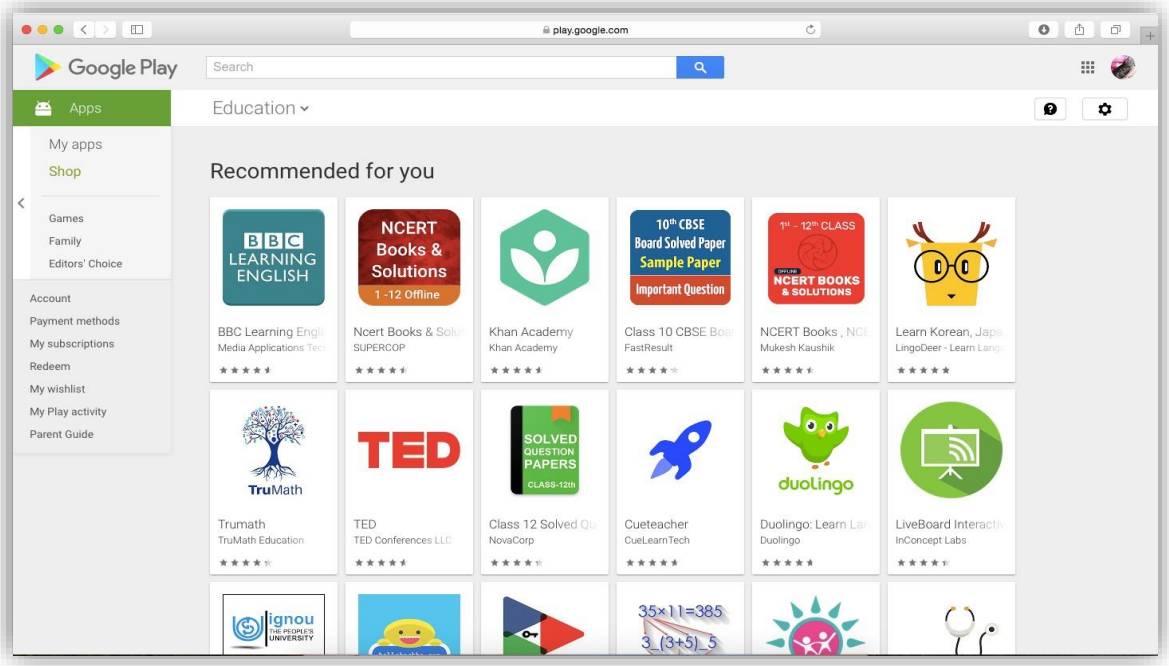
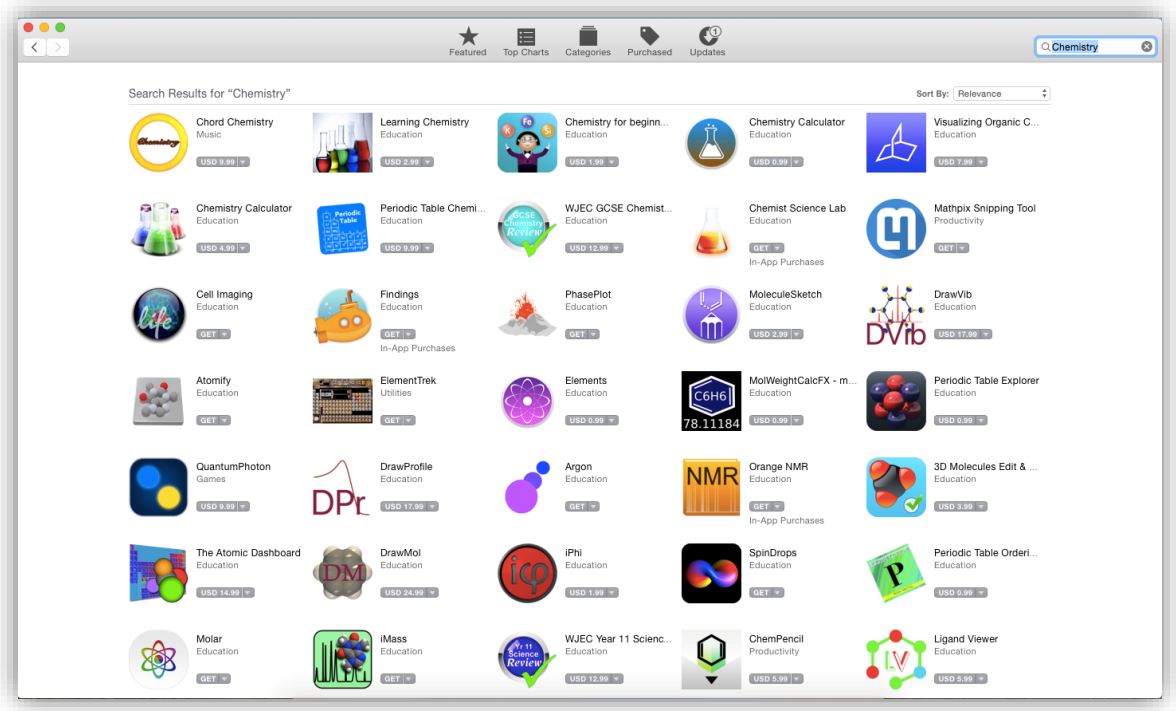


Figure 2. Screenshot of the Google Play Store Education section, 31st March, 2019

It should be noted that while there are numerous apps available, these "are largely untested and unregulated" (Hirsh-Pasek *et al*, 2015, p. 3). It is important that educators interact with an app and look for its evaluation report, if any. Otherwise, there is a need to examine the value and purpose of an app before using it in the classroom or recommending it to learners. Specific searches for Chemistry and Chemistry games, on further search, resulted in a number of apps on Apple's App store (Figure 3) as well as the Google Play Store (Figure 4).



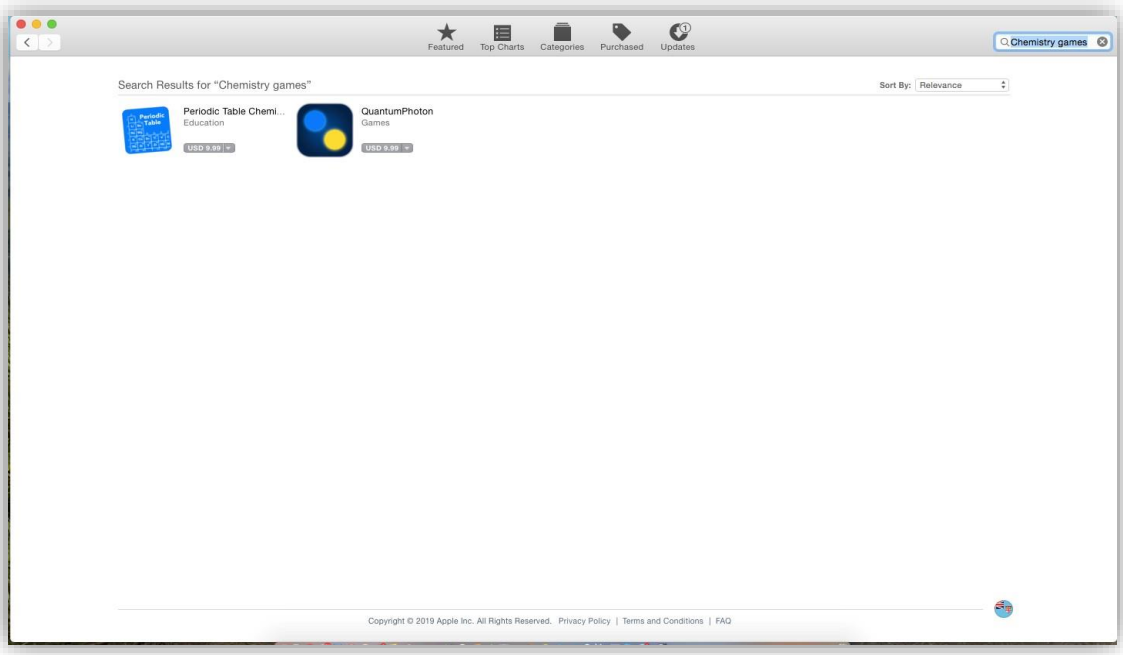
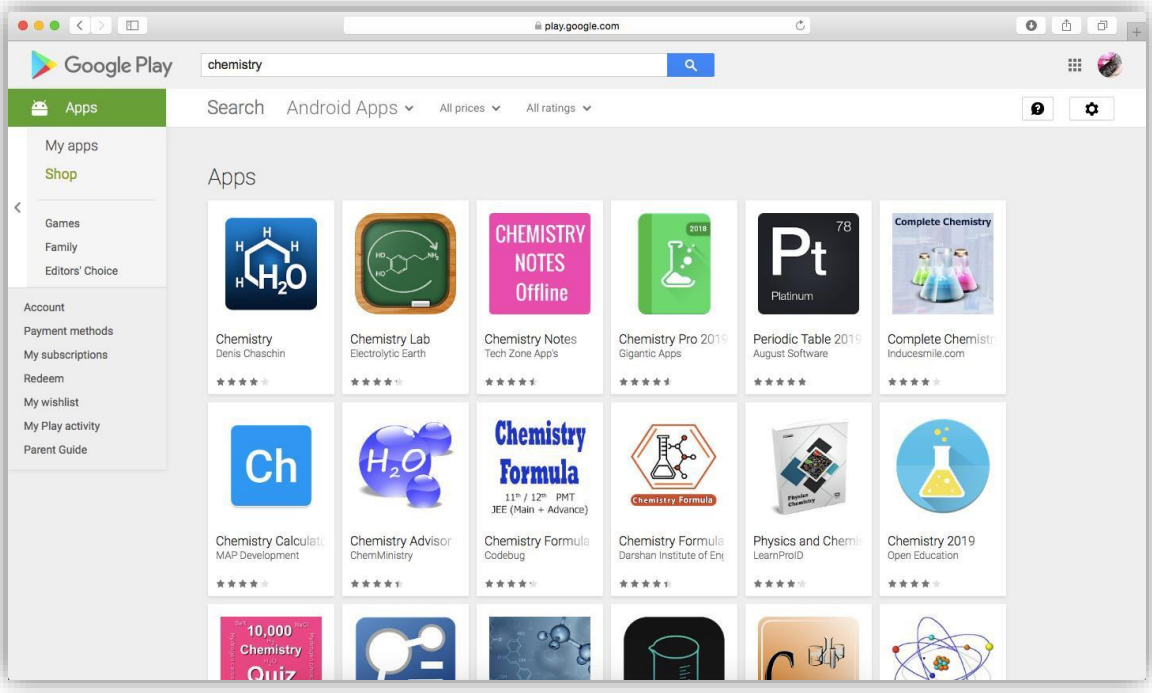


Figure 3. Screenshots of the App Store for Chemistry & Chemistry games app, 31st March, 2019



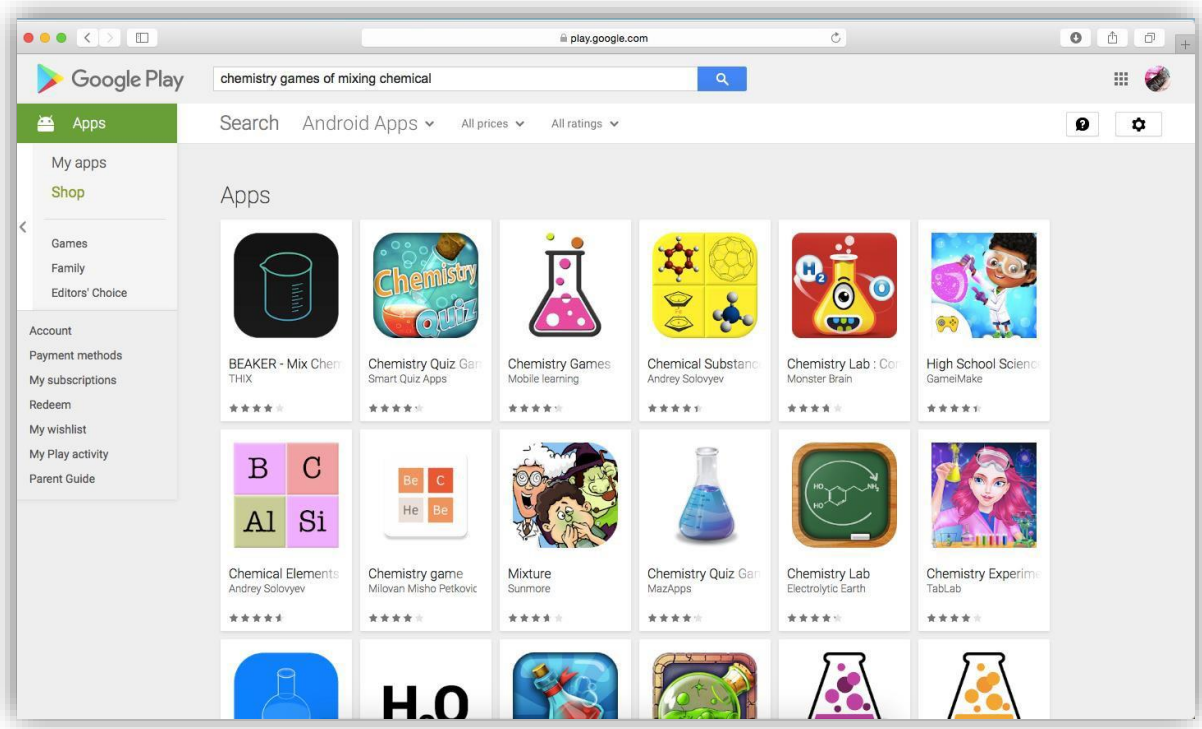


Figure 4. Screenshot of the Google Play Store Chemistry and Chemistry games app, 31st March, 2019

Currently Apple's App store and the Google Play store offer a number of mobile apps and the find feature in each helps to locate apps for different subjects and topics. In addition to the Apple's App Store and the Google Play store, there are a few other databases, which are mainly geared towards pre-school to high school and should be useful for the teacher- education colleges, and institutes.

Some of these app databases are:

- Appitic: This is a database created by Apple Distinguished Educators. However, the website at the time of writing this chapter was not working but some 1800+ apps by Apple have been compiled by the former teacher Greg Swanson in his blog, which provides an evaluation of these apps. Swanson's blog can be found on: https://appsineducation.blogspot.com.
- Apps4Edu: The Utah Education Network project created Apps4Edu, which lists apps from different sources and have been evaluated through a star rating system: https://www.uen.org/apps4edu/ .
- EdShelf: The "Edshelf is a socially curated engine of websites, mobile apps, desktop programs, and electronic products for teaching and learning" (https://edshelf.com) which helps individuals select apps.
- Commonsense: Commonsense media is an independent non-profit organization which reviews and rates apps in an effort to assist educators and parents (https://www.commonsense.org/education/).

There are many other app databases available on the web. We have provided a list of apps for Science, Technology, Engineering, Arts, and Mathematics (STEAM) in appendix 2 at the end of this chapter, which educators might want to evaluate and integrate into their pedagogical practices. Considering the need for different expertise required for successful implementation of an app, it is crucial that a team of experts from various field should be engaged with the app developer in app development in order to optimize its learning component. We will now focus our attention to using apps for education and learning.

Integrating educational apps in learning and teaching

Amidst a myriad of educational apps, there is a need for decision-making abilities to select apps that are suitable for the intended purpose. Integration of apps in learning and teaching should work better when the ministry of education or higher education authorities consult experts to implement the eLearning project. For instance, around 5000 tablets (received as a donation from the Indian Government), pre-loaded with apps and a learning management system, loaded by the Ministry of Education were distributed to highlands schools in Fiji (Kate, 2015). The apps in this case were selected by the Ministry of Education in India. However, the applicability of these apps in a Fijian context is worth examining. The Ministry of Education in Fiji, in its efforts to enhance technology integration, has focused on tablet use in the schools, starting with distribution of tablets to provide digital textbooks to replace paper-based educational materials (Cava, 2016). The schoolteachers in Fiji can always add more educational apps onto these tablets once they have scrutinised available apps in different subject areas. Similarly, USP too is currently distributing free tablets to all its first year students in its efforts to provide learners access to digital devices and resources. This presents a scenario, which seems conducive to the use of educational apps provided the teacher has the required knowledge and skills for the integration of apps in learning and teaching. In their effort to illustrate the significance of purpose Cherner *et al* highlight how "multiple apps may seem to address the same subject area, skill, content, or knowledge, the way they do so differs, resulting in widely varying effectiveness" (2014, p.164). Therefore, it is crucial that teachers understand an app so well that they can decide if it serves a given purpose.

Highfield and Goodwin (2013) highlighted how an app developer's philosophical belief may influence the pedagogy underpinning a particular app. For example, they found that 75% of apps in their study were underpinned by behaviourism and thus the apps followed an instructive pedagogical design. There needs to be a clear understanding of what we want the students to achieve and then design pedagogy accordingly. Biggs and Tang (2011) remind us of the need to focus on what the student is doing, rather than the teacher, in the classroom. 21st century education focuses on learners and the 4Cs (critical thinking, creativity, collaboration and communication) skills that they need to develop. The students should engage with content to achieve the learning outcomes and a meaningful learning experience. The teacher needs to provide the opportunity for students to think and work towards meaning-making and knowledge construction. In higher education, inquiry- based learning is being encouraged as it is believed to facilitate student-centered learning. According to Savery (2006), inquiry based learning is:

> a student-centered, active learning approach focused on questioning, critical thinking and problem solving. Inquiry-based learning activities begin with a question followed by investigating solutions, creating new knowledge as information is gathered and understood, discussing discoveries and experiences, and reflecting on new-found knowledge. (p.16)

Inquiry-based learning focuses on learning where the student takes the lead. It is an active learning approach as it involves critical thinking and problem solving. It is therefore important that educational apps are designed to incorporate inquiry-based learning. Educational app developers need to take into account the current trends in technology and design, their own experience with technology, their intuitive sense of how learning take place, and what students will find interesting (Hirsh-Pasek *et al.,* 2015). They advocate, "Apps designed to promote active, engaged, meaningful, and socially interactive learning four "pillars" of learning – within the context of a supposed learning goal are considered educational" (p. 3). Cherner and Fegely (2017) describe that, as teachers assign a task, students work to identify key facts, theories and relate them to the problem. There are different means by which students can actually solve these problems. Educational apps can be used in creating such active learning in eLearning or mLearning. For any inquiry-based lesson, it is important to first derive a problem statement before it is solved. Cherner *et al* (2014) emphasise that it is vital for teachers to study any app carefully before using it to design inquiry-based lessons and ensure that the app is compatible with the lessons. It is equally important that the teachers have extensive knowledge of the apps in order to formulate and decide which is the best app for any lesson.

In order to encourage inquiry-based learning, Cherner and Fegely (2017) presented a visual map for the creation of app-based learning (Figure 1)

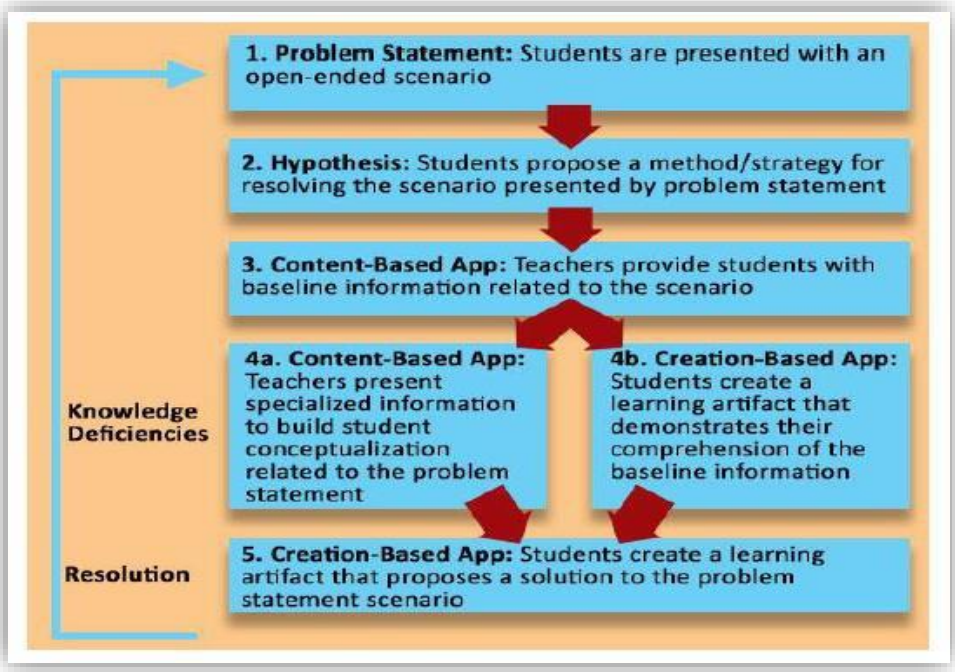


Figure 5: A Visual Map for Creating App-Based Lessons (Cherner & Fegely, 2017; Reproduced with permission)

This will enable students to engage and look for solutions, which will help them to move to step two. The students are then provided the content-based app, which helps them to think about their hypothesis in step three. The students are either able to support their hypothesis or re-formulate their hypothesis. The teacher's role is important in step four, where, based on their students'

needs, they decide between options 4a/4b and make the students aware of their knowledge deficiency. At this point, where teachers select 4a, they will need to guide students with additional content-based apps to build on previous knowledge from step three. If the students are able to support their hypothesis, they use step 4b to produce artifacts (which could be anything such as a written solution, image or a graphic organizer). "A key element when using path b is that the task students complete using the criterion-based app demonstrates their understanding of the content; it is not designed to modify or affirm their hypothesis, which will be addressed in step 5" (p. 6). The last step culminates into a refined solution to the problem statement which student can share with each other, provide, and receive feedback on it. The framework's final component is that step 5 cycles back to step 1 and this is to encourage students to share their findings and solutions with the other students. This enables all students to reexamine their solutions and modify if needed.

One of the challenges in selecting an educational app is finding the right app for a particular lesson that is open-ended, exploratory, encourages interaction, and engages learners. Walker (2011). There is a need for comprehensive criteria on evaluating the educational apps. We perform a quick comparison of two evaluation rubrics, developed for evaluation of educational apps by Buckler and Peterson (2012) and Walker (2011). Walker (2011) states that the cost of a particular app should not be included in the evaluation process as there are many good apps available free of cost. On the other hand, there are many expensive but poor quality apps available as well. It must be noted that this evaluation rubric was also developed for apps for use with adults with special needs. It was interesting to note how the two research teams agreed on one component (feedback) but not on another one, which one would assume as a crucial one (cost). This is an indication of the need to adapt evaluation rubrics to suit our context. In the case of Walker and Buckler and Peterson, both studies are based in the United States and yet they differ. One can only predict that criteria for the Pacific Island Countries user would certainly require some thought too.

Table 1: Evaluation rubric for educational app.

Rubric			
Walker (2011)		**Buckler and Peterson (2012)**	
Curriculum Connections	Skill or concept-linked to the learning outcome can be taught directly using the app.	*Application*	Are the skills applicable to an individual's needs?
Authenticity	Can the app create problem-based learning environment linked to real life?	*Benefit*	Does the app benefit an individual's daily life?
Feedback	Can the app provide constructive and timely feedback to improve performance?	*Feedback*	Can the app provide constructive and timely feedback to improve performance?

Differentiation	The app's ability to target specific skills at various difficulty levels	*Adjustability*	Are the app settings adjustable to individual's needs?
User Friendliness	Ease of use of the app	*Ease of Use*	Easy steps required to use the app
Student Motivation	Student show improvements in performance and is motivated to use it to full potential.	*Cost*	Will the benefits outweigh the cost?

According to other researchers, the evaluation rubrics, provided by Buckler (2012) and Walker (2011), are more generalizable reflections on the app's worthiness (Cherner, Dix, & Lee, 2014; Lee & Cherner, 2015). Cherner *et al* (2014) considered purpose, content and value of the app as the three important constructs for the selection of an educational app. For evaluation of apps in blended and inquiry-based learning, Cherner and Fegley (2017) classified apps in three categories namely: (i) Skill-Based Apps, (ii) Content-Based Apps, or (iii) Creation-Based Apps. In this framework (Figure 1), it is the responsibility of the teachers to select the apps for the type of instruction described. It is crucial for teachers to select the most appropriate app for any lesson as it will impact on the students. If a wrong app is selected, without much research on its functionalities, then there is room for potential challenges and confusion amongst the students. The modern apps offer a pathway for students to have access to the digital world and live in an era of modernized technological learning environment. However, for maximum benefits, "the design of educational apps should creatively combine principles from the Science of Learning with the affordances of this versatile medium" (Hirsh-Pasek, *et al*, 2015, p.26). Therefore, the design of an app and its appropriateness in the targeted lesson (i.e. selection of the fit-for- purpose app) results in the optimum learning impact on the learner.

It would be useful to share an example of an app-based lesson for science from Cherner and Fegely (2017), which is about creating connections to the periodic elements.
The problem statement is "How are periodic elements used?" (p.7). The teacher gives the instructional objectives to the students, "Students will choose a periodic element and study it by constructing it at the atomic level, researching uses for the element and listing three facts about it, and then creating a detailed model of it" (p.7). It is important to note that the instruction given are crisp and clear. The students work on the problem making use of the following educational apps in three simple steps.

> *Step 1*: NOVA Elements (2013) app (freely downloadable at[57]). Here, the students are required to select and construct an element from the periodic table after reading about its chemical makeup. They then use one of the app's feature to add protons, neutrons and electrons to make the structure of the atom of that element.
>
> *Step 2*: One HD (2012) app (freely downloadable at[58]) is used to find three facts about a selected element using the *All Search Engines*. Making use of the search engine, the student's research how the element is used with reference to different industries for example, manufacturing, art, and culinary purposes etc.

Step 3: Brushes Redux (2016) app (freely downloadable at[59]) is used to create a detailed model of their selected element with their researched material on the element.

In summary, by the end of this task, the student would have created a learning artifact using two content-based apps and one creation-based app. This example denotes a very clear explanation on how the 3 steps identified above can be utilized in reality and how we all as teachers can develop such lessons in our classes. It is very important for us to understand the requirements of each step and to identify and select the most appropriate app for any lesson. Such framework and educational apps promote student engagement and allow interactive learning and support in achieving the learning goals.

It is crucial for the teachers to start by experimenting with the limited number of creation- based apps in order to select the most appropriate app for any lesson and apps such as Haiku Deck (2016), Penzu (2016) and Popplet (2016) can be utilized for these experiments. These apps can be used for different purposes and are a meaningful and engaging learning environment. It is vital for teachers to explore content-based apps and select appropriate ones. As teachers gain experience in the use of these apps, they must transform them into learning opportunities for students. To ensure that the students actually engage in the learning process, there is a need to develop appropriate assessment with clear linkages to learning outcomes.

Conclusion

There is a continuous addition of new educational apps on the World Wide Web and AppTrace is a good place to monitor app analytics. With the increasing number of apps, it is imperative for teachers to ensure that apps are scanned and evaluated as an 'educational app', prior to its use for the learning process. There are many programs available to carry out the evaluation and the researchers need to join hands and assist the teachers in using good quality resources for their app-based lessons.

It would help to conduct surveys involving teachers who are utilizing these concepts and analyze how they plan instructions with the framework (Cherner & Fegley, 2017) and then evaluate the accuracy of the students' learning, when concluding app-based learning. This would enable researchers and educators to make recommendations to revise the framework.

High school teachers are responsible for preparing their students for college level and tertiary teachers have the responsibility for preparing the students for the work force. This requires students to be proficient at critical thinking, creativity, collaboration, and communication, while using technology proficiently. It is very important that teachers are experienced in using app-based lessons, which will enable them to test the technological proficiency and the aforementioned 4Cs of their students. This practice will not only keep the students up to date with the technology but also assist teachers to keep abreast of the recent developments, making it a win-win situation for all.

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57 https://itunes.apple.com/us/app/nova-elements/id512772649?mt=8

58 https://itunes.apple.com/us/app/all-search-engines-in-one-hd/id478948302?mt=8

59 https://itunes.apple.com/gb/app/brushes-redux/id932089074?mt=8

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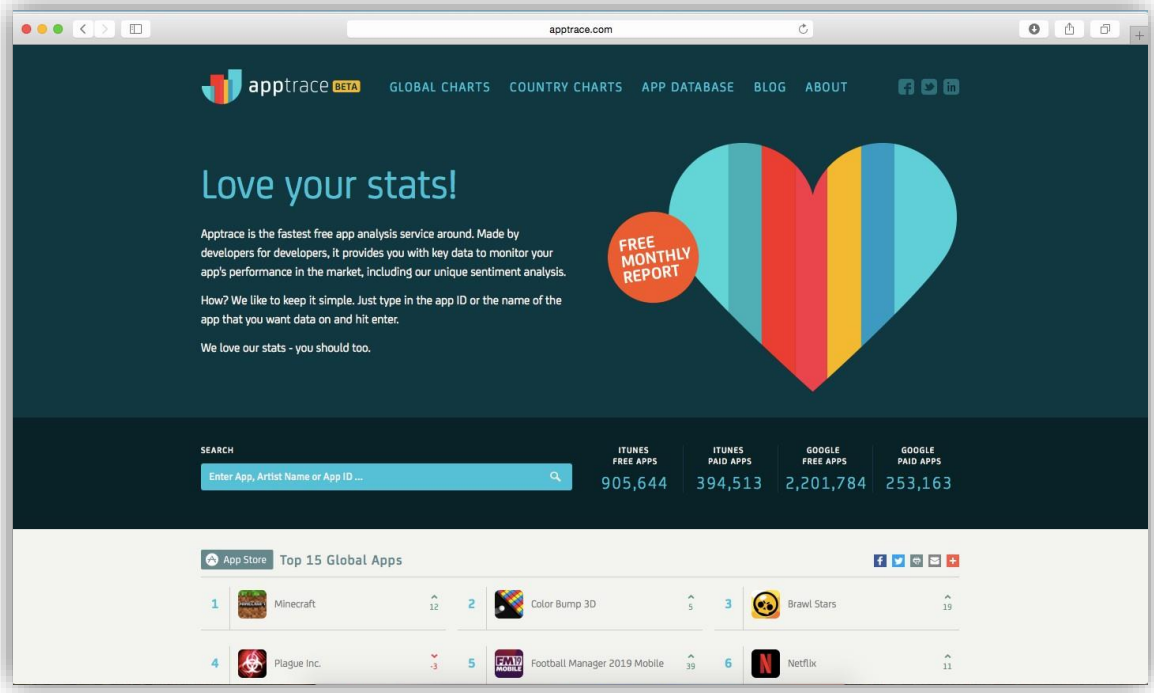
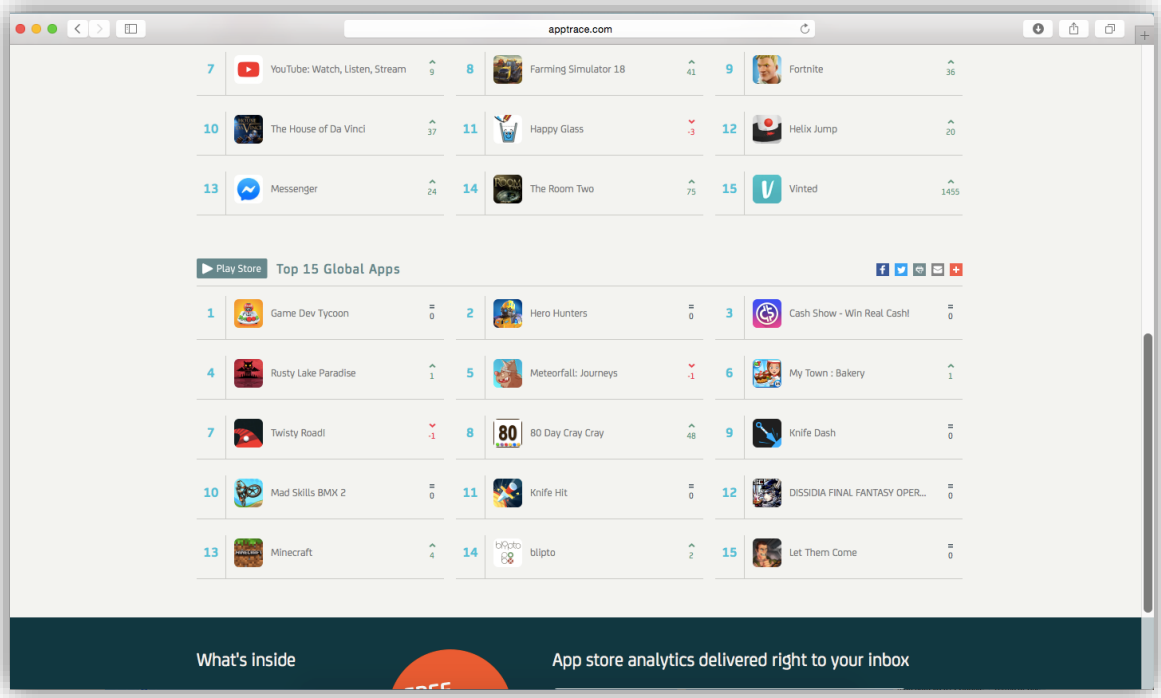
Appendix 1: Two screenshots from App trace revealing number of free and paid apps from Apple and Google





Appendix 2: Available STEAM Apps at a glance.

Subject area	App name	Advantage	Disadvantage	Available at
	Math Bingo	Designed for primary aged students, Allows user to practice addition, subtraction, multiplication and division, Allows three levels of difficulty, Allows quick recall of facts, Good tune for correct answers and buzz for incorrect answers are given	Instructive app design, Contains predetermined task, Requires homogeneous answer, Minimum cognitive input from the learner.	ABCya.com
	Area of Rectangles	Low cost, $0.99 Ranked in top 10 by Haugland Scale and Productive Pedagogies Dimensions (Kevin, 2013), Interactive, Areas of irregular shapes is possible by combining two or more triangles, Game section allows six levels of timed questions and motivates students to play better next time, Easy to use.	Imperial units are used.	Brainingcamp, LLC
Mathematics	Quickmath step-by-step math solver	This App is free, Most common problems in algebra can be solved, Allows you to expand, factorize and simplify a number of problems in algebra, Most common problems in calculus can be solved, Gives the answers directly step by step, Definite and indefinite integration can be performed. Equations and inequalities can be plotted as well, most common types of percentage problems can be solved here as well, Very versatile math educational software.	Some students may take this as an education app for solving their math assignments, Students may forget to solve the problems on their own and just looking at the solution they may feel that they have understood the problem/solution.	quickmath.co m
	MalMath	It's free and works offline, Step by step solver with explanation, Available in 13	Some students may take this as an education app	webteam@edu cationalappsto re.com

		different language, Can solve problems in integrals, derivatives, limits, trigonometry, logarithms, equations and algebra, Graphical analysis possible, Saves and shares graphs and solution.	for solving their math assignments, Students may forget to solve the problems on their own and just looking at the solution they may feel that they have understood the problem/solution.	
	Mathemagics - Mental Math Tricks	Low cost, approx. $2.99, Learning with clear step by step instructions, Innovative and easy ways to do addition, subtraction and simple multiplication and division without the use of calculators, Allows to reduce problems in to smaller more manageable pieces in order to reach solutions quicker and more accurately, Allows novel ways of thinking with math.	This app is only available on the App Store for iOS devices.	Blue Lightning Labs
	PocketCAS Mathematics Toolkit	One of the innovative mathematics application on the App Store, Has basic school maths all the way up to calculus, algebra and statistic, Essential tool that can be used by student, teacher and engineer, Provides features comparable with a TI-89 calculator on your Mac, iPhone or iPad.	High cost, approx. $8.99, Cannot function without internet access, This app is only available on the App Store for iOS devices.	Thomas Osthege und Daniel Alm
	Math Ref	Low cost, approx. $1.99, Over 1,400 formulas, figures, and examples to support with math, physics, chemistry and more, Tools such as a unit converter, quadratic solver, and triangle solver support execute common calculations fast.	Decreases human thinking capacity, Cannot function without internet access, May not be reliable at all times as a single program error can	Happy Maau Studios, LLC

			give inaccurate results.	
	Yup - Math & Science HW Help	Students have access to unlimited math, chemistry and physics support 24/7, Tutors are available 24/7.	Costly, approx. $20/hr, Negative reviews, Some tutors were not able to help and explain properly, Cannot function without internet access, The App is more like text messaging.	Yup Technologies Inc.
	College Algebra Practice, Prep	Its free and works offline, Best Education App - 2016 Apply Awards,Best Education App - 2016 Apply Awards, 56 College Algebra practice tests are available, Diagnostic test is available to identify what you already know, and what additional work is required when it relates to College Algebra	This app is only available on the App Store for iOS devices.	Varsity Tutors LLC
	The Elements by Theodore Gray	The Elements is constructed on the internationally best-selling edition of The Elements, by Theodore Gray, More than 500 stunningly photographed, high resolution, rotatable objects, Detailed and current information from Wolfram Alpha, Beautifully composed pages for every Element in the periodic table, Fun stories and fascinating facts, 3D rotation of all objects with details, Engaging introduction explaining the structure of the periodic table, Available in English plus 16 other languages.	Price $8.99	Touch Press Inc.

Science-Chemistry	Molecules	Molecules are an application for viewing three-dimensional renderings of molecules and manipulating them using your fingers, Free, Added support for the new Retina iPad to the rendering engine and artwork, Added a colour key for elements to iPad interface.	Cannot use files previously saved via iTunes, No structural annotation, Needs to be able to search for enzymes and biological molecules like ATP by their common abbreviations.	Brad Larson
	Buffers	Low cost, approx. $0.99, Buffers is a scientific tool for designing buffer solutions for pH control, Buffers is useful both as a handy reference of available buffering agents and as an accurate, portable buffer calculator for chemical, biochemical and biological research, 42 commonly used buffering agents available, Generate accurate recipes covering broad pH, concentration and temperature ranges, Access detailed information about each available buffer system, E-mail, text, copy or print recipes.	There is no molarity or dilution calculator. You cannot add any buffers even without the pH calculations	Akkyra Systems
	Science Bank	Free, Covers a range of topics, space, biology, chemistry, earth sciences, environment, and physics.	Minimum cognitive input from the learner, Mainly pictures are available with little detail.	JD Star Education
	3D Brain	Free, Covers a range of topics, space, biology, chemistry, earth sciences, environment, and physics. Excellent app for learning different parts of the brain, 29 interactive structures,	This app is only available on the App Store for iOS devices.	Cold Spring Harbor Laboratory

		Each in depth structure comes with facts on functions, disorders, brain damage, case studies, and links to modern research, Graphical views of different sections of the brain.		
	3D Cell	Free, Offers facts and visualization on human cell, neuron, bacteriophage, prokaryotic cell and sperm cell through 3D models, Graphical/videos of different sections of the brain, Rotation and scale adjustments can be controlled for the 3D models, Excellent app for learning different parts of the 3D cell.	This app is only available on the App Store for iOS devices.	Vaibhav Kokare Education
Science Biology	Pocket Heart	Free, Can be downloaded and used freely without internet, Smart design, interactive quizzes, clinical cases and over 30,000 words of learning material, 3D view with excellent detail, Offers students an exceptional way to view the workings of the heart.	Price $8.99.	Pocket Anatomy
	GeneIndexHD	Free, Quickly provides information about genes from various sources, Gene indexes for many mammals, plants, invertebrates, and bacteria, Just a search engine on genes.	One must be 17 years old to download this application, Not downloadable in some countries, Cannot function without internet access.	https://geneindex.keithching.com
Science Physics	NASA	Free, Learn the latest images, videos, mission information, news, feature stories, tweets, NASA TV, Over 16,000 images, 14,000 videos with live	This app can read, modify or delete the contents of your USB storage,	NASA Education

		NASA TV viewing, Allows 2D maps and 3D earth models, with 3D planet models and information, One can share information via social media.	Modify device system settings.	
	College Physics	Free, It is an introductory, two semester college physics app and covers key fundamental physics concepts, Gives real life examples, illustrations and explanations, Features study progress with 34 study units, 282 lessons, 1140 flashcards and 938 glossaries, Excellent app for physics lessons.	This app can read, modify or delete the contents of your USB storage.	Open Education
	Pocket Physics	Free, Contains most of the important concepts, equations, and formulas of physics, Covers 21 core topics in physics and Homework covers basic physics to complex problems, very useful for students as well as for teachers.	More improvements can be made to this app such as adding more examples, search options, images, etc.	Geckonization Education
	World of Goo	Physics builder challenges Problem thinking and creatively learning focused about building structures and geometry.	Educators may need to interpret for academic application.	worldofgoo.com
	AutoCAD 360	Great CAD design and drafting program Work well for various professions: project management, Electrical/Mechanical/Civil engineering, Architecture and so on.	Monthly premium $4.99	Autodesk inc.
Technology & Engineering	MathPix Problem Solver	Allows taking a snapshot of a math problem where the app then solve it. It reads handwriting or	Reduce critical thinking	App Store or Google Play

		printed text to input complex problems and then output the answer directly Free.		
	Engineering Professional	Organizes all equation those ever need to solve engineering problems 650 individual formulas for engineering 100 conversion formulas, and a section for determining Area formulas	Price- $11.99 Only suitable for iOS 4.3 or later. Compatible with iPhone, iPad, and iPod touch.	App Store By Multieducator Inc.
	FingerCAD	Useful tool for quick designing of floor plans Allows you design in 3D Design file can be converted in several other formats	Gimmicky for beginners Price- $2.99	App Store
	Graphing Calculator	Graphing calculator allows picking an equation, set values to see the respective graph.	Only compatible with Apple platform	App Store
	HVAC Professional	Specifically designed to deal with heating and air conditioning included HVAC related 200 formulas. Developed following complete International Mechanical Code	Price- $7.99 Only compatible with Apple platform	App Store By Multieducator Inc.
	iCircuit	One of the best App to sketch (on the run) out circuits and components Also allows test functions, check voltages and help troubleshoot Suits all platforms	Price- $9.99	App Store By Krueger Systems, Inc.
	iEngineer	Most comprehensive database of information about hardware (i.e. Screw, Bolts) sizes. Both US and Metric screw sizes as well as tap information, clearance sizes, shear force capacities, unit conversions and many more intricate	Only compatible with iOS 11.	App Store

		features and data are available.		
	LuxCalc Fluid Calculator	This app is able to calculate the thermos-physical properties of various fluids. High degree of accuracy. Both US and Metric units are available. Graph trend plots available for changes in density, viscosity, thermal diffusivity and more. Tool's precision as one of its best features for this App.	Only compatible with Apple and Windows OS.	iTunes/App Store
	Truss Me!	This is one of the App to design and test structures before construction.	Only compatible with Apple and Android. Price-$1.99	iTunes/App Store
	ArcGIS	Navigate maps, collect and report data Used for GIS analysis	The ArcGIS app is no longer be available for download	esri.com
	GeoMedicine	Used to explore local environmental factors that may impact health safety. Visualize vulnerable populations, identify community resources, enable disease surveillance, and connect community stakeholders.	Full version needs to purchase	esri.com
	BAO	Perform site screening in the field with demographic and market information.	Full version needs to purchase	esri.com
	Biomedical Engineering (BME)	BME exam review app contains the 21 major sections. Suitable for USMLE and LPN candidates. Free	All topics are not covered.	Google Play
	Mechanical Engineering	A one Stop Solution App for Mechanical Engineers Covers 1000+ topics. Useful for all mechanical engineering students and professionals for a quick	Graphics and images are provided in low resolution.	Google Play By Softecks

		theoretical review about a specific topic.		
	Civil Engineering Basics	Covers 300+ topics. Useful for all civil engineering students and professionals. Free App	Only useable online	Google Play By Education Apps For Students
	DNA Shot	Used to Identify and displays DNA sequences based on pictures Android base app Hybrid (Expt lab)	Requires Camera as additional hardware	Google Play