Implementation of an Android Mobile Learning Application

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Abstract

This study was carried out in two parts. The first part was building a mobile application that can help an individual with little or no knowledge of python programming language. The second part of the study was conducting studies on the effectiveness of the built application in a real-world scenario, within a group of students in the university with different programming skills to ascertain effectiveness of the mobile learning app in education.

This report provides valuable insight into the effectiveness of learning a programming language through the Learn Python app and what the users learnt about the various aspects of the application. It also sheds light on the importance of User Experience in the development of any mobile application or software in general.

Another motive of this research work was to understand the opinion of people on the topic of m-learning. Mobile based learning has been around for a while now but has not caught up yet with the existing and conventional methods of learning. This study aims at buttressing more on m-learning and to promote mobile learning as a medium of learning which has its own advantages over other mediums. Mobile learning is an alternative way to learn rather than the conventional way people are used to. It makes learning easier and flexible using mobile gadgets.

Keywords: Implementation of android, android mobile app, Mobile learning application, m-learning app, learn python.

Categories and Subject Descriptors: K.3.1 [COMPUTERS AND EDUCATION]: Computer Uses in Education - *Collaborative learning*, *Computer-assisted instruction (CAI)*, *Computer-managed instruction (CMI)*, *Distance learning*.

Foreword

The thesis work was done at the School of Computing, University of Eastern Finland during the spring of 2018.

My sincere gratitude goes to my family, friends, teachers and most especially my supervisors Dr. Jarkko Suhonen and Dr. Solomon Oyelere.

List of abbreviations

App	Smartphone/Mobile Application
GUI	Graphical User Interface
UI	User Interface
UX	User Experience
PEP	Python Enhancement Proposal
M-Learning	Mobile Learning
E-Learning	Electronic Learning
TEL	Technology Enhanced learning
AR	Augumented Reality
VR	Virtual Reality

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1. INTRODUCTION

This thesis presents chip away at an Android based mobile Python tutor, Learn Python App. Python is a simple to learn, powerful programming language. Imagined in the late 1980s as an educating and scripting language, Python has since turned into a fundamental device for some software engineers, specialists, analysts, and information researchers crosswise over scholarly world and industry. It has proficient high-level data structures and a straightforward however compelling methodology towards object-oriented programming [1]. Python's rich syntax and dynamic composing, along side with its interpreted nature, make it a perfect and idea language for scripting and fast application advancement in several areas on most platforms [2]. A Python snippet is 3-5 times shorter than a Java snippet for the same functionality and 5-10 times shorter than a C++ snippet for the same functionality. Python application is in its easiness and exquisiteness, as well as the convenience of the large ecosystem of domain-specific tools that have been built on top of it. The various application of the Python language is a result of the blend of many different features that give this language an advantage over other languages. Python is a powerful multi paradigm programming language, enhanced for programmer efficiency, code readability, and software quality [3]. Python language applications include:

- GUI based desktop applications
  - Image processing and graphic design applications
  - Scientific and computational applications
  - Games
- Web frameworks and web applications
- Enterprise and business applications
- Operating systems
- Language development
- Prototyping

1.1 The Objective of the Learn Python Application

The application is intended to be utilized by beginners and also as a supplement to conventional labs. The Learn Python application will provide a quick tour of some of Python’s vital syntax and semantics, built-in data types and structures, control flow statements, function definitions, and other parts of the language. The application contains a series of theory notes describing each topic in brief before putting the user through a series of questions based on the aforementioned theoretical description of the topic. The topics selected for the tutorial cover all the basic cases one needs to learn in order to get introduced to any programming language. Python is most likely one of only a handful couple of programming languages which is both basic and powerful. This is useful for learners and also for experts, and all the more essentially, is enjoyable to program with. The Learn Python application is made to enable users to take in this magnificent language

and create programs rapidly. The Learn Python application teaches users Python by gradually constructing and setting up aptitudes through procedures like practice and retention, at that point applying them to progressively troublesome issues. Before the finish of the instructional exercise, the users will have the tools expected to start adapting more complex programming points. This application is a self-learning course in Python programming. This application aims to be (1) a help for beginners, (2) a discussion of numerous advanced topics that are appealing to Python programmers, and (3) a Python worksheet with loads of exercises and examples.

This thesis also contains the results from the studies conducted so as to evaluate the usability and effectiveness of the Learn Python application. A questionnaire is a research tool that is mostly used to gather data from a group of people or population of individuals in a specific region. By using questionnaires, substantial volumes of data can be gathered from a huge amount of people within a little period of time with moderately less expensive way. They allow participants the time to consider their responses carefully without any means of intrusion. Questionnaire results can easily be quickly quantified and analyzed further 'scientifically' and objectively than other methods of research. When the data is computed, it can easily be compared with other existing study which may be used to measure variation in data. Each participant gets the same set of questions. Using a closed-form questions, responses from participants are consistent, this helps with quick analysis especially when dealing with a large number of participants. The energy from the participants was empowering. The questionnaires covered a wide variety of topics related to the application and its usability in mobile based learning.

The thesis also provides an overview over the effectiveness of the idea of mobile based learning. Mobile learning supports, constant access to learning through the meaning of a mobile device. The participants are able to learn at their leisure and at their own pace. Mobile learning makes learning more accessible to all kinds of people. Mobile learning as an educational activity is only logical particularly when the technology in use is completely mobile and when the users of the technology are not restricted or fixed to a location while they learn [4]. In day to day life, mobile learning requires a learner and mobility within an environment in which they seek to learn. The ideas of Python programming are logical and mathematical in nature. Theoretically, computer programs can be built by not making use of a computer. Programmers can deliberate on the feasibility of a program and reason about its precision and efficacy by probing abstract signs that resemble the features of real-world programming languages but appear in no real-world programming language [5]. Mobile learning has improved upon e-learning by making it a stride further and enabling understudies to learn practically anyplace a mobile signal is accessible. New mobile innovation, for example, smartphones, is assuming a substantial part in rethinking how individuals get knowledge. The current developments in mobile innovation are shifting the main role of mobile phones from the typical use of just making or receiving phone calls to recovering the most recent data regarding any matter. Mobile smartphones are fully capable of providing educational materials that the coventional cell phones could not offer, this makes them a valid learning portal useful for learning purposes[6]. This thesis attempts to shed some light upon mobile learning and its applications and effectiveness.

1.2 The Aims of the Thesis

The aim of this thesis is to understand in a better way the effectiveness of the Learn Python application. Learn Python application was built to make learning Python language easy for both beginners who want to learn the Python language from the ground up and also for experienced developers who want to brush up their basics. A group of people were asked sequence of questions both before and after using Learn Python application in order to gauge their understanding of Python language. Another aim of this thesis is to determine whether the application is user friendly enough for the user to understand and learn from it without any guidance from anyone. Programming is taught much like writing. Learners begin to read and explain programs, and then with time they start to write simple codes, and as time goes on they start to write gradually complex programs. As time goes on they get the feel and see the patterns on their own logically and how to take challenging tasks and write a program that can resolve the solves the problem. The moment students attain this point, programming turns out to be exicting and fun, making them comfortably creative in program writing [5]. Therefore, the app starts with the terminology and fundamentals of Python programs.

Taking in computer programming at college stages has always been a dificult task. This thesis elaborates on mobile framework application that supports the construction of Python programs. It portrays a versatile application that supports those development of Python programs, while utilizing outline rules that might aid in supporting a tenderfoot learner. Additionally, particular plan rules have been actualized to handle the prohibitive qualities mobile devices with small screens. A recent survey for mobile learning [7] research indicated computer science to make a standout amongst the practically basic orders applying mobile learning. This thesis aims at studying the effectiveness of mobile learning in the modern scenario.

This paper takes a glance at ways that smartphones with cell network enhance learning and engage understudies. Wireless technology is an approach to give new content and encourage information access to wherever a student is found. It empowers, enables, and encourages learning in ways that change the learning condition for students both inside and outside of typical classrooms.

2. Review of Relevant Literature

It is vital to consider that information in particular field comprises there layers. To start with, there are the essential examinations that experts direct and dispense. Second are the reviews of those examinations that outline and offer new version worked from and regularly reaching out past the important researches. Third, there are the observations, conclusions, sentiment, and translations that are shared informally that end up being knowledge of field.

2.1 The Python Language

Python is an extensively used advanced programming language for multi-functional programming, created by Guido van Rossum and first released in 1991 [8]. It has simple easy-to-use syntax, allowing it to be a flawless language for beginners or novice willing to learn computer programming from the beginning. It has varieties of applications from Web development (like: Django and Bottle), scientific and mathematical computing (Orange, SymPy, NumPy) to desktop graphical user Interfaces (Pygame, Panda3D). The syntax of the language is spotless, with shorter length of code [9]. Python very similar to the English language, using regular english words like ‘not’ and ‘in’ in writing programs, or script, that any regular person would be able to interpret or explain the function of the program.

Python has an active and self-run system type with automatic memory management system. It is compatible with various programming paradigms, such as object-oriented, imperative, functional and procedural, with enormous full standard library. As opposed to having the majority of its usefulness incorporated with its fundamentals, Python was intended to be profoundly expansible. This smaller measured quality has made it especially well known as a method for adding programmable interfaces to current applications.

The main features of Python are:

Python is Interpreted - Python is managed at runtime via the interpreter. Programmers need not to compile their program before running and executing it. Exactly like PERL and PHP.

Python is Simple - Python is a simple and minimalistic language. Reading a basic Python program makes it look as if one is reading English.

Python is Interactive - Programmers can be seated at a Python console and link to interact with the interpreter straightforwardly to develop their projects.

Python is Object-Oriented - Python supports Object-Oriented pattern or system of programming that encapsulates code within objects.

Python is a Beginner's Language - Python is an incredible Language for upcoming software specialists.

Python is Free and Open Source - Python is like a case of a FLOSS (Free/Libré and Open Source Software), meaning anyone can flexibly make copies of this product, read and interpret the source code, make amendments to it, and utilize some parts of it for a new project.

Python is Portable - Owing to its open-source character, it has been ported to several different platforms i.e it has been modified to work on different platforms.

Python is Extensible and Embeddable – Other languages can be used to enhance and extend the functionality of a Python program and Python programs can also be embedded into other language programs as well.

Python is Strongly Structured – Due to its strong structuring concepts (nested code blocks, functions, classes, modules, and packages) and its reliable use of objects and object-oriented programming, Python permits programmers to write rich, logical applications for slight and huge tasks [10].

Python has Libraries - It has been existing for more than 20 years, so many code inscribed in Python language has evolved over the past 20 years, being the fact that its an open source programming language, many of these codes have been released for languages to use in the form of libraries.

Most companies and organisations use Python for software development such as NASA, CERN, Yahoo, Industrial Light and Magic, and Google [5]. A lot of people use Python for many different purposes such as testing microchips for companies like Intel, to powering Instagram, and for building video games with the PyGame library. Programmers who are very vast can achieve many great things using Python, but the exquisiteness of Python language is that it is handy to those who are just starting to learn programming and makes them to challenge some more interesting and exicting problems faster than many other languages.

Python has an arrangement of principles, called PEP 8, that advise each Python programmer about how best to organize their code. This implies the engineer dependably knows where to start new code lines, that's practically some Python snippet anybody can get, regardless of whether it was composed by an amateur or prepared by an expert. It will look fundamentally the same and simple to peruse by any programmer. It's a multi-functional programming language, meaning it's capable of being used to develop almost anything, with abundance of useful tools in its libraries. Professionally, Python is best used for backend web development, artificial intelligence, data analysis, and scientific computing. Several Python programmers with vast knowledge of Python language have also used the language to develop games, desktop apps and productivity tools, so there are abundantce of tools in its library for beginers who are interested in Python [11].

Python language is used in:

Desktop GUI applications
Image processing and graphic design applications
Scientific and computational applications
Web development
Video Game development

Software development
Internet of things

So overall, Python programming language is a type of language that allows programmers to program effortlessly in anefficient way.

2.2 Mobile Learning

M-Learning or "Mobile Learning", means differently to diverse groups, as a subsection of E-Learning, educational technology and distance education, that concentrates more on learning over different aspects particularly learning with the aid of a mobile device [12]. As part of mobile learning definition, it can be said to be, "any kind of learning that occurs usually when the learner is mobile (not at a fixed), prearranged position, or learning that occurs when the learner benefits from the learning opportunities provided through the means of mobile technologies" [13].

Mobile learning utilizing mobile gadgets is so far still in its early stage pertaining to both technologies and teaching approaches. Thus, there are still some unanswered questions amongst experts in the field how mobile learning ought to be characterized: such as gadgets and technologies; as far as the portability of students and the flexibility of learning, and regarding the students' involvement of using mobile devices for learning. Most analysts and teachers apparently assume portable learning as the closest relative of e-learning. Pinkwart, et al. (2003) for example, characterizes e-learning as 'learning supported by digital “electronic” tools and media’, and by similarity, mobile learning as 'e-learning that makes use of mobile devices and wireless technologies ' [14].

Mobile Learning vs. e-Learning: e-Learning as a phenomenon address any dispersal of instructive information through Internet. e- Learning can be regarded as a subsection of technology-dependent training. It likewise joins various learning exercises administered via the internet, that includes mobile learning.

e-learning	m-learning
classroom lectures or computer lab	learning anywhere at anytime
e-mail-to-e-mail	instant messaging
isolated location	no geographic boundaries
travel time to reach to the internet site	no travel time with wireless internet connectivity

Table 1 Mobile Learning vs. e-Learning

Mobile learning can be said to have come to address some of today's educational matters. Gadgets, for example, tablets and smart devices empower development and help understudies, tutors, and guardians access digital content and adapted appraisal imperative for a post-industrial world [15]. Mobile devices, used as a part of combination with near universal 4G/3G mobile networks, are important devices to improve learning for understudies. As verified by Irwin Jacobs, the establishing director of Qualcomm, Inc., "Always on, constantly connected mobile devices with students has the tendency to theatrically advance educational results."

2.3 Why Mobile Learning?

Mobile learning nowadays has become very important as it has many advantages and ease of working when compared to the traditional way of learning. One of the key advantages is the Portability as it is not limited to a place or a geography. It can be used anywhere in the world. The convenience of learning by Mobile is also not restricted to classroom as it can be continued from anywhere at anytime. Many people or students can collaborate and learn together using the mobile learning technology. The technology is highly adaptable and it can help in learning the skills and the knowledge. Mobile learning is also useful to many of the individuals to learn as per their personal interests and it has very rich media and content that is used in the learning process making it easy and interesting for all the students.

Advances in technology are altering training. Progressively versatile tablets and cell phones are reshaping how workers and customers around the world get to and get data, including instruction. These gadgets help students take full advantage of training by giving anyplace access to content. This makes learning more applicable and self-coordinated than at any other time in recent years [17].

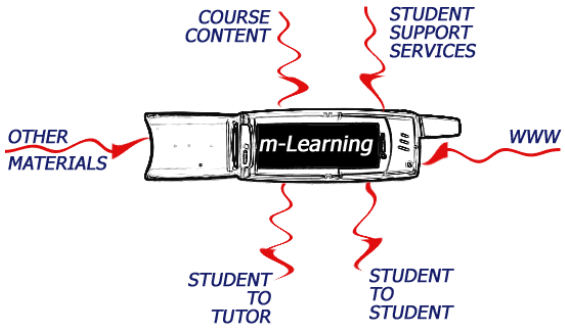

Figure 1: Mobile Learning Environment [12]

Mobile technologies are an appealing and simple means to keep up education aptitudes and increase steady access to data. They are inexpensive and can be effortlessly dispersed. Mobile

technologies encourage distance learning in circumstances that there is limited or no direct access to proper education.

- Individual: Mobile learning can be tailored to fit each learner's capabilities, knowledge and learning style, and is intended to support personal learning habit rather than general office work.
- Multi-literacies/rich media: Lessons in mobile learning can be assisted by rich graphics, videos and interactive media to make learning process easy and interesting [16].

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2.4 M-Learning in Programming Education

Mobile applications provide us with the tremendous range of creativity as well as the other activities that are beneficial to us. They are suitably used for education and other routine purposes in our day to day lives. Mobile has become an integral part of our life. The telephone and mobile environments in today's scenario are used not only for communication but also for multiple purposes. One of the key utilization of the resource is the development of the many programming languages and learning of the same. The mobile applications which are developed for the programming education play a unique role in learning for an individual. They offer unique solutions for developing the infrastructure limitations in the system where proper and adequate communication and wireless infrastructure are required for using the mobile devices.

For optimum use of mobile education, mobile devices are usually connected to internet network either by the 3G/4G or through the wireless communication service. M-Learning has proven to enhance learning and teaching environments, according to recent review of mobile learning research which showed that the field of computer science have habitually embraced the use of mobile education than any other field of disciplines applying m-learning[27]. Most smart devices are capable of running programs and the proliferation of smartphones and other smart devices in the society makes it easier for everyone to learn seamlessly.

The contents of mobile educational apps are now tailored to suit everybody's need. Courses are administered through this channel to enable reach large audience of learners irrespective of their geographical locations. Several academic institutions have adopted m-Learning in programming education and nowadays, there are many applications for m-learning such as Yammer, MobileEdu, Moodle Mobile, SoloLearn, Teachmate, CodeHub and Programming Hub etc. and Learn Python app is a new m-learning app similar to them.

Learn Python app is not any different from the conventional mobile apps for leaning programming, it is most suitable for beginners as it addresses the basics of Python programming education in details. It teaches the rudiments of Python programming which makes it bit better and novice-friendly as it progresses to more difficult topic. The interface and design are fascinating enough to

encourage learners to want to learn more, it is also equipped with many tasks to contend with after each exercise.

In general, the astonishing surge in owning smartphones and smart mobile devices in recently is generating a budding interest and constant awareness in m-learning. These devices are not only limited to smartphones. Other portable mobile devices such as game consoles and even digital and video cameras are beginning to be used to facilitate m-learning education due to the convergence in mobile technologies that is now underway. The adoption of m-learning implementations have wide ranging which include some online resources, interactive classroom activities, fieldwork, educational games, language learning, personal timetabling and work based training all using mobile devices of any type [31].

2.5 Relevance of developing mobile apps for python programming

Considering how tedious learning can be to some and the proliferation of smartphones and smart devices, one can only admit that the world is gradually evolving into a smart world, where every gadgets are connected to a network or the other. The impact of inventions of Technology Enhanced learning (TEL) to support education is so tremendous that mobile devices are beginning to take a front row in this evolution. This can be regarded as a process of revolution in which a new thing is happening about how people are learning [28].

These inventions have led to the development of different mobile apps that help students with learning creatively. These has made learning very bearable and interesting compared to the conventional forms of learning. Most of the programming mobile apps are equipped with built-in compilier that helps the students to be more creative. These inventions have primarily led to the development of different kind of Python programming apps, that has made learning python programming very easy.

The relevance of developing mobile apps for python programming is so huge apart from the fact that it is an incredible language for beginners, its open source nature makes it suitable to run on many different platforms that lets programmers interact with the python console to compose their projects easily without wasting too much time. As an interactive programming language, many other languages can be used to enhance or extend its functoinality due to its flexibility which also allow it to be swiftly embedded into other progamming languages.

Python with robust libraries and many other add-on packages useful to address specific tasks in programming is an essential ingredient in building python mobile apps for programmers as its functinality is not limited to any platform or geographical region. As m-learning phenomenon is ubiquitous and continiously evolving with time, it is pertinent to take full advantage of the process by implementing educative mobile apps for learning and in this case, python mobile apps.

As a means of encouraging more people to learn python programming which was the fastest growing programming language in 2017 according to a global survey of codeacademy learners, more people are gravitating towards python and are staying there [29]. So, to give more learners the chance to be closer to python, more python programming apps are required. Mobile apps are

seen as a useful tool to fascinate people to learn more due it is flexibility and no limitation to geography.

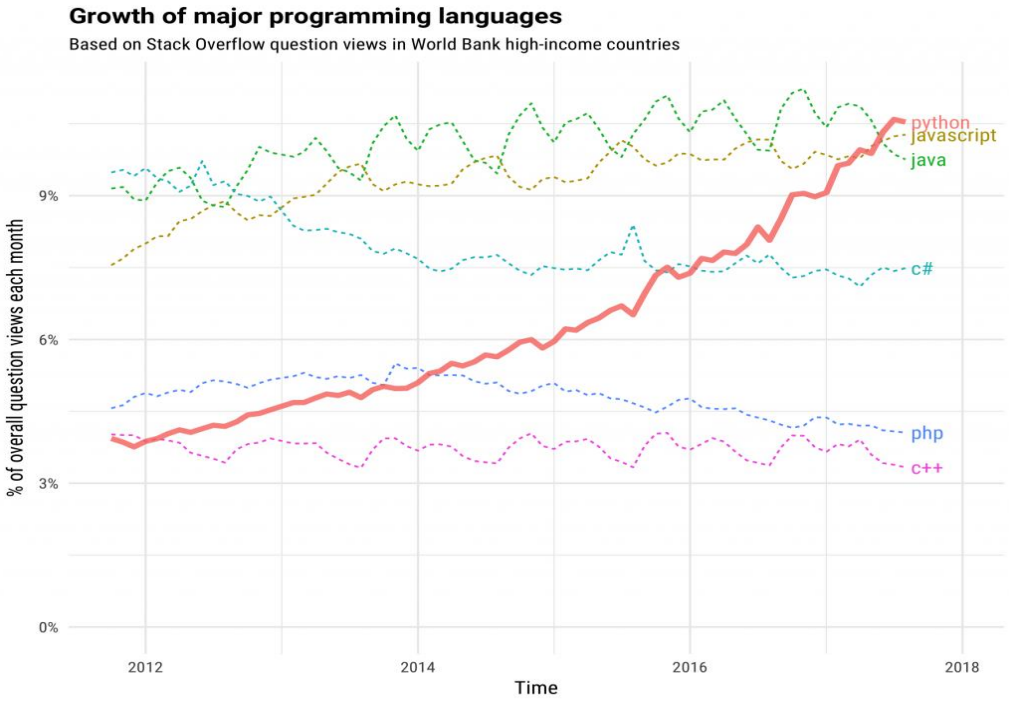

Figure 2: The Incredible Growth of Python [30]

The unbelievable growth of python langugage in recent years has also created a buzz around it, more people are being aware and getting really more interested in it. Its application to variety of purposes such as data science, machine learning and even acadmic research has strenghten the use and effectiveness of python programming [30]. Amongst other programming languages it's a household name.

Based on the popularity of python language and its application, the development of programming apps is pertinent to facilitate learning for academic use. For high-income economies and academic environments there is a steady growth of constant usage of python application such as in the United States, United Kingdom, Germany, Canada and other countries alike [30].

2.6 The Future of m-Learning in Education

The exponential growth of m-learning in education is well greeted with many academic institutions actively engaging in all forms of m-learning practices. Although, there have been many innovations in mobile learning till date, but still yet, many aspects of m-learning have not been adequately explored. Wearable technology can make m-learning more interesting. As technology evolves, it keeps getting smaller and smaller. As smartwatches are increasingly gaining popularity these days and the concept of google glasses with a future insight to smart

contact lenses, that can additional signal information to the wearer's eyes. Wearable devices can transform the concept of m-learning with a boost to social learning at the same time[32].

M-learning through Augmented Reality AR, where for instance, a look through a mobile phone camera can provide extra information for the viewer, making learning more personalised. With no doubt, the AR phenomenon incoorporated with m-learning will make learners stay glued to mobile learning. This can allow learners to overlay something virtual onto something real through the use of their mobile cameras. AR devices like google goggles, wikitude and Layar show the possiblity for using a mobile gadget to give more information about objects, places, etc. Apart from these known AR kits, there have been few m-learning apps where Virtual Reality VR, has once been superimposed onto a real location so as to give a new learning experience[33].

The adoption of m-learing has also sprung up the development of different mobile apps for learning. This has automatically aided the progressive growth of m-learning. There are many learning resourses online now and a lot of mobile apps. There has been rise in online enterprises like iTunesU and MOOC (massive open online course) phenomenon, to furnish learners with surplus resources with no limits for our own teaching and learning purposes. So, it is safe to say, soon in the future, a mobile app can be developed for everything we want to teach[33].

2.7 User Experience

The rate of infiltration of cell phones is developing in the overall populace. Cell phones and tablets are fit for giving significantly wealthier usefulness to the client than customary gadgets. Sensors which are regular part of the components used in making smartphones and other smart devices are now better equipped with more fuctionalities such as location sensor, accelerometer, gyroscope, camera and microphone. They make the applications to benefit from context awareness, by getting input about the context of the user and surrounding environment [21].

In this ever-growing market of mobile applications there is always competition. And in order to get an upper hand over the competition the application needs to have some extra features over other apps. There is a standard practice that is taken into consideration about how consumers perceive the usage of a newly developed application which is the user experience – the perception of the users on the effectiveness of the product. There are many factors to be considered to be able to create a wonderful user experience and it ranges from human behavior and interaction design to an appreciation of the technical constraints that the product brings [22].

2.8 What is User Experience?

Jakob Nielsen and Don Norman, describe UX as encompassing "all aspects of the end-user's interaction with the company, its services, and its products" [23]. This might be considered a broad view of what User Experience really is. But is applicable on all types of fields that include interaction with users. A good user experience means the user will return for more. User experience has many related areas such as:

- User Experience Architecture
- Information Architecture
- User Experience Design
- Interaction Design
- Navigation Design
- User Interface Design
- Usability Engineering
- Content Strategy

All the different areas of software development are encompassed within User Experience. The boundaries between all these areas are broad and working on one might sometimes mean working on others too. There are three basic principles UX, although, there roles can be subject to debate:

- Focus on the user: The process of focusing on what the user requires from the provided solution and what changes can be made to make it better.
- Measure: The process of measuring the level of satisfaction achieved from the service provided to the user.
- Iterate: Repeating the above two steps to make changes in the provided solution to keep up with the ever-changing needs of the users. [24]

According to Jesse James Garrett there are five different planes of user experience [25]:

1. **Surface**: It is the uppermost layer of user experience that the users get to interact with. It can be the front end of a website or the user interface of an application. It may contain images and scripts for better user experience.
2. **Skeleton**: Beneath the surface is the skeleton. The containers where things need to be placed on the upper level are placed here.
3. **Structure**: The skeleton is a concrete expression of the more abstract structure. For example, in a website the structure defines how users get to a particular page and where next they can visit when done on that page.
4. **Scope**: What features and functions of a particular software are being the question that constitutes the scope of a software. Scope defines what a particular software solution will need to do and how to do it.
5. **Strategy**: The strategy plane contains what the creators want the software solution to achieve and the purpose of the solution.

All the development is done from bottom to top. The strategy is decided first, and the process moves up the planes as the software develops.

2.9 Importance of User Experience

User experience is an essential feature in today's competitive market as users tend to flock towards better user experiences and more and more products rise up to outperform the current leaders. Recently, study from Forester Research [26], a properly-designed user interface is likely

to increase a website’s conversion rate by up to a 200%, and an improved UX design is also likely to increase conversion rates up to 400%.

According to Forbes Council’s Goran Paunovic, obviously understanding the reason customers visit a website and their needs go in line with both the audience and the business, affording brands with the justification and trails for improved user experience. [27]

Making User Experience Design (UX) of a mobile application is the way toward upgrading consumer loyalty and steadfastness by enhancing the ease of use, convenience, and pleasure in the association between the client and the mobile application. User Experience consolidates all parts of end client connection with the mobile application. A User Experience designer will direct a study on the mobile applications relating to a particular industry and the client necessities that should be fulfilled. For the success of a mobile application, it is most extreme vital that the clients have a pleasurable affair while cooperating with it and in addition they are spellbound by the visual interest of the application. An ideal balance of UI and UX will help in procuring more number of clients for the mobile application and additionally keeping them engaged on the application for quite a while. In the plethora of mobile applications, client loyalty has turned out to be obscure. On the off chance that the portable application clients are open to interfacing with a particular mobile application and think that it’s helpful that is where User Experience comes into play.

It's vital to understand that UX configuration is a continuous procedure. With each version and change, the manner by which the clients are utilizing an application ought to be at the focal point of the development process. In the event that the update makes key highlights harder to access or increases the quantity of taps to somebody's goal, the course needs to be corrected.

3. THE LEARN PYTHON APP

The Learn Python app is an Android-based app where a user can study Python and get the basic knowledge about the language. This app illustrates python language and it is meant to be used for learning purposes. It is relevant for both beginners who want to learn the Python language from the ground up and also for experienced developers who want to brush up their basics.

The main features of the Learn Python application are:

- Easy to use console
- Steady learning curve
- Descriptive texts before chapters
- Multiple choice type questions
- Fill in the blanks type questions
- User information management
- User progression storage

The course is easy to understand and covers all the important topics in Python development ranging from the very basic programs of "Hello World" to complex methodologies and implementations. The course is designed for learners who are beginers or with a little bit of programming knowledge. The objective is to furnish them basic knowledge of the role programming can play in providing solutions to some computational tasks, irrespective of their field of study, they can confidently write some little programs and then some more complex programs to be able to achieve some useful programming skills.

Having completed the tutorials in the Learn Python app the user should be able to:

- Understand the Python console
- Understand Python variables, data structures and dictionaries
- Perform mathematical operations in Python
- Create functions in Python
- Create and understand loops in Python
- Create and understand lists and tuples in Python
- Use conditionals to make decisions

3.1 Division of the System

The Learn Python application system is divided into two parts:
The user management part
The tutorial parts

User management part: User Management part of the application allows the user to view and manipulate the details provided by them at the time of registration. It is a display screen that shows private information of a particular user. This part includes all the pages like “Home page”, “Login/Sign-Up page”, “User Settings page” and “Forget password page”. The main purpose of this part is to provide user full access to user data and change any information that the user wants changed. A profile page is used to store descriptive information of a person. In this case, the user profile is used to store the progress made by the user in completion of the Python tutorial.

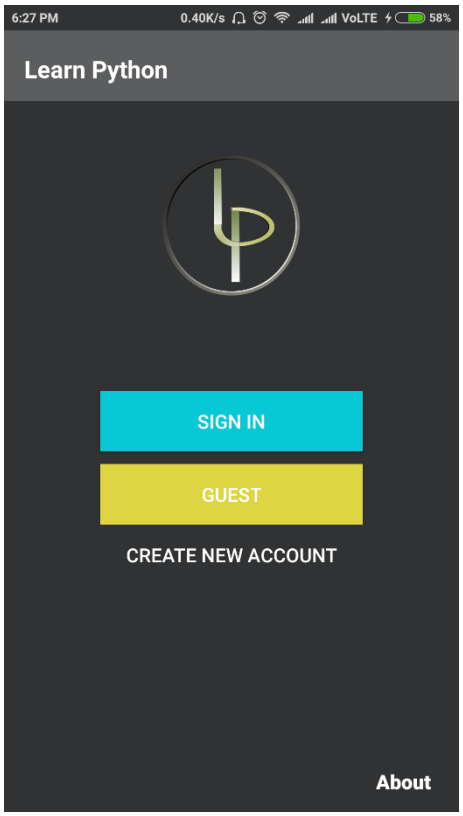

Figure 3: App Home Screen

Tutorial part: This part includes topic listing page and all the tutorials included within the app. The focus of this part is on providing a list of topics to the user and keeping track of the tasks the user has completed. The user can move forward if and only if they have completed the previous topic. Also, the user can only move to the next question if and only if they have answered the current question correctly. In this section where the user follows the instructions displayed on the screen, they attempt the exercises and then get the feedback based on their activities.

The tutorial section follows the basic characteristics of any tutorial:

- **Presentation of the view:** This section explains and shows the user the user interface. In this case it is done using theoretical portions.

- **Demonstration of a process**: This uses examples to demonstrate how a process or workflow is done. In this case it is done using code samples to explain the syntax and functioning of Python Language.
- **Method of review:** It emphasizes or checks the understanding of the content in the related module or section. Here it is done using multiple choice type questions and fill in the blank type questions.
- **Transition to additional modules or sections:** It further develops the already given instructions. The tutorial section is assembled in such a way that it utilizes user's previous knowledge from earlier sections.

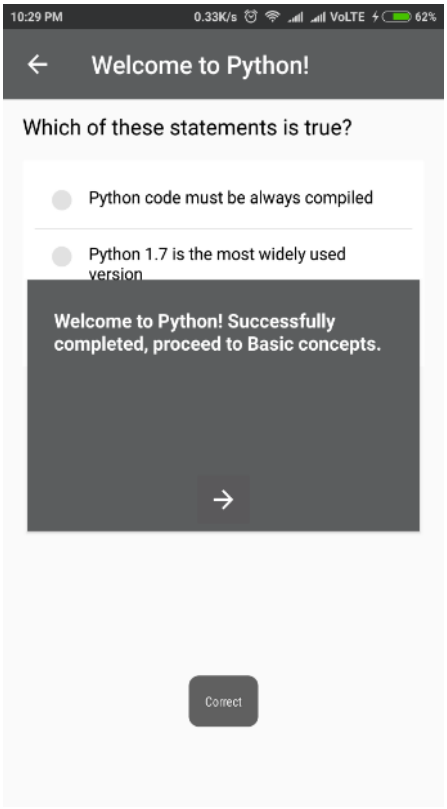

Figure 4: A typical tutorial screen from the app

3.2 Topics covered

Topics were chosen on the basis of what a new Python Developer needs in order to have a grasp of Python code. Special care was taken into the ordering of the topics so that the learning curve is never too steep for any newcomer (See fig. 47 in Appendix 1). After collecting data about the basics of the Python Language following list of topics was curated:

- **Introduction:** This topic introduces the basics about the Python language to the user. It talks briefly about the structure and history of Python. It describes how Python is a great and friendly language to use and learn and how it can be adapted to both small and large projects.

- **The Python Console:** This topic covers the basics of Python console and shows the basic programming techniques of the language. The Python console affords programmers the luxury of a fast access to run and execute commands, the try out or test code without creating a file. Providing access to all of Python's integral functions and any installed modules, the Python console offers the chance to discover Python.

- **Values and Types:** This topic covers all the various types of values in the Python language. A value is one of the principal things; similar to a word or a number; that a program control. Values are often referred to as objects. These values are classified into different classes, or data types. Every value in Python has a data type. Since everything is an object in Python programming, data types are classes and variables are instance (object) of these classes.

- **Variables:** This topic discusses about the various types of variables supported by the Python language and their usage. A variable is an area in memory used to store some data (value). They are given one of a kind names to separate between different memory locations. In Python, a variable doesn't need to be declared before being used. Simply assigning a value to a variable will make it exist.

- **Dictionaries:** This topic covers a specific type of data structure in Python language known as Dictionaries. In Python dictionaries are unordered sets of objects. Dictionaries are much similar to lists, just slightly different due to the way dictionaries are accessed. They are accessed through keys not through position. Dictionaries are associative arrays (called hashes). Each key of a dictionary is linked to a value.

- **Arithmetic Operators:** This topic covers basic arithmetic operations in Python i.e. addition, subtraction, multiplication and division. Arithmetic Operators are unique signs in Python language that execute arithmetic computation. It operates on a value called operand.

- **Quotient and Modulo Operators:** This topic covers the application of quotient and modulo operators in Python language. The Modulo operator provides remainder of the division of left operand by the right whereas the Quotient operator the quotient value of the operation.

- **Strings:** This topic covers the usage and application of strings in Python language. Strings are one of the very common data types in Python. Strings are created in a simple way by just enclosing characters in quotes. In Python a single quote is treated same way as double quotes.

- **Functions:** This topic covers the usage of functions in the Python language and their applications. Functions in Python are useful in separating the code. Any code within a function can be used somewhere else without rewriting it due to the object-oriented nature of Python. Arguments can also be added to functions to have more flexibility. Functions can be defined by using the keyword def before the function name.

- **Lists:** This topic covers the usage and application of a specific type of data structure i.e. lists. Lists are the most flexible data type available in Python that can be collected as a list of comma-separated values in square brackets. Important note about lists is that the items in a list do not need to be of the same type.

- **Tuples:** This topic deals with the description and application of tuples. It provides information about the properties and usage of tuples in Python. A tuple is a succession of unchallengeable Python objects. Tuples are successions, much the same as lists. The contrasts amongst tuples and lists are, the tuples can't be changed not at all like lists and tuples utilize parentheses, while records utilize square brackets.

- **Loops:** This topic covers the usage of loops in Python language. A loop statement lets programmers to run and execute a statement or a group of statements many times.

3.3 User Management

A user profile is a visual show of individual information related to a particular user, or an adapted work area. A profile is a strict digital representation on ones identity. It can also be attributed to a digital symbol of a user prototype. It is mainly used to store information of a user. The user profile information stored in the system can be retrieved at any point in time. User Profile guarantees that the client's personal settings are connected to the client's applications, regardless of the area and end point gadget. A user profile is a stored data of specific user’s data that describes the user's specific area of activity. For proper user experience for users, it is essential when developing an app to incorporate user profile features, this will enable a swift UX and also allow users to effeciently interact with the app. According to techopedia.com “A user profile is an accumulation of settings and data linked with a user. It can clearly be said to be a digital representation of the character of the user with respect to the operating environment, which could

be operating systems, software applications or websites. The user profile helps in linking characteristics or features with a user and helps in determining the interactive behavior of the user along with preferences." [18].

The Learn Python application provides all the basic user management modules expected from any modern application. User Management part of the application allows the user to view and manipulate the details provided by them at the time of registration. The main purpose of this part is to provide user full access to user data and change any information that the user wants changed. (See figs. 47, 48 and 49 in Appendix 1).

The users can:

- Create an account: This option allows the users of the application to create a new user account on the Learn Python application. The account creation requires a few personal details and once the account is created the user can have access to all the tutorials present in the application.
- Change their details: In this option the user can change the details provided by them including the user name, address etc.
- Recover their password: In case the user is unable to remember their password then they can recover their password using the e-mail address the used in registering their account.
- Change their password: Here the user can change the password for their account.
- Login to their account: Here the user can login to their account and access the full content of the Learn Python application. The guest user is only able to access only the first chapter of the tutorial section. The login section provides the user the ability to access the full potential of the Learn Python app.

3.4 Topic Structure

Topic-based authoring is a method of content creation in which information is structured in small chunks of a particular type. Each topic represents an independent piece of information. Every topic covered in the application has almost the same structure as described in the figure below.

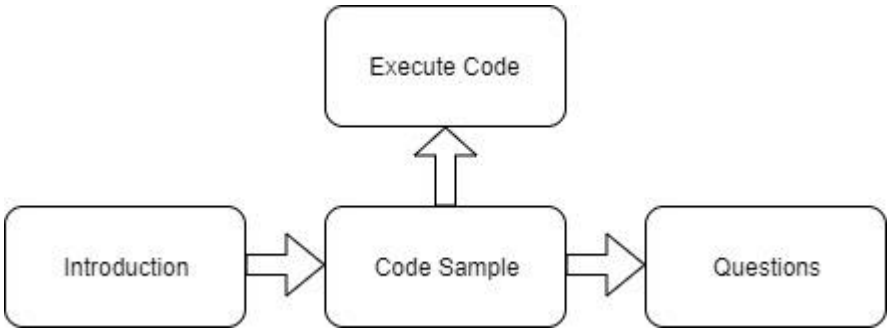

Figure 5: Topic Structure

Every topic starts with a brief theoretical description of the basics. The introduction of the topic usually consists of a textual description of the topic and may contain some syntax guidelines which can be used while coding in Python. Once the user has completed reading and understanding the basics they can move on to the questions section.

If the topic has code execution part in it, then the user is faced with a code example. The code example provides the user with the problem question as well as the solution to the problem so that the user can easily understand the syntax and semantics of the Python language. The user can then choose to execute the code or move on to the question section. If the user chooses to execute the code the user is directed to the Python console of the application where the user can not only execute the provided code in real time but also experiment with the provided code. The user is given freedom to completely alter the code in Python console.

The question section mainly consists of two types of questions:

- Multiple Choice Type Questions: These are types of questions for objective assessment that the respondents are required to choose the correct answer from serveral options that best answers the asked question [19].
- Fill in the Blanks Type Questions: This type of questions consists of some part of sentence in which some of the parts are missing (close text), and the respondent is required to complete the sentence with the missing item [20].

The user can only move to the next question if and only if they manage to provide right answer to the current question. Also, all the options in the multiple-choice type questions are shuffled every time the user reopens the application so that they cannot move forward by simply remembering the correct option number thus emphasizing on the learning aspect of the application. (See figs. 51, 52, 53, 54 and 55 in Appendix 1).

3.5 Data Structure

The app uses two main types of data structures:
- Shared Preference
- Array lists

Shared Preference: The app uses shared preference to store persistent data such as user data and user progress in the form of key value pairs. The data stored in shared preference remains stored even after the app has been closed and removed from the memory. The data is stored as a part of application data.
Array lists : Array lists are used by the app to add options for multiple choice type questions. The options are added to the arraylist and shuffled so that user gets different order of options every time he opens the same question.

4. Research Methodology

This section of the write-up outlines the methodology employed in the research. During the research process, there were two major techniques used to gather reliable data and information necessary for the aim of this research. The first method is questionnaire, which gives moderate and effective data from a substantial number of participants while the second method is the interview method which allows the researcher to get more detailed information from the participants.

4.1 Research Context

Python language has always been around for so many year but the exponential growth in recent times has drawn more attention to the programming language. Learn Python mobile app was developed to facilitate and promote the use of python language. The research is intended to establish how well people are familiar with mobile learning apps for programming in education and to also ascertain the efficacy of python mobile learning apps for learners.

4.2 Data Collection

Gathering information is something that can come in different diverse structures, regardless of whether it's a person essentially doing examination and gathering preexisting data sets, or an analyst specifically completing a survey or something of that nature. There are no evident rules or guidelines that one can simply tail, it generally relies upon the particular sort of information accumulation that they are directing, and one should make certain, that whatever kind they are doing, the technique for gathering is consistent and reliable.

The first part of collecting information in this case, was to choose the set of topics that one needs to understand and be able to create Python code. So, the topics were carefully chosen and ordered so that the user of the application can get at ease with the logics and syntax used in the Python language, and the learning curve is never too high when going from one topic to another. A list of reference books, papers and websites is provided in the appendix of this research which were also used in the development of the Learn Python application and the syllabus it covers.

The second part of the information collection process was to conduct studies on a group of people to decide the effectiveness of the application. A group of 15 participants with diverse backgrounds in programming experience both from University of Eastern Finland and other Universities across Finland were chosen as a sample space for this research. The method of information collection was questionnaire. Questionnaires give a discreetly economical, brisk and efficient way for gathering lots of data from a substantial sample of people. It helps to gather information discreetly and quickly even if the researcher is not physically available when the questionnaire is being answered by the respondents. It’s a safe and reliable means of measuring specific attributes such as attitudes, opinions, human behavior and even intentions of relatively

large amount of subjects cheaply and quickly than other methods. This part of the study was conducted in two steps, (1) interview questions and (2) research question. The type of questions used were both open and closed questions. Closed questions are the types of questions which the answers have been predetermined by the reseacher that fits in well into the categories that are already decided. For the closed questions in the questionnaire, the participants were provided with an answer sheet in which they had to mark their opinions out of five distinct choices:

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

The above rating scale is used to measure the strength of attitudes or emotions and in this case, these set of choices provide a clear medium of understanding of the participants' opinions regarding the Learn Python application, and its effectiveness in being able to teach Python language through mobile devices. The questions were consistent, and all participants were asked the same type of question in a sequential manner.

The total number of questions asked are listed as follows:

- Interview Questions – 10 Questions
    1. Have you ever used a mobile learning app before?
    2. What type of mobile learning app have you used if possible give names of the apps
    3. What are the features you like in Learn Python mobile app?
    4. What is your observation about the compiler in the app?
    5. How would you describe the general look of the app?
    6. Could you tell if you notice some inconsistence while using the app?
    7. Name something you would like to see in the app
    8. How would you rate Learn Python app on the scale of 1-5 and give reason for the rating?
    9. In general, what is your comment about Learn Python app?
    10. Overall, how satisfied are you with the app?

- Research Questions – 6 Questions
    1. Perceived Ease of Use
    2. Learnability
    3. General View
    4. User Interface
    5. User Satisfaction
    6. User Acceptance

- Open Questions – 8 Questions
    1. How do you perceive the use of Learn python programming app?
    2. Is Learn Python app suitable for learning python programming?
    3. How do you think mobile learning apps motivate learning?
    4. What is your view about the user interface of the app?
    5. How satisfied are you with the app?
    6. In general, does Learn Python app meet your expectations?
    7. Could you tell how long you have been programming?
    8. Do you have other comments or suggestions to help improve the app?

Questionnaires are a method accustomed to gathering established data from a number of people - i.e. the same information is collected equally. Usually, they are used to gather information in a statistical frame. Normally, a questionnaires contains different studies that the respondent needs to answer in a predetermined format. There are two types of questionnaires:

- Open Ended: An open-ended inquiry means that the participants plot their own answer in their chosen format i.e. subjective answers.
- Closed Ended: A closed-ended inquiry means the participants are only allowed to choose their answers from the list of options provided in the questionnaire.

5. DATA ANALYSIS

The application contains 42 questions in total out of which there are 30 multiple choice type questions and 12 fill in the blanks type questions. The problems are presented in a fixed order of increasing difficulty. The application also contains 27 code examples to help the user understand the Python syntax better.

5.1 Research Questions Category

These questions were asked to a group of 15 people after they had completed the tutorial present in the Learn Python application. The group of people was chosen at random with varying level of skills in programming (ranging from no previous knowledge of programming to intermediate level of programming knowledge). All the questions asked in the questionnaire were closed-ended and the users were asked to choose from a given set of answers. The answers were then collected and put into tables for statistical calculations. Bar charts were also formulated from the given answers in order to visualize the response from the participants.

5.2 Perceived Ease of Use

This question was asked to the participants in order to ascertain how much they thought the app was accessible to them. The question was closed-ended and intended to ask about topics such as:

- If they found the app to be easy to use
- If the app was user-friendly
- If it required the fewest steps possible to accomplish what they wanted to do with it
- If they noticed any inconsistencies as they used it
- If they thought both casual and frequent users would like it

The bar chart for the answers provided by the participants is given below:

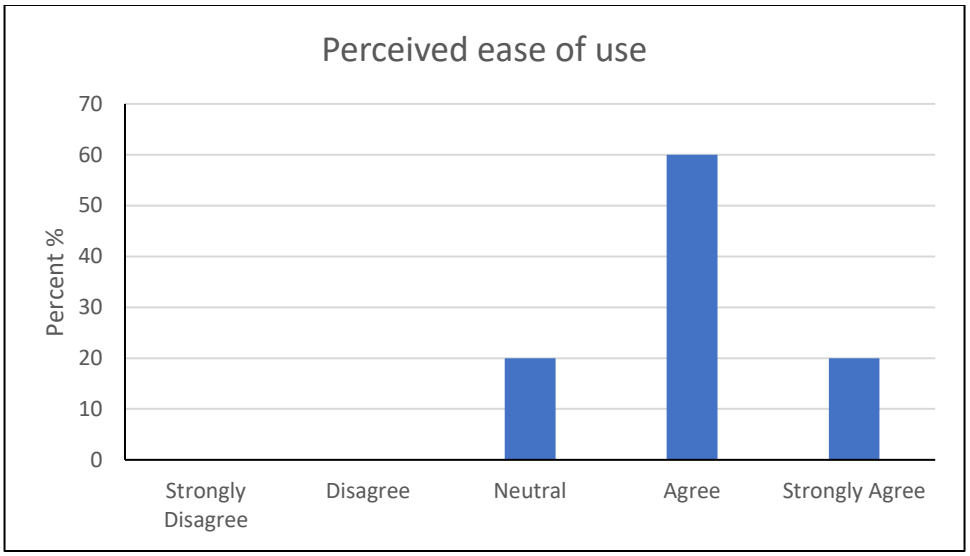

Figure 6: Percieved Ease of Use

As is clearly visible from the results most of the participants(60 percent) found the Learn Python application to be easy to use. 20 percent of the participants strongly agreed with the notion that the application was easy to use. While only 20 percent of the people chose to stay neutral on the question.

5.2.1 Perceived Ease of Use: The app is easy to use

This question was asked to find out what the participants thought about the overall ease of use of the Learn Python application.

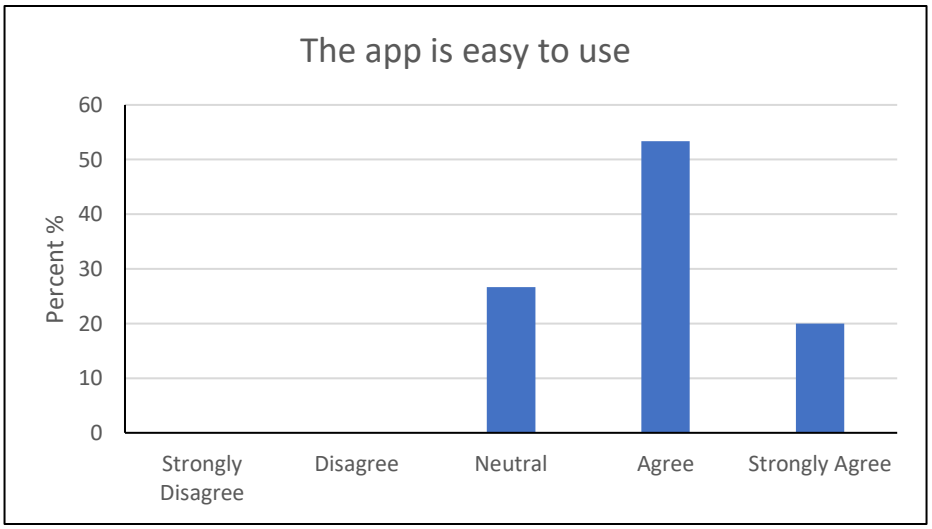

Figure 7: The app is easy to use

As is clearly visible from the graph provided the majority of the participants (more than 70 percent) agreed with the assertion provided in the question that the app was easy to use. Out of which 20 percent strongly agreed. A small group of participants (27 percent) chose to stay neutral on the topic.

5.2.2 Perceived Ease of Use: The app is user friendly

This question was asked to find out whether the participants thought if the Learn Python application is user-friendly or not.

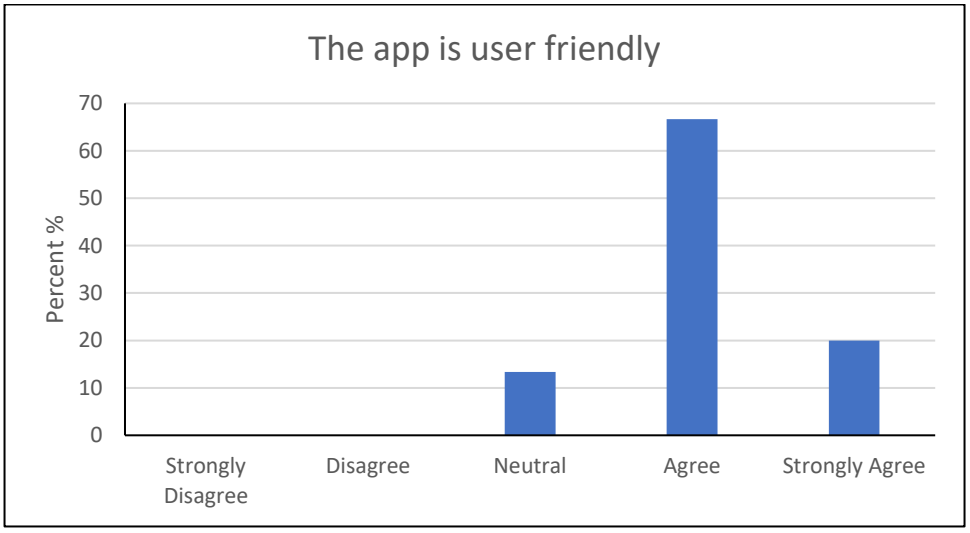

Figure 8: The app is user friendly

As is clearly visible from the graph provided the majority of the participants (more than 80 percent) agreed with the assertion provided in the question that the app was easy to use. Out of which 20 percent strongly agreed. A small group of participants (17 percent) chose to stay neutral on the topic.

5.2.3 Perceived Ease of Use: I did not notice inconsistencies as I used the it

This question was asked to find out whether the participants found any inconsistencies in the Learn Python application while they were using it.

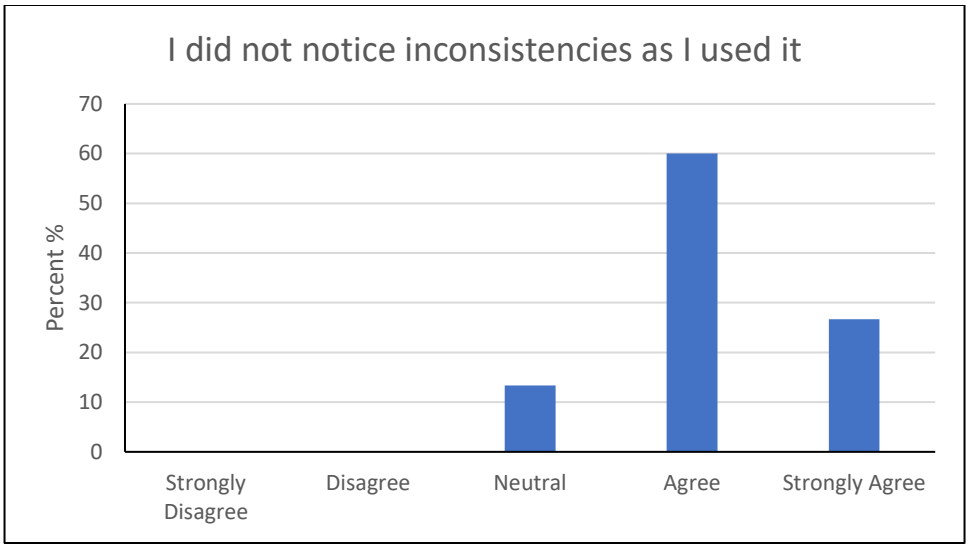

Figure 9: I did not notice inconsistencies as I used it

As is clearly visible from the graph provided the majority of the participants (more than 85 percent) agreed with the assertion that they did not find any inconsistency while using the Learn Python app. Out of which 28 percent strongly agreed. Only (13 percent) of the participants chose to stay neutral on the topic.

5.2.4 Perceived Ease of Use: Both occassional and regular users will like it

This question was asked to find out whether the participants thought that both occasional and regular users would find the application equally interesting or not.

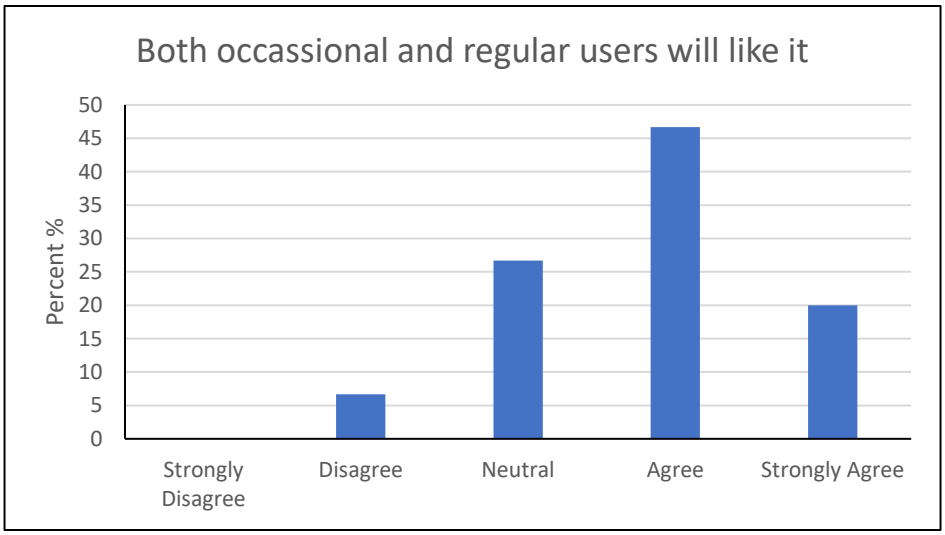

Figure 10: Both occasional and regular users will like it

As is clearly visible from the graph provided the majority of the participants (more than 60 percent) agreed with the assertion that both occasional and regular users would like using the Learn Python app. Out of which 20 percent strongly agreed. Only 27 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3 Learnability

This question was asked to the participants in order to ascertain how much they thought the app was helpful to them in learning the Python language. The question was closed-ended and intended to ask about topics such as:

- If the app provided the required function keys for coding
- If the explanations and examples in the app made learning easier
- If the app had all the functions and capabilities they expected it to have
- If the app helped them better understand the basics of Python programming
- If the topics and exercises contained in the app were suitable for learners
- If the compiler in the app was suitable for Python programming language
- Whether each topic covered in the app made Python learning understandable

The bar chart for the answers provided by the participants is given below:

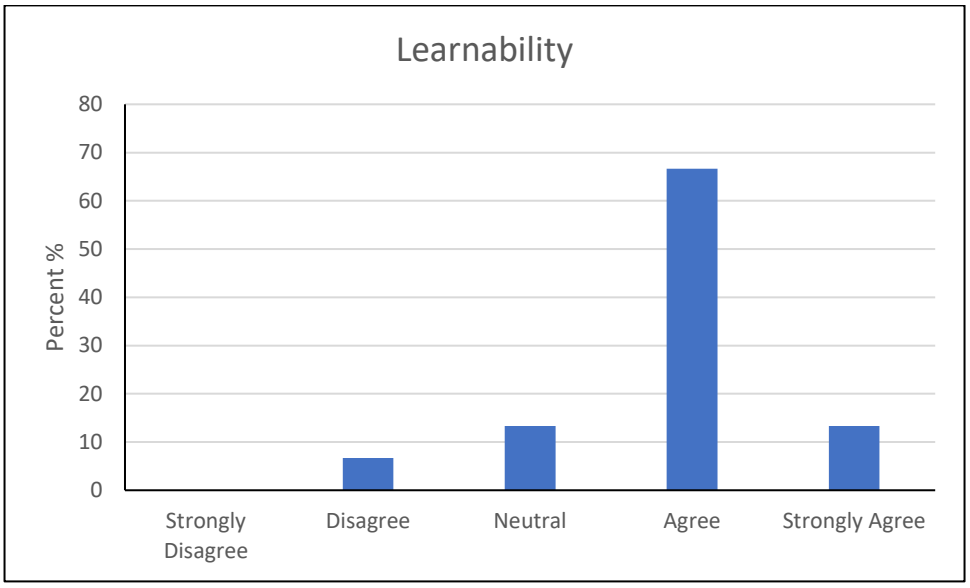

Figure 11: Learnability

As is clearly visible from the results most of the participants(67 percent) found the Learn Python application to be easy to learn from. 13 percent of the participants strongly agreed with the notion that the application was easy to learn from. While only 6 percent of the people disagreed with the question. 13 percent of all the participants chose to stay neutral on the topic.

5.3.1 Learnbility: The app provides the required function keys for coding

This question was asked to find out whether the participants thought that the app provided the required function keys for Python programming.

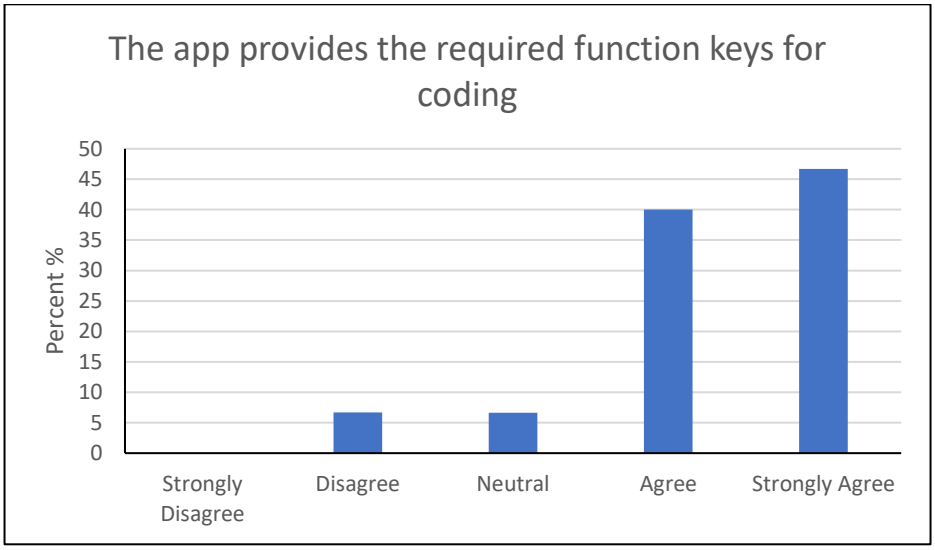

Figure 12: The app provides the required function keys for coding

As is clearly visible from the graph provided the majority of the participants (almost 90 percent) agreed with the assertion that the app provided the required function keys for Python programming. Out of which 20 percent strongly agreed. Only 7 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3.2 Learnbility: Explanations and examples in the app makes learning easier

This question was asked to find out whether the participants thought that the explanations and examples provided in the Learn Python app helped in learning Python programming or not.

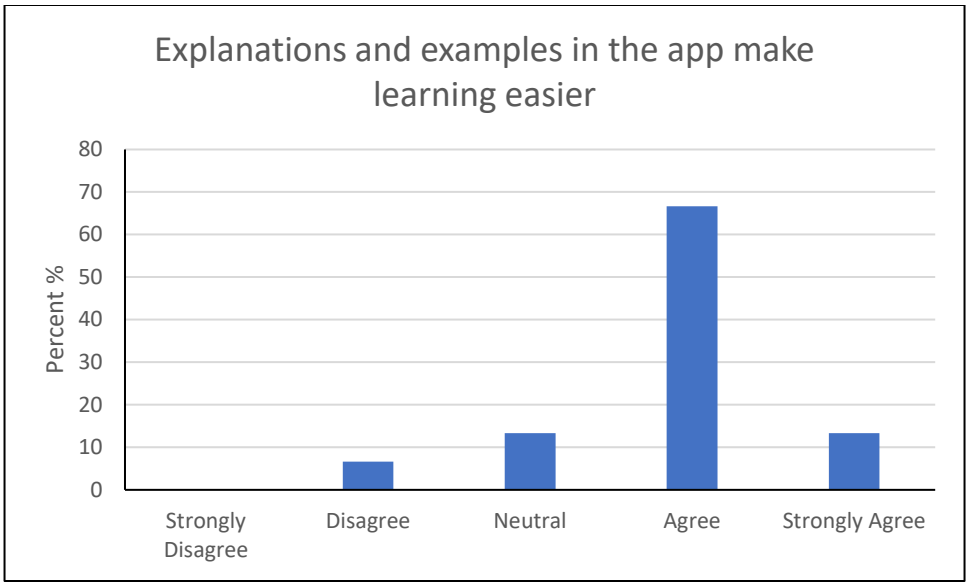

Figure 13: Explanations and examples in the app makes learning easier

As is clearly visible from the graph provided the majority of the participants (more than 75 percent) agreed with the assertion that the explanations and examples in the app make learning easier. Out of which 27 percent strongly agreed. Only 20 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3.3 Learnbility: This app has all the functions and capabilities I expect it to have

This question was asked to find out whether the participants thought that the Learn Python app had all the functions and capabilities they expected it to have or not.

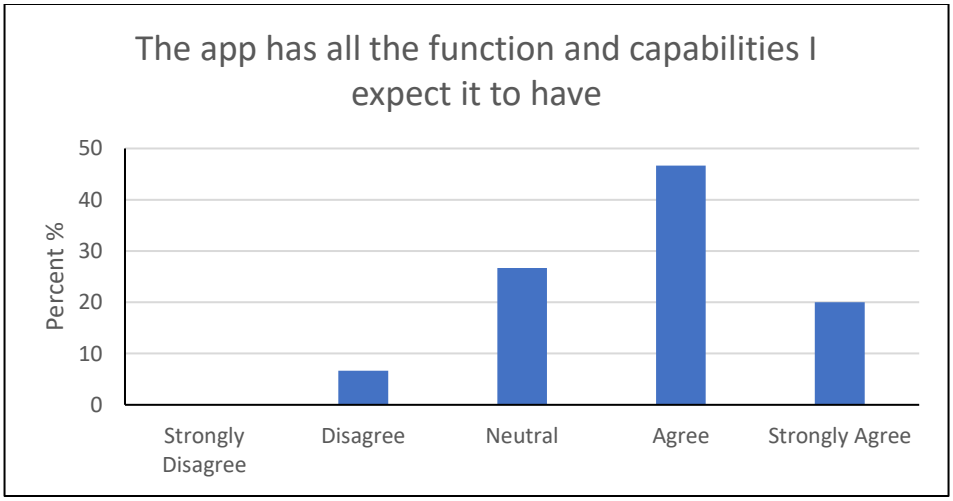

Figure 14: This app has all the functions and capabilities I expect it to have

As is clearly visible from the graph provided the majority of the participants (more than 65 percent) agreed with the assertion that the Learn Python app had all the functions and capabilities they expected it to have. Out of which 20 percent strongly agreed. Only 27 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3.4 Learnbility: The app helped me better understand the basics of python programming

This question was asked to find out whether the participants thought that the Learn Python app helped them better understand the basics of Python programming or not.

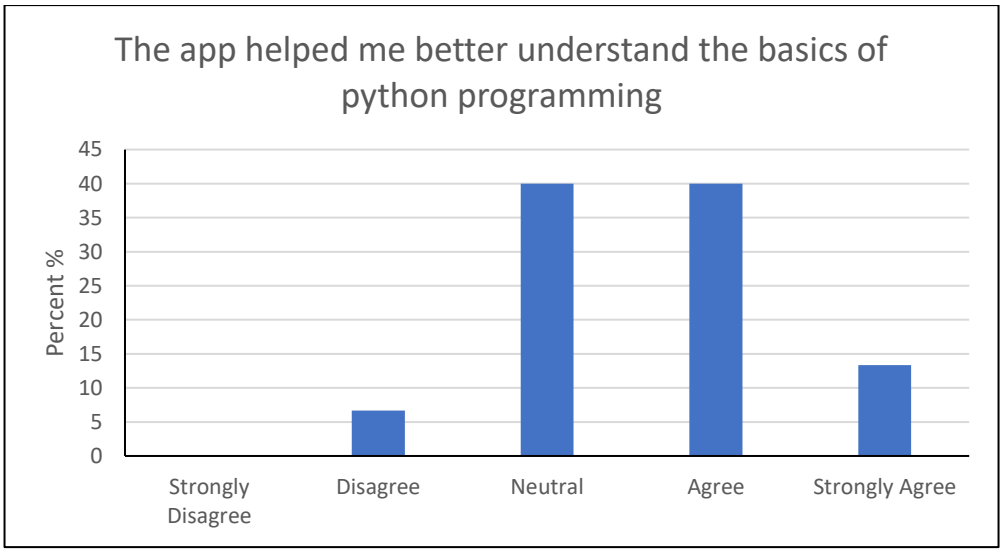

Figure 15: The app helped me better understand the basics of python programming

As is clearly visible from the graph provided the majority of the participants (almost 55 percent) agreed with the assertion the Learn Python app helped them better understand the basics of Python programming. Out of which 13 percent strongly agreed. Whereas 40 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3.5 Learnbility: The topics and exercises contained in the app are suitable for learners

This question was asked to find out whether the participants thought that the topics and excercises contained in the app were suitable for learners or not.

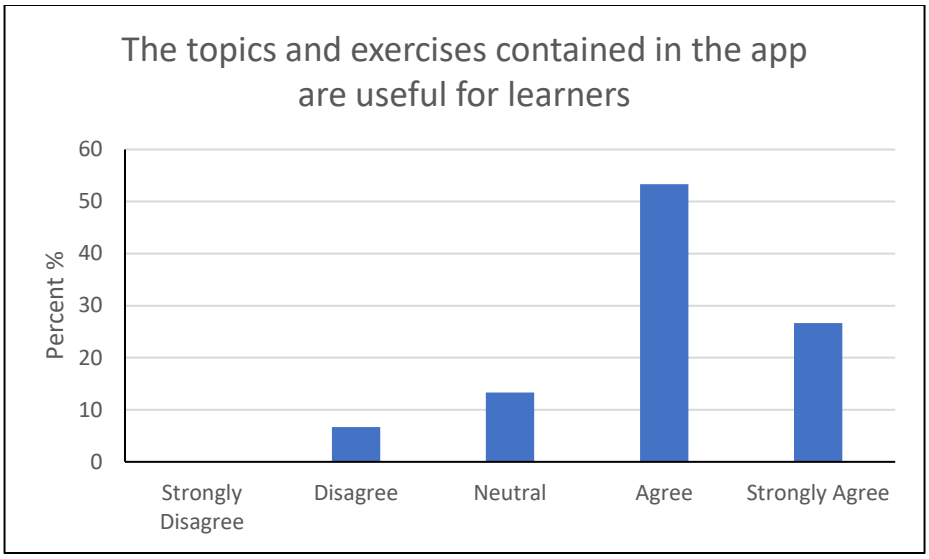

Figure 16: The topics and exercises contained in the app are suitable for learners

As is clearly visible from the graph provided the majority of the participants (80 percent) agreed with the assertion the topics and excercises contained in the app are suitable for learners. Out of which 27 percent strongly agreed. Whereas 13 percent of the participants chose to stay neutral on the topic. And a mere 7 percent chose to differ from the opinion.

5.3.6 Learnbility: The compiler in the app is suitable for python programming language

This question was asked to find out whether the participants thought that the compiler in the app was suitable for Python programming or not.

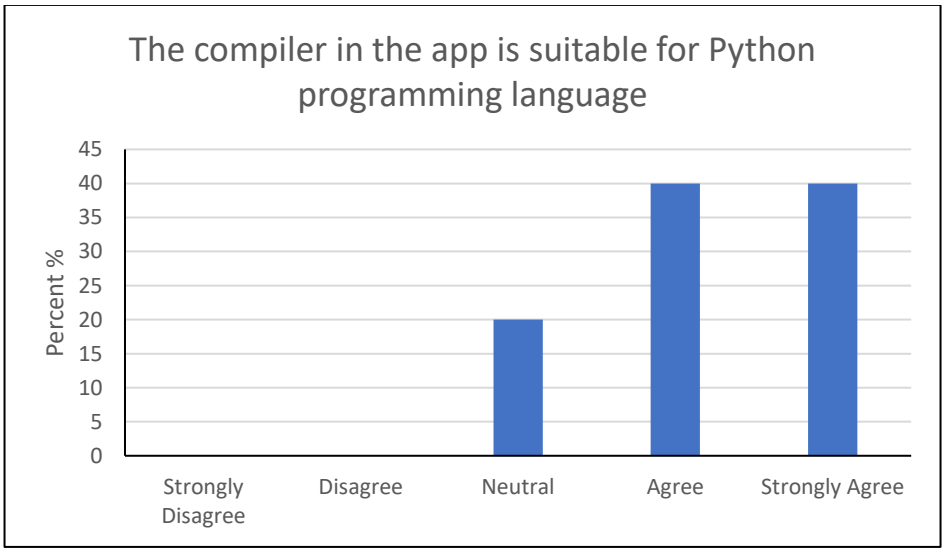

Figure 17: The compiler in the app is suitable for python programming language

As is clearly visible from the graph provided the majority of the participants (80 percent) agreed with the assertion provided. Out of which 40 percent strongly agreed. Whereas only 20 percent of the participants chose to stay neutral on the topic.

5.3.7 Learnbility: Each topic covered in the app makes python learning understandable

This question was asked to find out whether the participants agreed with the choice of topics in the Learn Python application or not.

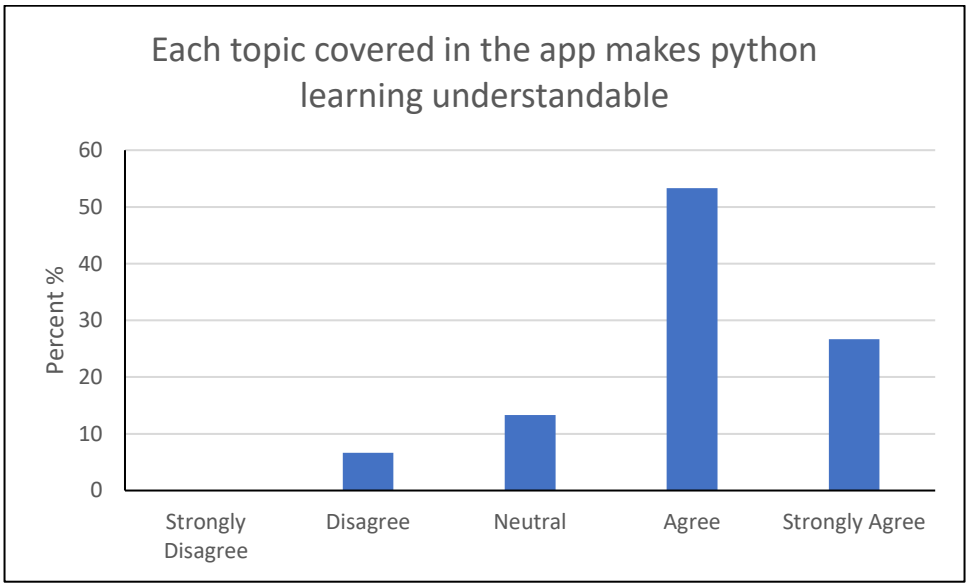

Figure 18: Each topic covered in the app makes python learning understandable

As is clearly visible from the graph provided the majority of the participants (almost 80 percent) agreed with the assertion provided. Out of which 27 percent strongly agreed. Whereas only 13 percent of the participants chose to stay neutral on the topic and a mere 7 percent chose to differ.

5.4 General View

This question was asked to the participants in order to ascertain what they thought about the idea of mobile-based learning in general. The question was closed-ended and intended to ask about topics such as:

- Whether m-learning apps motivate learning
- If they were easily distracted while learning on mobile

- If they thought that mobile learning apps can motivate learning
- If mobile learning should be encouraged
- If they cannot be motivated to learn programming on mobile
- If they felt comfortable learning anywhere on mobile

The bar chart for the answers provided by the participants is given below:

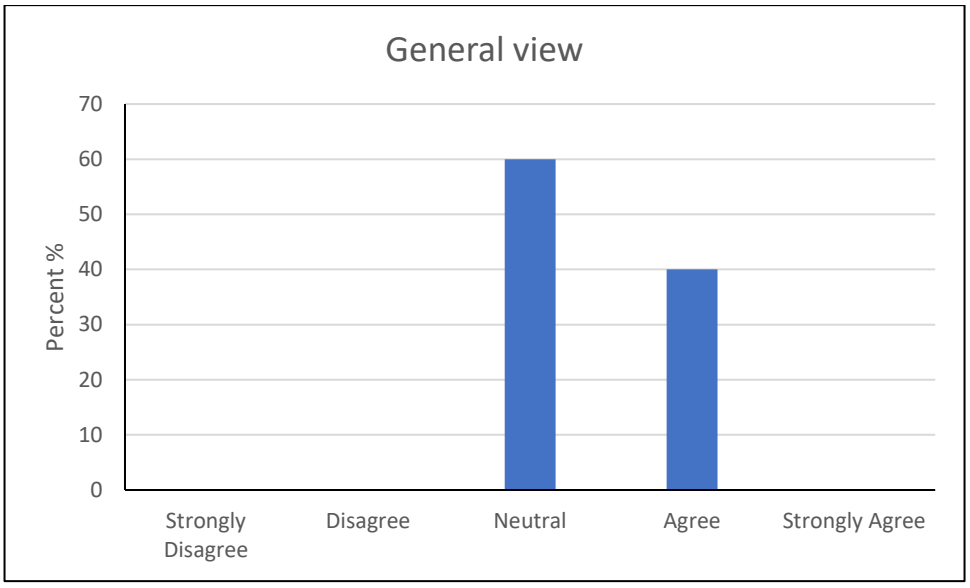

Figure 19: General view

As is clearly visible from the results most of the participants(60 percent) chose to stay neutral on the topic of mobile learning. Whereas 40 percent of the participants agreed with the notion of mobile learning.

5.4.1 General View: Mobile Learning apps motivate learning

This question was asked to find out whether the participants agreed with the assertion that M-Leaning motivates learning.

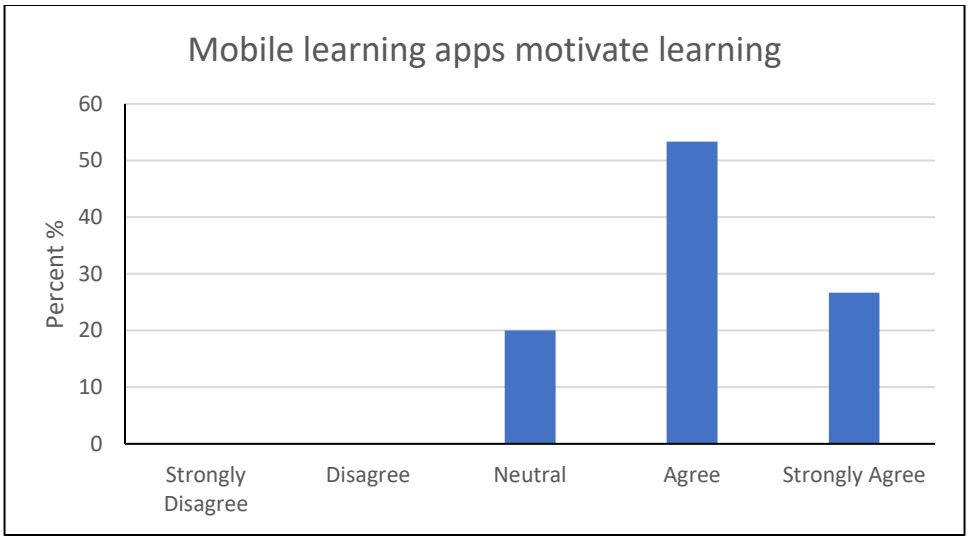

Figure 20: Mobile learning apps motivate learning

As is clearly visible from the graph provided the majority of the participants (80 percent) agreed with the assertion provided. Out of which 27 percent strongly agreed. Whereas only 20 percent of the participants chose to stay neutral on the topic.

5.4.2 General View: I am easily distracted learning on mobile

This question was asked to find out whether the participants thought that they were easily distracted while learning on a mobile device.

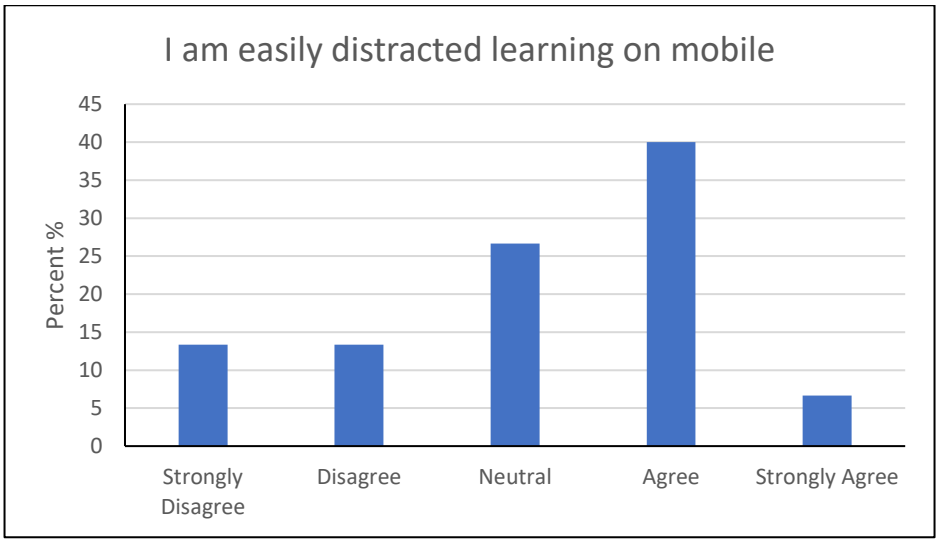

Figure 21: I am easily distracted learning on mobile

As is clearly visible from the graph provided almost 50 percent agreed with the assertion provided. Out of which 7 percent strongly agreed. Whereas only 27 percent of the participants chose to stay neutral on the topic. Also 26 percent of the participants disagreed with the assertion provided.

5.4.3 General View: Mobile learning apps can motivate learning

This question was asked to find out whether the participants thought that mobile leaning apps could motivate learning in general.

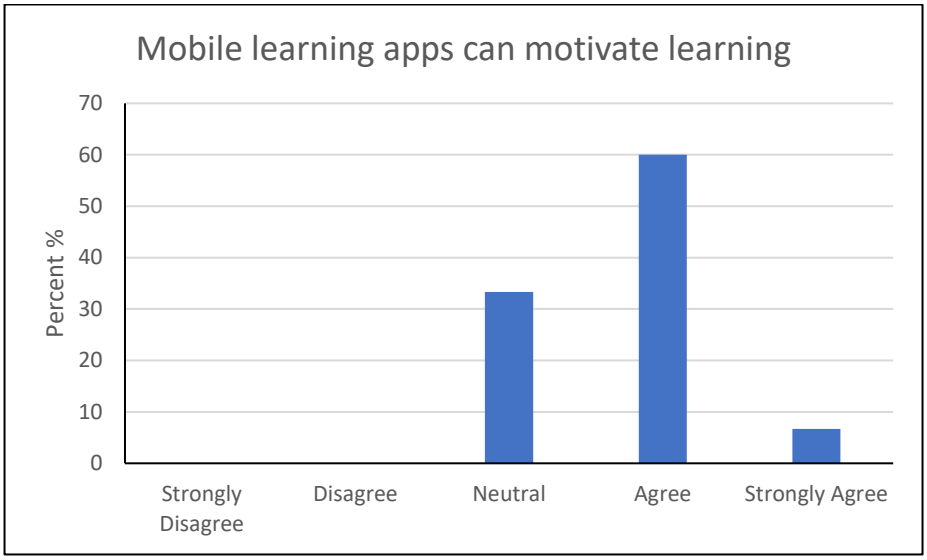

Figure 22: Mobile learning apps can motivate learning

As is clearly visible from the graph provided the majority of the participants (almost 70 percent) agreed with the assertion provided. Out of which 7 percent strongly agreed. Whereas 33 percent of the participants chose to stay neutral on the topic.

5.4.4 General View: Mobile learning should be encouraged

This question was asked to find out whether the participants thought that mobile leaning should be encouraged or not.

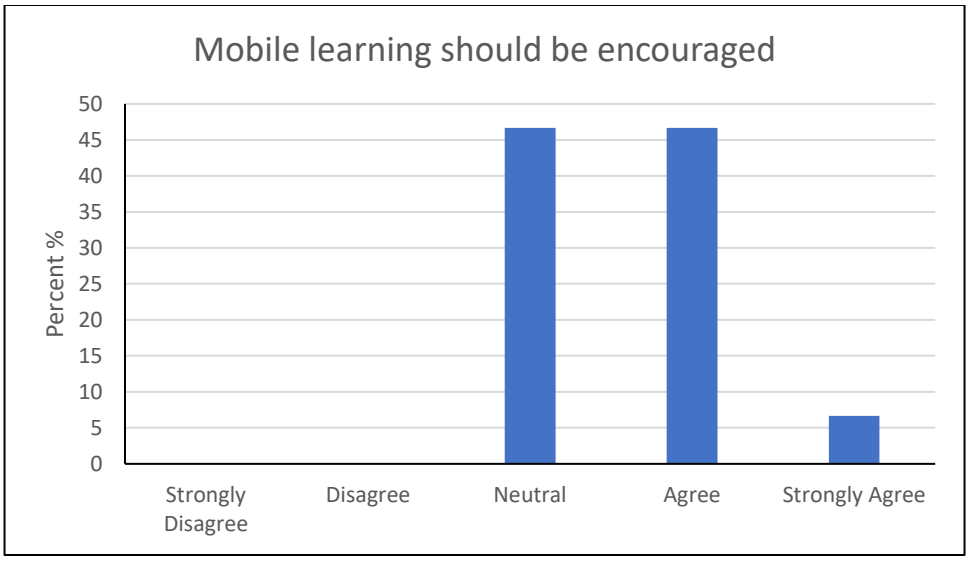

Figure 23: Mobile learning should be encouraged

As is clearly visible from the graph provided the majority of the participants (almost 55 percent) agreed with the assertion provided. Out of which 7 percent strongly agreed. Whereas 47 percent of the participants chose to stay neutral on the topic.

5.4.5 General View: I cannot be motivated to learn programming on mobile

This question was asked to find out whether the participants thought that they could not be motivated to learn on mobile.

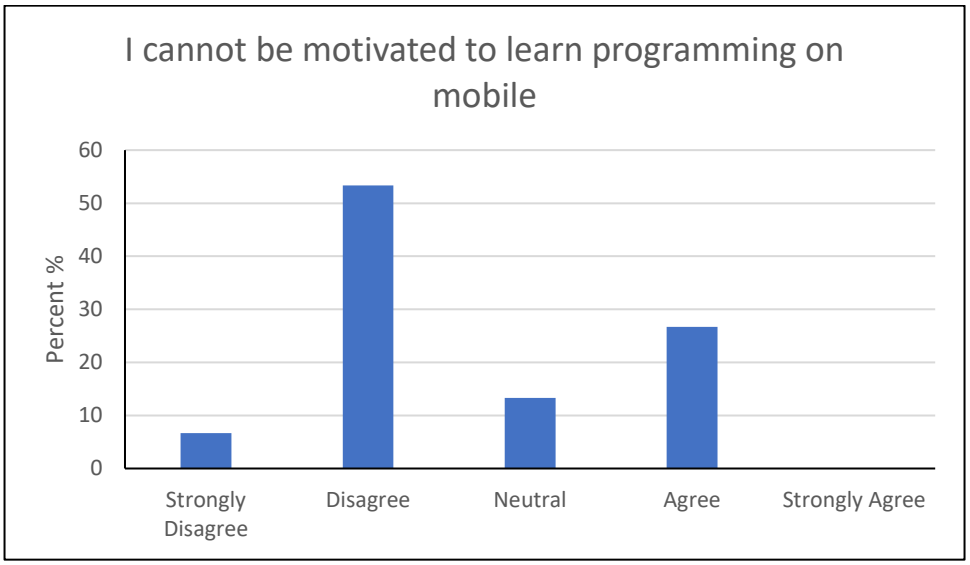

Figure 24: I cannot be motivated to learn programming on mobile

As is clearly visible from the graph provided almost 27 percent of the participants agreed with the assertion provided. Whereas 13 percent of the participants chose to stay neutral on the topic. And 60 percent of the participants chose to disagree.

5.4.6 General View: I feel comfortable learning anywhere on mobile

This question was asked to find out whether the participants felt comfortable learning anywhere on mobile or not.

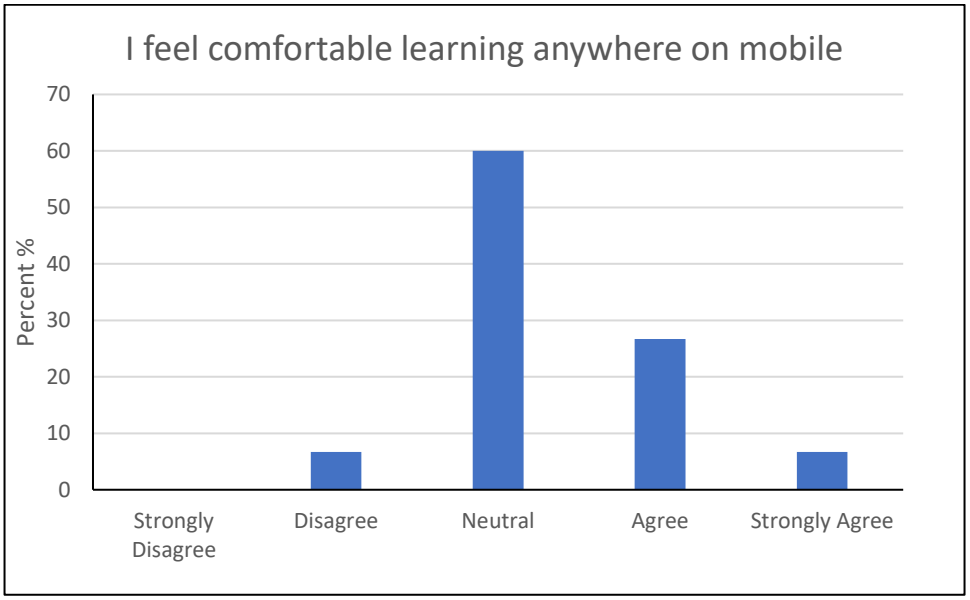

Figure 25: I feel comfortable learning anywhere on mobile

As is clearly visible from the graph provided almost 34 percent of the participants agreed with the assertion provided. Whereas 60 percent of the participants chose to stay neutral on the topic. And 7 percent of the participants chose to disagree.

5.5 User Interface

This question was asked to the participants in order to ascertain what they thought about the user interface and whole look and feel of the Learn Python app. The question was closed-ended and intended to ask about topics such as:

- If the welcome page of the app met their expectations
- If the characters in the app were legible
- If the menus and icons responded swiftly to touch

- If the sign in and register screens met the basic standard
- If the settings screen worked correctly as expected
- If the organization of information was consistent
- If the sequence of screens was well prepared

The bar chart for the answers provided by the participants is given below:

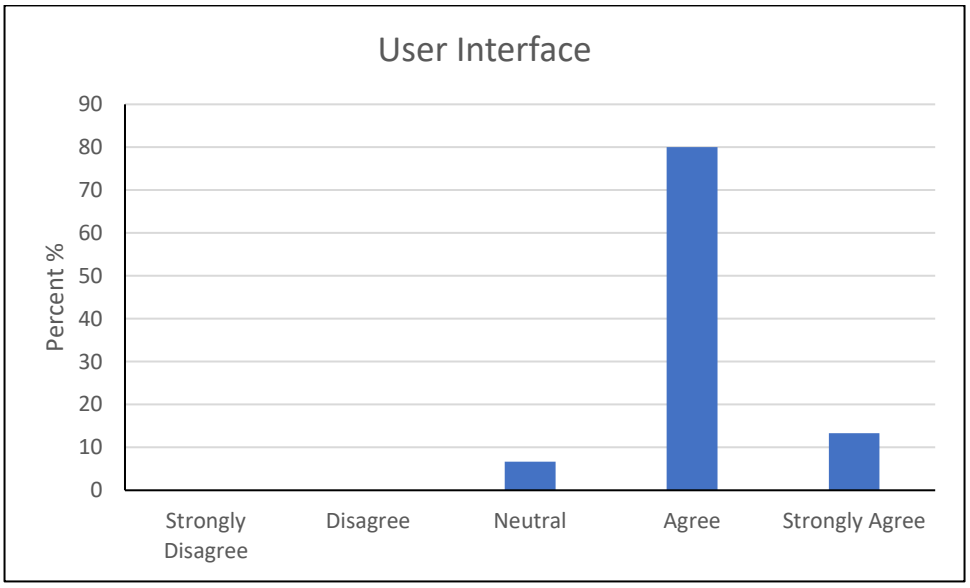

Figure 26: User Interface

As is clearly visible from the results most of the participants(80 percent) chose to agree on the topic of the Learn Python app having a good User Interface. Whereas 13 percent of the participants strongly agreed with the notion. Only 6 percent of total participants chose to stay neutral on the question.

5.1.1 User Interface: The welcome page of the app meets my expectation

This question was asked to find out whether the participants liked the welcome page of the Learn Python app or not.

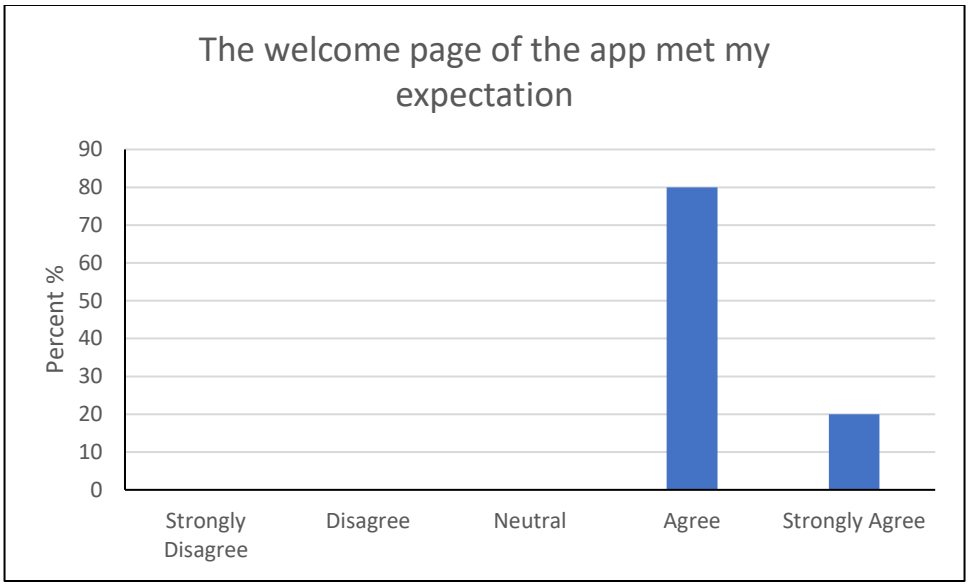

Figure 27: The welcome page of the app meets my expectation

As is clearly visible from the graph provided all of the participants agreed with the assertion provided. Out of which 20 percent strongly agreed.

5.5.2 User Interface: Characters in the app are legible

This question was asked to find out whether the participants found the written characters in the Learn Pyhton application to be legible.

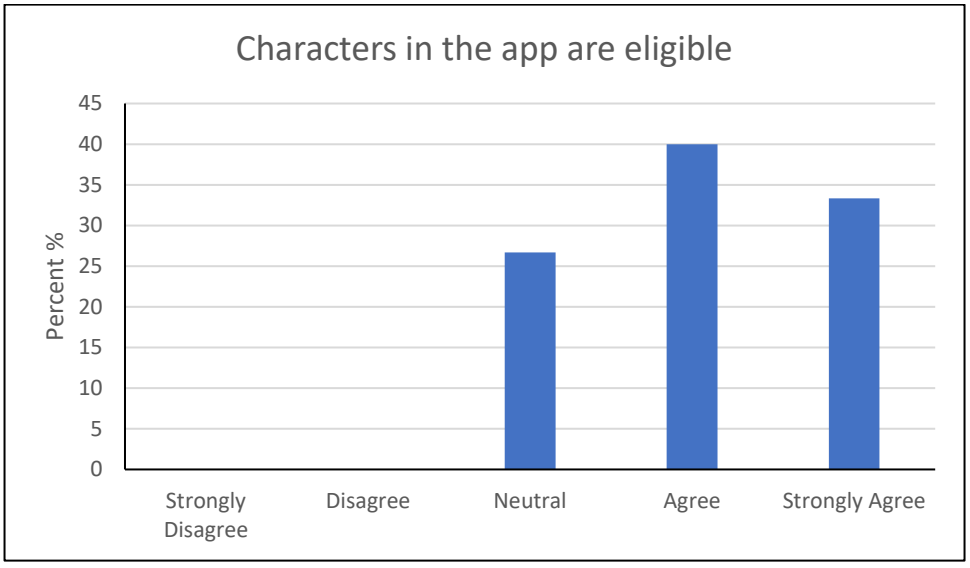

Figure 28: Characters in the app are legible

As is clearly visible from the graph provided most of the participants (73 percent) agreed with the assertion provided. Out of which 33 percent strongly agreed. While 27 percent chose to stay neutral.

5.5.3 User Interface: The menus and icons respond swiftly to touch

This question was asked to find out whether the participants found the Learn Python app to be touch responsive or not.

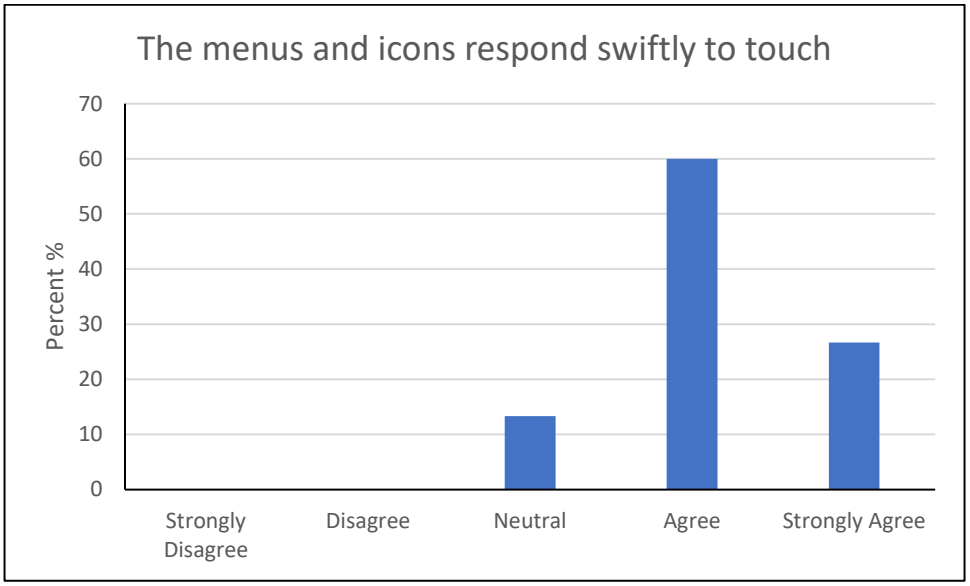

Figure 29: The menus and icons respond swiftly to touch

As is clearly visible from the graph provided most of the participants (87 percent) agreed with the assertion provided. Out of which 27 percent strongly agreed. While 13 percent chose to stay neutral.

5.5.4 User Interface: The sign in and register screens meets the basic standard

This question was asked to find out whether the participants found the Learn Python app's sign in and register screens to be on par with the standards.

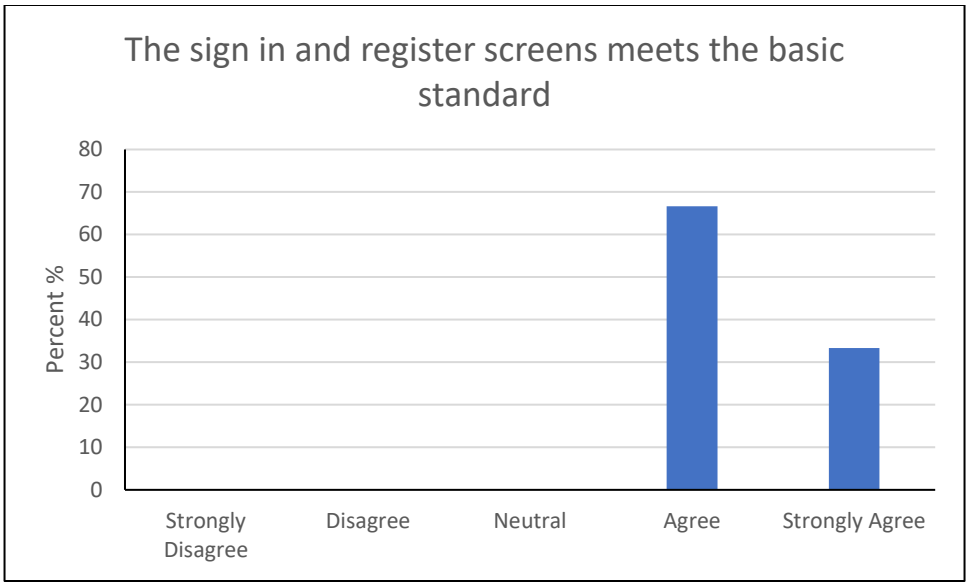

Figure 30: The sign in and register screens meets the basic standard

As is clearly visible from the graph provided all of the participants agreed with the assertion provided. Out of which 37 percent strongly agreed.

5.5.5 User Interface: The settings screen works correctly as expected

This question was asked to find out whether the participants found the Learn Python app's settings screen to be on par with the standards.

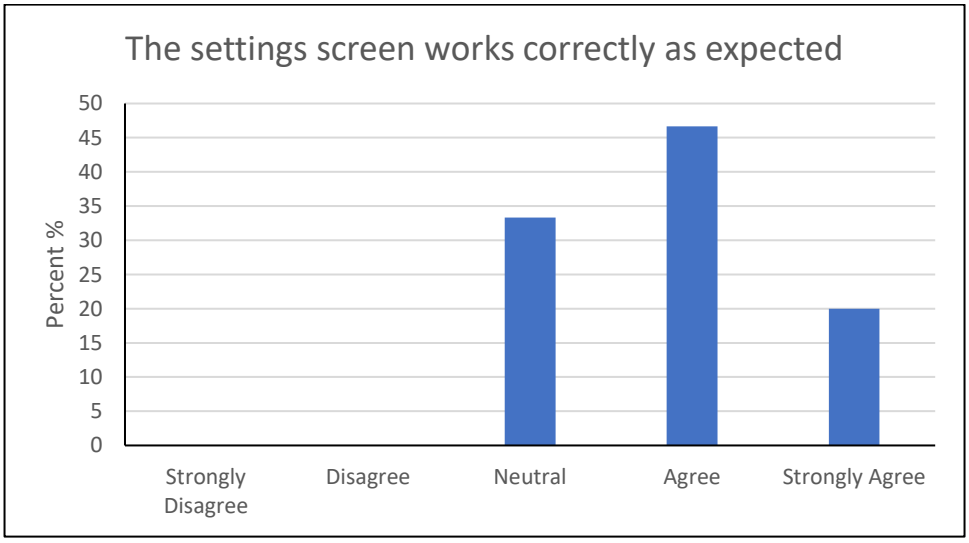

Figure 31: The settings screen works correctly as expected

As is clearly visible from the graph provided most of the participants (67 percent) agreed with the assertion provided. Out of which 20 percent strongly agreed.

5.5.6 User Interface: Organization of information is consistent

This question was asked to find out whether the participants found the Learn Python app's organization of information to be consitent.

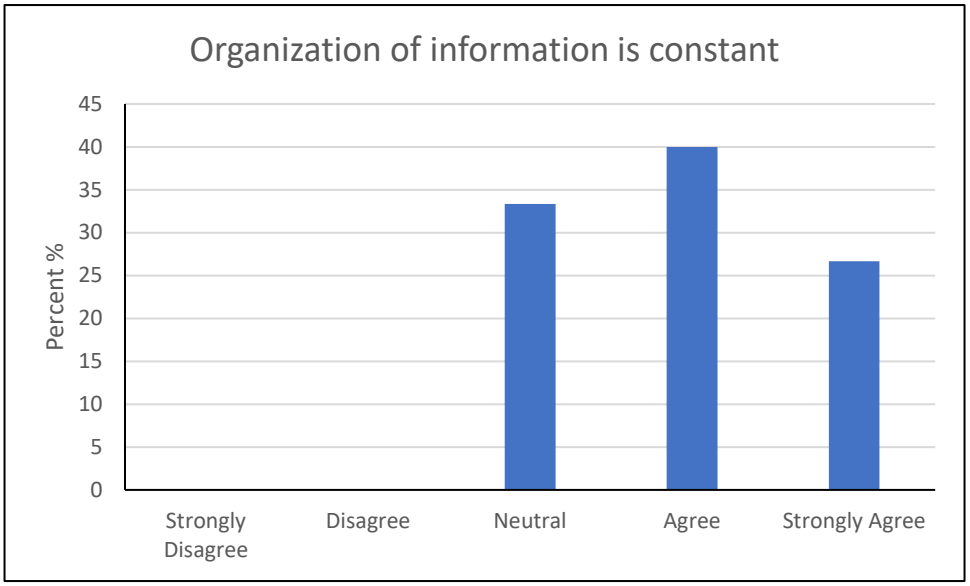

Figure 32: Organization of information is consistent

As is clearly visible from the graph provided most of the participants (67 percent) agreed with the assertion provided. Out of which 27 percent strongly agreed. Whereas 33 percent of people chose to stay neutral.

5.5.7 User Interface: Sequence of screens are well prepared

This question was asked to find out whether the participants found the Learn Python app's sequence of screens to be well prepared.

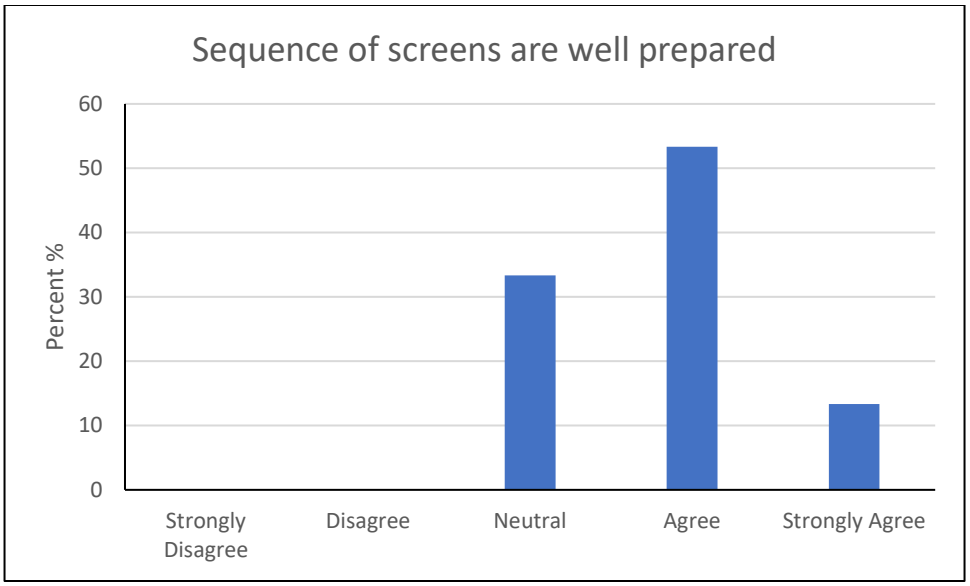

Figure 33: Sequence of screens are well prepared

As is clearly visible from the graph provided most of the participants (67 percent) agreed with the assertion provided. Out of which 13 percent strongly agreed. Whereas 33 percent of people chose to stay neutral.

5.6 User Satisfaction

This question was asked to the participants in order to understand if they were satisfied after using the Learn Python app. The question was closed-ended and intended to ask about topics such as:

- If they were satisfied with how the next task unlocked after completing each exercise
- If they were satisfied with the input interface of the app
- If the 'Hint' button helped to remember vital information about each topic
- If they felt comfortable running codes on the compiler
- If they were satisfied with how easy it was to use this app
- If they would recommend it to a friend

The bar chart for the answers provided by the participants is given below:

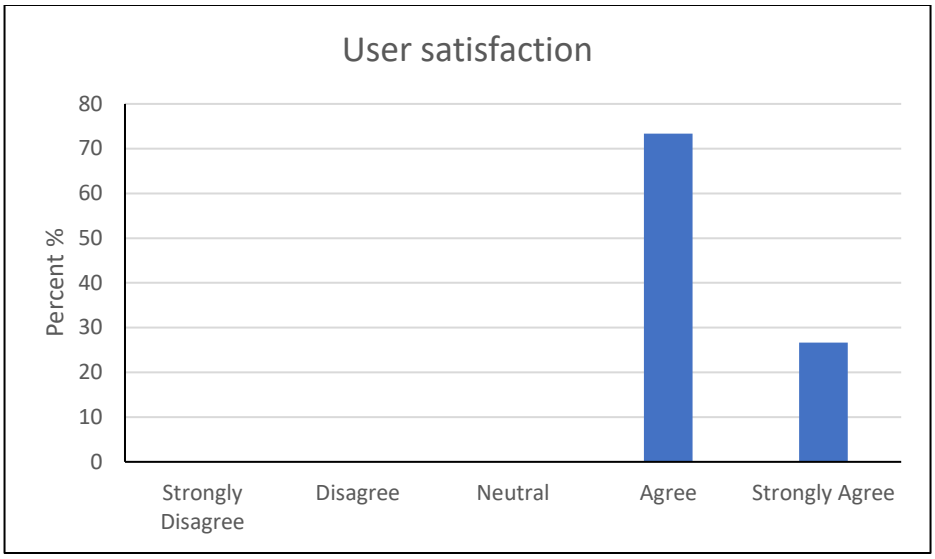

Figure 34. User Satisfaction

As is clearly visible from the results most of the participants(73 percent) chose to agree on the topic of the Learn Python app providing them with user satisfaction. Whereas 26 percent of the participants strongly agreed with the notion that the application was incredibly satisfying and provided them with results that they expected.

5.6.1 User Satisfaction: I am satisfied with how the next task unlocks after completing each exercise

This question was asked to find out whether the participants found the Learn Python app's "complete task to unlock the next task" approach to be satisfying.

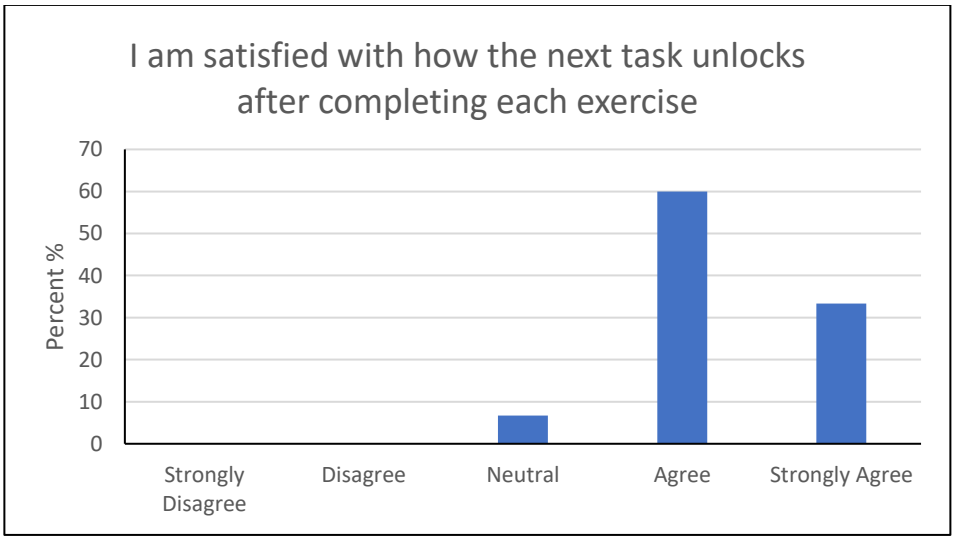

Figure 35: I am satisfied with how the next task unlocks after completing each exercise

As is clearly visible from the graph provided most of the participants (93 percent) agreed with the assertion provided. Out of which 33 percent strongly agreed. Whereas 7 percent of people chose to stay neutral.

5.6.2 User Satisfaction: I am satisfied with the input interface of the app

This question was asked to find out whether the participants found the Learn Python app's input interface to be satisfying or not.

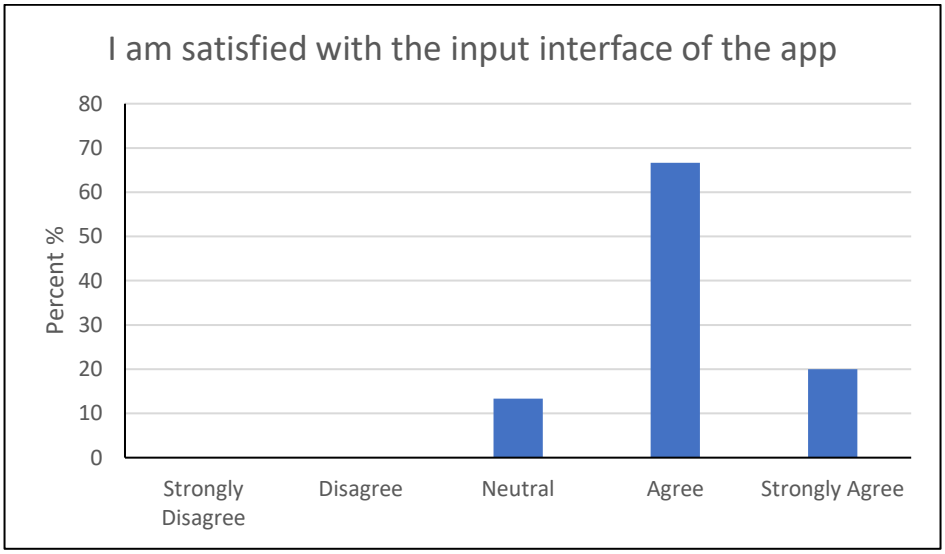

Figure 36: I am satisfied with the input interface of the app

As shown in the graph above, most of the participants (85 percent) agreed with the assertion provided. Out of which 20 percent strongly agreed. Whereas 15 percent of people chose to stay neutral.

5.6.3 User Satisfaction: The 'Hint' button helps to remember vital information about each topic

This question was asked to find out whether the participants found the Learn Python app's 'Hint' button to be useful or not.

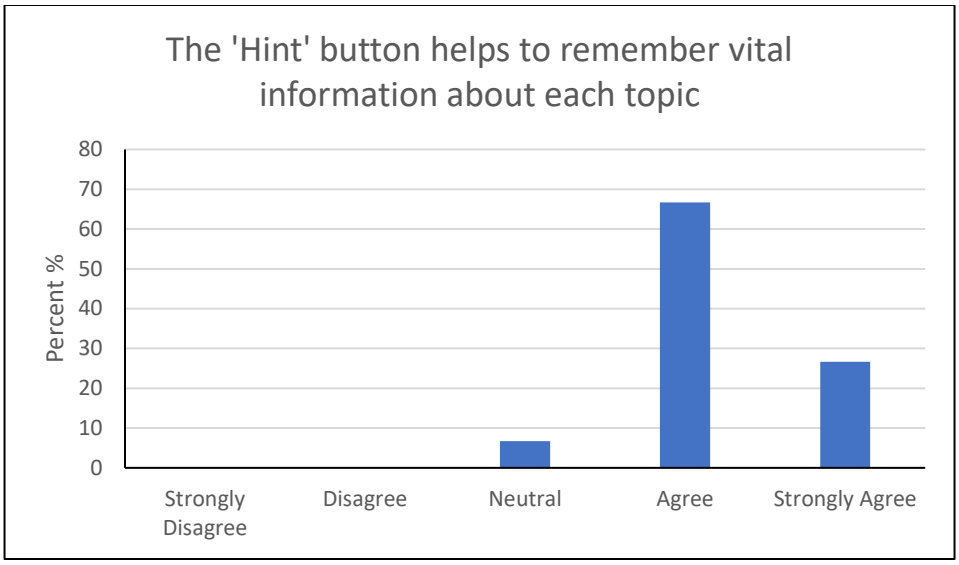

Figure 37: The 'Hint' button helps to remember vital information about each topic

As is clearly visible from the graph provided most of the participants (93 percent) agreed with the assertion provided. Whereas 7 percent of people chose to stay neutral.

5.6.4 User Satisfaction: I feel comfortable running codes on the compiler

This question was asked to find out whether the participants found it comfortable to use the app's built-in compiler.

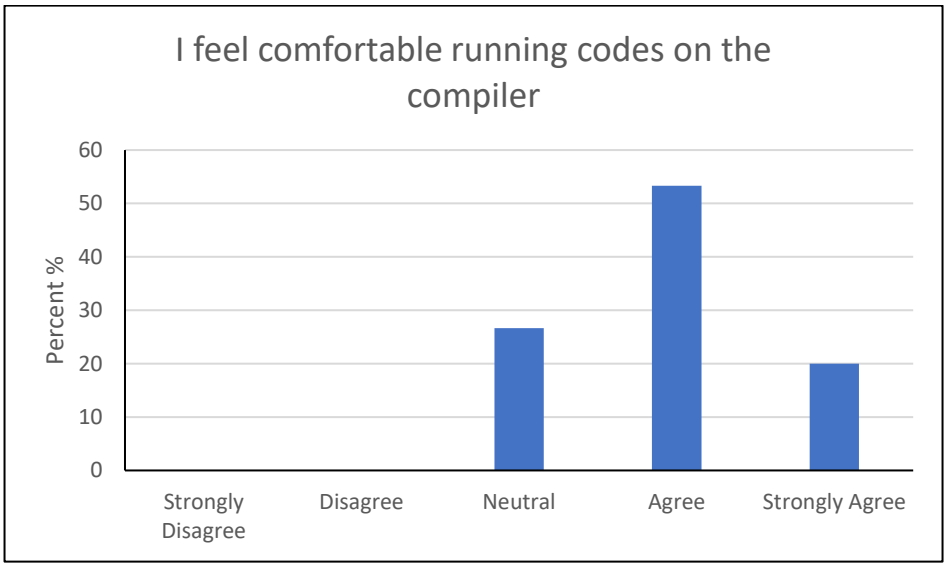

Figure 38: I feel comfortable running codes on the compiler

As is clearly visible from the graph provided most of the participants (73 percent) agreed with the assertion provided. Out of which 20 percent strongly agreed. Whereas 27 percent of people chose to stay neutral.

5.6.5 User Satisfaction: Overall, I am satisfied with how easy it is to use this app

This question was asked to find out whether the participants found the ease of use of the Learn Python app to be satisfactory.

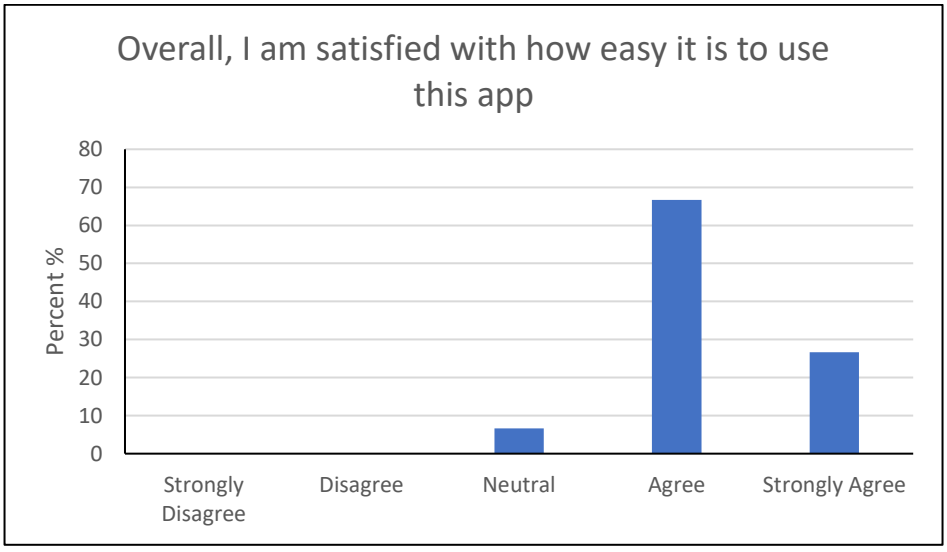

Figure 39: Overall, I am satisfied with how easy it is to use this app

As is clearly visible from the graph provided most of the participants (93 percent) agreed with the assertion provided. Out of which 27 percent strongly agreed. Whereas 7 percent of people chose to stay neutral.

5.7 User Acceptance

This question was asked to the participants in order to understand if they felt, after using the Learn Python app, that it was an acceptable mobile learning application. The question was closed-ended and intended to ask about topics such as:

- If they were satisfied with the ease of completing the tasks in each scenario
- If they were satisfied with satisfied with how the app saved session after an idle moment
- If they were satisfied with the support information when completing the tasks

- If they were satisfied with the design and interface of the app
- If they found the app as a complete learning tool

The bar chart for the answers provided by the participants is given below:

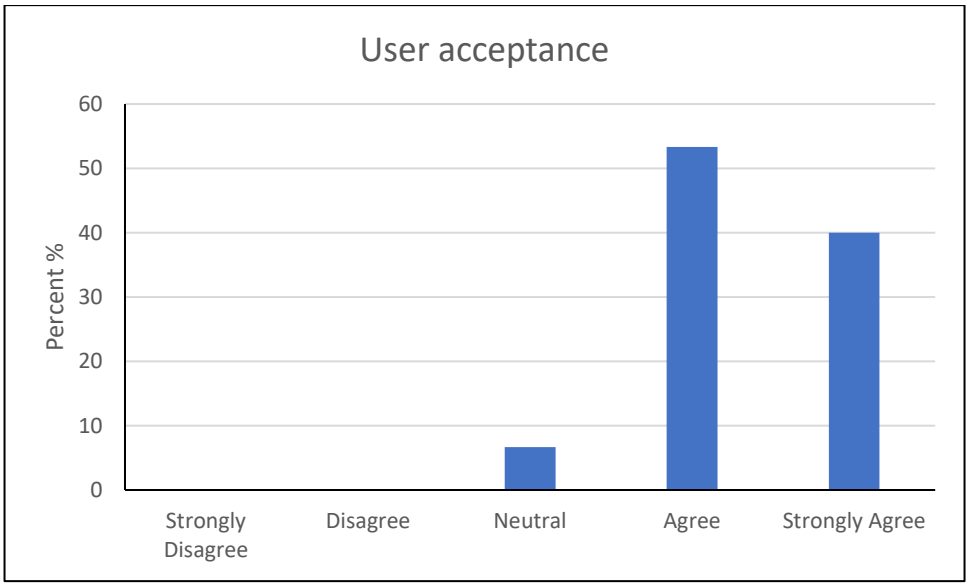

Figure 40: User Acceptance

As is clearly visible from the results most of the participants(53 percent) chose to agree on the topic of the Learn Python app being an acceptable mobile learning solution. Whereas 40 percent of the participants strongly agreed with the notion. Only 6 percent of the participants chose to stay neutral on the topic.

5.7.1 User Acceptance: Overall, I am satisfied with the ease of completing the tasks in each scenario

This question was asked to find out whether the participants found the ease of completing tasks in the Learn Python app to be satisfactory.

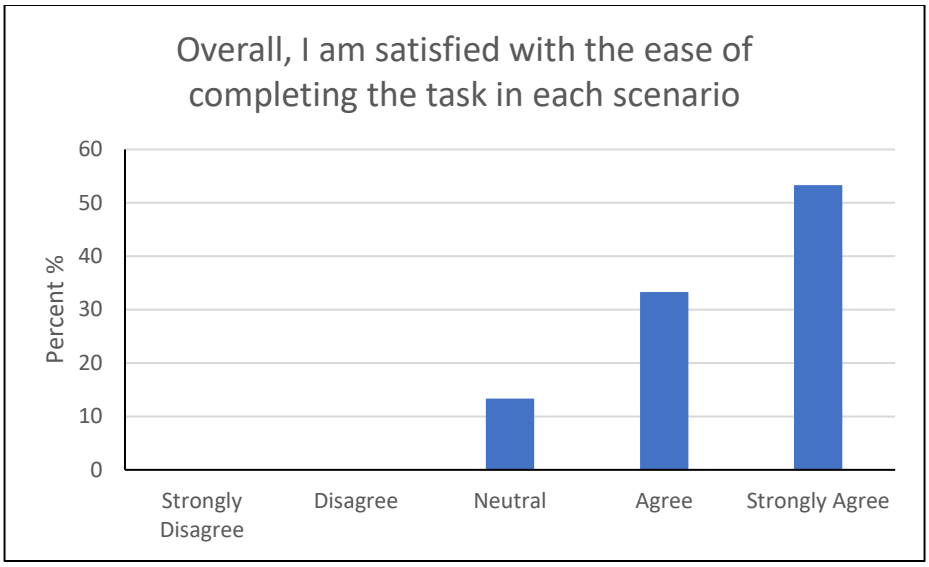

Figure 41: Overall, I am satisfied with the ease of completing the tasks in each scenario

As shown in the graph above, most of the participants (86 percent) agreed with the assertion provided. Out of which 53 percent strongly agreed. Whereas 14 percent of people chose to stay neutral.

5.7.2 User Acceptance: Overall, I am satisfied with how the app saves session after an idle moment

This question was asked to find out whether the participants found the app's auto-save feature to be satisfactory or not.

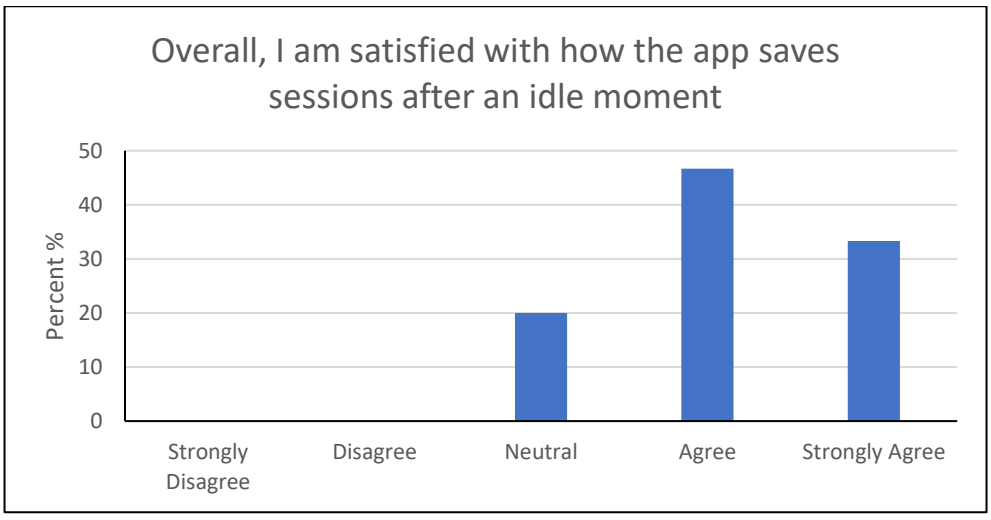

Figure 42: Overall, I am satisfied with how the app saves session after an idle moment

As is clearly visible from the graph provided most of the participants (80 percent) agreed with the assertion provided. Out of which 33 percent strongly agreed. Whereas 20 percent of people chose to stay neutral.

5.7.3 User Acceptance: Overall, I am satisfied with the support information when completing the tasks

This question was asked to find out whether the participants found the support information provided with the tasks to be satifactory or not.

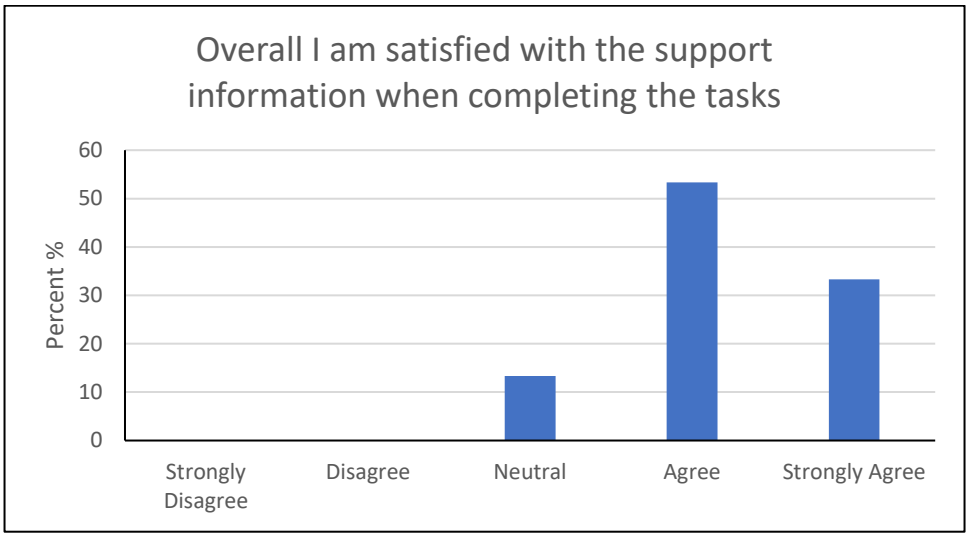

Figure 43: Overall, I am satisfied with the support information when completing the tasks

As is clearly visible from the graph provided most of the participants (86 percent) agreed with the assertion provided. Out of which 33 percent strongly agreed. Whereas 14 percent of people chose to stay neutral.

5.7.4 User Acceptance: Overall, I am satisfied with the design and interface of the app

This question was asked to find out whether the participants found the design and interface of the Learn Python app to be satifactory or not.

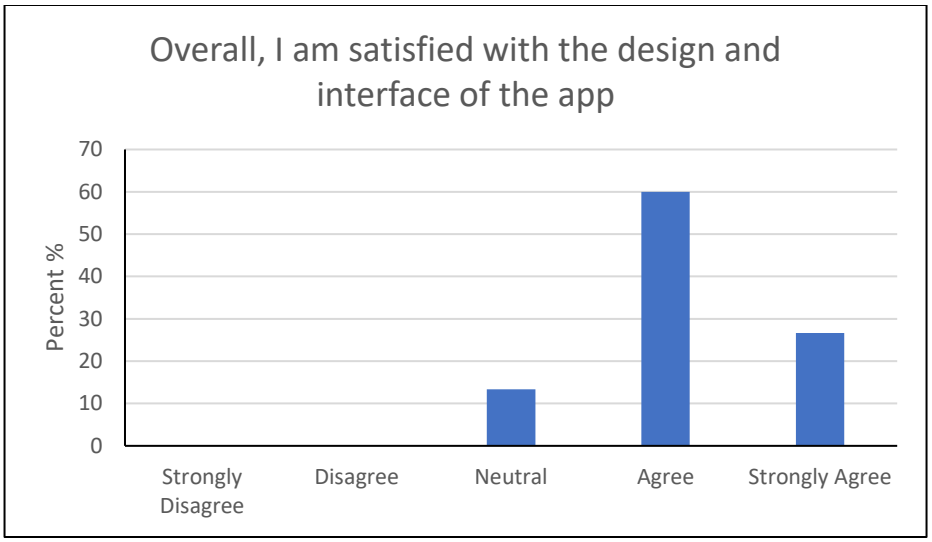

Figure 44: Overall, I am satisfied with the design and interface of the app

As is clearly visible from the graph provided most of the participants (86 percent) agreed with the assertion provided. Out of which 26 percent strongly agreed. Whereas 14 percent of people chose to stay neutral.

5.7.5 User Acceptance: Overall, I find the app as a complete learning tool

This question was asked to find out whether the participants found the Learn Python app to be a complete learning tool or not.

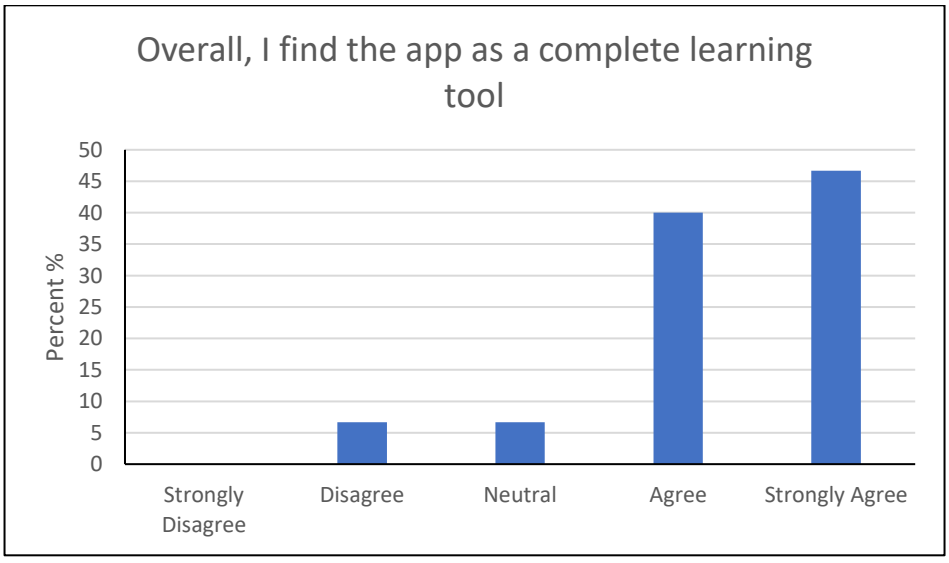

Figure 45: Overall, I find the app as a complete learning tool

As is clearly visible from the graph provided most of the participants (86 percent) agreed with the assertion provided. Out of which 46 percent strongly agreed. Whereas 7 percent of people chose to stay neutral. And 7 percent chose to disagree.

5.8 Interview Questions

These questions were asked to a group of 7 people after they were introduced to the Learn Python application. The group of people were chosen at random with varying level of skills in programming (ranging from no previous knowledge of programming to intermediate level of programming knowledge). All the questions asked in the questionnaire were open ended and the users were allowed to freely answer the questions in as many words as they wanted.

5.8.1 Have you ever used a mobile learning app before?

This question was asked to measure the experience of the participants in the field of mobile learning. Mobile learning being a new environment for learning attracts lesser people than other conventional mediums of learning. This inquiry is proposed to measure the experience of the client base in mobile learning. The answers provided were vastly different from one another as there were users who have used multiple mobile learning applications before as well as others who hadn't heard of mobile learning ever before. So out of the total number of respondents, 71.4% have used or familiar with mobile learning apps while the remaining 28.5% have never used or not interested in mobile learning apps.

5.8.2 What type of mobile learning app have you used if possible give names of the apps

This question was mostly intended at participants who had previous experience in mobile learning. This question was asked to get to know the types of applications that the users have used in the past for mobile learning to better assess the features that people like to have in their mobile learning applications. Majority of the respondents who are familiar or have used mobile learning apps are said to have used various mobile learning apps. Amongst those apps mentioned by the 57% of the respondent, moodle mobile, CodeHub and Programming Hub were the most common ones.

5.8.3 What are the features you like in Learn Python mobile app?

This question was asked in order to better understand what the participants liked the most about the application. Features such as user management and randomized questions were appreciated by the users as well as the selection of topics and overall learning curve of the complete tutorial section of the application. Of all the varying features of Learn Python app, 85.7% of those who participated in the survey were pleased with the overall features such as randomization of the exercises after each session, the screen sequence and user management interface while 14.2% remained neutal about the features.

5.8.4 What is your observation about the compiler in the app?

This question was asked in order to understand the opinion of people in regards to the compiler included in the application. The compiler is the part of the application which allows the users to run their own Python code in the mobile application so that they have practical knowledge of how the Python code works. The overall reception of the compiler was good and the participants mostly enjoyed working on the in-app compiler. Out of all the participants, 85.7% were pleased and satisfied with how the in-built compilier works on the app while 14.2% were indifferent about the compilier.

5.8.5 How would you describe the general look of the app?

This question was asked to ascertain if the overall look and feel of the application was appealing to the participants or not. The UI (User Interface) of an application needs to be attractive and easy to understand for the users to get the most out of the application and to attract the users to come back another time. A bad UI can repel users away even if the content of the application is perfectly all right. The general reception of the interface was good and people were easily able to navigate through the application without facing any major problems. In this aspect of the interview, there was a unanimous agreement amongst the participants, in which they all approve of the general look of the app, noting that it was easy to use with the simple layout interface of the app.

5.8.6 Could you tell if you notice some inconsistence while using the app?

This question was asked from the participants to find out any inconsistencies in the learning experience when they were using the Learn Python application. This could be anything from application crashes to inaccessible menus and settings or something to do with the course material selected for the application. The response was mostly positive and most of the participants found the user experience to be consistent all throughout the tutorial provided in the Learn Python application. A very high percentage of the participants admitted that there were no inconsistences while using the app. Most of this participants making up 71.4% of them found the app error free and did not experience any for of displeasure while usisng it. 28.5% complained about the app crashing on their phones but this was largely due to their old fashioned phones. So, overall, the app is free of any inconsistences.

5.8.7 Name something you would like to see in the app

This question was asked to find out if the participants had any suggestions in order to make the application suit their learning need better. User suggestions are important to take into consideration in the construction of a software so that the software could be made to best suit the needs of its users. If the software is built with user suggestions taken into consideration it is more likely to meet the needs of its target audience. With varying opinions from respondents ranging from their personal experience from other apps to their own ideas, most of the suggest they would like to have

more exercises in the app while some mentioned they would like to the app to be social media friendly where knowledge could be shared with other users and comments field created.

5.8.8 How would you rate Learn Python app on the scale of 1-5 and give a reason for the rating?

This question was asked in order to get opinions of the participants on the overall user experience of the Learn Python application. The second part of the question was to gather information about what the participants found to be the greatest feature or the biggest problem of the Learn Python application. The answers provided by the participants provided deep insights into the measures to be considered to make the application more accessible to the users. 57.1% of the respondent rated the app 4, 28.5% rated it 3 and 14.2% of the participants chose not rate the app.

5.8.9 In general, what is your comment about Learn Python app?

This question was asked to get the overall view of the Learn Python application from the participants. This was more of a general question and did not concern any technical aspects of the application. The answers provide were mostly positive and the participants found the Learn Python application to be a useful tool for learning Python language on the go. Out of all the participants, 85.7%, making vast majority of the respondent agreed the app was a useful learning tool.

5.8.10 Overall, how satisfied are you with the app?

This question was asked of the participants to find out if they were satisfied after using the application. The overall response of the participants was generally positive and they were generally satisfied with the features provided in the application. A good percentage of the participants are also satisfied with the overall usage and features of the app. 71.4% of them are completely satisfied with the user experience and the way the app works.

6. CONCLUSION

In this thesis, a new mobile learning application for Python programming called the Learn Python app was introduced. The Learn Python app is an Android-based app where a user can study Python and get the basic knowledge about the language. This app illustrates python language and it is meant to be used for learning purposes.

This write-up has glossed over the concept of Mobile learning in general. The importance and relevance of mobile learning is increasing every day. And it is important for developers to understand that mobile can be a medium for learning too. This study also reveals the predisposition of people towards mobile learning and how it is changing with time. People are accepting the fact that mobile devices can be used for learning purposes and adapting to it.

The application is right now under testing and assessment. And so far, the response of people has been mostly positive towards the Learn Python application. Most of the participants found the application to be easy to use and an effective medium to learn from. A few issues that should be settled as recognized in early testing stages incorporate; more articulated guidelines for the first use, ease of use of the code editor needs change and it ought to be conceivable to save a program with a specific end goal to use it again. The hints, prompts and selection of options to use in program have been absolutely accepted by the users of the application.

Future work will be to implement feedback from users into the first model and repeatedly test it with those with programming skills. Also efforts will be put into making the application more user friendly and engaging.

6.1 Guidelines for developers of mobile learning applications

Here are some suggestions for the developers who want to develop mobile learning applications in the future based on the studies conducted.

- **Segmentation of Content:-** Dividing content into smaller segments not only makes keeping milestones and track of progress easier, it also helps in the successful relay of knowledge to the user as the attention span of the user is usually lesser on the mobile devices.
- **User Interface:-** A good user interface will keep the user returning back for more whereas a bad user interface will push the user away even if the content is of the top quality. User Interface is the first thing the user interacts with in an application.
- **User Experience:-** Similar to the user interface a good user experience will help the application retain the users for a longer period of time. The more time the users spend on the application the more information can be endowed upon them.
- **User Suggestions:-** User feedback is one of the most important pillars in the development of any successful application. It is the best source for criticism of bad aspects of programming and user experience, which can be used to further build upon the already existing platform.

- **Balance Between Challenging and Easy to Understand:** The application needs to be easy to understand so that even the beginners can keep up but it also needs to be challenging so that all the newly developed skills can properly be tested. A perfect balance needs to exist between the two to create a better learning experience.
- **Make the Experience Unique:** The application needs to follow all the existing standards of the industry but also needs to add its own flair in order to stand apart from the millions of other apps flooding the application market.

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APPENDIX 1

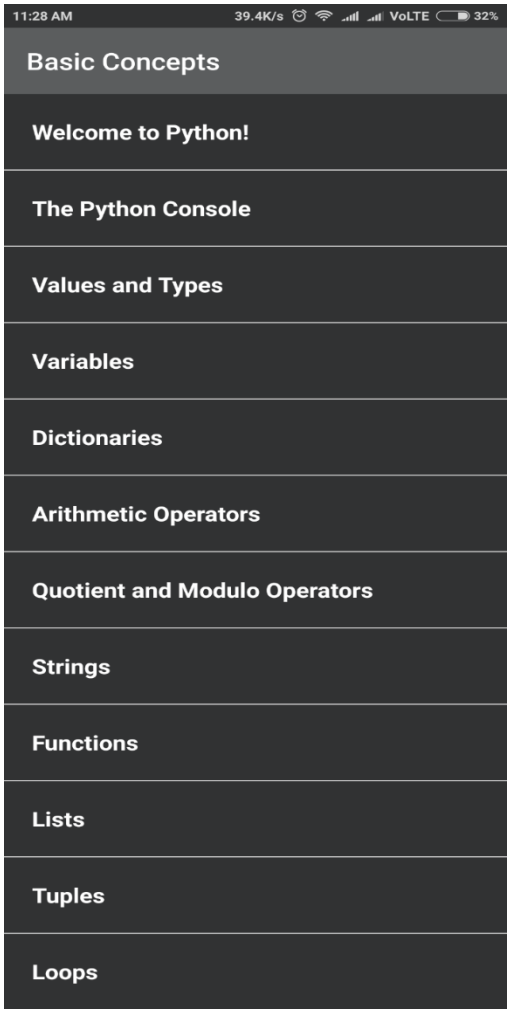

Figure 46: Topic Listing Page

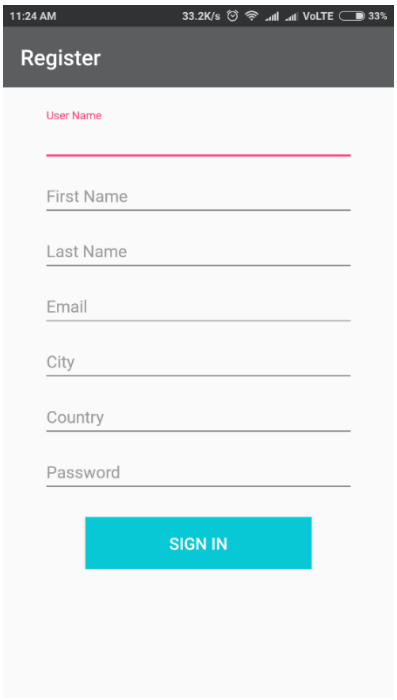

Figure 47: Create Account and Registration Page

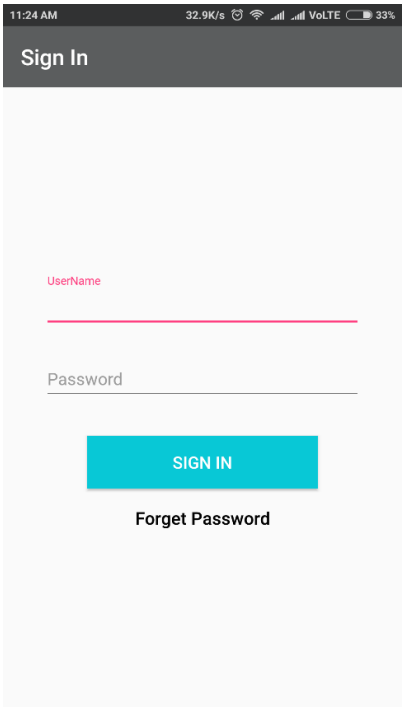

Figure 48: Login Page

Appendix 1(2)

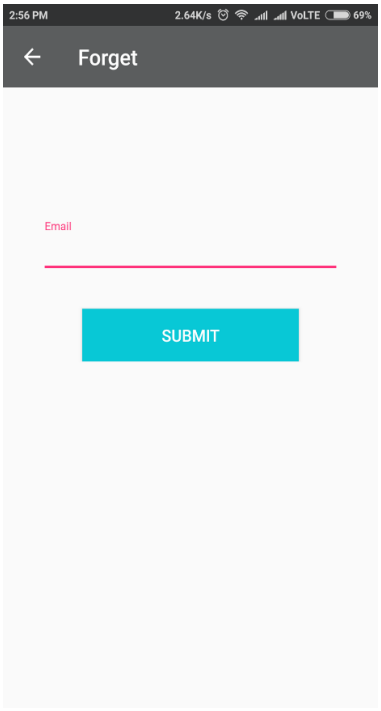

Figure 49: Forgot Password Page

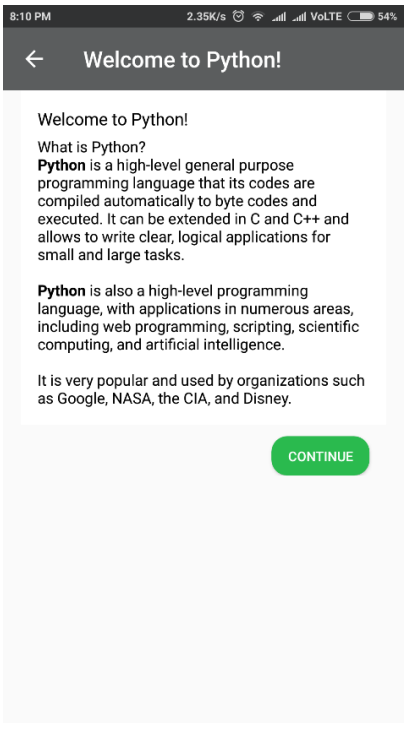

Figure 50: Introduction Page

Appendix 1(3)

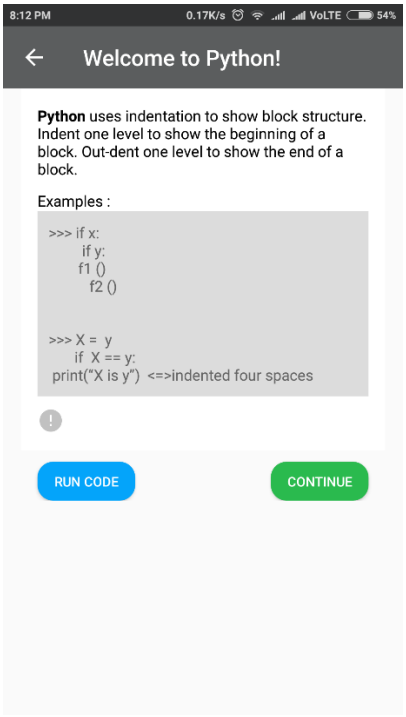

Figure 51: Code Sample Page

Figure 52: Compiler Page

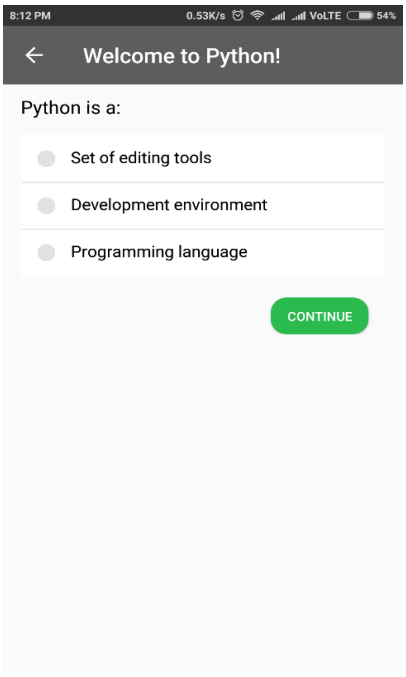

Figure 53: Multiple Choice Type Question Page

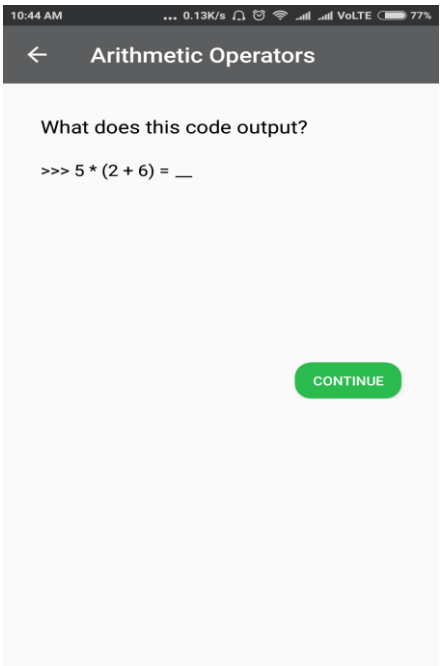

Figure 54: Fill in the Blank Type Question Page

APPENDIX 2

2.1 Interview Questions

Faculty of Science and Forestry
School of Computing
University of Eastern Finland

Questionnaire form
Interview

1. Have you ever used a mobile learning apps before?
   _____
   _____
   _____
   _____

2. What type of mobile learning app have you used if possible give names of the apps
   _____
   _____
   _____
   _____

3. What are the features you like in Learn Python mobile app?
   _____
   _____
   _____
   _____

4. What is your observation about the compiler in the app?
   _____
   _____
   _____
   _____

5. How would you describe the general look of the app?
   _____
   _____
   _____
   _____

6. Could you tell if you notice some inconsistence while using the app?
   _____
   _____
   _____
   _____

7. Name something you would like to see in the app

_____
_____
_____
_____

8. How would you rate Learn Python app on the scale of 1-5 and give reason for the rating?

_____
_____
_____
_____

9. In general, what is your comment about Learn Python app?

_____
_____
_____
_____

10. Overall, how satisfied are you with the app?

_____
_____
_____
_____

2.3 Questionnaire Template

UNIVERSITY OF EASTERN FINLAND

Faculty of Science and Forestry
School of Computing
University of Eastern Finland

Questionnaire form

Dear Participant,
My name is Olumuyiwa, Ayodeji Olufemi, I am master's student at IMPIT under the supervision of Dr. Jarkko Suhonen and Dr. Solomon Oyelere. My MSc thesis topic is Implementation of Android-Based Mobile Learning Application for Python Programming. As part of my master's thesis research, I am currently running a research study on Evaluation of Android Mobile App (Learn Python) to determine the usability and the user experience of the app as a learning tool. The case study is Learn Python mobile app developed for learning python programming language and for this reason I would appreciate your participation in this survey. Moreover, the results of the research may be published, but the data collected via the questionnaire will be anonymously analyzed and your identity will not be revealed. At any time during the study, you have the right to withdraw your consent to participate in this study. If you have any questions concerning the research study, you can reach me via my e-mail at ayodejol@uef.fi or if you prefer, you may also contact Dr. Jarkko Suhonen in person.

Thank you in advance.
Sincerely,
Olumuyiwa, Ayodeji Olufemi

I have read the information given above. I hereby consent to participate in the study: Yes ☐ No ☐

PART A: DEMOGRAPHIC DATA
Please tick (✓) in appropriate box

Main study subject: _____

Please rate your agreement with each of the following statements below according to the scale:
5-Strongly Agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly Disagree

PART B: Research Questions

		5	4	3	2	1
1	**Perceived Ease of Use**					
	The app is easy to use					
	It is user friendly					
	It requires the fewest steps possible to accomplish what I want to do with it					
	I don't notice any inconsistencies as I use it					
	Both occasional and regular users would like it					

2	**Learnability**					
	The app provides the required function keys for coding					
	Explanations and examples in the app makes learning easier					
	This app has all the functions and capabilities I expect it to have					
	The app helped me better understand the basics of python programming					
	The topics and exercises contained in the app are suitable for learners					
	The compiler in the app is suitable for python programming language					
	Each topic covered in the app makes python learning understandable					
3	**General View**					
	M-learning apps motivates learning					
	I am easily distracted learning on mobile					
	Mobile learning apps can motivate learning					
	Mobile learning should be encouraged					
	I cannot be motivated to learn programming on mobile					
	I feel comfortable learning anywhere on mobile					
4	**User Interface**					
	The welcome page of the app meets my expectation					
	Characters in the app are legible					
	The menus and icons respond swiftly to touch					
	The sign in and register screens meets the basic standard					
	The settings screen works correctly as expected					
	Organization of information is consistent					
	Sequence of screens are well prepared					
5	**User Satisfaction**					
	I am satisfied with how the next task unlocks after completing each exercise					
	I am satisfied with the input interface of the app					
	The 'Hint' button helps to remember vital information about each topic					
	I feel comfortable running codes on the compiler					
	Overall, I am satisfied with how easy it is to use this app					
	I would recommend it to a friend					
6	**User Acceptance**					
	Overall, I am satisfied with the ease of completing the tasks in each scenario					
	Overall, I am satisfied with how the app saves session after an idle moment					
	Overall, I am satisfied with the support information when completing the tasks					
	Overall, I am satisfied with the design and interface of the app					
	Overall, I find the app as a complete learning tool					

PART C: Open Questions

1. How do you perceive the use of Learn python programming app?

2. Is Learn Python app suitable for learning python programming?

3. How do you think mobile learning apps motivate learning?

4. What is your view about the user interface of the app?

5. How satisfied are you with the app?

6. In general, does Learn Python app meet your expectations?

7. Could you tell how long you have been programming?

8. Do you have other comments or suggestions to help improve the app?