**GHANA INSTITUTE OF MANAGEMENT AND PUBLIC ADMINISTRATION (GIMPA)**



**SCHOOL OF TECHNOLOGY**

**HOME TEACHING MADE EASY**

**(A DIGITAL PLATFORM FOR FINDING PRIVATE TUTORS)**

**By**

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**APRIL 2019**

**HOME TEACHING MADE EASY**

**(A DIGITAL PLATFORM FOR FINDING PRIVATE TUTORS)**

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**By**

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**DECLARATION**

I declare that except for the references to other people’s work, which have been duly acknowledged, the work presented here was carried by us, undergraduate student at the Ghana Institute of Management and Public Administration reading Information Communication Technology, under the supervision of Mr. Nana Kwame Amagyei.

I declare that this work has never been submitted partially or wholly to any institution for award of a certificate.

………………………………………. ………………………………..

Blessing Obeng Date

(Student)

………………………………………. ………………………………..

Mr. Nana Kwame Amagyei Date

(Supervisor)

# ABBREVIATIONS

**GRE** Graduate Record Examinations

**IGCSE** International General Certificate of Secondary Education

**TOFEL** Test of English as a Foreign Language

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# INTRODUCTION

## Research Background

Student tutoring was brought about by a British Army chaplain and later adopted by Joseph Lancaster who was to teach 350 children single-handedly (Potter, 1997). From then, tutoring has over the years become a parallel educational sector from mainstream education (Dang & Rogers, 2008) for students all around the world. Other researchers have come out with the point that the proliferation of tutoring has now become a worldwide phenomenon (Bray & Kwok, 2003; Dang & Rogers, 2008; LeTendre & Baker, 2005) Whiles some countries have a more formal approach to tutoring of students, others are more informal and mostly based on the discretion of parent.

Tutoring can be seen as supplemented assistance given to students by academic development practitioners or other learning facilitators, to aid the students gain proficiency in academic skills. Tutoring also provides some learning support in specific learning areas and assessment tasks (Luescher, Schreiber, & Moja, 2017). In a minimalistic sense, Gordon (2002) simply defined tutoring as the individualized educational assistance for both children and adults.

As of now, there is a growing demand for out-of-school learning products and services including educational websites and private tutoring (Scanlon & Buckingham, 2004). Tutoring sessions are available to give after-school teaching services in academic subjects to students in hope of improving academic performance (Huang, 2013).

In current times, most families are unable to provide their wards with the much needed “extra help” to meet the requirements of advancing in the educational system (Ventura & Jang, 2010). Tutoring is also a way out for busy-scheduled parents in order to keep their children occupied. As pointed out by Scanlon and Buckingham (2004), for parents dealing with pressured lives in conjunction with the premium place on quality time with their wards, they in turn use money as a form of solution.

The concept of private home tutoring was to provide supplementary classes for extra subjects but has now spun to include basic subjects like English and mathematics (Scanlon & Buckingham, 2004).. Private home tutoring was formerly available for the older wards who were preparing for exams. These times are now changing as private home tutoring is now being made available for younger-aged wards (Scanlon & Buckingham, 2004). This is because most parents are of the belief that investing in educational goods and services gives an educational advantage to their wards which they feel inadequate to provide (Scanlon & Buckingham, 2004).

There are many upsides to tutoring for both teachers and students. Teachers are able handle the each lesson session with more ease (Potter, 1997). The teacher can also observe the student in order to make a more detailed evaluation of the student’s strengths and weaknesses in varying areas. From the student’s perspective value the one-on-one interact

## Research Problem

Parents are facing increasing pressure to invest into their ward’s education by providing resources at home (Scanlon & Buckingham, 2004). Though parents have embraced the idea of private tutoring for their wards, a platform for finding a qualified and experienced tutor is virtually non-existent in Ghana. Parents are mostly limited to choosing tutors from the school of their wards, or ones recommended by their friends. This causes parents to choose tutors not based on the competence and experience but rather on the fact that they are the only option available. This can cause a student to end up with bad tutor.

Next is the unique abilities and learning rhythm of each student. Though the traditional classroom method gives students the basic understanding of a subject, it does not fully address the individual needs of each student. One such need is the learning speed. Some students may find the classroom teaching a little fast-paced, leaving them confused after a class and unable to catch-up with subsequent topics. This will definitely have a negative impact on the student’s general academic performance.

Also with the importance of cost, finding tutors that can fit with the budget of a household is not always the case here in Ghana. Low income earning parents are faced with demands on their children by their mainstream teachers (Bray M. , 2013). Parents are therefore forced to make the hard decision of the household making a sacrifice which can release some funding for the student to continue their lessons with the private tutor. This is because the parents are aware that should their wards drop from private tutoring, they will fail to secure the curricular knowledge (Bray M. , 2013).

In discussing cost, one cannot leave out the quality of service. Parents end up paying for a tutoring service that are not up to standard. Some tutors are more concerned with a student passing an exam than imparting any knowledge. This creates some limitation for students, as they are robbed of the basic understanding needed to solve a problem, no matter how it was twisted.

Lastly is the competence and experience of tutors. There is an endless case of tutors teaching courses which they are not well versed in. One reason for this is tutors wanting to help students in spite of their lacking knowledge in the subject area. Another reasons is parents pleading with a tutor to take up an additional subject just because the teacher might be good with other subjects.

## Research Methods

Using a mixture of past literature and informal interviews with some parents and wards, this research will take the quantitative research approach to aid in coming up with a suitable solution for addressing the research problem.

## Research Purpose

The goal of this research is to come up with a suitable artefact that provides parents with the needed platform and information for choosing a home tutor for their wards as well as keeping track of the learning progress of their wards. The platform will include a portfolio of each tutor, lesson transcripts for wards, tutoring schedules and upload support.

## Research Objectives

To suggest, design, develop and implement Home Teaching Made Easy which is a digital platform for finding tutors in various subject areas. The system is to provide relevant information about tutors and their area of expertise to help a parent make an informed decision when settling on a tutor.

## Research Significance

Undertaking this research will help in discovering challenges being faced by parents when finding tutors for their wards. It also highlights the benefit of coming out with a one-stop credible platform convenient for parents who do not have to waste time looking for tutors for their wards. Tutors also get to have equal advantage of being chosen by parents based on their qualification and ratings and not based on whose ward they may have tutored. From their cellphones, parents will get the chance to be actively involved in the education of their ward(s) by tracking their learning progress no matter where they find themselves.

Each student is unique in their own way. Finding a qualified tutor who is able exercise patience in understanding a student, so as to tailor each lesson uniquely to improve the student’s academic strength areas and build up on the weaknesses goes a long. This can help the student settle better in class, boost their confidence and increase their class participation.

## Research Outline

The ensuing chapters covering this research work are organized as follows:

* **Chapter Two: Literature Review: -** dives into past literature about tutoring in general, the ways in which tutoring happens and the impact of technology on tutoring in both past and present times.
* **Chapter Three: Methodology: -** looks into the chosen architecture for the new system and the development method used in building the system, as well as the various tools used for development Justification for these choices will also be included in this chapter.
* **Chapter Four: System Analysis and Design: -** gives an in-depth look into the proposed system with the aid off diagrams. A few of the diagrams are: Use Case, Activity and Sequence. Requirements and stakeholders of the proposed system are also captured in this chapter.
* **Chapter Five: Conclusion: -** this chapter concludes the research work. It covers the limitations of the system and also challenges faced during system testing. Future works are also noted in this chapter.

# LITERATURE REVIEW

## Introduction

Globalization has become a major influence in the way the world conducts business. Same as businesses, the educational sector with all its varying forms and dimensions, has not escaped the impact of globalization (Ventura & Jang, 2010). Also, the revolution in communication— in the form of the Internet—, has brought about the death of distance (Cairncross, 2001) in our everyday interaction. As such with globalization as an impacting entity and the internet as its driving force, the education sector had now been monumentally revamped to include privatization and franchising (Ventura & Jang, 2010). Kumon is one such organization that has franchised private tutoring outlets in South Korea, United States of America (U.S.A), Taiwan, Japan, Australia and Brazil (Russell, 1996). In relation to privatization, qualified teachers are now able to offer their tutoring service to those in need at a fee. The private tutor industry as described by Dang and Rogers (2008), has come a long way and is now the third great sector of education. Through globalization and privatization, the learning environment has been redefined (Bray M. , 2013). As such education can now be offered from, and delivered to any part of the world.

With the access to mass education, there is the increasing need to have a form of support system—in the form or private tutors—to aid students with their studies in some form (Owen, 2002). Private tutors form a support system which provides an anchor on which the educational system rests (Wheeler & Birtle, 1993). This support system should be able meet the three necessities of **knowing** the student, **tracking** a student’s progress in relation to studies, and **supporting** the student (Owen, 2002).

People still view private tutoring as a lesson around a table between a tutor and one or more students (Ventura & Jang, 2010). This is currently not the case, as private tutoring has evolved to be so much more, by taking advantage of technological advancement to spread its reach and render better services. Online tutoring and off-line tutoring are the main divisions of private tutoring (Ventura & Jang, 2010). Off-line tutoring encompasses the traditional technique of tutoring in-person in a school or a one-on-one session (Ventura & Jang, 2010) at a chosen location. Online tutoring takes care of all web-based tutoring session through internet, intranet or extranet (Ventura & Jang, 2010). Online tutoring is seen as a subset of e-Learning (Sho, 2004),—describes how electronic technology can be used to promote effective learning. Online tutoring also offers the added feature of downloading previous lesson sessions (Ventura & Jang, 2010). With this feature, students can go over a lessons as a way to revise.

## Review of Past Research and Systems

### Private Tutoring through the Internet: Globalization and Offshoring (Ventura & Jang, 2010)

The search for supplementary support for education and technological advancements has brought about a new paradigm—tutoring via the internet. Formerly, tutoring involved a tutor with one or more students seated around a table; but tutoring has evolved to be so much more. Killing the distance (Cairncross, 2001) through globalization, in conjunction with growing technologies, online tutoring offers a student with diverse products from around the world. With online tutoring, all types of education can now be provided across borders (Bray M. T., 2009) using the internet.

The growing support for online tutoring has one of its arguments founded on the communication focus given to the student. The focus on the students paves a way for the formation of a tutor-student bond which helps the tutor in knowing the student better. In knowing the student, a tutor can take some measures and tailor each lesson session to address the needs of the student. Some of the measures taken can be to focus more on improving the weaknesses possessed by the student or peaking the interest of the student in a subject they dislike. These actions by the tutor fulfils the three necessities of the support system. In contrast to traditional teaching, private tutoring helps each student to form a commitment towards learning, which will in turn be evident through an improvement in their general academic work. Online tutoring gives students signed on to the service equal access to tutors. Students can make an informed choice based on a tutor’s experience and competence, service price, language proficiency and curriculum content, and reviews which are all listed in the tutor’s profile.

Despite the online tutoring trend that is fast catching on, tutoring that uses the traditional of in-person approach is still in very high demand.

### Wyzant (Wyzant; Sidehusl, 2019; Wyzant Inc., 2019)

Wyzant is an in-home tutoring and marketing service platform that connects students with tutors in a wide range of subjects from the elementary level all the way to university and beyond. A student in this case refers to any person who needs assistance with a subjects. As such, a student can even be a working individual. Tutors are allowed to set their preferred pay rate, but are restricted to an amount between $30 and $60 per hour. The tutors are however expected to pay a commission fee of 25% on their total earnings each month. To ensure payment agreements are met, students do not pay the tutors directly, but instead, go through a central payment system where total calculations and deductions are made.

In using Wyzant, students are first required to enter the subject they require help with. A search to filter all tutors who teach the subject entered by the student is then made. After the initial filtration of tutors based on subject, a series of questions is then posed to the student to ensure the suggested tutor best fits the need of the student. The questions asked of the student are:

1. Why the subject in question is being learnt?
   * work
   * school
     + which grade?
       - adult
       - college
       - high school
       - middle school
       - elementary
   * other reasons
2. When does the student need help?
   * today
   * within a few days
   * within two weeks
   * sometime this month
3. When is the student available for lessons?
   * Sunday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Monday [morning
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Tuesday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Wednesday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Thursday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Friday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Saturday
     + morning (before noon)
     + afternoon (12-5pm)
     + evening (after 5)
   * Anytime - I’m flexible
4. Where will the student want to have the lesson?
   * Online
   * At home
   * At a public place
   * Let the tutor decide

After results are presented based on answers given, the student can further filter the tutors based on gender, hourly rate, and tutor’s age. After deciding on an instructor, the student can then communicate with the tutor via instant message—a functionality integrated into the system. The student then books a favorable time based on the tutor’s availability. Payments from student to tutors are made securely through the Wyzant system after a lesson takes place.

Some of the features included in Wyzant that makes it one of the best includes:

* easy booking—as students can view a tutor’s schedule before booking;
* finding an ideal tutor—as tutors are presented to students based on their specified filters.
* tracking progress—student sees all lesson summaries in one place.
* giving feedback—student can add a review to their tutor’s profile
* online tutoring—this another tutoring option, aside the in-person tutoring.

### Home Tutors Ghana. (Home Tutors Gh)

Is a professional home tutoring service in Accra, Ghana that has been offering in-person tutoring for well over eight (8) years. The Home Tutors Gh. service has over 500 professional tutors that specialize in various subject area pertaining to the local and international curricula. The Home Tutoring Gh. service is suited for students either in primary, Junior high or Senior high. Students pursuing Adult Education are also not left out of the customer base. Tutors are also available to assist students preparing for entrance exams (A.I.S., C.I.S., T.I.S. and S.O.S.) as well standardized exams like SAT, TOFEL and GRE. To ensure smooth service delivery and customer satisfactions, there are supervisors who perform regular follow-up visits to the homes of all who are signed unto the service. Home Tutor Gh. offers each customer access to their question bank. The questions in the question bank are organized into topics that are further categorized under the various examinations.

To monitor students’ progress, evaluate their academic performance and actively communicate with parents, Home Tutor Gh has a customized software system that incorporates the aforementioned functionalities by keeping monthly records of students’ results.

Requesting for a tutor is a simple process as one is required to provide their name, contact information (preferably phone number), their location, their ward’s academic level and the subject for which they are requesting help with. Within twenty-four (24) hours of processing the request, an academic coordinator gets in touch with the parent for further clarification if need be or with finalized details.

### StudyLoft (Bray M. , 2013; Ventura & Jang, 2010; Conroy, 2005)

A private tutor that caters for a student’s immediate needs is a service students will be willing to pay for; this birthed the app StudyLoft. The underlining focus of StudyLoft was to offer the service of private tutoring in subjects like Accounting, Biology, Chemistry, Economics, Mathematics, and Physics at a very low cost using the internet as a medium of delivery. One area in which StudyLoft exceled was to offer students assistance with their homework. Peak hours for StudyLoft was between 08:00 hours and 16:00 hours. During peak hours, StudyLoft was mostly heavily staffed, resulting in cheaper service rates.

### My Home Teacher (Akakpo, 2018)

My Home Teacher provides parents the opportunity to give their wards who need tutoring a one-on-one tutoring experience. Tutoring sessions are handled by competent professionals with sessions being held right in the comfort the home of the student. The originators of the “My Home Teacher” service believed that the student’s home creates a cordial learning environment in order for the student to relax and be able to put out all the questions they couldn’t put out whiles in the mainstream classroom at school.

## Implication of Research

Online tutoring platforms, in different combinations, offer services that include but not limited to private tutoring (both online and off-line), homework help, examination preparation and assistance with written papers. These are unique services that can be considered for in-person tutoring services as well.

Having an online presence can be seen to offer an added advantage to the tutoring service being rendered. Aside from reaching a wider student base, the students will be able to reach the service any time within their day. Another advantage is the parents being able to keep track of their ward’s progress often with convenience without waiting to see a tutor. Also students can view their progress report as well to serve as a motivation.

An online resource platform made up of a question bank, practical session, e-books and downloadable tutoring sessions can be a valuable addition to any tutoring platform. With the e-book and downloaded tutoring sessions, students will not always have to depend on their tutors, but can take the initiative to study. With the question bank, students get to have a feel of how standard exams are set and what is required of them when answering certain questions; this makes them better prepared by reducing the “unknown” feeling exam give. The e=books can also be useful when parents cannot afford the extra of purchasing a book.

## Chapter Summary

From the literature review it can be seen that though some websites exist that try to connect students with tutors, the data gathered by the websites are not comprehensive to make a detailed analysis. As a result, further contact is done between the organization offering the service and the parents via phone before a tutor is matched to the student. This process is a quite cumbersome and can be scaled down if the required information can be included in the basic query given. Also, just as Wyzant is a convenient mobile app serving the citizens of the United States of America (U.S.A), there is none such app that serves the citizens in Ghana. This has created the need for a system that can easily connect parents to the much needed qualified tutors for their wards.

# METHODOLOGY

## Introduction

Technology as defined by Ferré (1995), is the practical implementation of intellect or skill, making it a practical field. Rather than being solely conceptual, the implementation aspect of technology comprises the creation of artefacts.

Through technology using artefacts, the gaps found in the environment that sometimes create problems can be solved. The identified gaps must first be properly conceptualized—using among others, experience, observation and data—and represented (March & Smith, 1995). Next, various possible approach to arriving at a solution must be constructed and finally the problem’s optimum solution must be implemented and evaluated using proper criteria (March & Smith, 1995). This process, from conceptualization to evaluation, is handled through the research methodology.

In Information Technology (IT) the two most distinct and known research methodologies are the Natural Science and Design Science research methodologies (March & Smith, 1995). Natural Science research is a descriptive research methodology aimed at producing some form of knowledge by understanding the nature of area being studied (Hempel, 1966). Design science research on the other hand is a prescriptive research methodology aimed at using knowledge acquired to improve the performance or function of the area being studied (Simon, 1996). Building and evaluating are the two basic activities found in design science research (March & Smith, 1995). Where building is the fabrication of an artefact for a targeted purpose and evaluation is determining how well the fabricated artefact performs in an environment.

## Design Science Methodology

The design science research is the methodology chosen for this work. This is because of the build activity in the design science research. Also, as a requirement, an artefact is to be created as an end product of this research work, using the knowledge acquired from the research as a reference to come up with an optimum solution. In designing the artefact, the in-depth research helps so as to avoid repeating mistakes that occurred with past systems. The mistakes could include that of design, implementation, service type and target audience.

Using a combination of the design science methodology model by Gregor & Hevner (2013) and Peffers, et al., (2007), the research methodology is going to involve going through a five-step activity process. The five- step activities are:

* **Realizing a problem situation: -** at this stage, the various problems encountered whiles using an existing system for achieving a task is deduced. The existing system can refer to a manual method of achieving the task, or an implemented system that lacks the features or functionalities to address the identified problems.
* **Analyzing published literature for ideas: -** this activity dives into published articles or books that have touched on and or implemented a similar solution in their own way. Most often the challenges faced, the method of implementation and the future works in the literature works can better inform on what to avoid and what is worth implementing in the proposed solution.
* **Developing prototype pattern solutions: -** Features and functionalities that address the various issues identified in the first activity stage are together to complete the proposed solution. From the literature review, the various discoveries made can also be put together to come up with an optimum and unique solution from those that already exist.
* **Testing and revising prototypes solution patterns: -** the proposed solution is now texted extensively in the stage so as to bring to light the loopholes and flaws in the proposed solution.
* **Proof-of-concept demonstration of the proposed solution’s applicability: -** at this stage, the proposed solution is tested against the problems found in the first activity stage. This is to observe if there are features and functionalities that address each listed problem.
* **Summative evaluation: -** At this stage, the system is tested against the listed functional and non-functional requirements. This is to establish that all functional requirements are covered. Also, it is to assess if after each functionality test, the required results are being acquired.

### Realizing a Problem Situation

The situation was realized from personal experience, observation and informal interviews and discussions.

#### Personal Experience

Through personal experience whiles in search for a private tutor, it was realized that though there were a few sites online that offered the tutoring service, one did not have the chance to see the list of the tutors nor their profile. From the tutor service sites, a parent had to request for a tutor by inputting their name and phone number. Further communications were done through phone conversions.

#### Observation

With the tutor sites being unpopular, it was observed that most parents just go in for the class teachers of their wards or any other teacher from the school of their wards. This something brings about some form of favouritism in the classroom from the teacher towards the student(s) they tutor. At times, teachers give the student(s) they tutor a preview to a quiz or an exam to be taken, with the tutor preparing the student adequately. In light of this, the student tends to excel academically but unfortunately, this is not a true reflection of the student’s strength.

#### Informal interviews and Discussions

Through the informal interviews and discussions it was revealed that most parents in the same vicinity end up using the same tutor for their wards simply. This is for the lack of avenues for one to search for tutors. So, though the available tutor serving the vicinity might not be the best option out there, most parents just make do.

### Analyzing Published Literature for Ideas

From literature search, it can be deduced that once there were some websites that offered in-person tutoring services, then there is the demand for tutors in the country. As such, having a more comprehensive system where parents can have access to a limitless pool of tutors, search tutors based on a list of criteria, vet the tutors based on their tutoring strength and reviews and eventually connect the parents to tutors will better address demand.

In this era where mobile technology is more a necessity than a luxury, evidently seen through its pervasiveness (Srivastava, 2010), offering a solution via mobile application is a step in the right direction. Mobile technology offers its users a dual advantage of connectivity with convenience. The mobile platform also grants businesses the chance at reaching more consumers irrespective of their location this is in contrast to the brick-and-mortar businesses that are bound by location.

A feedback feature through the app for both parents and students can play a vital role (Hatziapostolou & Paraskakis, 2010; Hyland, 2000). The feedback feature can is a great way of keeping parents updated with information on their ward(s) tutoring journey. The information can consist of an evaluation of the ward’s achievements or a ward’s competence and understanding improvement (Hyland, 2000). Feedback targeted at the students can go a long way to motivate them and boost their confidence (Hyland, 2000). For feedback to make a significant impact, it needs to be constructive, peculiar to the recipient, well-timed, and in line with learning results and assessment criteria (Juwah, Macfarlane-Dick, Matthew, Nicol, Ross, & Smith, 2004; Race, 2001; Race, 2013).

### Developing Prototype Pattern Solutions

#### Architectural Design

This is where a system design that will meet the functional and non-functional requirements of the proposed system is chosen (Sommerville, 2015). The estimated number of users, the application complexity and required interface, and the overall transactional needs of the system are put into consideration before choosing an architectural design (Gallaugher & Rarnanathan, 1996).

The Two-Tier Client/Server model is the architecture chosen for the proposed solution. The client/server architecture is seen as involving two software entities: a client that always sends requests and a server that responds to the request made by the client (Kratky & Reichenberger, 2013; Gallaugher & Rarnanathan, 1996). Stemming from the exchange of data from both ends, there is the need of inter-process communication which the client/server architecture offers (Kratky & Reichenberger, 2013). The client, being a software entity can be located on any supported device (Gallaugher & Rarnanathan, 1996). The two-tier client-server model has the three components of an application—data, presentation and processing—being distributed among the client and server (Gallaugher & Rarnanathan, 1996). The client handles the presentation component and the server handles the storage and accessing of data. Both client and server split the processing component with the client taking a major chunk of the processing responsibility in terms of application logic (Gallaugher & Rarnanathan, 1996). The client/server architecture has one of its advantage being a reduction in application development time (Gallaugher & Rarnanathan, 1996). The distributed nature of the architecture where independent services are run on separate servers but come together as one application makes it easy to add or upgrade servers without affecting the system operation (Sommerville, 2015).

#### Development Platform

The proposed solution will primarily be available through a mobile application via the Android operating system (OS) with the supported OS version being Android 4.4 and above. Android is the OS of choice due to its market shares in Ghana as of January 2019. See ***Figure 1***. Therefore developing for the Android platform is to target a larger potential consumer base for the system. Android 4.4 (Kitkat) was chosen as the least supported version because, the percentage of users on Kitkat (4.4 = 6.63%) are more than the percentage combination of users on the lower versions (4.3 and below = 3.65%). See ***Figure 2***. The development platform is what informs the tools to be used in the

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| **Figure 1. Mobile OS Market Share in Ghana (January - March 2019)** |

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| **Figure 2. Android Versions Market Share in Ghana (January - March 2019)** |

development of the proposed solution. With the mobile platform choice, the tools to be used will be Android Studio Integrated Development Environment (IDE) and Firebase.

**Android Studio: -** this tool is for coding the presentation and processing components for the client. Android Studio incorporates Extensible Markup Language (XML) and Java in the IDE. Whiles the XML helps in coming out with interface layouts for the presentation component, Java helps in writing the business logic and some data manipulation flows for the processing component. It was chosen since it is the official IDE for the development of Android applications (Android Developers, 2019).

**Firebase: -** Firebase is a NoSQL realtime database hosted on the cloud, that flawlessly supports both mobile and web development (Firebase, 2019). It allows for data synchronization and storage in realtime making collaboration possible and allowing users the convenience of accessing their data from any device (Rajat, 2017). For firebase backed applications, users can continue performing their transactions even when offline (Firebase, 2019). This is as a result of data being saved locally to the client’s device (Firebase, 2019). Data is synched when connection to the device is regained (Firebase, 2019). Firebase uses JSON objects to store data because it is lighter and faster (Firebase, 2019; W3Schools, 2019).

### Testing and Revising Prototypes Solution Patterns

#### Development Method

Some development methods happen to incorporate the process of testing in their outlines. This happens to be applicable to the chosen development method for the proposed solution.

Due to racing changes with software requirements, an equally swift development method is required to keep up. The Extreme Programming (XP) development method which happens to belong to the Agile development framework, aims at producing high-quality, useful software in increments rapidly (Sommerville, 2015). Systems involved using XP, highly involve the system stakeholders and end-users in the specification and evaluation of each increment (Sommerville, 2015). During the specification and evaluation process, stake-holders and end-users are allowed to suggest design changes or point out missing requirements which are then included in the next increment (Sommerville, 2015). XP uses test-first development technique since testing is done within increment development as well as between incremental releases (Jeffries & Melnik, 2007; Sommerville, 2015). The tests employed by XP are the units and functional tests (Agile Alliance, 2018).

### Proof-of-Concept Demonstration of the Proposed Solution’s Applicability

As the functional and unit testing were done during development, this stage deals with the developed system being tested as a whole against the problems identified in Research Problem section of this research. This way, the proposed solution’s applicability is tested using some form of demonstration.

With demonstration being required, the scenario testing—a testing technique supported by XP—can be used. The scenarios are in the form of stories that describes possible ways the system may be used, with each scenario consisting of quite a few requirement (Sommerville, 2015). The tester plays the role of an end-user by running through each scenario to observe how the system responds to varying inputs (Sommerville, 2015).

### Summative Evaluation

Coming out with a highly effective system that addresses all problems identified is the intended target of any system development. With the overall functional requirements being met, there is the need to evaluate the system against its non-functional requirements.

System quality is mainly measured using non-functional requirements because, system features and functionalities can be well implemented but should the interface design be difficult to use or the system continuously hang, the system impossible to use (Sommerville, 2015), thereby marring the overall user experience. Incorporating a user-friendly interface will go a long way to influence the use of the system by many. Also, performance of the system is very important as it impacts the overall user experience. Therefore, system quality is also about the non-functional requirements like availability, dependability, usability and efficiency (Sommerville, 2015).

# SYSTEM ANALYSIS AND DESIGN

This system analysis and design (SAD) deals with understanding identified problems, planning, developing and specifying into details the list of requirements a system should fulfill. Simply put, system analysis and design is the investigation of problems and the formulation of a solution to address the problems (Your Dictionary).

This chapter includes an overview of the current system and an analysis of the proposed system. The proposed system analysis is made up of the requirements—functional and non-functional—as well as Structural and behavioural diagrams using the Unified Modeling Language (UML).

## Current System Overview

For parents who want tutors currently result to either talking to the teachers of their wards, or using the same tutors as their neighbours. When a tutor is identified, the parent calls up the tutor to agree on a tutoring schedule, tutoring duration and tutoring fee. The tutor does not get to access the student before accepting the offer. This transaction can see a student end up with a tutor who is not a good fit, due to the lack of a reference point like customer reviews. This relates to a tutor not being able to address some of the challenges being faced by the student. Tutoring goes beyond imparting knowledge but also psychological.

Keeping track of tutoring schedules manually which are mostly not consistent can elude most parents and students. Students often are unprepared for a tutoring session due to schedule mix-ups or miscommunication. Some students also forget to work on a given assignment causing the tutoring progress to be stunted.

## Proposed System Design

There will be a student/parent instance and a tutor instance of the mobile application. Both instances of the app will have different functionalities and interfaces tailored for the intended user.

## Requirements Engineering

### Functional Requirements

Functional requirements are the list of services to be provided by the proposed solution. The functional requirements are normally in line with addressing the identified problems in the research (Sommerville, 2015). The functional requirements of the proposed solution are:

The parent should be able to

* sign up
* log in / log out
* search for a tutor
* filter the tutor search results
* request a tutor
* rate a tutor
* add ward(s)
* view ward(s) timetable
* receive notification on ward(s) assignment and quizzes
* recommend tutor
* view tutor’s feedback

The student should be able to

* view timetable
* view outstanding quizzes
* view tutor’s feedback

The tutor should be able to

* view schedule
* approve tutoring request
* create an assessment
* update progress report
* give feedback
* view list of clients

The administrator should be able to

* approve a tutor
* blacklist a tutor

### Non-Functional Requirements

These are the list of performance and function restrictions the proposed solution is to abide by. Non-functional requirements can refer to system properties like portability and security or system implementation restrictions like least memory size (Sommerville, 2015). The non-functional requirements of the proposed system are:

The system should be:

* Useable: - this relates to how fast an end-user is able to figure out and use a system fully.
* Accessible: - this means the system should be able to be used by a wide range of consumers; from those with the least supported device specifications as well as those with little bandwidth speed to those with the best device specification and internet bandwidth speed (Romano, Loiacono-Mello, & Mccoy, 2005).
* Reliable: - this refers to the system consistently carrying out its intended function without fail within a specified period. At the heart of reliability is service continuity ( Distributed Generation Systems, 2017).
* Maintainable: - this refers to ease of being able to repair or upgrade the system without interrupting the entire service. It also refers to the ability to easily restore system operations to normal after a failure.

## UML Diagrams

UML diagrams are used to graphically represent the model of systems in many forms like system functions (use cases), action flow from one activity to another (activity diagram) and sequence of message interaction between objects (sequence diagram).

### Use Case Diagram

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| Figure 3. Use Case for Parent |

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| Figure 4. Use Case for Tutor |

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| **Figure 5. Use Case for Administrator** |

### Activity Diagram

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| Figure 6. Activity Diagram for Scheduling a Tutor |

### Sequence Diagram

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| **Figure 7. Sequence Diagram for Scheduling a Tutor** |

### Class Diagram

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| Figure 8. Class Diagram of Tutoring System |

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