AALBORG UNIVERSITY
COPENHAGEN

Semester: **4TH**

Title: **ELECTRONIC TEXTBOOK SERVICE FOR SENIOR HIGH SCHOOLS IN GHANA**

Aalborg University Copenhagen
A.C. Meyers Vænge 15
2450 København SV

Semester Coordinator: Henning Olesen

Secretary: Maiken Keller

Project Period: FALL 2016 – SPRING 2017
Group number: ICTE34 BD L1

Semester Theme: MASTER'S THESIS

Supervisor(s):

1. **IWONA MARIA WINDEKILDE**
2. **PER LYNGGAARD**

Student: GABRIEL BAMPOE

Abstract:

This project involves discovering which electronic textbook technical solution and business model is suitable for Senior High School students in Ghana. The goal is to show which of the solutions used in other contexts also apply to the Ghanaian Senior High School case.

To do this, factors important to stakeholders and the general conditions in Ghana were explored. Upon examination of the factors and conditions, it became clear that copyright issues and internet connectivity problems are of great interest. It also became relevant that students have access to devices. The mode of provision of these devices were seen to have a bearing on the technical solution and revenue model applicable to an electronic textbook service provider.

The study found the handing out of dedicated devices to students and the brokerage revenue generation models optimum. The use of Android operating system and ePub reading software for the devices were also found appropriate.

A business model was developed for an operator of the E-textbook service. Design aspects incorporating copyright protection were also looked at.

Pages: 112
Finished: 6th JUNE 2017

E-TEXTBOOK SERVICE IN GHANA

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The introductory chapter will present the motivation behind the project. The background comprising key terms used in the project, a brief description of Senior High School (SHS) education in Ghana including the current textbook delivery model will be discussed. In this chapter, the problem formulation, research questions and the delimitation of the project will also be outlined.

1.1 MOTIVATION

As technology continues to evolve, its effect on various sectors of economies including education becomes important. It is alluded to that the use of digital textbooks is gaining grounds at all levels in education due to the presence of technology and Internet (Mardis et al., 2010). Most research pertaining to the use of electronic textbooks (E-textbooks) is limited to studies at the tertiary level with just few focusing on pre-tertiary education (Eicker-Nel and Matthee, 2014). At the High school level, one of such few examples is the collaboration between Clearwater High School in Florida and Amazon to distribute kindles loaded with textbooks to students (Embong et al., 2012). Although there are some disadvantages of using digital textbooks, the numerous benefits of moving from paper-based textbooks to E-textbooks make it worthwhile for businesses and governments to consider. This ranges from access to myriad of reading materials, convenience, cost reduction, environmental friendliness etc (Waller, 2013). According to analysts at CafeScribe (an E-textbook selling site), college students who buy E-textbooks in the U.S would not only save $2000 over the four years of study but will also conserve six trees (Cafescribe, 2007).
As it can be seen in fig. 1 below, the global market of E-books has seen consistent growth in revenue from 2009 to 2016.

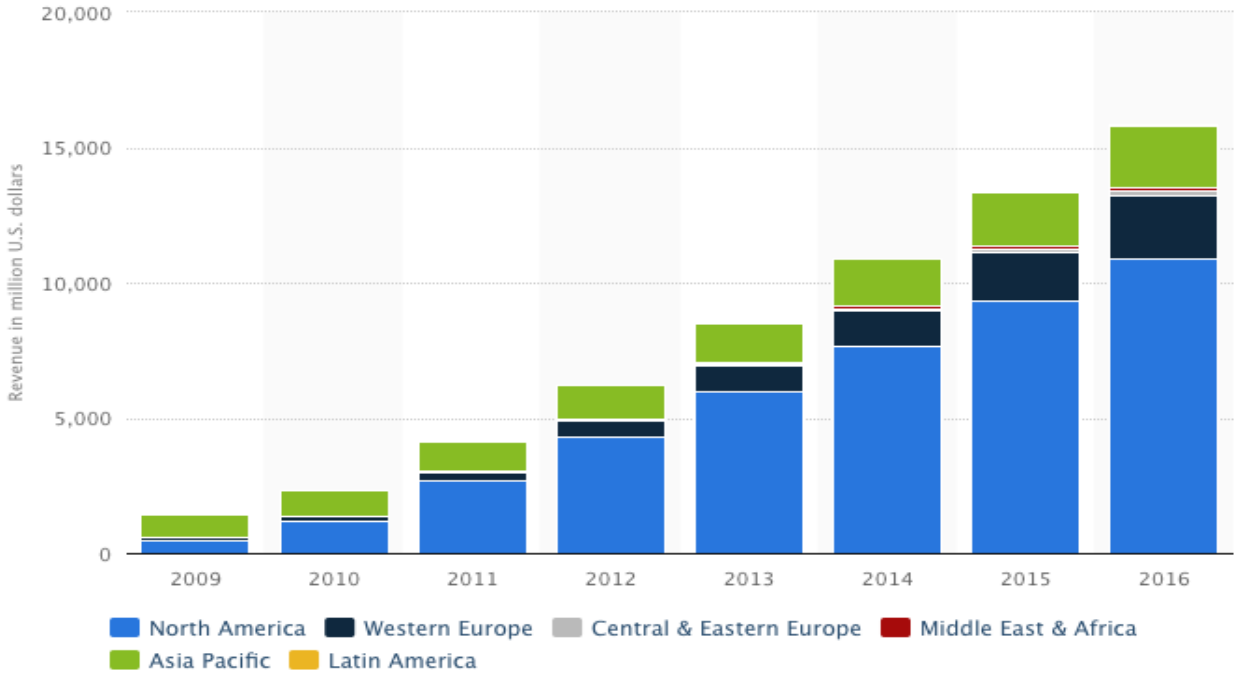


Figure 1: Global E-book revenue from 2009 to 2016 by region (Statista, 2017).

Some Governments over the world have embraced the concept of e-reader integration into the educational system. In Malaysia, the government purchased 50,000 e-readers to year 4 and 5 pupils in 2010. Similar projects have taken place in Portugal, Venezuela and some other countries (Embong et al., 2012).
Researchers also point to the fact that cost is the main driver of E-textbook development (Grajek, 2013; Ji et al., 2014). “Until E-textbook format and features are standardized and business models generate sizable cost savings, E-textbook adoption is likely to evolve slowly” (Murray et al., 2011, pg. 49). In a study by Worldreader, a recommendation was made to stakeholders to pilot an effective Business Model in the delivery of e-readers to students in Ghana to ensure sustainability (Worldreader, 2012).

1.2 BACKGROUND

The purpose of this section is to define and specify the terms used in this project. A description of the SHS educational system in Ghana including how printed textbooks are delivered to students is also done.

1.2.1 E - BOOK

Electronic book (E-book), sometimes spelt as E-book or referred to as digital book is a book that can be read on a computer screen, a special E-book reader, a personal digital assistant (PDA) or even a mobile phone. That is to say E-books are consumed on a screen rather than on paper (Nelson,2008). Although E-

books can be read on PDAs or on smartphones, usually e-readers are used to access them. This is because smartphones may be good for bit-sized reads but painful for long sustained reading. Mostly E-books are electronic versions of a printed book but there are exceptions where an E-book has no printed equivalent (Lim and Hew, 2014).

1.2.2 E -TEXTBOOK

E-textbooks are digitized forms of textbooks, which may include multimedia content (pictures, audio, video etc.) and are envisioned to replace printed textbooks (Lee, Messom and Yau, 2012). E-textbooks are differentiated from E-books in the sense that whilst generally E-books can be read for a number of reasons including personal enlightenment and leisure, E-textbooks are read to understand a particular course mostly as part of an educational curriculum (Wong et al., 2011). E-textbook is therefore a subset of E-book.

1.2.3 E-READER

An electronic reader (e-reader) is the digital device that displays electronic texts as its main function. Although E-books can be read on computers, PDAs, mobile phone etc., a specialized software application is needed to read E-books on these general-purpose devices (Lim and Hew, 2014). In this project, e-readers are sometimes referred to as digital devices or dedicated devices.

1.2.4 BRIEF DESCRIPTION OF SHS EDUCATION IN GHANA

There are about 863 Senior High Schools (Private and Public) in Ghana with a total student population of approximately 800,000 students. Among these students, about 77% live in boarding facilities on the school campuses (EMIS (a), 2015, EMIS (b), 2015). School hours begin at 7am and ends between 2pm and 3pm with two long breaks within the period (St. Louis, n.d). The SHS curriculum for each program of study is composed of 4 core subjects and 3 or 4 elective subjects chosen based on individual student's preference (WAEC, n.d). The academic year in Ghana for SHS lasts for 9 months representing 3 different terms (Eben, n.d). During the academic year, for each of the core and elective subjects, students use at least a textbook, an exercise book, past exam questions with answers and blank writing books for taking notes in class. One characteristic of SHSs in Ghana is the uniformity in the study environments. Students follow the same course plan, write the same final exams etc. At the individual school level, students wear the same uniform clothing to classes and mostly use the same textbooks for studies (Yfuusa, n.d.).

The Government of Ghana through the Ministry of Education provides some textbooks, which students can borrow and return at the end of the 3-year study period. Also Government purchases textbooks for students in deprived communities (MoE Ghana(a), n.d). Parents also buy some books needed for their wards education to supplement what is provided by the government. This mostly includes textbooks, exercise books, past questions with answers and blank writing books for notes (Ghana Schools Net, 2014). According to a research done by USAID and Worldreader in 2012, the Government of Ghana pays a subsidy of $85.12 per student for paper-based textbooks throughout their SHS studies (Worldreader, 2012). Now, with textbook prices mostly on the increase (Badkar, 2014), this is expected to be even more than $85.12. Furthermore, this subsidy is about half the overall amount spent on textbooks, as parents would have to buy the remainder of the textbooks needed to complete the set for the education.

1.2.4.1 CURRENT TEXTBOOK DELIVERY MODEL FOR SHSs IN GHANA

To achieve the Government of Ghana's vision of 1:1 ratio of students to textbooks, parents are required to supplement government-funded supplies (MoE Ghana(a), n.d.). In effect, some of the books used by students in SHSs in Ghana are funded by the Government of Ghana and others are funded by students or parents. For the sake of simplicity, costs borne by either students or parents will be attributed to students in this report. Either way of funding necessitates different service and money flows.

For the government-funded textbooks, after the Ministry of Education (MoE) has made a list of approved textbooks, a textbook selection committee of each individual school makes choices amongst the approved textbooks. Different textbooks from different publishers can be selected for different courses. Funds is provided to the publishers of the chosen textbooks by the government. The publishers in turn provide the textbooks to the individual school authorities who then make it available to the students (MoE Ghana(a), n.d). Fig. 2 below illustrates the interactions among the various stakeholders in the textbook delivery system indicating the service and money flows for government funded textbooks in Ghana.

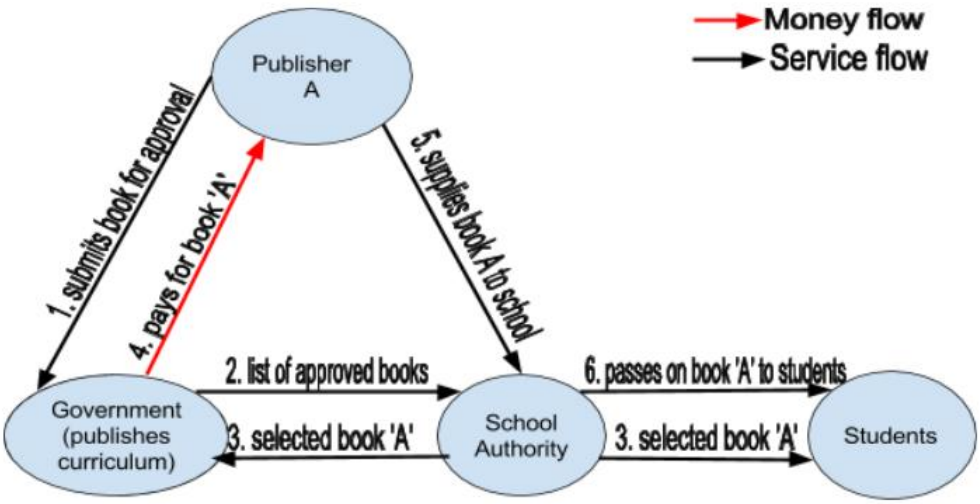


Figure 2: Interactions indicating service and money flows for government-funded textbooks.

The student-funded model follows a similar path with respect to the service delivery. However, the money flow differs. Here, payment for the textbooks is made by the students to the school authorities who then remit to the publishers accordingly, just like any other item on the student bill (Ghana Schools Net, 2014), see fig. 3.

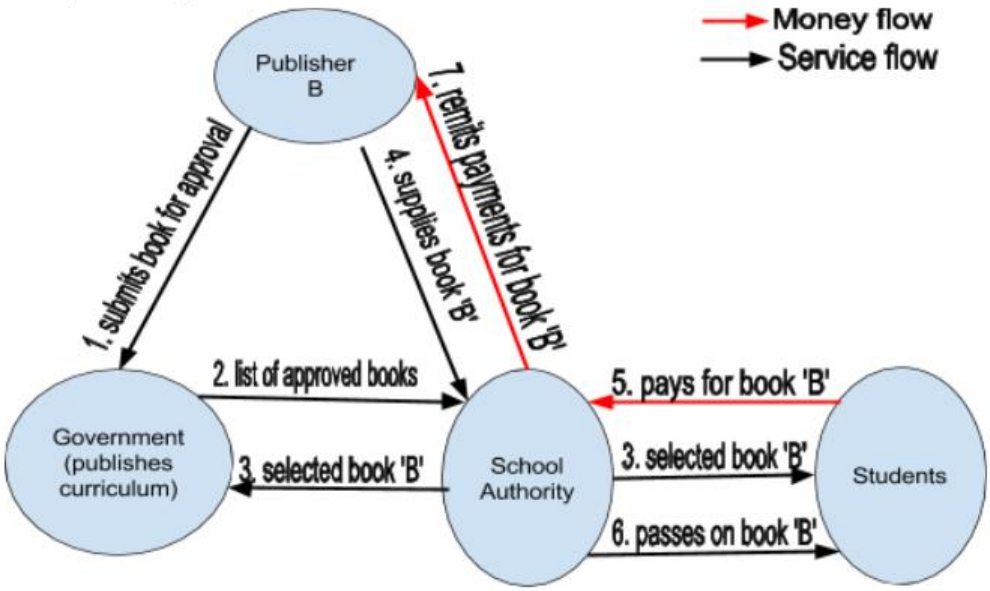


Figure 3: Interactions indicating service and money flows for student-funded textbooks.

Other issues with the textbook ecosystem has to do with the strict policy for local participation by Ghanaians. The Ministry of Education of Ghana stipulates that textbooks used by students in Ghana must have 70% Ghanaian authorship, 60% Ghanaian participation in printing and major involvement of local booksellers as part of the distribution process. Further to this, textbooks must contain 80% of the

Ghanaian syllabus for each course with topics which must be completed in each academic year or for the whole study level (MoE Ghana (a), n.d).

1.3 PROBLEM FORMULATION

The use of printed textbooks is not cost effective neither is it environmentally friendly (Cafescribe, 2007). E-textbooks are seen as the substitute to printed textbooks in the near future due to cost issues and its ubiquitous usage as well (Yoo and Roh, 2016).

There is difficulty in new textbooks reaching students in remote areas in Ghana on time. In some remote locations, it takes as long as 5 months into the academic year for textbooks to reach students. Furthermore, there is inadequacy in the exposure of teachers and students to ICT devices leading to the churning out of students who are largely digital illiterates in this 21st century (Worldreader, 2012).

It is alluded to that cost is seen as the main driver for E-textbook adoption (Grajek, 2013). Therefore, a business model that will make an E-textbook service cost effective for users is likely to gain traction in a developing country like Ghana. Again, several technical issues including internet connectivity, software, stable electricity etc. can present serious challenges to a system like E-textbooks in Ghana (Amenyedzi et al., 2011).

Lastly, issues relating to the acceptance of this new system and the copyright issues it may arouse can also affect its viability. It is therefore important to research on which technical solution of E-textbooks is feasible for Senior High Schools (SHSs) in the Ghanaian context and also an effective business model to match.

1.3.1 RESEARCH QUESTION

Which E-textbook solution is optimal for SHS education in Ghana considering measures critical to stakeholders' adoption and ecosystem conditions in Ghana?

1.3.2 SUB-QUESTIONS

- What are the states of the art E-textbook technical solutions deployed worldwide?
- Which business models exist for E-textbook service?
- Which measures are critical to stakeholders' adoption and use of E-textbooks in Ghana?

- How does ecosystem conditions in Ghana favour the use of E-textbooks?

- Which technical solution is suitable for E-textbooks for SHSs in Ghana?

- Which business model(s) is suitable an E-textbook service operator in the Ghanaian case?

- How will the business model and system design layout of the E-textbook service be?

1.3.3 DELIMITATION

In this section, the intentional choices made to determine the project scope are addressed as follows:

- Mainly investigating which E-textbook revenue generation model fits the situation in Ghana and coming up with a business model.
- Investigating the viable E-textbook technical solution in relation to platform type, operating system and reading file type therefore avoiding security, reliability and maintainability of device and platform.
- Finding which measures are more critical than others to stakeholders' intention to accept E-textbook with no regards to correlation between measures.
- Considers only one mode of delivery of devices to students and therefore only one solution.
- Software/ website process ends at design stage and selects only one use case.

The next chapter of the report looks at the body of literature within the field of E-books and E-textbooks globally and specifically in Ghana. The literature review will show what existing research captures and aspects that need additional consideration

2. LITERATURE REVIEW

The educational system at the SHS level in Ghana has seen major progress over the years. This ranges from the construction of additional SHSs, capacity building for teachers and heads of schools, provision of science and ICT resource centers, provision of some textbooks to students, award of scholarships to needy students among others (MOC Ghana, 2015). This been said, however, a host of problems still confront education at the SHS level in Ghana. A study by Worldreader in Ghana shed some light on these problems. Key amongst them and relevant to this project is the difficulty of new textbooks to reach students in remote areas on time. In some remote locations, it takes as long as 5 months into the academic year for textbooks to reach students. Furthermore, there is inadequacy in the exposure of teachers and students to ICT devices leading to the churning out of students who are largely digital illiterates in this 21st century (Worldreader, 2012).

There are many different models that have been developed to understand technology acceptance and use. Hsiao and Tang whilst explaining undergraduate behavior of E-textbook adoption in Taiwan considered five of such models. These included Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Decomposed TPB, Combined TAM and TPB and finally Unified Theory of Acceptance and Use of Technology (UTAUT). It was concluded that UTAUT is the best model in the context of e- textbook services (Hsiao and Tang, 2014). In a separate study on the uptake of E-books, researchers acknowledged the fact that UTAUT provides a solid theoretical foundation for technology acceptance studies. The research considered constructs which were critical to users' adoption and uptake of E-textbooks (Yoo and Roh, 2016).

Yates stated that diffusion theory presents a structure that helps advocates understand why some innovations are adopted by some and not others. E-textbook advocates can use diffusion theory to clarify and explain issues that increase or hinder the diffusion of E-textbooks. It is essential to have a concrete understanding of how to introduce new ideas into the social system, and diffusion theory helps promote an understanding of this process (Yates, 2001). In this regard, a study by Cartwright was conducted to discover why E-textbooks had not been adopted extensively in K-12 education in the US as a replacement to printed textbooks. Rogers diffusion of innovation theory formed the basis of this study (Cartwright, 2015).

Researchers have looked at the underlying enabling technologies of E-Textbooks in the past. Lee et al. in one of such researches considered the technical aspects in relation to the various solutions for an E-textbook service. In the same report, a recommendation was made for future works to focus on business models and

digital rights management. The need for governmental support and good ecosystem for an E-textbook solution to thrive was also emphasized (Lee, Messom and Yau, 2012).

The importance of ecosystem conditions to the success of an E-textbook solution in Ghana has been investigated before. Amenyedzi and Co. in their research on the use of computers and the internet as a supplementary source of educational materials in Ghana stated several problems standing in the way of such an initiative. These include the lack of adequate computers, poor internet connectivity in schools, inadequate power supply etc. (Amenyedzi et al., 2011).

This project supplements work that has already been done in the field of technology (specifically E-textbook) acceptance and use and E-book technical solution. The seeming lack of studies on the business models applicable for a nationwide E-textbook solution is also addressed. Testing of the UTAUT in relation to E-textbooks has previously been done in the context of undergraduate studies in developed countries. This study analyses it in the Ghanaian context and also at the Senior High School level. The study also considers an ecosystem wide acceptance by using the Diffusion of Innovation (DOI) theory. In the same vein, the technical solutions and business models are related to conditions in Ghana to ascertain the optimum. For instance, the business model is aligned with the SHS system in Ghana where students serve as individual clients rather than libraries serving as intermediaries.

The strategy for answering the research questions of this project is discussed in the following methodology chapter.

3. METHODOLOGY

To begin with the research and to get a broader understanding of the E-textbooks terrain, the state of the art E-textbook technical solutions available and deployed the world over was explored. Furtherance to this, the range of E-textbook business models available was also looked into.

The research setting is Ghana where printed textbooks can take about 5 months into the academic year to reach some students in the remote parts of the country. Also, where lack of exposure to ICT leads to the churning out of High School graduates who are largely digital illiterates (Worldreader, 2012).

In all, inputs from 108 participants was used in this study. This comprises 94 SHS students, 10 SHS teachers, 2 government officials and 2 publishing house representatives. A deductive research approach was employed where various stakeholders were engaged in interviews or administered with questionnaires. The primary data obtained from the stakeholders was then tested using the Unified Theory of Acceptance and Use of Technology and Rogers' Innovation Diffusion Theory. Hypotheses already postulated about critical factors concerning the use of E-textbooks were either confirmed or disproved.

Due to lack of facilitating conditions, interviews were done face-to-face and questionnaires were administered using printed A4 sheets. The responses of the questionnaires were then entered into 'Microsoft Excel' and the appropriate 'MEANS', 'VARIANCES' and 'STANDARD DEVIATIONS' calculated.

In a similar fashion as done by Yoo and Roh, the Unified Theory of Acceptance and Use of Technology developed by Venkatesh and co. served as the basis for discovering which measures are critical to the Ghanaian stakeholders' behavioral intentions and uptake of E-textbooks at the individual user level (Yoo and Roh, 2016; Venkatesh et al., 2012). At the ecosystem level, Rogers Diffusion of Innovation theory was used to find out these critical measures from other stakeholders.

Secondary materials provided information about the conditions in Ghana with respect to infrastructure and systems and their level of readiness to support an E-textbook service.

Analysis was done on inputs from literature, state of the art, data collected and the ecosystem conditions. Triangulation of data from the various data sources was done for cross verification of the critical factors. These critical factors were the basis for comparisons made between the various technical solutions and business models. Requirement specifications and business model requirements were then developed. These were then used to generate the system design and business model respectively.

For the system design, the most suitable operating system and reading software were determined by relating the requirement specification with a study that

compares operating systems of six (6) different platforms. Further to this, UML use case, activity and sequence diagrams were designed using the ArgoUML software to show how copyrights of publishers can be protected. Finally, the Business Model and Value Proposition Canvases served as the framework upon which the business model of the platform was designed.
Relevant conclusions and answers to the research questions put forward were obtained from this methodological approach.

The next chapter looks at the applicable theories used in this project.

4. THEORETICAL FRAMEWORK

To assess the factors which will play into the acceptance of an E-textbook service in Ghana, several theories were considered. At the individual acceptance of technology level, Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB) and Unified Theory of Acceptance and Use of Technology (UTAUT) are the relevant theories in the adoption of technology. Diffusion of Innovation (DOI) theory and the Technology, Organization and Environment (TOE) framework are commonly used in wider organizational contexts (Oliveira and martins, 2011).

Although TAM is a widely used model in technology acceptance, after an in-depth model comparison, Hsiao and Tang concluded that UTAUT is the best model to be applied in the E-textbook context. This is because UTAUT proposes that motivational variables directly influence behavioral intention without the effects of attitude as is the case of both TAM and TPB (Hsiao and Tang,2014). Furthermore, TAM excludes the influence of social factors (Polin, 2014) which are expected to play a role in the acceptance of such technology. UTAUT, which also combines key elements from TAM (ease of use and usefulness) and TPB (subjective norm) (Hsiao and Tang, 2014) was therefore used as the model for the adoption at the individual level in this project.

At the wider ecosystem level of acceptance, both TOE and DOI relate to the technological and organizational structure in terms of scope, size and managerial structure (Oliveira and martins, 2011). However, as Yates puts it ; “E-textbook advocates can use diffusion theory to clarify, calculate, and explain issues that increase or hinder the diffusion of innovations”. He also indicates the necessity to have a concrete understanding into how to introduce new ideas into a social system by using DOI theory (Yates, 2001). Because DOI theory has characteristics such as relative advantage, compatibility, complexity, trialability and observability, which change agents can give their inputs to, it is the model used for the analysis at the ecosystem level.

The pattern chosen for the business model is the Multi-sided platform. This is because the characteristics of the business in relation to connecting sellers and buyers of textbooks through the internet makes it a clear example of a multi-sided platform business. Also, major companies in the E-book industry such as Amazon, Apple and Google all run the sale of books using the platform pattern where they take a commission on sales by connecting buyers and sellers (Giammatteo, 2015).

Although several business model frameworks exist, the Business Model and Value Proposition Canvases will be used in this project because the combination enables businesses to visualize, design and test how to create value for customers. It is used by major companies including Microsoft, Intel, GE and

MasterCard (Strategyzer, n.d). Different revenue models used by businesses are explored as well as part of the business model.
To end this chapter, a description of data and method triangulation which will be used later on the data obtained is done.

4.1 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

UTAUT is an integration of eight (8) existing models of technology acceptance - TAM, TRA, TPB, C-TAM-TPB, the motivational model, the model of personal computer utilization, the innovation diffusion theory and the social cognition theory. It initially consists of four main constructs (i.e. performance expectancy, effort expectancy, social influence, and facilitating conditions) with some other moderating factors (i.e., gender, age, experience, and voluntariness) as shown in fig. 4 (Venkatesh et al. 2003). These constructs and moderating factors feed into the behavioral intention for the use of a technology or information system. As it has been established in literature, there is a strong relationship between intention to use and the actual usage of a system (Yoo and Roh, 2016).
UTAUT can be modified through the elimination or addition of constructs or moderators (Venkatesh et al. 2012).

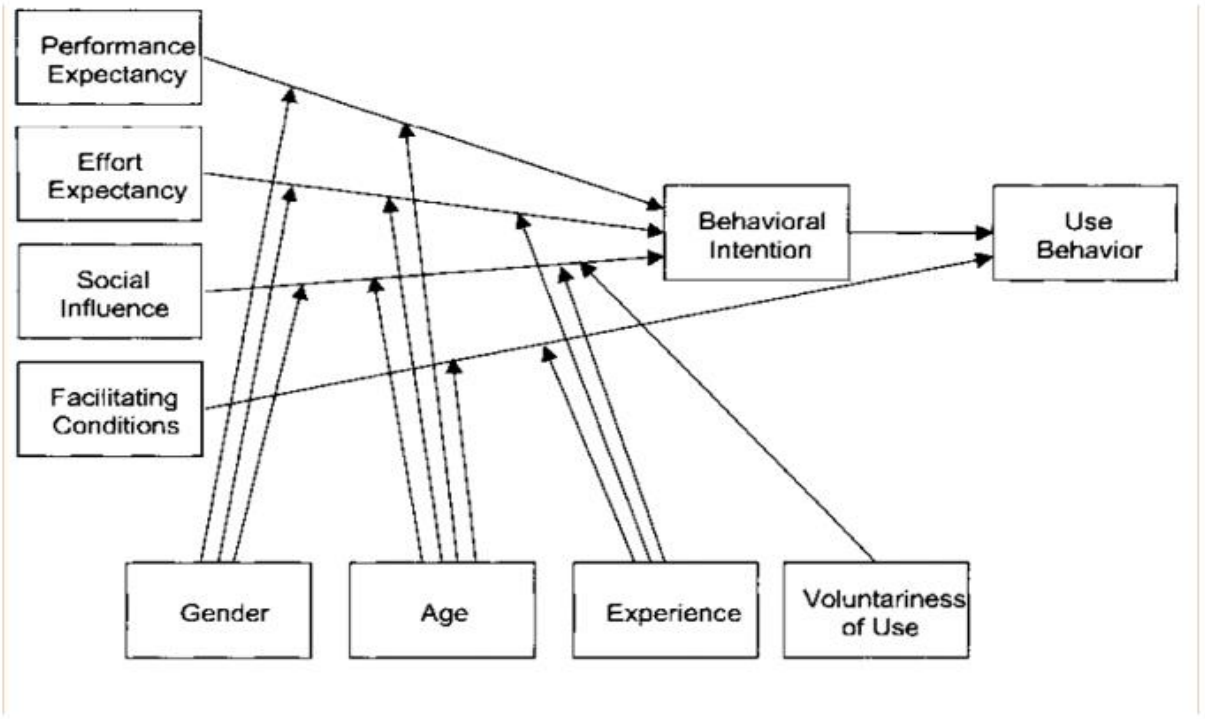


Figure 4: UTAUT model (Venkatesh et al., 2003)

Performance expectancy (PE) is seen as the degree to which using technology will provide benefits to consumers for performing certain activities; *effort expectancy(EE)* is the degree of ease associated with consumer's use of a particular technology; *social influence(SI)* is the extent to which consumers perceive that important people (e.g. family and friends) believe they should use a particular technology; and *facilitating conditions(FC)* refer to consumers' perceptions of the resources and support available to perform a behavior. Originally, facilitating conditions was not a mere predictor to behavioral intention but rather a direct impact on technology use. However, this changed in UTAUT2 (Venkatesh et al., 2003; Venkatesh et al., 2012).

During a study to ascertain which aspects are critical to user's adoption and uptake of E-textbooks, researchers collected data from students of Mid-Atlantic University in the U.S.A. and analyzed it based on the UTAUT model. Performance expectancy, effort expectancy and facilitating conditions were hypothesized to have positive impacts on users' intention to adopt E-textbooks. Social influence was however assumed to have no influence on users' intentions. As it turned out, these hypotheses were confirmed by the results of the study.

In that study, voluntariness of use as a moderating factor was dropped because it was initially shown to have no impact in the context of consumer technology use. After the study, it was discovered that the other three moderating factors (gender, age and experience) had no moderating effect on the intention to use E-textbooks. (Yoo and Roh, 2016).

In this project, a new construct- price value (PV)- is added to the four original constructs. Similar to the case of UTAUT2, because a business model is to be developed, the addition of the 'price value' construct is fit for this context. The price value is the tradeoff between the perceived benefits of a technology and the monetary cost for using it. When one perceives the benefits of using technology to be greater than the monetary cost, then there is a positive price value and a positive impact on intention to use(ITU) (Venkatesh et al., 2012). All the moderating factors are eliminated from this study. This is because a similar previous study (Yoo and Roh, 2016) have shown that the moderating factors have no effect on intention to use. Also, especially for the age factor, all the students are in a close age bracket of 15-17 years (MoE Ghana, 2015), which makes them have similar characteristics.

4.2 DIFFUSION OF INNOVATION (DOI) THEORY

Rogers defines diffusion as a process between members of a social system to bring about positive social change and that is communicated through a specific network over a period. By this, he groups members in a social system as innovators, early adopters, the early majority, the late majority and the laggards.

He also indicates that the process of innovation diffusion consists of 5 stages: knowledge, persuasion, decision, implementation and confirmation (Rogers, 2003). The study of diffusion theory can lead to the design and development of successful and academically reliable innovations (Surry, 1997).
The characteristics of innovation helps to explain their different rates of adoption. These characteristics include:

- *Relative advantage*: the degree to which an innovation is perceived to be better than the original idea.
- *Compatibility*: the way an idea is seen to be consistent with the values, past experiences and needs of potential users.
- *Complexity*: the degree to which an innovation is perceived as difficult to use.
- *Trialability*: the rate at which an innovation offers trials on limited basis.
- *Observability*: the degree to which the results of an innovation are visible to others (Rogers, 2003).

The three main reasons for an innovation to be adopted are relative advantage, compatibility and complexity (Cartwright, 2015). An adopter must feel that there is a relative advantage of an innovation over what precedes it and also that the user must perceive the adoption to hold more advantages than disadvantages. There should also be the belief that an innovation is compatible with their ideas and values. Finally, the innovation must be seen to be easy to understand and use. Rogers also points out that the level of acceptance may be revealed in monetary situations, but social status factors, straightforwardness, and performance are also important motives (Rogers, 2003).
E-textbook technology must be compatible with local performance standards. It should also serve as a supplement to the classroom instruction and should apply to real world situations (Cartwright, 2015). Ease of use is a crucial element for E-textbooks to be adopted because it should be able to be used by a diverse population and cater to all types of learners' needs (Kelley, 2011).
Change agents play a major role in the transition to a new system. Change agents are individuals or groups who influences clients' innovation decision in a direction deemed desirable (Rogers, 2003). The director of ICT at the Ministry of Education (MoE) in Ghana, who oversees the formulation and recommendation of policies for the use of ICT in teaching and learning (MoE Ghana(b), n.d) was solicited to participate in this study because he qualifies as a change agent in this context. So were inputs collected from of publishers and teachers, whose collective decisions could lead to change.
The DOI theory will be used in this project to discover which factors are critical to the adoption of the E-textbook service in Ghana at the wider ecosystem level.

The idea is to find out how change agents (Government and publishers) perceive E-textbooks in the light of some of the characteristics of the DOI theory. These characteristics include how they perceive the relative advantage of E-textbooks over printed textbooks, the compatibility of E-textbooks with the values and conditions in Ghana and the level of complexity of the use of E-textbooks. The characteristics of observability and trialability are not considered because they provide minimal inputs for cross verification with the other theory used.

4.3 BUSINESS MODEL DESCRIPTION

The multi-sided platform pattern is described in this section. An elaboration of what makes up the Business Model and Value Proposition canvases is also done. Finally, the revenue models of businesses are also considered.

4.3.1 MULTI-SIDED PLATFORM (MSPs)

Multi-sided platforms are technologies, products or services that create value between two or more customer groups by enabling direct interactions between them, see fig. 5. Examples of MSPs and the participants they connect include eBay(buyers and sellers), Uber(professional drivers and passengers), Ticketmaster(event venues and consumers), Google's Android OS (handset manufacturers, application developers and users) etc. (Hagiu, 2014).

The value of an MSP to any group normally depends on the extent to which it attracts more users on the other sides, in other words, its network effect (Osterwalder and Pigneur, 2010).

Multi- sided platforms can be grouped into three (3) categories namely: market-makers, audience-makers and demand coordinators. Market makers include eBay, shopping malls etc. They enable members of distinct groups to transact with each other. Members of a group value the service highly if there are more members of the other group. Advertising- supported media such as magazines, newspapers etc. fall in the category of audience-makers. They match advertisers to audiences. Demand-coordinators generate indirect network effects across two or more groups through their goods and services. These platforms do not strictly sell 'transactions' like market-makers or 'messages' like audience-makers. Examples include Windows OS and Visa credit card (Evans, 2003).

Usually, E-book platforms are owned by non-publisher third parties with the financial, marketing and technology as well as a forward thinking business vision of digital transformation in the publishing industry. In the E-book market, Amazon's kindle bookstore, Apple's ibookstore, Barnes and Noble's Nook study etc. are examples of MSPs. An E-books platform provider acts as a middleman between publishers and readers. Through the platform, readers consume content and publishers sell to readers. E-book platform providers normally make

additional profit from selling the E-book devices to readers. This gives them more market power over the publishers as more readers adopt their platforms (Jiang, 2012).

There are fundamental strategic decisions every multi-sided platform entrepreneur or investor should consider carefully- the number of sides to bring on board, platform design, pricing structures and governance rules. Normally, no side of the platform is willing to join without the other(s) leading to the 'chicken and egg' problem. As such, most MSPs subsidize at least one side of their platform (Hagiu, 2014).

The E-book platform provider has to make strategic decisions such as how much to charge for the reading devices and whether to make its platform compatible with other E-book providers' platforms. According to literature, an E-book platform may charge both sides fixed membership or usage fees or sometimes a combination of both. Furthermore, just like other two-sided markets, one side of the market arrives before members of the other side. E-book platforms need to get publishers on board first before readers. Lastly, the total contents available on a platform are critical to consumers' adoption and the total size of the E-book market (Jiang, 2012).

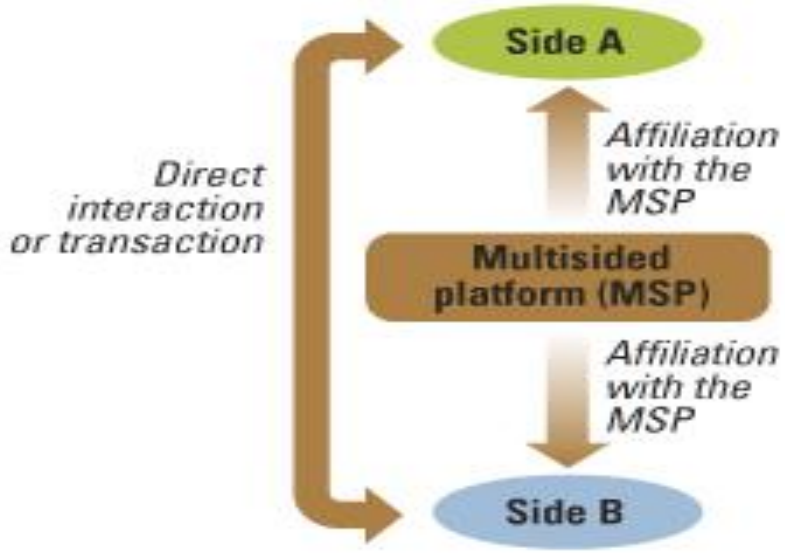


Figure 5: Multi-sided platform interactions

The Multi-sided platform will be applied in this project to indicate the sides that make up the business and the role the platform operator plays.

4.3.2 BUSINESS MODEL AND VALUE PROPOSITION CANVASES

A business model describes the rationale of how an organization intends to create, deliver and capture value. The business model canvas by Osterwalder and Pigneur helps in describing, analyzing and designing business models. It consists of 9 building blocks- Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Cost Structure, Key Activities, Key Partners and Key Resources.

The different groups of people or organizations a business aims to reach and serve makes up the Customer Segments. The products and/or services that create value for a specific customer segment is the Value Propositions of that segment. Channels indicates how a company reaches its customer segments to deliver value proposition. It also shows how the company communicates with its customers. The type of relationship a company establishes with specific customer segments make up the Customer Relationship segment of the building blocks. For the business model to work, some important assets are required and these are the Key Resources. The most important activities a company must engage in to make its business model work are the Key Activities. Most businesses do not provide the value all alone. A network of suppliers and partners assist the business model to work and these represent the Key Partnerships. The Cost Structure describes all the costs incurred to operate the business model. Finally, the Revenue Streams represents the money a company generates from each customer segment (Osterwalder & Pigneur, 2010).

The building blocks of the BMC can be analysed in relation to multi-sided platforms. There are two or more customer segments each with its own value proposition and associated revenue stream. One customer segment can enjoy free or reduced prices usually subsidized by revenues from other customer segments. Value is created in 3 main areas- attracting user groups, matchmaking and reducing transaction cost. The platform is the key resource of multi-sided platforms and as such platform management and promotion remains the key activities. Also, the main cost incurred relates to developing and maintaining the platform (Osterwalder & Pigneur, 2010).

The Value Proposition Canvas is a tool to visualize, design and test how a business creates value for customers. It is made up of the customer profile and the value map. In essence, it expands the value proposition and customer segments elements of the Business Model Canvas.

At the customer profile, functional, social or emotional jobs customers want to get done are outlined. Next, the pains customers experience in trying to get these jobs done also form part of the customer profile. The pains include frustrations in using existing solutions, risks and obstacles related to performing the job. The other element that forms part of the customer profile is the gains. It is how

customers measure success for a job well done. Simply put, gains are the reasons customers want the jobs to be get done. Some gains come as a surprise to customers when the job is done.

The value map comprises three elements: products and services, pain relievers and gain creators. Products and services which the value proposition of a business builds on are listed in the value map. How these products and services help eliminate or minimize the pains of the customers are also described. Finally, how the products and services produce or maximize outcomes or benefits for customers is also outlined.

It is important to achieve fit between what matters to customers in the 'customer profile' and how products and service help them to ease pains and produce gains in the 'value map' (Strategyzer, n.d).

Fig. 6 is a visual representation of the Business Model and Value Proposition Canvases.

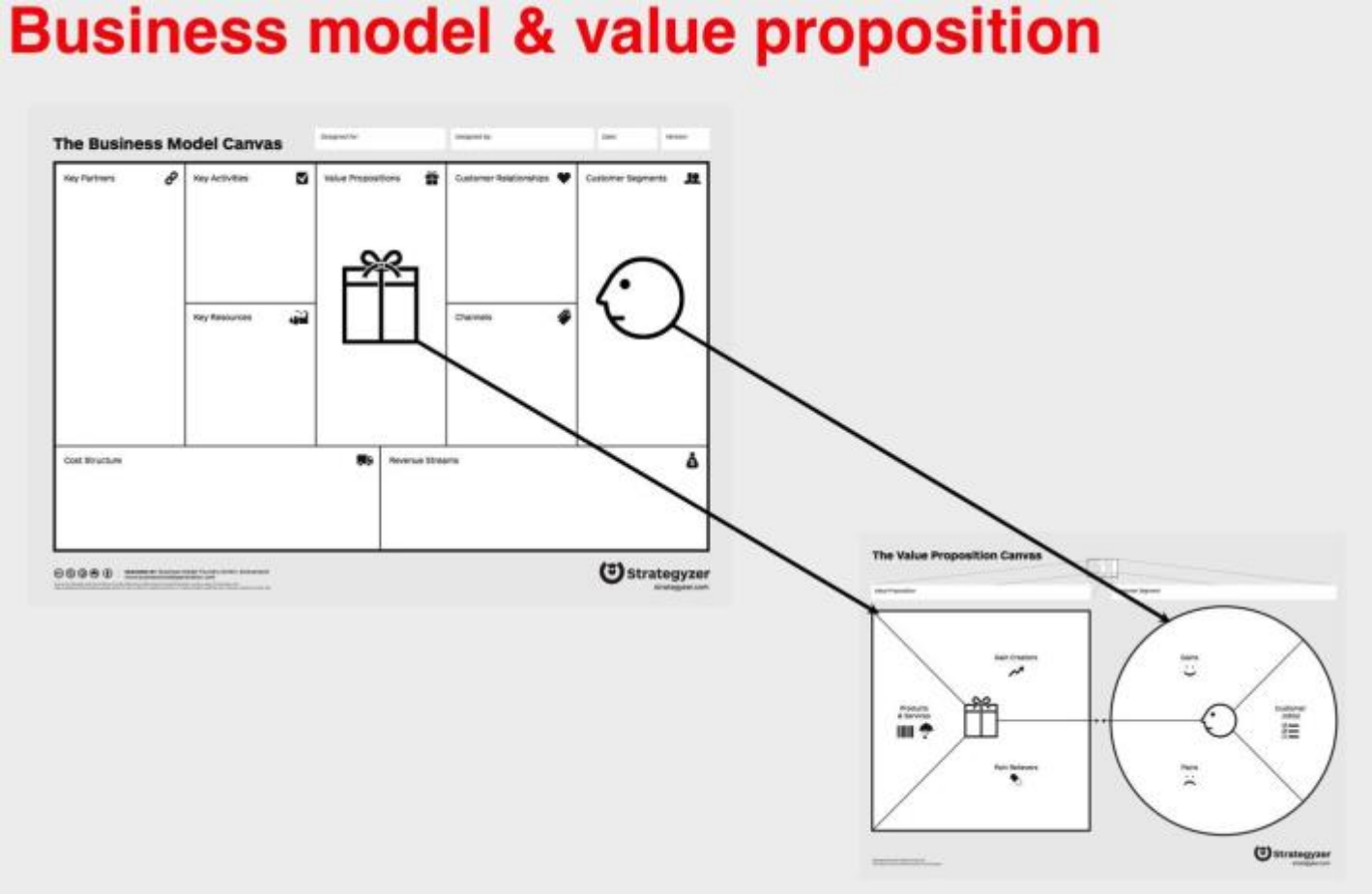


Figure 6: Business Model and Value Proposition Canvases (Blank, n.d)

The Business Model and Value Proposition Canvases are used in the design of the Business Model for the E-textbook platform. It helped capture all the

necessary aspects of the platform, specifically, how value is created for each customer segment.

Describing the taxonomy of business models, Rappa groups businesses according their revenue generating model. A case for 9 different business models according to revenue streams was made. These are Brokerage, Advertising, Infomediary, Merchant, Manufacturer, Affiliate, Community, Subscription and Utility (Rappa, 2000). In the next section, the business models according to revenue streams are discussed.

4.3.3 BUSINESS MODELS (ACCORDING TO REVENUE MODELS)

For long term sustainability, every company must have at least one source of revenue (Hartmann et al., 2014). A business model can either involve a one-time transaction revenue or recurring revenues resulting from ongoing payments for value proposition or customer support. Seven different revenue streams are identified as common with businesses: asset sale, usage sale, subscription fees, lending/renting/leasing, licensing, brokerage fees and advertising (Osterwalder & Pigneur, 2010). Asset sales relate to the Merchant model according to Rappa. So does Usage sale relate to Utility. Seven different business models relevant to information services are considered below.

4.3.3.1 BROKERAGE

Brokers bring together buyers and sellers and also facilitate transactions. In order words, they are market-makers. The role of brokers can be between Business to Business (B2B), Business to Consumers (B2C) or Consumer to Consumer (C2C) (Rappa, 2000). Brokers earn a commission each time they successfully enable transaction between a buyer and a seller (Osterwalder & Pigneur, 2010). Brokers reduce search and transaction cost among other things on the web. The brokerage business model in the ICT era can be described in terms of Multi Sided Platforms where the platform earns a commission on every transaction it facilitates. For instance, Amazon takes a commision of between 30% and 65% (based on the price of the E-book) for books sold on its platform and Apple also takes a flat commission of 30% no matter the price of the E-book (Giammatteo, 2015).

4.3.3.2 SUBSCRIPTION

The charge (usually monthly) for continuous access to a service makes up the subscription revenue stream. It is common for most sites to combine free content

with ‘premium’ (for subscribers only). One pays for the subscription fees irrespective of actual usage rates. Usually, subscription model is combined with advertising model (Rappa, 2000).

4.3.3.3 ASSET SALE

It involves the sale of ownership rights to a physical product and stands as the widely understood revenue stream. For instance, Amazon.com sells physical objects such as books, consumer electronics etc. online and the buyer is free to use, resell or even destroy it after buying (Osterwalder, 2010). Amazon, Apple etc. also sell physical devices on which E-books can be read. Amazon offers the kindle specifically for reading and Apple’s ipad is also designed for digital reading (Wikipedia, 2017).

4.3.3.4 ADVERTISING

Similar to traditional media broadcast advertising model, digital content services also engage in web advertising. Usually, the broadcaster (i.e a website) provides content and other services like email for free. This is mixed with advertising messages in the form of banner ads. This model works best when the volume of traffic is large and specialized and the banner ads are the major source of revenue for the broadcaster (Rappa, 2000).

4.3.3.5 LENDING/ RENTING/ LEASING

In the lending/renting/leasing business model, usage of an asset is granted in exchange for a fee. This provides recurring revenues for the lender whilst the user only pays for the usage period of the product or service rather than bearing the full cost of ownership. This model is very common with vehicle usage services (Osterwalder & Pigneur, 2010). For E-books, several websites offer readers the chance to borrow E-books at low cost for a period after which their access is revoked. This is particularly convenient for readers who are on a budget or just need to read portions of a book (Knight, n.d).

4.3.3.6 INFOMEDIARY

Information intermediaries businesses earn revenues by assisting buyers and/or sellers understand a market. On the side of the sellers, data about consumers and their consumption habits are carefully analyzed and provided to help sellers undertake targeted marketing. For consumers, data about producers and their products are useful when considering a purchase (Rappa, 2000).

4.3.3.7 USAGE SALE

Also called the ‘on-demand’ or ‘utility model’, it is based on metering usage or ‘pay-as-you-go’. Traditionally this approach has been used for essential services

such as water, electricity etc (Rappa, 2000). Here, the more the service is used, the more the customer pays. For instance, a telecom operator charges customers for the number of minutes spent on the phone (Osterwalder, 2010).

Rappa indicates that, it is possible to combine several of these business models to form an overall business strategy (Rappa, 2000). The business model of the E-textbook service may dwell on a combination of some of the above discussed models to ensure maximum value potential is extracted from the platform.
The Revenue Models discussed above are considered in relation to the E-textbook platform to make a choice of which one(s) apply in the business of the project.

4.4 TRIANGULATION OF DATA, THEORIES AND METHODS

Data triangulation involves using different sources of data which includes different times for data collection, different places from which data is collected and the different people involved. Different theories can be used to analyze data collected and that will represent a Theory triangulation. Finally, more than one method of data collection can be used in a research indicating Method triangulation (Wilson, 2016).
In this project, different people at different places were consulted for data-students and teachers on campus as well as government officials and publisher representatives at their offices. Two different theories (UTAUT and DOI) were used to find the critical factors for different groups. However, these theories apply to different levels of analysis and different data and therefore doesn't constitute a theory triangulation. Method triangulation was also at work as different methods of data collection were used (questionnaires, interviews and secondary materials).
The triangulation method will be beneficial in this project to determine which of the critical factors to stakeholders' cuts across all data sources.

The overview of the theoretical frameworks described above makes it possible to follow their use later in the project. The next chapter looks at the state of the art E-textbook technical solutions and business models available.

5. STATE OF THE ART

In this chapter, the state of the art E-textbook solutions already in use in the world is explored. It starts by looking at open E-textbook solutions which are free to use by high school students. Further to this, three E-textbook technical solutions (web-based, reading software based and device based) are discussed to find their components, strengths and weaknesses. The chapter also looks at the business model options offered by some E-textbook providers to schools and individual students.

5.1 OPEN EDUCATIONAL RESOURCES (OERs)

E-textbooks are seen as less expensive alternatives to printed textbooks. This is because of the additional cost involved with printed textbooks in the area of printing and logistics. For instance, it is estimated that printing and logistics alone constitute about one-third of the price of textbooks (Baglione et al., 2016).
Because cost is seen is one of the drivers for the shift from printed textbooks (Hsiao and Tang, 2014), solutions which are entirely free are options worth considering. In this section, two of the 'open' sources of educational materials available freely to everyone, are looked at.

5.1.1 CK12 FLEXBOOKS

CK12 (connect kindergarten to 12th grade) flexbooks are free open source E-textbooks with a focus on STEM education in high schools (Classroom Aid, n.d.). With a belief that every child on the planet should have equal access to great education, the textbooks used in the study are published by the largest publisher of K–12 open textbooks in the United States, the CK-12 Foundation. The authoring of CK-12 E-textbooks starts from classroom teachers who do the initial writing. Subsequent reviews are then done by experts in the subject-matter (Wiley et al., 2012). The CK12 E-textbooks are free for anyone around the world to view and download online. The textbooks have extensions to workbooks, quizzes and tests with corresponding answer keys. Contents on CK12 can be accessed from desktops, tablets or mobile phones. Performance of students on the CK12 platform can be tracked by teachers who can also place students in study groups. Interactive learning activities which adapts to individual student performance are also incorporated in CK12. There are several users across the various continents of the world who patronize the CK12 platform. In sub-saharan Africa, Nigeria, South Africa and Madagascar already have students and teachers who patronize CK12 for personal uses (CK12 Foundation, n.d.).

5.1.2 OER COMMONS

The Institute for the Study of Knowledge Management in Education (ISKME) created OER Commons which was supported in part by William and Flora Hewlett Foundation as part of the Foundation's worldwide OER initiative. OER Commons is a free public digital library and collaboration platform which is mainly for knowledge management and educational innovation across the world. It offers a comprehensive infrastructure for instructors at all educational levels to identify high-quality OER and collaborate around their adaptation, evaluation and use to address the needs of both teachers and students (OER Commons, n.d.). OER commons supports all subjects and all media types. It embeds participatory processes with contents coming from trusted individuals and organizations (Classroom Aid, n.d.). Students can search, browse and evaluate a growing collection of over 50,000 high-quality OERs. In some cases, users on the OER platform can download a resource and share it with colleagues (OER Commons, n.d.).

5.2 E-TEXTBOOK TECHNICAL SOLUTIONS

The design and implementation of an E-textbook solution encompasses several technical issues. This ranges from the text format, device type and mode of access among others. Gu and co., reveal that there are over thirty (30) different E-book text formats available with five (5) of them being mainstream. It was also noted that E-books can be categorized under the device type and mode of access as either web based, reading software based or dedicated device based. EPUB, HTML, CHM, PDF and TEXT are currently the most frequently used formats in the development of E-textbooks (Gu et al., 2015). Among these, the International Digital Publishing Forum (IDPF) has formalized the EPUB (IDPF, 2014). PDF is another popular one with compatibility on most devices. Although both PDF and ePub can be used in offline mode and digital rights can be managed using Adobe ADEPT to protect sold files (Overdrive, n.d.), some other reasons make ePub a better option for textbook publishers than PDF. For instance, PDF files do not work well on E-ink devices (Eikebrokk et al., 2014).

Originally, E-textbook projects were just aimed at digitizing printed textbooks with no aim of adding interactivity (Gu et al., 2015). However, now, interactivity in E-textbooks is very significant. The ePub format is based on HTML5 and CSS3 making it more suitable for interactive and multimedia contents such as tables, charts, audio, video etc (Eikebrokk et al., 2014).

In the early years of E-textbook development, they were used as a supplementary multimedia learning resource rather than a standalone replacement to printed textbooks. They were mostly delivered as CD ROM

attachments to the printed textbook. However, a lot of issues made the use of CD ROMs less a better choice if E-textbooks were to replace printed textbooks completely. It had limited storage capacity and didn't make it possible for several students to participate in a lesson collaboratively as well. Accessibility to content and usability are strict requirements to make an E-textbook mandatory so that students and teachers have contents readily available (Lee et al., 2012). Below, the three categories of E-textbooks according to accessibility options is looked into.

5.2.1 WEB- BASED

In the web-based category of E-textbook solution, textbook content of a standard format (e.g. HTML or XML) is made available on the internet. The content can therefore be accessed by any device that provides a web browser and also has internet connection. Students can be allowed to download the E-textbook to their device either after paying a fee or for free. Web-based content is the most popular type of E-textbook and provides web-browsing functions (Lee et al., 2012). A popular example of web-based E-textbook is Barnes and Noble's Nook study.

Nook study by Barnes and Noble serves as a web-based rental service for E-textbooks, see fig. 7. Students can rent a book for some days or purchase it outright. It allows for note taking, easy searching and highlighting. Organization of coursework by putting material of the same subject together is also allowed (Noble, n.d).

Figure 7: Barnes and Noble web page (Noble, n.d)

5.2.2 READING SOFTWARE BASED

Reading software can be tailor-made for reading contents of certain formats. Textbook content of such formats can only be read using such proprietary software. Mostly, such reading software is found in smart devices such as android phones and tablets, ipads and iphones etc. VitalSource and iBooks are examples of reading software based E-textbooks. Through partnerships with Pearson, Cengage Learning and McGraw Hill Education, CourseSmart provided E-textbook rental services at a cost up to 60% less than in the case of printed textbooks (Lee et al., 2012). In 2014, VitalSource acquired CourseSmart and migrated all its users to its platform accordingly. Some features of the VitalSource include allowing students to download E-textbooks onto multiple devices at any given time (VitalSource, n.d). CourseSmart had the option of allowing students have access to several E-textbooks offline but this feature was eliminated when it was acquired by VitalSource. Other important features of CourseSmart included bookshelf and navigation option, notetaking and highlighting, page printing and automatic updating (CourseSmart, n.d).

Apple's iBooks also comes across as one of the reading softwares for E-textbooks. Thumbnail indexes, built-in videos (see fig. 8), interactive animations, quizzes and review questions, study cards and note sharing are some of the features of the iBook software.

Figure 8: iBook with built-in video (Diaz, 2012).

5.2.3 DEDICATED DEVICE BASED

A dedicated E-textbook device comprises various components including an operating system (OS), network access (Wi-Fi, cellular or Bluetooth) and display (electronic paper or LCD). These devices are specifically made for reading E-books or E-textbooks. They can be made to accept wide range of formats including HTML, EPUB and XML or can be made to accept a single customized format (Lee et al., 2012).

Some implementations of a dedicated device based E-textbook include the Creative Classrooms Lab project funded by the European Commission across several member states. The project involved Ministries of Education (MoE) or Responsible Organisations from 8 participating countries. 45 classrooms across Austria, Belgium, Czech Republic, Italy, Lithuania, Portugal, Slovenia and United Kingdom. Students and teachers experimented with tablets over a period of two years (Bannister, 2015).

In the US, a survey indicated that 78% of elementary schools, 69% of middle schools and 49% of high schools use devices for studies regularly. In the 2012-2013 school year, 6500 students and teachers in a large metropolitan school district in the Southwest of the US were issued with ipads to aid in teaching and learning (Ditzler et al, 2016).

Commercially purposed e-readers have taken over the market for the delivery of E-books and E-textbooks. Few examples include the Amazon kindle, ipad, chromebook, Sony reader, Nook, Kobo, PocketBook and Onyx. Most of these e-readers use the internet through Wi-Fi or cellular data and an in-built software to connect to a digital library or E-book retailer to buy, borrow or receive an E-book. (eBay, 2016).

From the information available on the various categories of E-textbook solutions, it can be said that each has its own strengths and weaknesses. Lee et al., simplifies these traits in a table as shown on table 1 below.

Category	Strengths	Weaknesses
Web-based content	-Accessible by any device that provides web browser	-Internet access is mandatory
Reading software	-The contents of E-textbooks are downloadable for both online and offline use.	-Must use specific reading software to read. -The reading software is tailor-made to read

		content of certain formats.
Dedicated device	-Provide built-in and tailor-made functions such as submitting assignments through E-textbooks, assessing students and monitoring students' academic performance.	-Must use dedicated device to read. -Must use specific reading software found in dedicated device.

Table 1: Strengths and Weaknesses of E-textbook solutions (Lee et al., 2012).

5.3 E-TEXTBOOK BUSINESS MODELS

Looking at the business model format used by major providers of E-textbook service to schools or individual students is vital in making key business model decisions for a new entrant in any part of the world.

Apart from engaging members of the general consumer market of e-readers, major players also have specific programs with some schools and district education authorities especially in the US. The next section looks at how devices, software and support for using the E-textbook platform has being handled between some schools and major players like Google, Apple and Amazon.

5.3.1 GOOGLE (CHROMEBOOK)

In 2015, 53% of the market share for K-12 devices (excluding desktops) bought in the US by schools and districts were Google chromebooks. The Oakland Unified School District alone acquired 10,000 chromebooks. School districts purchase the chromebooks for students and teachers because it allows teachers to offer individualized learning plans for students through the 'Play for Education' software it comes with. It also offers advantage in its competitive price (Taylor, 2015). 33 schools in the Charlotte-Mecklenburg Schools in North Carolina also purchased chromebooks (about $220 per device) for all students in 2015 in the 1-to-1 program. One of the reasons for their choice of the chromebooks was that teachers were already using a number of google apps and as such it was easy for them to incorporate the free 'Google apps for education' into their teaching (Schaffhauser, 2015). For instance, 'Google classroom' allows teachers to manage and control classes effectively. Teachers are able to distribute assignments, share feedbacks and track progress of students. Students on the other hand have access to tools such as docs, slides, drive etc. on which they

can collaborate easily online (Google, n.d.). Millions of E-books and E-textbooks can be bought online through 'google play books' and read through the chromebooks 'overdrive'. Amazon kindle books can also be read on the chromebook using the 'kindle's cloud reader for chromebooks' (Chromebooks, n.d.). It is also possible to rent some E-books and E-textbooks for usage for a period from Google play (Google support(b), n.d.).
Individual authors and small publishers can also publish and sell their books on 'Google Play' (Google support(a), n.d.). Google pays a royalty of 52% of the list price of E-books sold through their platform (Cutler, 2015).
What happens with this platform therefore is that the schools buy the devices from their own funds and google supports the education of the students with softwares and appropriate tools. Textbooks can be bought through Google's platform or otherwise.

5.3.2 APPLE (iPAD)

Burlington High School in Boston provided each student and teacher with an ipad in the ipad one-to-one program. Similar program has been initiated across several high schools in the US. To raise funds to procure the devices from apple, the school eliminated the budget spending on the computer labs and also decided to forgo printed textbooks. Apple on the other hand provides access to 'iBookstore' and 'iBooks Author' where students can find and purchase E-textbooks and teachers can create interactive course materials for students respectively. The iBook reading platform is also made available to students (Apple Education, n.d.). The iBook Author allows small publishers to publish for free. The author retains rights of distribution of the document if it is created as a PDF or EPUB. However, if it is to be distributed in the proprietary '.ibooks' format, then it may be sold only through the iBooks Store (Apple, 2017). On the iBookstore, apple uses a brokerage business model. Apple pays a royalty of 70% of the selling price of the E-book on every E-book bought through the platform (Giammatteo, 2015).

5.3.3 AMAZON (KINDLE)

Amazon is mostly interested in education at the higher education and individual student level by offering Kindle E-textbook sales and E-textbook rentals more than engagements at institutional levels (Catalano, 2016). This been said, there are however few examples of use of Kindles in High Schools. Amazon kindles are used by students in Falcon High School in Colorado as part of the commitment of the school's authorities to prepare students to be global citizens. The devices are bought from Amazon by the school's authorities and issued to students. Students are however charged the market price of $139 for the

replacement of the kindle if it is destroyed due to abuse or neglect. Amazon provides the students access to the 'Amazon Education' platform where purchases of school supplies and E-textbooks can be made (Falcon, 2016).
Amazon's focus in education is not with just with selling the Kindle tablet. It has to also do with the app. In Brazil, working with an agency of the Ministry of Education, Amazon has been converting and wirelessly distributing more than 200 textbook titles to teachers in public high schools. These textbooks are to be used in the free Kindle Reading App on about 600000 government-issued tablets. The free kindle reader can run on iOS, MacOS, Windows and Android (Carrenho, 2014).
Catalano suggests that, once students are in Amazon's ecosystem, they will increasingly find their school's paid content and buy it through Amazon (Catalano, 2016). Amazon also has the option of renting out some E-textbooks for specific periods (Amazon, n.d.). The brokerage business model is also at work on the kindle platform. Amazon pays publishers royalties of between 35% and 70% (based on the price of the E-book) for books sold on its platform (Giammatteo, 2015).
Amazon offers almost the same deal with schools as Apple and Google in the US. However, in the case of outside market (as done in Brazil), they also offer the Kindle app freely to be used on other devices.

The state of the art E-textbook technical solutions and business models explored above will provide options for the selection of the technical solution and business model for this project.
In the chapter below, the ecosystem conditions in Ghana which will be vital for an E-textbook service to succeed are investigated.

6. ECOSYSTEM IN GHANA

This chapter looks at the various actors and systems that will be relevant for an E-textbook system to thrive in Ghana. This comprises human institutions that must work hand in hand, the infrastructure and legal systems that must be in place to make such a system successful. The current situation in Ghana with regards to these systems is discussed below.

6.1 STAKEHOLDERS

The stakeholders that will be important for an E-textbook system for SHSs in Ghana will essentially include the current stakeholders in the printed textbooks ecosystem. This includes the Ministry of Education (MoE), authors, publishers, teachers, parents and students. The value chain begins with authors who make their works available to publishing houses. Approval is sought from (MoE) by the publisher before the textbook can be offered on the market. The MoE through its Evaluation Coordinating Committee (ECC) takes all textbooks submitted by publishers through an evaluation process. After this, the MoE approves textbooks that meet the criteria set out in the evaluation process based on the curriculum and other factors. For the SHS level, the MoE also selects 2 of the approved textbooks for each subject and then purchases it for distribution mostly to deprived schools. Publishers of approved textbooks then start to market their books competitively. At each individual SHS level, a Textbook Selection Committee (TSC), comprising teachers and parent representatives, decide which of the approved textbooks for each subject is best for students in the school. The final stage is that parents or students buy the approved textbook which are not supplied by government but needed for their studies (MoE Ghana(a), n.d).

6.2 INTERNET CONNECTIVITY

Some E-textbook solutions, especially the web- based, requires at least some form of internet connectivity before it can work. Other solutions require internet connectivity for updating the textbooks, updating software and for accessing other services that come along with the E-textbook platform (Lee et al., 2012).
Whilst Africa in general lags the rest of the world in internet connectivity, it is bridging the gap very quickly. For instance, internet connectivity in Europe in 2005 was 19.6 times greater than that of Africa but reduced to 3.6 times in 2014 (Nyirenda-Jere and Biru, 2015). In Ghana, internet usage is mostly characterized by mobile data subscriptions. At the end of October 2016, the mobile data subscriptions in Ghana were 19,427,776 representing a 69.43% penetration rate. As shown in fig. 9 below, the number of data subscriptions in Ghana is on the

ascendancy as internet coverage continue to reach new areas and people (NCA Ghana, 2016).

Figure 9: Data subscription trend in Ghana, Jan- Oct 2016 (NCA Ghana, 2016).

With respect to coverage, the map below (see fig. 10) shows internet coverage in areas in Ghana covered by the largest voice and data service provider in Ghana, MTN Ghana, in yellow. Other service providers increase the nationwide coverage by adding onto the wider coverage provided by MTN. The penetration rate of 69.43% is because of the population distribution in Ghana (see fig. 10). Although the network coverage is less than 69.43% of the total land size as depicted on fig. 10, because majority of the population reside in the major cities in the middle and southern part of the country, that is where network connectivity is focused as well by operators.

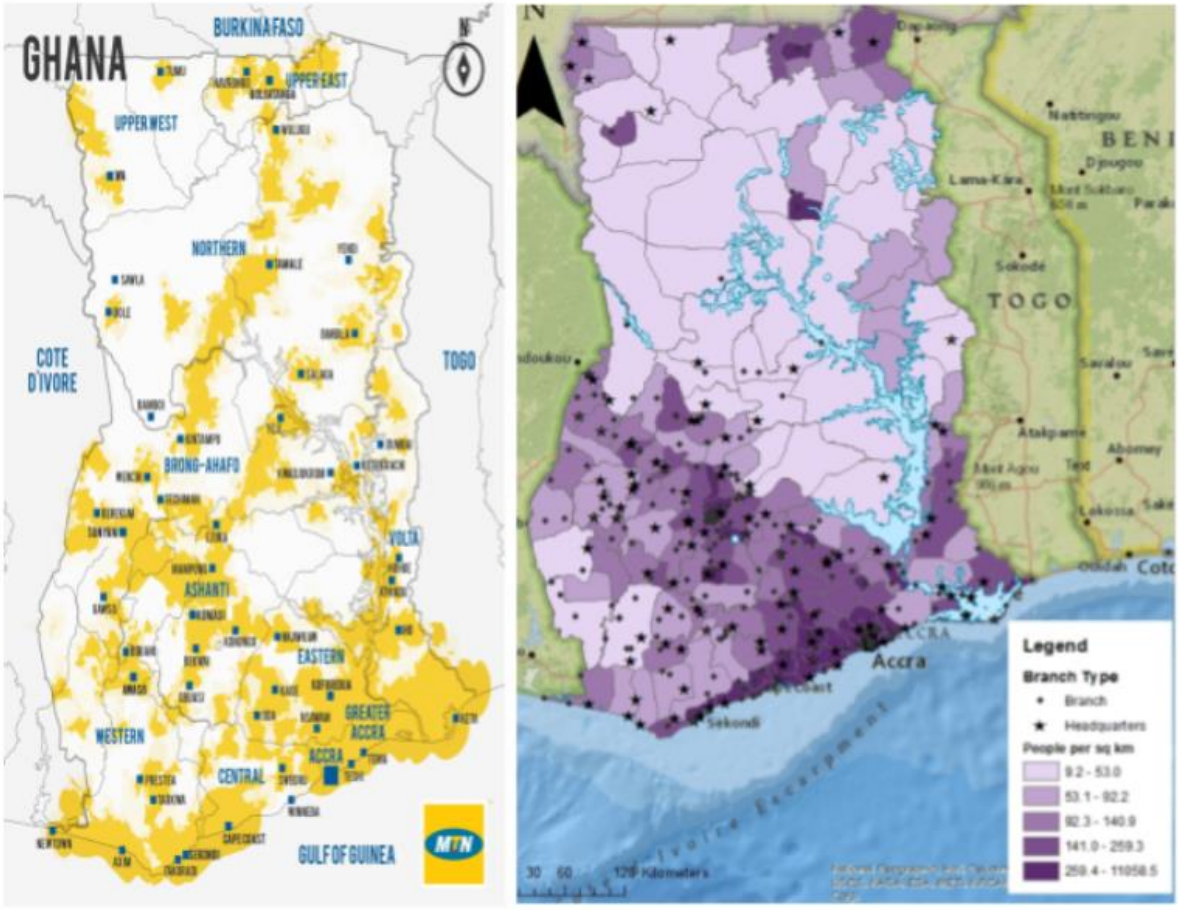


Figure 10: Internet coverage map (MTN Ghana, n.d) & Population density map of Ghana (Haverfordmfc, n.d)

At the SHS level, as part of the school connectivity project, 370 SHSs in Ghana, representing 43% of SHSs have been connected to internet by the Ghana Investment Fund for Electronic Communications (GIFEC) (GIFEC, 2016a). GIFEC plans to expand this project to include all other SHSs in the country but provides no specific time for achieving this. To reach the SHSs in the rural areas where there are no terrestrial networks, GIFEC has installed a VSAT hub in the capital of the country, Accra, with the capacity of connecting 2000 communities nationwide to the internet. Already, 100 of such communities have been connected to the hub (GIFEC, 2016b).

6.3 ELECTRICAL POWER

To fully realize the potential of any mobile device and its use in education depends entirely on electrical power and network connectivity (Goundar, 2011). It is therefore important to look into the power situation in Ghana with respect to coverage of electricity and its stability as these will be part of the determining factors for the success of an ubiquitous E-textbook service.

Ghana has increased tremendously it's electricity access from 58% of the population in 2009 to 80.5% of the population in 2016 and continues to add more people day-in, day-out (H.E. Mahama, 2016). This represents a 38.7% increase in the number of people connected to the national power grid over the period of 7 years. At this rate, it will take about 5 more years from 2016 for the country to reach 100% electricity coverage.

At the public SHS campuses where majority of students (about 77%) reside during academic semesters, access to electricity is very high. About 98% of the campuses are connected to the national electricity grid (EMIS (b), 2015).

Apart from the issue with access which the statistics proves Ghana has performed well, there is another important aspect of electricity which is vital for an E-textbook service to thrive. This has to do with the constant supply (stability) of the electricity. In the 3rd quarter of 2016, Ghana had a suppressed peak load of 1700MW and an aggregate supply 1800MW which indicated a moderately stable supply of electricity. This was after a long period of load shedding which hampered economic growth in the previous few years. Although the consumption of electricity by all students in SHS in Ghana which based on calculation will be about 25MW (Vogt, 2016) per day is insignificant compared to the peak load, it is important that there is efficient management of electricity supply wholly to enable students have access to their digital contents always.

Ghana is expected to have financial and operational stability and further improve quality in power supply by reducing technical, commercial and collection losses when the Millennium Challenge Compact between Ghana and the USA comes to full force as expected (MIDA, 2014). The power outlook for 2017 in Ghana is hinged on factors including financial and fuel supply challenges (ACEP, 2016).

6.4 DEVICES AND DIGITAL CONTENT

E-textbooks obviously require an electronic device on which it can be read. This can range from laptops, e-reader tablets, desktops, notebooks etc. (Midberry, 2011). This section looks at the access and use of digital devices by SHS students in Ghana.

The use of ICT devices (especially mobile phones) in Ghana for the whole population is growing dramatically such that for every 100 people, there are 128 mobile phones (Laary, 2016). Although some SHS students have access to personal ICT devices, there is not much in literature on access and use of such personal devices among SHS students. However, it is right placed to suggest that SHS students who mostly do not work and depend wholly on their parents for their upkeep cannot afford to buy and use mobile phones and other ICT devices. Most parents certainly cannot also afford to buy mobile phones for all

their kids in Ghana after paying fees for their education and providing other supplies (GNA, 2016).

A study by Wilson and co. suggests the use of ICT by SHS students in Ghana in schools is very low (Wilson et al., 2014). Almost all SHSs in Ghana have a computer laboratory furnished with computers which students use during ICT lessons. However, the computers in the laboratories are not enough. On the average, there is one computer for every 42 students. Students therefore have to use the computers on shift basis and this limits the time each student gets to spend in front of the computer (Ncomputing, n.d.). Furthermore, 69.2% of the computer laboratories in SHS in Ghana are closed after school hours (between 15:00 - 16:00) limiting further the access time for students (Read, 2015).

The Government of Ghana over the years is making progress in ensuring that students have access to ICT devices. The one-laptop per child policy (OLDPC) for pupils in basic schools, distribution of laptops to SHS campuses are all geared towards improving students' accessibility to ICT devices. It is however important to mention that such policies have been faced with challenges including funding which hinders their sustainability and as such students still largely lack access to devices (Asante & Ansah, 2015; GNA, 2013) .

With respect to digital content, publishers in Ghana just like most other African publishers lag behind other parts of the world. The Bellagio Publishing Network indicates that the inability of local publishers in Ghana to access credit financing and the high rates of interests on borrowing was cited by some publishers as reasons preventing them from going digital (Da Silva, 2014). There have been pilot projects by organisations such as Worldreader where a small number of textbooks by publishers in Ghana were digitized and converted to ePub format. Largely however and for commercial use, most publishers have their textbooks in hard copy (Zell, n.d.).

6.5 COPYRIGHT ISSUES

In the Internet age, concepts of intellectual property, copyright and originality are under attack due to the rampant exchange of online information. Digital technology makes copying, pasting and sharing very easy. Now more than ever, a whole generation of students have grown up to assume information just seems to be hanging out in cyberspace and doesn't seem to have an author (Trip, 2010).

In the E-book industry, students normally indulge in piracy to forgo the prices of textbooks. In the United States for instance, students normally form a community where they can upload textbooks unto the internet so that other students can download and use them for free (Strauss, 2014).

Copyright issues can delay the effective running of an E-textbook service. In China, an “e-schoolbag” project which involved the digitization of textbooks required a long time of implementation because of copyright issues (Pata and Valjataga, 2016).

In Ghana, the textbook development policy stipulates that majority of textbooks used by students in Ghana must be produced and distributed by locals (MoE Ghana(a), n.d.). The works of these locals are expected to be protected by the copyright law. Ghana’s current copyright law is Act No. 690 issued by the Parliament of Ghana in 2005. It is meant to protect various works of individuals or entities including literary works of which textbooks form part (Parliament of Ghana, 2005).

Notwithstanding this law, a number of copyright breaches still pertain. Students in Ghana tend to illegally photocopy complete books which are far too expensive for their budgets. In 2007 alone, there were more than 100 photocopying facilities operating on the campus of the University of Ghana alone. This attracted the attention of the local Reproduction Rights Organisation (RRO) pressure group ‘CopyGhana’ who viewed the practice as an infringement on copyrights and therefore called for a ‘blanket license’ for the photocopy activities (Darkey and Akussah, 2009).

In 2014, still without any license agreement, illegal photocopying still pertained on university campuses (News Ghana, 2014).

At the SHS level, information of copyright infringement is scarce. This can be attributed to the fact that students are mostly billed with the textbooks before the academic year begins and are therefore given original copies of the books in their schools (Ghana Schools Net, 2014).

The ecosystem conditions explored in this chapter will provide vital inputs into the solution for the E-textbook service. The state of the systems will determine whether the service should be provisioned to address them or not.

In the next chapter, data collected from the various stakeholders in Ghana are presented.

7. PRESENTATION OF STAKEHOLDERS' DATA

Information from various stakeholders in the book industry in Ghana were sought for to assist in the analysis. This includes facts, which were discovered as responses to either an interview or a questionnaire. Questions used for the questionnaires and interview can be found in Appendix A. Below, a presentation of the data collected from each of the considered stakeholders is done.

7.1 GOVERNMENT OF GHANA

On the part of the Government of Ghana, two separate entities were approached. First is the Ministry of Education, which is the main body in charge of overseeing the provision of relevant education to Ghanaians. As the implementation of an E-textbook service in any country depends also on available communication infrastructure, the trustees of the fund (Ghana Investment Fund for Electronic Communications (GIFEC)) intended to provide universal service and access in Ghana were also contacted.

7.1.1 MINISTRY OF EDUCATION (MoE)

At the Ministry of Education in Ghana, a questionnaire was presented to the Director of ICT as of November 2016 (Mr. Francis Avugbey) after an initial telephone conversation. The main aim of administering this questionnaire was to discover the extent of ICT development in SHSs in Ghana and the current assessment of the possibility of implementing and E-textbook solution for SHSs in Ghana.

On access to ICT devices and internet connectivity by students, it was mentioned that each SHS in Ghana has at least an ICT laboratory furnished with computers where students can access and use information at scheduled times. Three initiatives (E-learning, SEIP and E-transform) were also mentioned as providing equipped laboratories and internet connectivity to SHSs. Of importance to this research is the SEIP project where in collaboration with the World Bank, a platform (i-portal) where teachers and students can utilize multiple online resources to support teaching and learning is being created.

The director of ICT also agrees to the role teachers must play in the digital transformation of the educational system in Ghana. At this, he states that colleges of education in Ghana responsible for training teachers for SHSs have ICT incorporated into their curriculum. For teachers, already at post, several capacity building trainings in ICT are organized on regular basis for them, he indicates. Furthermore, teachers who have the intention of undertaking programs in ICT or any computer related program at the university level are also granted study leave appropriately.

With regards to the assessment of MoE on the use of E-textbooks in SHSs in Ghana, he reveals what the government intends to do. To quote him directly - “Government plans to gradually phase out the printed textbooks because it turns out to be more expensive in the long run. As I write now, learning materials in the form of text, audio, video etc. is being developed by subject experts in all 4 core subject”. He further mentions that monetary support from the World Bank and the Belgian Government has been offered to support this project on E-textbooks.
All in all, two major issues stand in the way of the use of E-textbooks for SHSs across all of Ghana according to MoE. First is the issue of copyright, which he sees as a very big challenge. He thinks adequate measures must be in place to protect intellectual property of MoE E-textbooks and that of other external publishers whose textbooks students in SHSs in Ghana patronize. Lastly, he indicates lack of countrywide internet connectivity to SHSs as another problem. However, with this, optimism was expressed with current interventions including the role of GIFEC in expanding internet access to all SHSs in Ghana.

7.1.2 GHANA INVESTMENT FUND FOR ELECTRONIC COMMUNICATIONS (GIFEC)

An interview with the Principal Technical Manager of GIFEC, Mr. Michael Takyi, was held in November 2016 to get more information on the internet infrastructure deployment in SHSs in Ghana. GIFEC is the Government of Ghana agency mandated to bridge the digital divide between the served and underserved communities in Ghana.
He underscored the role of GIFEC in providing internet connectivity to SHSs in Ghana through The School Connectivity project. With this initiative, about 370 SHSs over the country are connected to the internet. An indication was made to the fact that in rural areas in Ghana where there were no terrestrial networks, VSAT was used to provide internet connectivity. With respect to funding for such projects, it was revealed that 1% of profits of telecom companies in Ghana goes into the universal service fund that provides money for such projects. However, he mentioned that the recurrent costs will be borne by the users of the network. He further reveals that in his own experience, parents and students in Ghana do not complain about bills when they are related to ICT expenses because of the value they place on digital literacy.
In his view, the use of E- textbooks for SHSs in Ghana and the issues surrounding it can be looked at from three angles – content, readiness of end users and infrastructure. The need to put all textbooks used by SHSs in the electronic form is one aspect of the puzzle he sees as important. With respect to end user readiness, he reiterates the assertion by MoE Director of ICT that, teachers in training colleges are given comprehensive training in ICT and

therefore he expects that the transfer of such skills to students wouldn't be a problem. Finally, he sees the problem with internet connectivity and device distribution to students as just a matter of government policy. In his own words, he makes the point that – "I can tell you for a fact that, if Government of Ghana makes it a policy that it wants all SHSs in Ghana connected to high speed internet, it wouldn't take GIFEC more than 6 months to achieve that".

7.2 PUBLISHERS

Printed book publishers play a vital role in the educational system in Ghana. Although the Government of Ghana on its own publishes books for the core subjects, both core and elective subjects studied by students at the SHS level have books printed by other publishers. Two of such publishers were consulted and given questionnaires to obtain their perspective about E-textbooks. The idea was to find their willingness to go electronic, revenue method that would be preferred and their general concerns about how E-textbooks can work in Ghana.
Aki-Ola publications, which is the best seller of textbooks for SHSs in Ghana was the first to be considered. A wide range of titles (26 titles) is published by Aki-Ola for the variety of courses studied by SHS students which makes them an obvious choice to seek data from on textbooks in Ghana. Unlike Aki-Ola, Sam-Woode publications publishes only 4 titles for SHS students in Ghana. However, due to the high quality of their publications, which has earned them high reputation, administering a questionnaire there was seen to be worthwhile. The two publishing houses agreed on some issues and had some differences on other issues. A summary of their responses to the questionnaires can be seen in Table 2 below.

	Aki-Ola	**Sam-Woode**
E-textbooks have several benefits than printed textbooks and it's therefore the way to go in the near future	Agrees	Agrees
E-textbooks will reduce operational costs	Agrees	Agrees
Already have some textbooks in electronic format	No	Yes
Willing to co-exist with other publishers on an aggregate	Yes	Yes

platform		
Payment method preferred if the company goes electronic	One- time payment for outright purchase	Subscription service
Willing to invest in interactivity in their E-textbooks	Yes	Yes
Other publishers' decision to go electronic will push them to do same	Agrees	Agrees
Systems (e.g. internet connectivity) are ready for E-textbook take off in Ghana	Disagrees	Agrees
Any major general concern about E-textbooks.	Copyright issues and internet connectivity in schools	Copyright issues

Table 2: Data from publishers

7.3 STUDENTS

Being the ultimate majority users of the E-textbook platform, information from a sample of SHS students is an important input to this research. The idea was to find out which factors will be critical to their adoption and use of E-textbooks if it were available for their education.

To get a diverse perspective, 3 different SHSs in Ghana were confronted to assist in this data collection. Although authorities in all 3 schools showed initial interest in the exercise, it was only one of them (Achimota School, Accra) who eventually allowed for it to take place. Contacts in the other two schools cited a clash with other school activities as the reason for their inability to assist with the exercise at the requested period. 94 second year students from Achimota School participated in the survey. Achimota School is one of the elite mixed gender SHSs in Ghana, and therefore data from there provides perspectives from both sexes. Questionnaires were administered to them and they were to make their

choices based on a 5-point Likert scale where 1 was “strongly disagree” and 5 was “strongly agree”. The inputs from the questionnaires were assessed at the individual acceptance of technology level. As such, motivation for the type of questions was taken from various constructs that make up the UTAUT framework.

Due to lack of personal computing devices, each student was handed a printed copy of the questionnaire after which inputs were manually entered into the ‘Microsoft Excel’ software. The MEANS, VARIANCES AND STANDARD DEVIATIONS values for the various measures were then calculated and a truncated table of the data is shown in table 3 below. The full table, together with the questions for the measures can be found in Appendix A.

	PE1	PE2	PE3	PE4	EE1	EE2	SI1	SI2	FC1	FC2	FC3	PV1	PV2	PV3	ITU
	4	4	4	5	3	1	4	4	4	5	1	5	3	3	3
	3	4	5	5	5	4	4	5	4	5	4	2	4	4	3
	5	4	4	4	4	4	4	3	4	4	4	2	3	3	3
	4	4	4	4	5	4	4	4	4	5	4	4	4	4	5
	5	5	4	4	4	2	4	4	4	5	4	4	4	4	4
	4	5	4	4	4	4	4	4	4	4	4	4	4	4	2
	5	5	3	5	5	5	3	1	5	5	3	5	4	4	5
	5	5	5	5	4	4	2	4	1	5	4	5	2	2	5
	4	5	5	5	5	4	4	1	5	5	5	2	4	4	4
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	4	5	5	5	4	4	5	2	5	4	5	4	4	4	5
	5	5	5	5	5	2	4	1	3	5	4	1	5	5	5
	4	4	2	4	4	1	4	3	2	3	4	4	5	5	4
	4	4	4	5	5	2	4	2	4	5	4	2	4	4	5
	4	4	4	5	5	2	5	2	4	5	4	4	4	4	5
	5	5	4	5	5	4	4	1	4	4	1	3	3	3	5
MEAN	4.39	4.34	4.18	4.61	4.34	2.59	4.14	3.03	3.89	4.36	3.57	3.44	4.03	4.02	4.35
VARIANCE	0.3593	0.46	0.85	0.346	0.485	1.67	0.801	1.654	1.282	0.602	1.412	1.696	0.698	0.709	1.07
S.D	0.5994	0.68	0.92	0.589	0.696	1.29	0.895	1.286	1.132	0.776	1.188	1.302	0.835	0.842	1.03

Table 3: MEAN, VARIANCE AND S.D values from students’ data

The measures are linked to their constructs, which then has a MEAN value based on the measures attached to it. Fig. 11 below summarizes this for the students. The measures are the direct questions asked through the questionnaires or interview. A forward pointing arrow indicates questions in the direction of the construct whilst arrows pointing backward indicate reverse worded questions. The actual MEAN applicable for the reverse worded question is 5 minus the reverse worded MEAN.

If performance expectancy (PE) is high, it means majority of respondents are quite expectant of how the E-textbooks will provide benefits in their work.

A high Effort Expectancy (EE) implies that respondents think they do not need E-textbooks to be easier to use than they know it is now before they will adopt it.
If social influence (SI) is high, it means respondents perceive influence of others very much in their decision to use E-textbooks.
Conditions are not favourable for the use of the E-textbooks if the facilitating conditions (FC) construct or measures are high.
If price value (PV) is high, it implies respondents consider benefits of the E-textbooks over the price they have to pay for it.
Finally, intention to use is represented by just one measure which indicates students' intention to use the E-textbook system on the average.

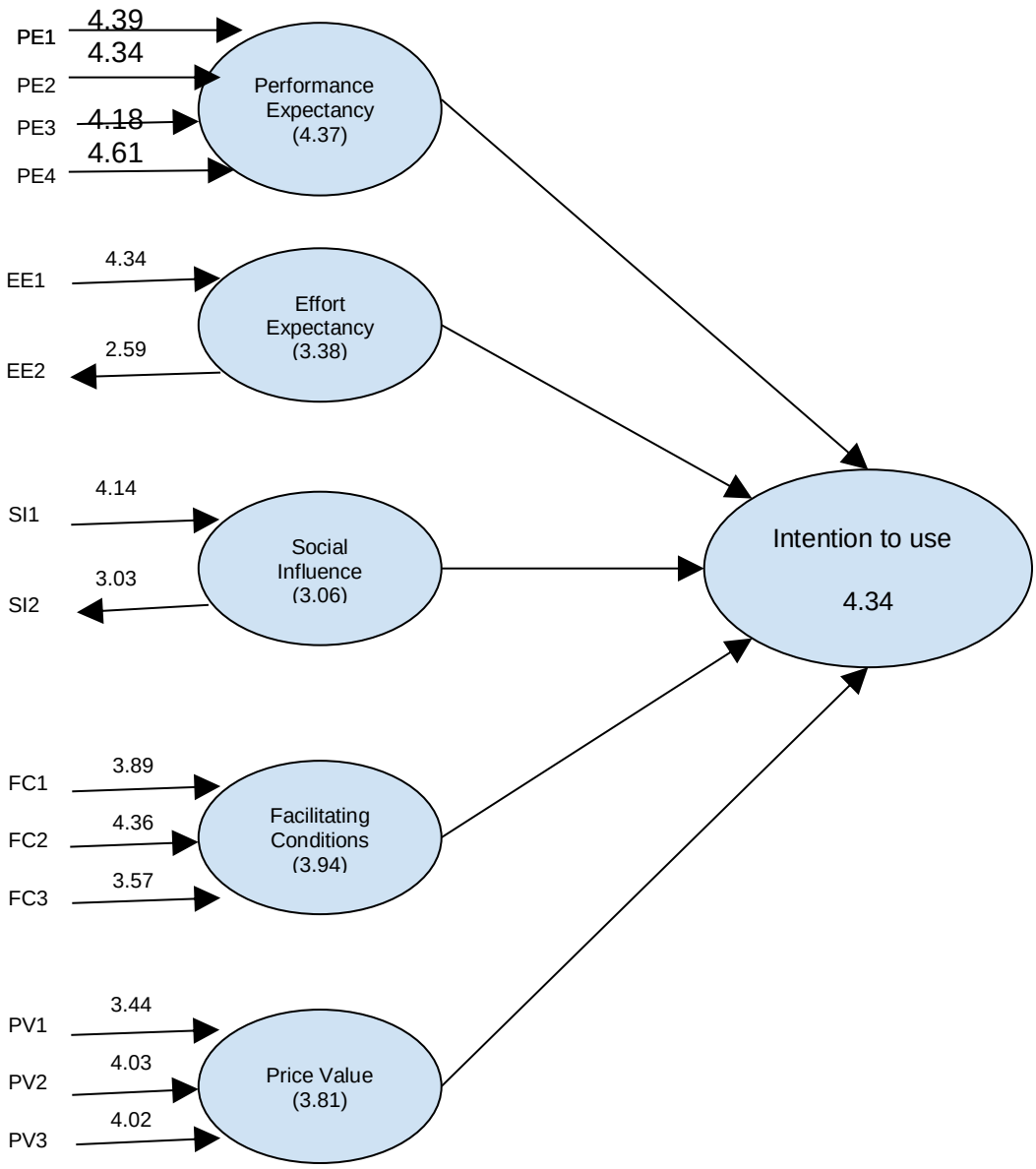


Figure 11: Combined MEANS of measures (students)

7.4 TEACHERS

When students will be required to use the E-textbook platform, teachers will be expected to patronize it as well. Factors critical to teachers' adoption and use of the E-textbooks were therefore seen as valuable inputs to this research.
10 teachers instructing different courses at Achimota School participated in the survey. Questionnaires were administered to them in the same fashion as done with the students using Likert scale, printed copies and using the Microsoft Excel to find the MEANS, VARIANCES and STANDARD DEVIATIONS. Table 4 below illustrates the data from teachers.

	PE1	PE2	EE	SI	FC1	FC2	PV	ITU
	5	5	5	5	5	4	5	5
	5	4	1	2	5	4	5	3
	4	4	4	4	5	4	4	5
	4	5	4	5	5	5	4	4
	4	5	5	4	5	5	5	5
	4	4	4	4	5	4	5	4
	4	5	4	5	4	4	4	4
	4	4	5	5	4	5	4	4
	4	4	4	5	4	4	4	4
	2	4	4	4	5	4	4	4
MEAN	**4.00**	**4.40**	**4.00**	**4.30**	**4.70**	**4.30**	**4.40**	**4.20**
VARIANCE	0.6667	0.267	1.3333	0.9	0.2333	0.2333	0.2667	0.4
S.D	0.8165	0.516	1.1547	0.948683	0.483	0.483	0.5164	0.63246

Table 4: MEAN, VARIANCE AND S.D values from teachers' data

The rules linking measures to constructs described for the students' data above also applies to the teachers' data. Fig. 12 below shows the linkages for the teachers' data.

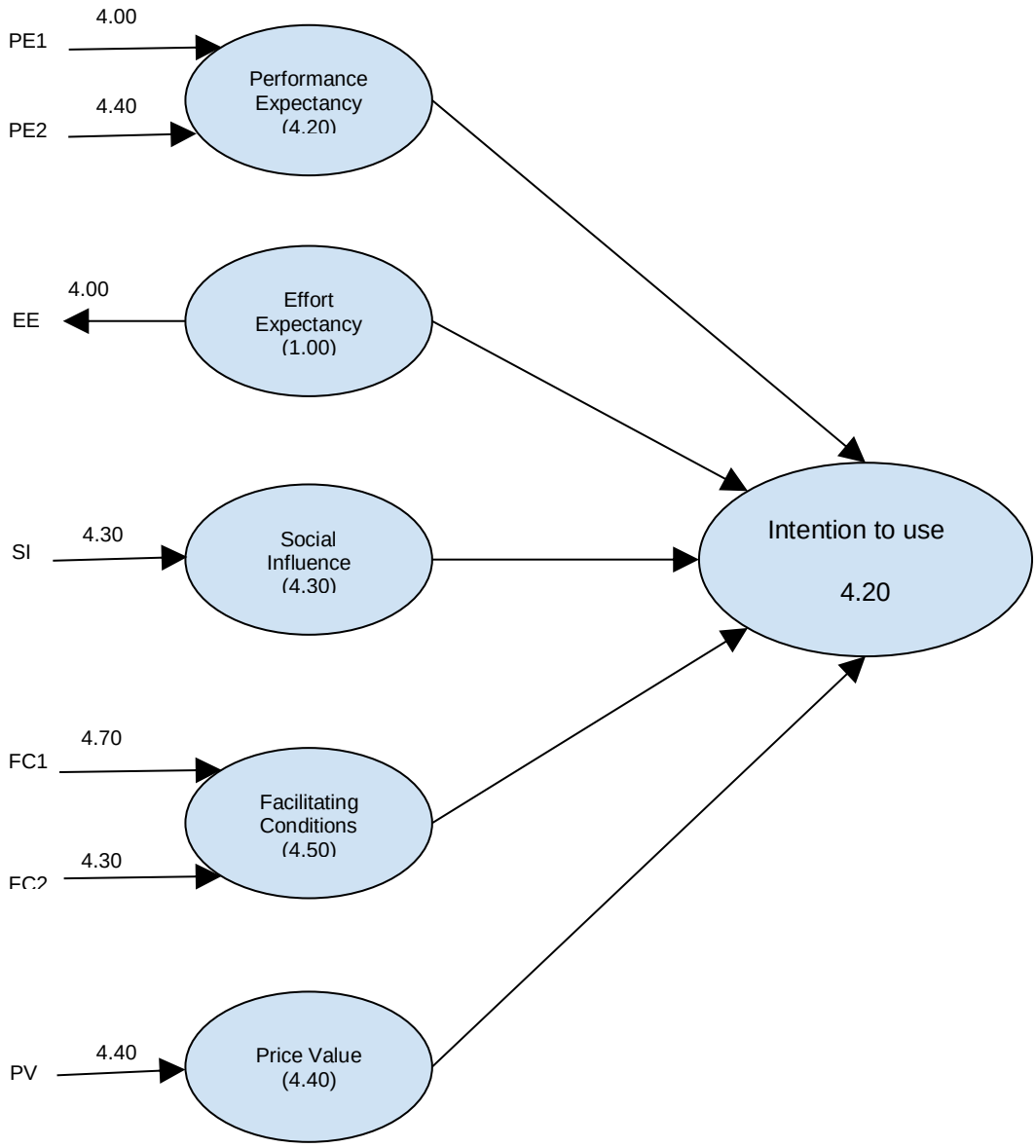


Figure 12: Combined MEANS of measures (teachers)

Now that the data obtained have been presented, it is important to analyse the data at both the individual acceptance level and wider ecosystem level. This will help in the comparison of the various technical solutions and business models presented earlier to make the optimal choices for the solution. The following chapter is where this analysis is made.

8. ANALYSIS

The analysis begins by looking at the adoption of E-textbooks at the individual level in Ghana using UTAUT based on the data from students and teachers. It is then followed by wider ecosystem adoption using DOI theory where data from government and publishers are analysed. Triangulation of data and methods is done to find the prevalent critical factors. The technical solution and business model including their requirements are also discussed.

8.1 UTAUT

The first part of this analysis looks at the adoption of the E-textbook solution at the individual level. The two groups which will be the users of the E-textbook platform are the students and teachers. Data collected from both groups based on the UTAUT model is analysed.

In the study involving students Mid-Atlantic University in the U.S.A. based on the UTAUT model, the following hypothesis were made:
(i) Performance expectancy, Effort expectancy and Facilitating conditions were assumed to have positive impacts on users' intention to adopt E-textbooks.
(ii) Social influence was assumed to have no influence on users' intentions (Yoh and Roh, 2016).
A separate paper also hypothesized Price Value to have positive impacts on behavioural intentions (Venkatesh et al., 2012).

It is clear from the results from the data in the sections 7.3 and 7.4 that all five (5) constructs of the UTAUT model will influence the decisions of both students and teachers. This confirms all the hypothesis made in the two previous papers except for the Social Influence construct which was hypothesized to have no influence on user's behavioural intentions. It is however important to point out that some constructs have a higher influence than others as the calculated MEANS show. Below, results from students and teachers are analysed in detail separately and the common grounds between both groups illustrated.

8.1.1 STUDENTS

On the average, the students who took part in the survey indicated an approximate 87% intention to use E-textbooks if it is an option for their studies in future. On the scale of 5, PE was shown to be the construct which was very critical to students in terms of their adoption of E-textbooks. This means that majority of the students are quite expectant of how E-textbooks will provide benefits in their education and enhance their academic performance. The four

measures that make up the PE construct has to do with: PE1- enhanced productivity, PE2- speed of task completion, PE3- use of the platform for other services apart from reading and PE4- expectation of interactivity in the E-textbooks.

Although all four measures had an average of over 4 on the 5-point likert scale, expectation of interactivity had the highest value.

The data reveals that only an average of 2.59 represents the need for training for students before they can use E-textbooks(EE2). Whether they require training or not, EE1 shows that an average value of 4.34 stands in for students who are positive that it will be easy for them to use E-textbooks. This implies that majority of the students do not need E-textbook technology to be easier than they currently know it to be before they will adopt it.

SI had the lowest comparative average amongst the five constructs in determining SHS students in Ghana's behavioural intention towards the adoption of E-textbooks. Although having a 3.06 average value on a 5.0 scale, the students didn't generally perceive the influence of people around them (especially fellow students) in determining their adoption of E-textbooks. This been said, however, specifically, the students are more likely to be influenced by the recommendations of their teachers and parents as revealed by SI1 with a MEAN of 4.14.

On the average, many of the students think conditions in Ghana are not ripe for the takeoff of an E-textbook service. This is indicated in the MEAN value of 3.94 representing their take on the facilitating conditions (FC). More so, an average value of 4.36 representing FC2 shows that students see internet connectivity as a condition that will restrict the effective use of E-textbooks in Ghana. Not as worrying as the internet connectivity issue, an average value of 3.57 represents the belief by the students that there will be a lot of copyright issues (illegal copying and sharing) if textbooks are made electronic.

For the final construct of price value, the students are less price averse- putting the benefits of the E-textbook technology above what they would have to pay to use it. For instance, average values of 4.03 and 4.02 represents students' agreement to pay more for interactivity in E-textbooks and their willingness to pay to keep the E-textbooks after their SHS education respectively.

An important factor worth noting is that most data points are clustered around the MEAN for the measures. The data follows the normal distribution rule with approximately 95% of the points within two standard deviations about the mean for most measures.

8.1.2 TEACHERS

According to the results from the teachers' survey, there was an 84% intention to use an E-textbook service to help in classroom work.

With the teachers, all the constructs had an average value of 4.00 or over on the 5-point scale.

The teachers think an E-textbook platform will make lessons very effective. They also believe it will be a helpful medium where students can even be assessed and their grades sent to them through the same platform as well. For this reason, average values of 4.00 and 4.40 were obtained respectively for both measures.

The degree of ease of use, signifying the effort expectancy (EE) is revealed to be 1.00 on the average for the teachers. This is because on the average 4.00 is the value that represents the view that the teachers think they will require some form of training before they can use E-textbooks.

SI has a high average value of 4.30 because majority of the teachers agree with the idea that the use of E-textbooks by other colleague teachers will influence them to use it as well.

Just like the students, the teachers are also of the thought that facilitating conditions for an effective E-textbook service are not ready in Ghana. MEAN values of 4.70 and 4.30 represent their worry about internet connectivity and copyright issues.

Teachers also put the benefits offered by an E-textbooks platform over the cost involved. This is indicated by the average value of 4.40 for the price value construct (PV).

Data points from the teachers' data are also clustered around the mean for the measures and follows the normal distribution rule, thus approximately 95% of the data points are within two standard deviations about the mean.

8.1.3 FACTORS CRITICAL TO BOTH STUDENTS AND TEACHERS

Both students and teachers indicate readiness to accept an E-textbook platform if it's available. However, as analysed above, either group has factors they deem critical to their acceptance. These factors can be issues on the grounds they believe should be resolved first or the factors are features they expect from the E-textbooks and the service in general.

Below, a summary of the critical factors to either group can be seen in Table 5, with factors common to both groups indicated in 'red'.

STUDENTS	TEACHERS
Interactivity (text, audio, video)	Training before use
Influence of teachers and parents	Influence of colleague teachers
Internet connectivity	Internet connectivity
Copyright issues	Copyright issues

Table 5: Factors critical to adoption by students and teachers.

8.2 DIFFUSION OF INNOVATION

When an organization adopts an innovation they are frequently adopted due to two types of innovation-decisions: collective innovation-decisions and authority-innovation decisions. The collective innovation-decision is when the members of the social system agree to adopt the innovation. The authority-innovation decision occurs when a few individuals with prominent positions of authority within an organization chooses to adopt or reject the innovation. Within an organization, these individuals are named champions who supports an innovation and eliminates resistance (Rogers, 2003). In the case of E-textbook adoption, an educational system will adopt an innovation when an authoritative decision is made to accept this innovation (Cartwright, 2015). In Ghana, this decision will have to be made at the Ministry of Education as part of the ICT policy for teaching and learning. The lead potential champion is the director of ICT at the Ministry of Education whose role is to formulate and recommend policies for ICT in the educational system of Ghana (MoE Ghana(b), n.d). Publishers will also need to be on board to facilitate the switch from printed textbooks to E-textbooks.

Considering the opinions offered by the director of ICT at the Ministry of Education of Ghana, it is easy for me to put him at the 'persuasion stage' of the 5 stages of innovation-decision outlined by Rogers.

The three main reasons agreed by Cartwright as the reasons for an innovation to be adopted is also confirmed by the results of the data from government and publishers in this research. The reasons of relative advantage, compatibility and complexity- where an adopter must feel there is relative advantage of an innovation over what precedes it, that an innovation is compatible with their ideas and values as well as local technical and performance standards and finally that an innovation must be seen to be easy to be used (Cartwright, 2015) are all revealed in table 6 below, according to the data from government and publishers.

	Data from Government and Publishers	Critical factor(s) inferred
Relative advantage (*advantages over previous solution*)	Government: ● Government plans to gradually phase out printed textbooks because it turns out to be expensive in the long run. Publisher(s): ● E-textbooks present benefits in easy updating, environmental sustainability and reduced operational cost.	● Cost reduction
Compatibility (*cultural norms, values, technical and performance standards*)	Government: ● Government will not support a platform that may not be corresponding to the curriculum, syllabus and cultural setting in Ghana. ● Most SHSs in Ghana do not have internet connectivity and that is one of the factors that will affect E-textbook usage. Only about 370 (43%) of SHS have some form of internet connection.	● Cultural compatibility ● Internet connectivity ● Copyright issues

	● The Ministry of Education is concerned about the protection of the digital rights of local publishers and already talks are ongoing on how to best to do this in the digital space. Publisher(s): ● We are concerned about copyright issues and how our work can be protected by any platform.	
Complexity (*ease of use according to standard of users*)	Government: ● Training in ICT are being organised for teachers to enhance their skills at least to the level where they can understand basic computing skills for teaching and learning. ● Students do not have their personal devices but use computers provided in ICT laboratories periodically and this limits their ICT skills. Publisher(s): ● We would like to see transactions	● Ease of use of platform ● Reliability of transactions on platform

	less complicated and tracking of sales easily done from the platform.	

Table 6: Factors critical to government and publishers

8.3 TRIANGULATION OF DATA AND METHODS

In this section, triangulation of data and methods is done to confirm the most prevalent factors necessary for an E-textbook service in Ghana. The UTAUT constructs of 'performance expectancy (PE)' and 'effort expectancy (EE)' relate to the DOI theory constructs of 'relative advantage' and 'complexity' respectively (Jung et al., 2012). In the same way, the 'facilitating conditions (FC)' construct of UTAUT has similar relation with the 'compatibility' of the platform with values and norms as well as technical and performance standards as revealed by the analysis using the DOI theory.

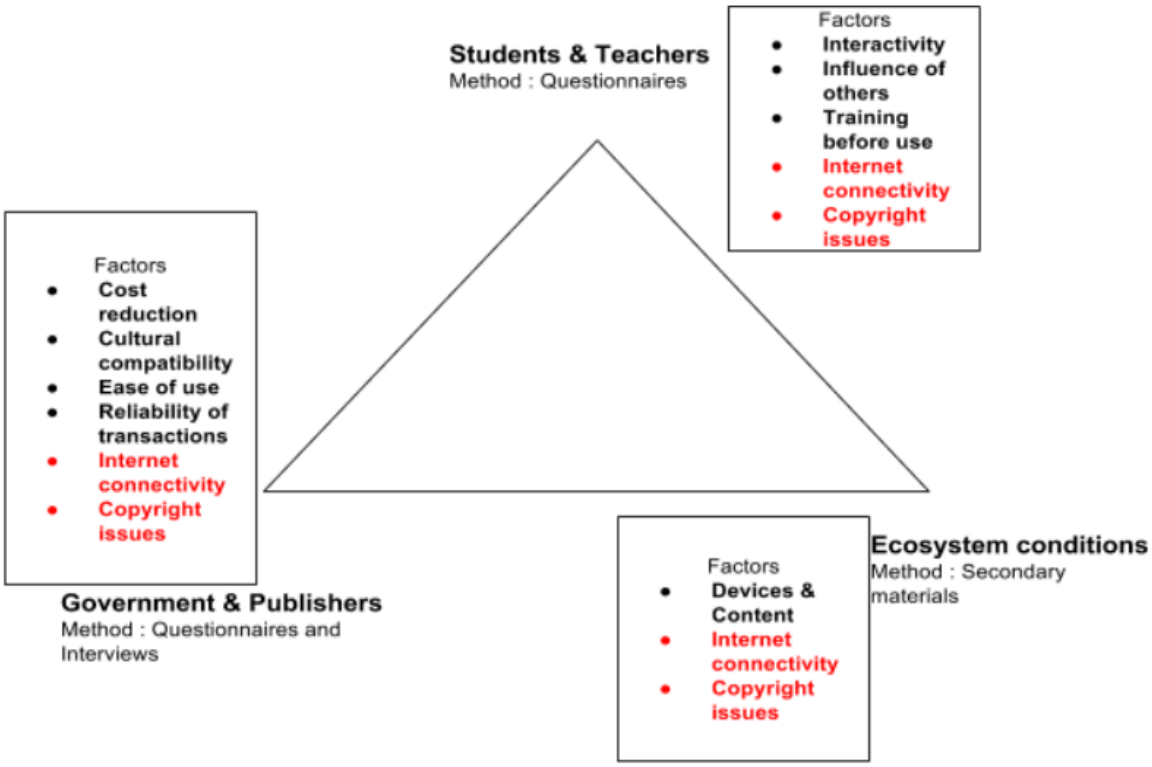


Figure 13: Triangulation diagram

Fig. 13 above outlines the factors which are critical to stakeholders in Ghana in relation to E-textbook adoption. It also shows the conditions of the ecosystem in Ghana. The factors above will be part of the determinants of the technical

solution as well as the business model to be chosen as suitable. Although each section of the triangle has its own factors, two of the factors indicated in 'red' colour (internet connectivity and copyright issues) are prevalent across all 3 sections. These two factors are hence the most critical and as such will play a key role in the choice of the solution and also will influence the system and business model designs more than the other factors.

8.4 TECHNICAL SOLUTION

The state of the art portrays that the technical solution of an E-textbook can be web-based, reading software based or device-based. But before that, it is important to indicate why an Open Educational Resource (OER), whilst been free, will not be the optimal solution for students in Ghana. There is no doubt solutions such as CK12 (connect kindergarten to 12th grade) offer rich content for high school students and teachers. It also has the benefit of coming at almost no cost which one would consider a vital factor for a developing country like Ghana. Nonetheless, other factors rule out the likelihood of an OER solution to succeed in Ghana. Firstly, because Ghana has a textbook development policy which stipulates that majority of textbooks used by students in Ghana must be produced and distributed by locals (MoE Ghana (a), n.d.), it presents a stumbling block for solutions which are fully foreign. This is not in line with the development of textbooks for the CK12 platform where the content is generated and published by experts in the US. Another factor has to do with cultural compatibility. As indicated already, the Ministry of Education is not ready to accept and work with any solution which does not embed the culture, curriculum and syllabus of Ghana's education especially at the lower level. Whilst platforms such as CK12 and OER Commons are expected to contain rich educational content, issues relevant to the US economy which would form the bedrock of some of the courses for high school textbooks will not be the same issues relevant to Ghana.
With these factors, it is expected that an E-textbook service for students in Ghana must be a novel solution tailor-made for Ghanaian students. The situation favours more of a locally managed platform. This is not to say students are prevented from having access to and reading from other foreign materials. Rich foreign materials can serve as supplementary materials to students. However, in order to follow the local curriculum and pass exams organised for students in Ghana, students must use local materials. Below, discussion about why the novel service must be a web-based, reading software-based or device-based is done.

8.4.1 WEB-BASED

Web-based solution has the advantage of being accessible by any device with web browser. Because most students in SHSs in Ghana do not already have their own digital devices (see section 6.4), this advantage presented by the web-based solution is limited. Further to this, internet connectivity which was seen as a major issue across all data sources (see fig. 13) is quite needed for the full operation of a web-based service, especially if the system will require students to read on the website. However, students can improvise the use of web-based solution by downloading sections of textbooks they will need for later use for a period that they have access to internet. More than half of SHS campuses in Ghana do not have internet connectivity at all and the outlook in the next years is not very well defined (GIFEC, 2016a).

8.4.2 READING SOFTWARE BASED

The reading software solution shares most characteristics with the device-based solution which will be discussed in the next section except for the fact that the software in software-based solution must be tailor made to read only file formats of the E-textbooks published on the platform. This means that the software cannot be used to read any other files (e.g in PDF) obtained from another source. Students will still read using a PDF reader or ePub reader for such files. The reading software solution is therefore not foolproof as students will sometimes require the use of other general reading softwares. Another disadvantage to the software based solution is that if the Government allows every student to bring their own devices, the proprietary reading software will have to be made for each of major operating systems. Whether the reading software will be developed from scratch or obtained as a license, it will add to the cost of the system unlike PDF and ePub which are free.

8.4.3 DEDICATED DEVICE BASED

With dedicated-device solution, students can be handed the devices at the beginning of their studies with the appropriate E-textbooks already downloaded to it or they can use an in-built software to connect to a digital platform to download the required E-textbooks for the academic year.

A dedicated device solution has an advantage over web-based and reading software-based because of the uniformity in file format and operating system as mentioned earlier. A dedicated device and file format will also make it easier to deal with copyright issues when devices and their owners can be easily identified. As already discussed in state of the arts, implementations of E-textbooks in the US have mostly involved the issuance of one brand of device to all students of a whole district (see section 5.3). In the case of Ghana, all

students can be considered a whole district with no significant difference in their study environments.
The internet connectivity problem with the web-based solution also has effects on the device-based solution. The problem with the device-based solution has to do with software update. An option to deal with this will be to hand USB keys containing the new software version to students. This same USB key can contain the textbooks needed by each student for a particular academic year. The downside of this will be the additional cost of USB keys which can be easily misplaced by students in High Schools.
A better solution will be to set up internet hotspots at schools without internet at the beginning of the academic year. This way, students can visit the platform holding the E-textbooks and make purchases and downloads to their devices. The same way, all updates to the software which will be used for reading and other study related activities can be downloaded. It is important to state that whilst the setting up of hotspots in some of the schools without internet access comes at a cost just like handing out USB keys, connecting the devices of the students to the internet once a while will be good for the general health of the devices and platform used. It will also enable the platform administrator collect usage information from the devices in order to add the right features to future versions.

8.4.4 THE SOLUTION

How devices will be provided for the students will determine which of the solutions fits best. If the Government makes it a requirement that students should bring their own devices, then a web-based solution will be the right option. In this case, students will got to the platform (either directly to the website or through an application), purchase and download E-textbook type (ePub) that matches their device's operating system, see section 8.4.1. The choice of ePub as reading software is made in design section 9.1.
If Government intends to provide devices for all SHS students, then a device-based solution will fit. Here, students will all use the same operating system and therefore there will be only one file type. They will still go to the platform and all download one E-textbook file type to their devices after purchasing, see section 8.4.3.
Finally, if the Government decides that students who already have devices should use it and then the Government provides devices for those who don't already have, then a web-based solution still fits.
Students should be able to read E-textbooks as part of the service. In all cases, the reading of E-textbooks on the system must be possible in offline mode because of the internet connectivity problem which makes the choice of ePub for

reading a viable option, see section 5.2. The service must have an application only through which the ePubs downloaded from the platform can be read on user devices. This application must also allow other documents (for instance) PDFs obtained from other sources to be read through it because these present no direct negative impact on the platform business. Administrator should be able to assign, revoke and reassign rights to users. This is especially important when after the three (3) year SHS period, a student decides to discontinue using the platform. In this case, all E-textbooks the student purchased must be downloadable in a format which is readable on his/her normal device without needing access to the platform reading software.

On the side of the publishers, the service must allow publishers to publish their textbooks electronically on the platform's website. This will enable all the E-textbooks on the platform to have a unique standard. The service must also allow publishers to offer their E-textbooks for sale. There is a direct interaction between the publishers and the students. This can be in a publisher offering package deals to students. In a similar way, there is an interaction between the publishers and government in the area of curriculum dissemination and content approval. The role of school authorities in passing on purchased textbooks to students and remitting payments to publishers as shown in fig. 2 and fig. 3 will be eliminated by this multi-sided platform. The service is depicted in fig. 14 below.

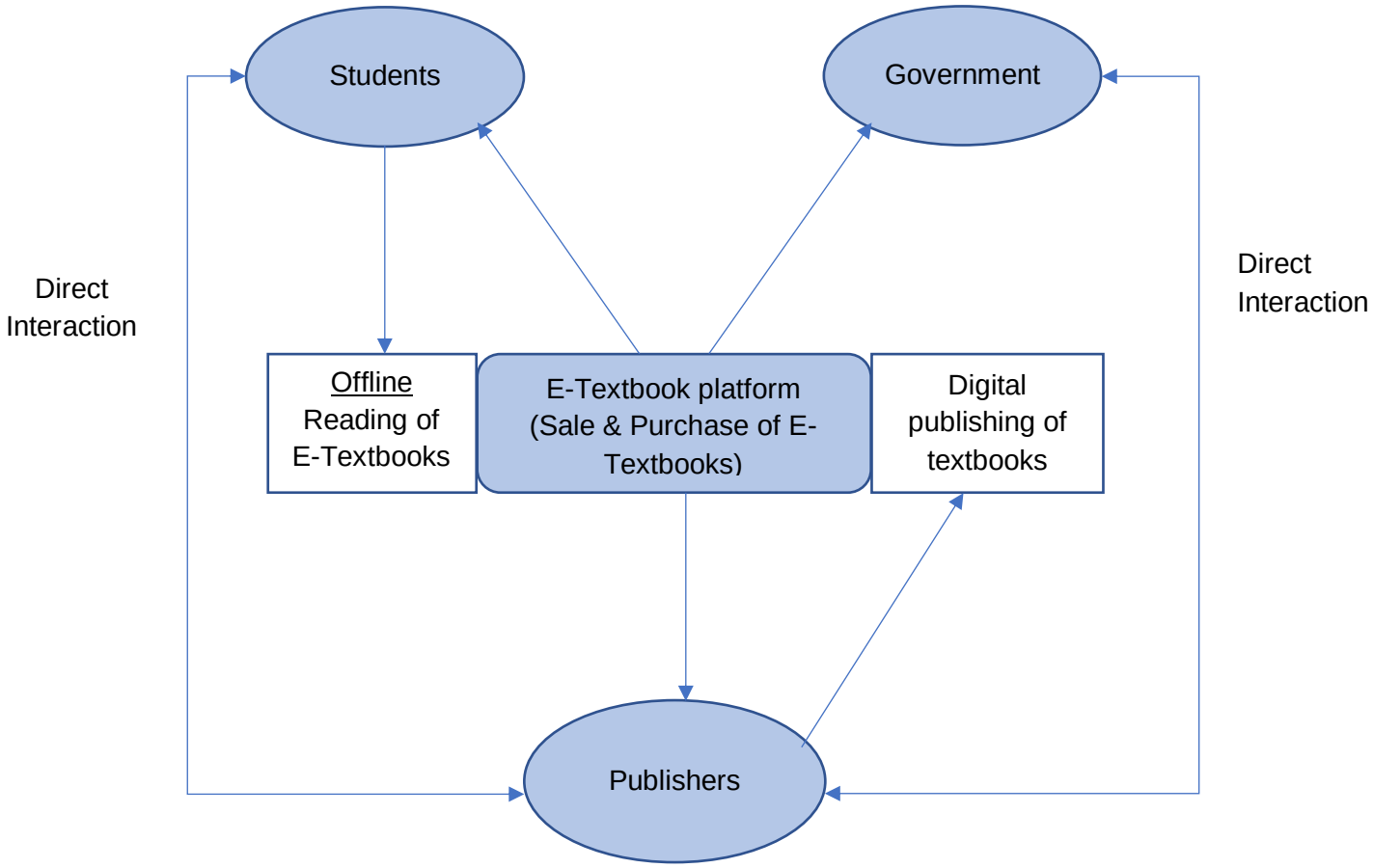


Figure 14: E-textbook platform solution

Because of the uniformity in the educational system in Ghana (see section 1.4) this project recommends and is delimited (see section 1.3.3) to the case where government supplies devices to students and hence follows the dedicated device solution from this point. It is however acknowledged that the web-based solution may also be an option depending on the device provision method.
Now that a decision has been made to use a dedicated-device solution, it is important to look at some of the requirements of the E-textbook platform, device and contents that will apply to this solution.

Below, the requirements specification for the platform, device and contents for the E-textbooks solution is described.

8.4.5 SYSTEM REQUIREMENT SPECIFICATION

The result of the analysis stage is a list of requirements necessary to build an ideal E-textbook solution. In table 7 below, the list of requirements are specified and prioritized. First, the functional requirements describing what the system should do are stated. These functional requirements (attached with F in table 7) will form the basis for developing possible use-cases of the system in the design chapter and are therefore all given a priority of '1'. Non- functional requirements (attached with NF) indicating how the system works are also listed in table 7. Some of the non-functional requirements will determine which operating system fits best for the system. However, other non-functional requirements relating to security, maintainability, reliability etc. are not part of the delimitation of this project, see section 1.3.3. Some of the items on the list for non-functional requirements are from the critical factors which were common to the various data sources (see fig.13) and as such are given a priority of '1' on the simple ranking scale used. Other items are critical to a group of stakeholders but not all stakeholders. Some general E-textbook requirements are also included. These requirements are given a priority of '2' or '3' depending on whether they relate directly to learning support (priority 2) or not (priority 3). This project will deal with requirements with priority '1' and '2' in the design section.

No.	Requirement Description	Reference	Priority
0	Users will be required to log into system (F)	Discussed below table 7	1
1	The system shall	See section 8.4.4	1

	enable publishers to publish their textbooks electronically (F)		
2	The system shall enable published E-textbooks to be offered for sale (F)	See section 8.4.4	1
3	The system shall allow students to purchase E-textbooks (F)	See section 8.4.4	1
4	The system shall allow students to download E-textbooks (F)	See section 8.4.4	1
5	The system shall allow students to read E-textbooks purchased through the platform(F)	See section 8.4.4	1
6	The system shall allow students to read other E-textbooks obtained from other sources (F)	See section 8.4.4	1
6	Reading of textbooks on the platform must work with or without internet connectivity (NF)	See section 8.4.3	1
7	Textbooks sold through the platform must be accessible on devices only if user is authorized	See table 5 and table 6	1

	to use it (NF)		
8	The file format for the E-textbook files must be able to embed interactive and media components (NF)	See table 5	2
9	Publishers must be given real time updates of transactions concerning their E-textbooks on the platform (NF).	See table 6	3
10	The device must have a minimum storage of 1.5GB	Discussed below table 7	3
11	Battery capacity should be enough for a minimum of 8 hours learning session.	Discussed below table 7	3
12	The reading software must allow for text search, underline, highlight, add and delete notes (F)	See table 6	2
13	A student must be the only one who has access to E-textbooks he/she purchased (NF).	Discussed below table 7	3

Table 7: System Requirement specification

Some of the requirements in table 7 above are general requirements seen as necessary for the E-textbook service. For instance, for any digital system, identity management is a key requirement. Hardly will any publisher or student get on board if there are no digital rights system in place.

The storage capacity of the device must be able to hold all the E-textbooks required for the 3-year SHS education period. With a maximum E-book size of mostly 20MB (Kudler, 2015) and 8 E-textbooks each with a past question book (making 16 E-textbooks in total) required for each year of the 3 years sums up to about 960MB storage space needed for the E-textbooks. An overhead of about 50% for unforeseen downloads gives a total storage space of close to 1.5GB.
Because students will be using the device for classroom studies and personal learning, adequate battery capacity is essential. The battery must sustain the learning activities of the students for the daily 8-hour school period (see section 1.4). Students can then charge devices when they close from normal school hours and return to their dormitories.
Privacy is a problem in this digital age. With respect to E-textbooks, the platform must be able to secure student's reading materials which they might have highlighted or made important notes to. No other person must have access to E-textbook files purchased and probably read by another student.

Other authors have looked into the requirements of E-textbooks.
Evaluating the requirement specification of E-textbooks, Nakajima and co. looked at the functions required on E-textbooks and the behaviour on six different platforms. They considered 52 requirements in 7 categories. The functions were implemented with the ePub format which is going to be one of the de-facto standards of E-books. Many ePub readers support only representation in ePub2 format. The ePub format is an open format so a publisher or reader need not pay any royalty fee. The results were verified on the windows, iOS, android and kindle linux operating systems. The results showed that iBooks3 on iOS worked best among the six E-book readers (Nakajima et al., 2013). The evaluation results of the 52 requirements can be seen in Appendix A. The requirements for the E-textbook platform of this project is related to the requirements found in the evaluation of Nakajima and co. in the design chapter.
The following section looks at the business model including applicable revenue models and business requirements for the E-textbook service.

8.5 BUSINESS MODEL

Here, the requirements of the business model for the E-textbook platform in Ghana is looked into. Further to this, the revenue models applicable to the platform for its operation in the Ghanaian context is discussed.

8.5.1 BUSINESS REQUIREMENTS

The requirements of the business is made up of choices and elements that will make the E-textbook service workable in Ghana. Inputs to the requirements

come from the ecosystem conditions, critical factors to stakeholders and other general measures necessary for the sustainability of the business. First, it is important to mention that this project looks at the platform for the sale of the E-textbooks between publishers on one side, and Government of Ghana and students on the other side. It also considers collaborations that will provide software and internet support for the use and download of the E-textbooks. This is the core mandate of the business. However, this does not rule out the possibility of having additional services as the platform evolves.

A strong prerequisite to this business model is the availability of devices to SHS students in Ghana. Implementation will only happen if students have devices. It is expected that the progressive interventions of the Government of Ghana (see section 6.4) will at some point sufficiently provide devices to all students or parents can be made to buy the devices for their wards.

Another requirement has to do with the textbook development and distribution policy of Ghana (see section 6.5). The policy stipulates Ghanaian participation in the writing, printing and selling of textbooks used by students in Ghana. In particular, it is required that local booksellers take up the distribution of textbooks. It is expected that in the era when textbooks go digital for students, this policy will still apply and therefore the platform will have greater reception if managed by a Ghanaian.

As discussed in introduction (see section 1.1), talk of E-textbooks and one of the things that comes up is the cost savings it presents. It will be required that the prices of E-textbook on the platform are lower than their printed versions.

One of the important things to the Government of Ghana regarding textbooks is the cultural compatibility of content, see table 6. Because there are already local publishers who have content that portray the values, culture, social and other aspects of Ghana, it is relevant for the platform to get involved with these local publishers.

The platform will require a Government of Ghana policy making it mandatory for students to use electronic textbooks only. This way, the platform is assured of having mass market of SHS students. This will also limit the incentive for people engaging in secondary markets because every student will have to pay for their school's selected textbooks at the beginning of the academic year.

Support is essential for the service to work. Because it will be necessary to protect the works of publishers from copyright infringements, partnership with the operating system company will be vital. Providing internet support for schools without access at the beginning of the academic year is also required for the success of the platform. To this effect a partnership with a mobile network operator is necessary.

As seen in table 2 above, the two publishing house representatives made separate preferences for either a one-time payment or a subscription service for the students. However, because school authorities can select different publishers for different courses (see section 1.4.1), it will be cumbersome to work out a subscription model for a group of publishers that students of a particular school patronize. This is especially difficult because the system will be generally new to publishers in Ghana. It is therefore required that students buy each e -Textbook on a one-time payment basis.

Because most local publishers in Ghana largely do not have their textbooks in digital format (see section 6.4), the platform will be required to assist publishers to digitize their textbooks and standardize them as well. This is based on the fact that the usage of the ePub format is free and as such the cost of digitization will be so low.

In order to diversify the revenue sources and make the platform business sustainable, other services can be provided for students. Although the initial cost of producing the first copy of an E-textbook can be high, the marginal cost of reproducing subsequent copies is very low. Large scale advantages associated with information goods can lead to easy reproduction and distribution of copies and possible price competition if there are competitors in future. This will drive down prices of E-textbooks. Although reproduction cost of copies also goes down, the platform must find other ways of extracting value. Going forward, alternate sources of revenue can be obtained by leveraging the data of the users. Apart from the purchase of E-textbooks, the platform can also be used as the medium of transaction of other products. Sellers of other products can be connected to a customer base of SHS students through the platform.

It will be in the interest of the platform operator to have a strategy of keeping the students on the platform even after their 3-year SHS education. This will present the students the opportunity of having all their textbooks at one location and the platform will also benefit and can expand because students will most likely buy all other books for further education through the platform. The platform must be provisioned to be a long-term service for the students in their High school, University and even in their adult life.

Table 8 below summarizes the Business Requirements. The requirements which are related to the core platform business model of E-textbooks are given a priority of ‘1’. Requirements which are not part of the business model of the platform operator but are processes and systems which must be in place before the implementation of the platform are given a priority of ‘2’. Finally, requirements which will be part of the business model of the platform but not at the start of the business and which will hence not be part of the current business model design in the next chapter are given a priority of ‘3’.

No.	Business Requirement Description	Reference	Priority
1	Devices must be available to students either by Government provision or the students are billed with it.	Section 6.4	2
2	A Ghanaian citizen should be significantly involved in the platform operation.	Section 6.5	1
3	E-Textbooks on the platform must be less expensive than their printed versions.	Section 1.1	1
4	E-Textbooks on the platform must represent the cultural and general social and economic setting of Ghana.	See table 6	1
5	A Government policy making the purchase and use of E-textbooks by SHS students must be in place.	Discussed in section 8.5.1	2
6	One -time payment system should be the sale option for the E-textbooks on the platform.	Discussed in section 8.5.1	1
7	The success of the service will require partnerships with a mobile network operator and software	Section 6.2 & section 6.5	1

	company.		
8	Platform should assist publishers to digitize and standardize their books.	Section 6.4	1
9	Alternate sources of revenue such as the sale of other products must be obtained from the platform.	Discussed in section 8.5.1	3
10	The platform should have a strategy of locking-in students even after their SHS education.	Discussed in section 8.5.1	3

Table 8: Business Requirements

8.5.2 REVENUE MODEL

The business models described about the use of chromebooks, ipads or kindles in High school (especially in the US) follow almost the same pattern. They follow the same pattern in terms of their revenue models with slight differences, see section 5.3.

With respect to Asset sale, both Apple and Amazon offer ipads and kindles for sale to schools. Google on the other hand allows other device makers such as Acer, Samsung, LG, HP etc. to produce the chromebooks whilst Google deals with the operating system and software.

All three (Google, Apple and Amazon) run platforms on which E-books can be sold and bought. Google has the Google Play platform on which E-textbooks can be published and sold by authors and publishers. Similarly, Apple and Amazon have iBookstore and the kindle E-book store respectively. As platforms, they all run a brokerage business model where they pay royalties to publishers and have the remainder of the selling price of the E-books as their commission. There is also the possibility of renting out E-books and E-textbooks to readers for usage for a short period.

The sale of the device will not form part of the revenue stream of the business model of the E-textbook operator. As such the revenue model of asset sale practised by major players in the E-book industry will not apply to this platform.

Because students will require access to E-textbooks they need for each course for most part of the academic year (see section 1.4), renting out the E-textbooks

to them for short periods of few months will not serve the interest of the students well. The renting revenue model therefore does not also fit very well in this case.
The platform will be a multi-sided platform where the operator will earn commissions on E-textbook sales. This is because the operator has no rights over the textbooks and therefore the viable choice for revenue generation from the platform will be the brokerage model. The platform operator will make a commision on the one-time payment of each E-textbook purchased by students on the platform.
Other revenue sources are possible after operating the platform for some time. For instance, data obtained from the students' can be of great value to the platform operator to access other business possibilities. However, this project doesn't consider such secondary business opportunities.

The analysis extensively shows which factors are important to the stakeholders in Ghana. It has also revealed which technical solution is feasible based on conditions that will prevail in the delivery of devices to students. The revenue stream applicable has also been reached. The next step is to work on the requirements produced from the analysis.
Aspects of the design of the system and the business model design are contained in the next chapter.

9. SYSTEM & BUSINESS MODEL DESIGNS

The discussion and selection of operating system and reading software best suited for the E-textbook service in Ghana begins this chapter. UML use case, activity and sequence diagrams focusing on protecting the copyrights of publishers then follows. The chapter ends with the design of the business model using the business model and value proposition canvases.

9.1 OPERATING SYSTEM AND READING SOFTWARE

As discussed in section 8.4.4 above, several requirements are needed for an E-textbook solution. The focus of this section is to link some of the relatable requirements with priority '1' and '2' with the sample requirements specification in table 10 in the Appendix A. This will help in the comparison of the various operating systems to discover which one best fits our priority requirements, see table 9 below.

As discussed earlier, (refer to section 5.2) although both PDF and ePub can be somewhat digitally protected from copyright infringements, the ability of ePub to also embed interactivity better makes it a better choice for the reading software. This is not to say PDF documents cannot be read through the system. With interactivity been one of the critical factors, the E-textbooks by Ghanaian publishers for SHS students will be published in ePub format. Students can however read other E-books obtained from other sources for instance in PDF on the platform.

Nakajima and co. evaluated 52 requirements and concluded that Apple device running iOS and iBooks3 software was the best for the requirements. In table 9 below, the requirements evaluation by Nakajima is modified by relating the priority requirements of this project to the items in table 10. The modified table also maintains the key used in grading the items as done by Nakajima and co. (Nakajima et al., 2013).

Priority requirements	Items from table 10	iBooks 3/iOS	Himawari reader/ Android	eBook reader / Android	Kindle reader /Kindle Linux	Readium / Windows	Calibre/ Windows
Textbooks sold through the platform must open on device	Usage restriction in case of copyright	X	Δ	Δ	O	X	X

only if user is authorized to use it (Copyright protection)	violation						
Features of the platform such as reading textbooks must work with or without internet connectivity	Offline authentication	TBE	TBE	TBE	TBE	TBE	TBE
The file format for the E-textbook files must be able to embed interactive and media components	Multimedia replay	O	O	Δ	Δ	O	Δ
The reading software must allow for ease of use features such as text search, underline and highlight and add and delete notes	Search text	O	X	O	Δ	X	O
	Add and delete, underline and highlight	O	X	O	O	X	X
GRADE		**9**	**4**	**8**	**8**	**3**	**4**

Table 9: Evaluation of requirements

During the evaluation of the ePub and operating systems, the following key was utilized:

- “O” shows that it works and has a grade of “3”
- “Δ” shows that it partially works and has a grade of “1”
- “X” shows that it doesn’t work and has a grade of “0”

- “TBE” shows that the authors couldn’t find a working implementation way and also has a grade of “0” (Nakajima et al., 2013).

Details indicating why for instance an item works partially and therefore should be given a grade of ‘1’ on a particular operating system is missing from the reference. However, the idea is to show that an item graded ‘3’ on one software platform and graded ‘1’ on another simply suggests that particular requirement is covered better on the software platform with a grade of ‘3’.

From the evaluation results above, Apple and the iOS operating system still leads the way with 9 points, see table 9. Following closely is the software version running on an Android device and another running on Kindle Linux.
Using iOS as the solution would not be prudent because it restricts usage to Apple devices which are on the average more expensive than Android or Kindle devices (Chowdhry, 2015; Costello, 2017). Furthermore, it gives significant power to Apple which is against the business model and the role of the platform owner in the value chain discussed in the next section. Because the difference in points between iOS and Android and Linux per the requirements is just 1, there is much reason in considering Android and Linux as alternatives.
Between an ePub running on an Android device and another running on Kindle Linux, an Android solution seems a more viable option. This is because, due to smartphone proliferation in Ghana, students have at least had an experience of the Android operating system either by using their personal smartphones (those who have) or those of close friends or relatives. It will therefore be comfortable for them to use Android than to use Linux.

The result is that; the solution will be a novel device running Android operating system and using ePub for reading. The device will have an application installed on it through which users can access the platform and also open E-textbooks for reading.

9.2 UML DIAGRAMS FOR E-TEXTBOOK SYSTEM

The next process in the design of the website and/or application for the platform and reading software is to come up with use cases of the functional requirements of the service. Activity and sequence diagram for restricting unauthorized users access to read specific E-textbooks are also made in this section. All diagrams are made using ArgoUML software.

9.2.1 USE-CASE DIAGRAM

The functional requirements of the E-textbook system (see table 7) form the basis for the use-cases outlined in fig. 15 below. The actors involved are the publishers, students, system administrator and the payment processing system.
Both students and publishers are required to log into the system. Credentials such as email address, ID number and password are requested during log-in. At this same stage, a mechanism is used for the administrator to verify the log-in details. The administrator should be able to assign or revoke log-in credentials appropriately. During the payment for purchased E-textbooks, a payment processing system deals with the use of payment cards and other methods of payment. To prevent unauthorized access to E-textbooks, whenever a student tries to open an E-textbook purchased through the platform for reading, an administrative system checks whether the student is permitted to read that specific E-textbook. Students should also be able to check the status of resources on the device such as storage and battery life apart from the platform functional requirements.

Figure 15: UML USE-CASE DIAGRAM

9.2.2 ACTIVITY DIAGRAM

This project is delimited to the activity for the use-case of 'Read E-textbooks purchased through the platform' (see section 1.3.3) and how the system prevents unauthorized access. The choice of looking at this use-case and not all the others is because copyright issue is a concern that is critical to all the various stakeholders, see fig. 13.

Log-in is first done after which a valid user is directed to where he/she can open E-textbooks to read. A decision box is used to direct users with invalid details back to the log-in screen. Details of previous users whose rights are revoked after the three (3) year SHS period (as discussed in section 8.4.3) are considered invalid in the same way as non-users.

When a valid user clicks on an E-textbook purchased through the platform to read, the system has two options to decide from. If the user is authorized, the E-textbook readily opens for reading. Otherwise, access to the content is denied and the user is informed of unauthorized access. Fig. 16 below outlines the flow from one activity to the other as described above.

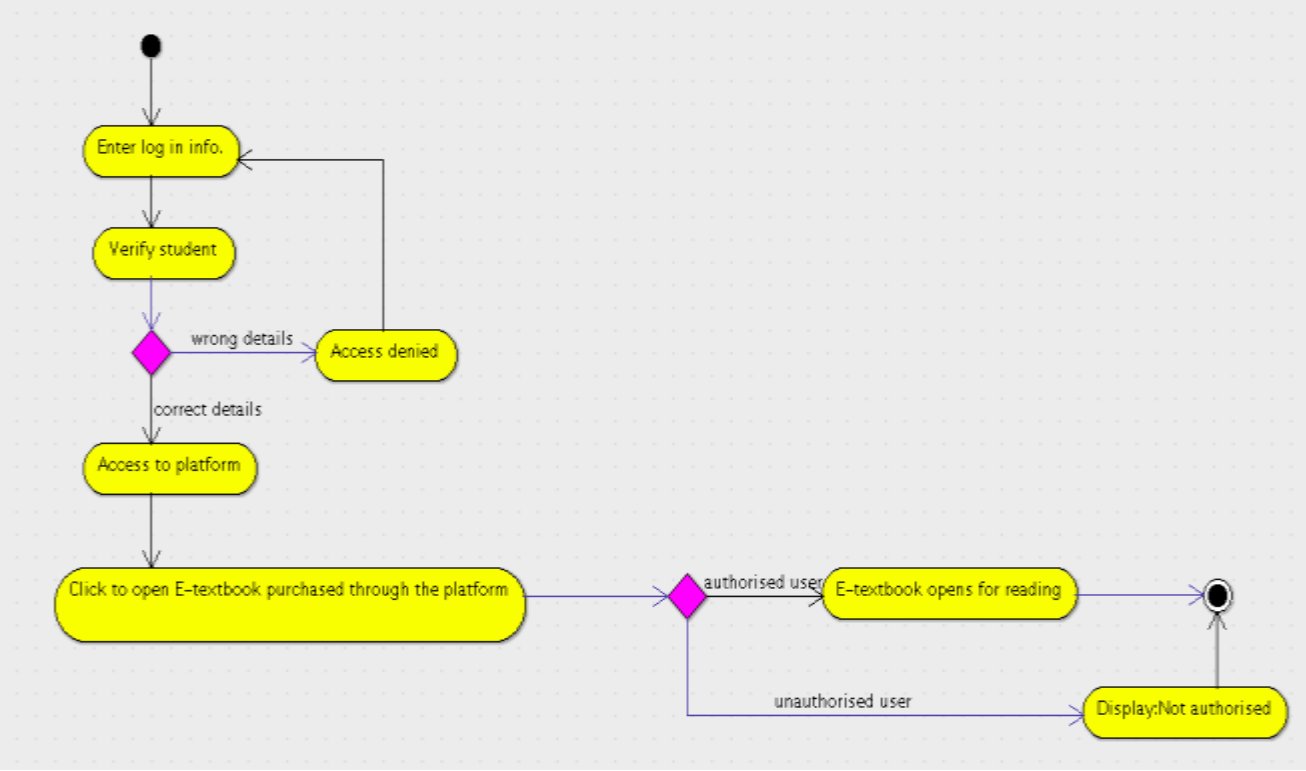


Figure 16: ACTIVITY DIAGRAM

9.2.3 SEQUENCE DIAGRAM

To show the interaction and exchange of messages between the various objects in the use-case of 'Read E-textbooks purchased through the platform', the sequence diagram is developed, see fig. 17.

It starts with the user visiting the service log-in page and entering log-in details. The account verifier then confirms or denies the entered details. A reply is sent to the user via the log-in page in either situation. In the case of correct details, the user is redirected to the main page of the service where he can click on a purchased E-textbook to open for reading. Two alternatives are applicable when the user clicks on an E-textbook. The user is either verified and authorized to read the E-textbook or denied. If the user is authorized by the E-textbook verifier, he/she is redirected from the main and the reading software opens where access is granted to the content of the E-textbook. Else if the user is denied authorization, a reply is sent to inform him/her of unauthorized access.

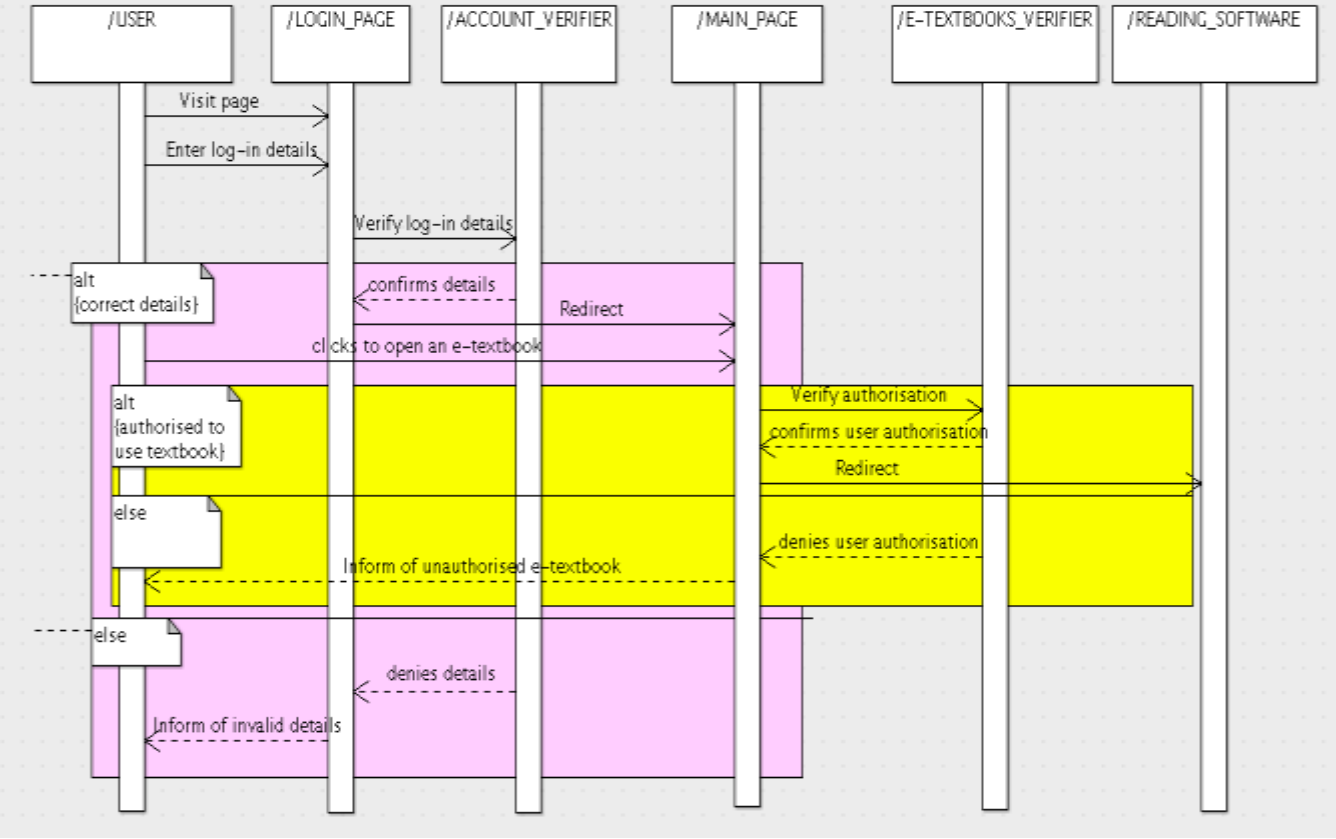


Figure 17: SEQUENCE DIAGRAM

9.3 BUSINESS MODEL & VALUE PROPOSITION CANVASES

In this section, the nine (9) building blocks of the business model canvas are followed through to connect the various elements in both the value and efficiency sides of the canvas. This is followed by an extensive look at the customer profiles and value map using the value proposition canvas. The two are put together in the end to obtain the entire business model design.

9.3.1 CUSTOMER SEGMENTS

Three different customer segments will be involved with the E-textbook platform. Students who will be the ultimate users of the E-textbooks from the platform are customers to the platform. So are publishers in Ghana who will now have to sell to students through the platform. The Ministry of Education of Ghana will also be a customer. This is because, the Ministry will continue its usual purchase of textbooks for students in poor communities. The customer profile in elaborated in the value proposition canvas in section 9.3.10 below.

9.3.2 VALUE PROPOSITION

To all customer segments, there is a general value in the reduction in transaction cost. Apart from this, each customer segment has its own value proposition. For the publishers, this will be a reduction in the operational cost relating to printing textbooks and transporting them for distribution. Students and the Ministry of Education will have value in the lower prices of textbooks than the printed versions. In addition to this, students will enjoy the convenience of having access to their textbooks wherever they are and not having to carry heavy backpacks loaded with textbooks. One of the visions of the Ministry of Education on promoting ICT and digital literacy amongst students will also be enhanced through the service. This and other relevant considerations are put across in the value map in section 9.3.11 below.

9.3.3 CHANNELS

The main way the value proposition will be delivered to the customers will be directly through the platform's website. Students will purchase and download E-textbooks through the platform's website. Publishers can publish their E-textbooks and will offer it for sale through the website. Other value proposition relating to reading is offered through a software application.

9.3.4 CUSTOMER RELATIONSHIPS

Customized profiles of each student will be kept. Additionally, a community will be created for the students where they can share their experiences and how they

overcame obstacles with the usage of the platform. This will be particularly important at the beginning of the academic year when students are downloading and arranging purchased E-textbooks. At the same time, personal assistance from the platform operator will be online to answer students during this period. When internet connectivity is widespread in all schools, the community help and personal assistance will be very effective.

9.3.5 REVENUE STREAMS

The revenue stream for this platform business will be the commission earned on the sale of the E-textbooks. A flat commission on the E-textbooks (as it's been done by apple on iBookstore) will be the preferred option for publishers who are new in this platform business and have indicated their preference for simple transactions (see table 6). Although it is important to consider the cost structure and prices of textbooks in Ghana in general (which this project doesn't cover), based on the commissions charged by other platforms such as iBookstore and Amazon and the requirement to make the E-textbooks even cheaper, a commission of between 20% - 30% of the selling price of each E-textbook will be well placed.

9.3.6 KEY RESOURCES

Just like any other platform, the key resource is the E-textbook platform and its brand image as being the first of its kind in Ghana. Other resources will include the server which will contain the E-textbooks.

9.3.7 KEY ACTIVITIES

The normal day-to-day business of the platform operator will be to manage the platform which includes assisting publishers to publish digitally on the platform. To see to it that all software systems and databases are running normally. Another activity will be to ensure copyright protection of E-textbooks published and sold on the platform. This can be in the form of restricting access to E-textbooks on devices and student profiles which were not used in the purchase of the particular E-textbooks. The final activity can be the promotion and provisioning of the platform for it to be the preferred platform for the purchase of E-books for students all over Ghana and not just for SHS students.

9.3.8 KEY PARTNERS

Implementation of this platform business will only happen if students have access to devices. As such, the Government of Ghana will be a key partner in this. Both with the provision of devices or ensuring students buy devices themselves and

also with providing the necessary regulation to make the platform mandatory for use by SHS students.
Another important partner is the device operating system provider. As it has already been determined that Android will be the most feasible operating system for the platform, an engagement with Google will help in the development of the best E-textbook format and features possible on the Android operating system.
The services of a local Mobile Network Operator (MNO), preferably MTN which has the widest network coverage in Ghana (see section 6.2) will be needed at the campuses of the SHS without internet access. They will be required to set up the hotspots at the beginning of the academic year for students to download the purchased E-textbooks and also to download the necessary updates to the platform.

9.3.9 COST STRUCTURE

The main cost will be for the development of the platform and its maintenance. A well developed and maintained database to hold the E-textbooks and an up and running website for access to the E-textbooks will take up part of the cost. Other costs will have to be made to partners. The MNO for its internet service and Google for its support with the usage of the Android operating system. Fixed cost relating to salaries will also form part of the cost structure.

Fig. 18 below summarizes the platform business using the business model and value proposition canvases with colour co-ordination between each customer segments and their respective value propositions.
The value proposition canvas portion of the business model is discussed as well. Reasons behind the inputs to this discussion is obtained from what customers will expect from an E-textbook platform and reading service.

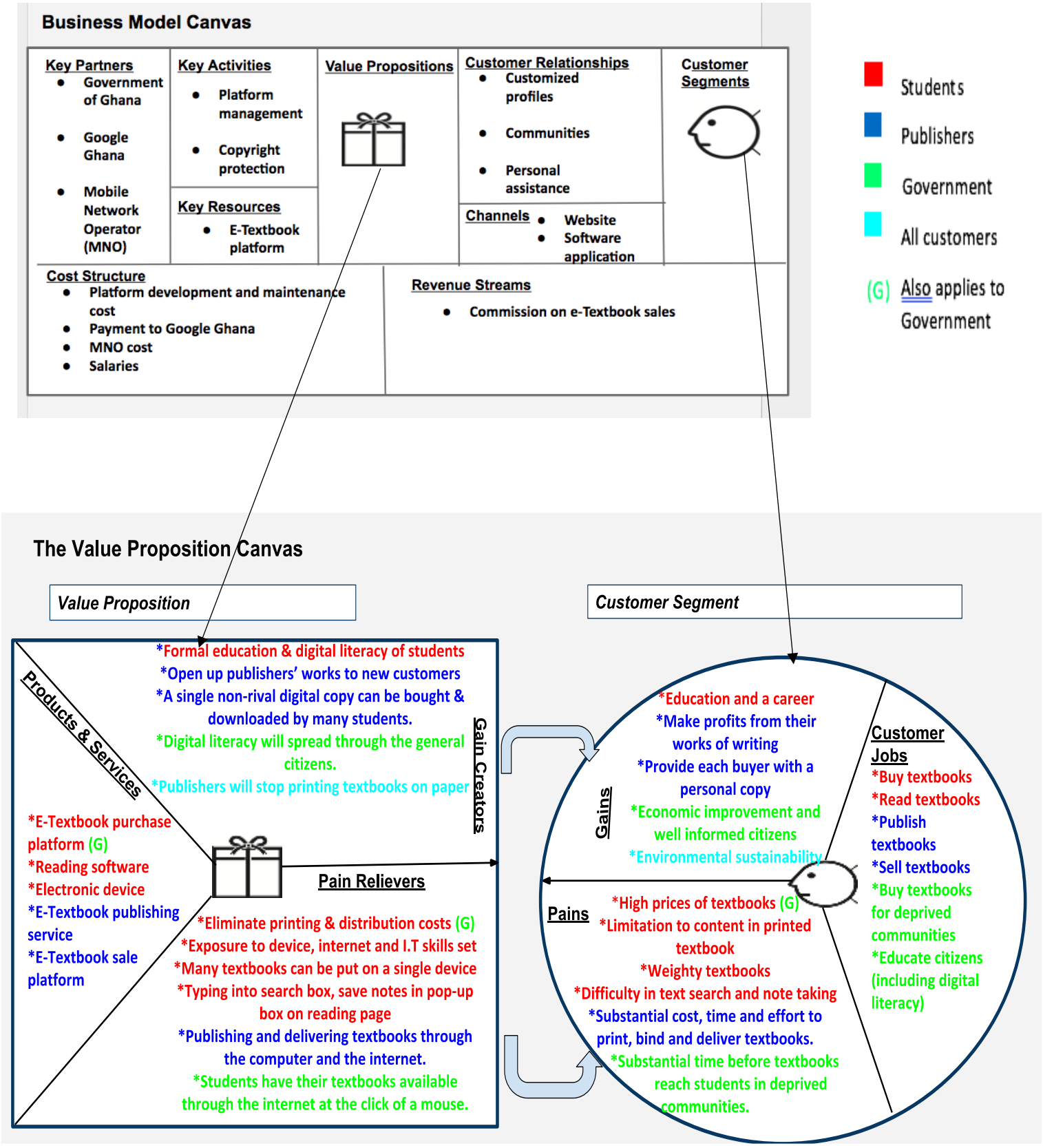


Figure 18: Business Model + Value Proposition Canvas for the E- textbook platform business

9.3.10 CUSTOMER PROFILE

In this section, the jobs users want to get done, the gain users will get from the platform and pains they want to be relieved of is outlined.

9.3.10.1 JOBS

Each of the customer segments intends to get a particular job done. Students want to buy books and also to be able to read them. Publishers want to publish textbooks and make them available for sale to students. The Government wants to buy textbooks for deprived areas in Ghana. This is because the big job the Government wants to get done is to get its citizens educated which includes digital education in this age.

9.3.10.2 PAINS

An obstacle publishers face is the high amount of time, cost and effort required to print, bind and deliver textbooks to students. This translates into high prices of textbooks for students and Government.

Another headache to the Government of Ghana is the delays in textbooks in reaching the rural areas due to inefficiencies in the supply chain. Students want to know more wherever they are reading. They want to refer to different sources but they are limited to the amount of content available in the textbooks they purchase only. They do not readily have an option of always looking up something online even if their school has internet connectivity because of the limited access to devices.

Again, studying 8 courses means carrying many textbooks to classrooms daily. These weighty textbooks are not good for the health of the students.

To search for a particular text or sentence in a printed textbook means students flipping pages to and fro and this wastes time. Further to this, students require a separate notebook to be able write notes whilst reading.

9.3.10.3 GAINS

Publishers will make more profit from selling their work by still making it possible for each student to get a personal copy of textbook. Government of Ghana will achieve economic improvement and produce globally competitive citizens. For students, this will be a gain in knowledge and skills relevant for a successful career in this computer age.

In general, there will be benefits to the environment which is a gain to all the customers and will translate in the quality of life of Ghanaian citizens in the long run.

9.3.11 VALUE MAP

The products and services offered in the end to the customers is outlined here. How the products and services will eliminate or minimize pains of customers, how they will maximize benefits that customers expect is also described.

9.3.11.1 PRODUCTS AND SERVICES

The solution offers a publishing service for publishers to make their textbooks electronic. On the platform, published E-textbooks are made salable by publishers and students can also purchase through the platform. As part of the service, the solution also offers students the opportunity to read using a software. The solution also requires that students have an electronic device for reading the E-textbooks.

9.3.11.2 PAIN RELIEVERS

Making textbooks electronic will make them cheaper because it eliminates some production costs like printing, binding, distribution etc. The solution to these supply chain processes is provided in front of a computer.

Textbooks will be delivered through the internet on the website of the platform provider. Due to this, purchased textbooks will be available to students in rural areas within just few minutes after purchase.

For students whose school have internet connectivity, a side benefit of the service will be the availability of digital devices which will enable them to readily harness the benefits of the internet. Such students will be opened to the wealth of knowledge on the web whenever they have internet. By the continuous usage of the device and platform, I.T skills of students will also be enhanced.

A weighty paper textbook is converted into an electronic file and so many of these electronic files can be accommodated on one device weighing barely like just one paper textbook.

By typing keywords into search box, items been searched in textbooks appear in seconds. Finally, notes can be taken whilst reading and saved directly in the same textbook page by using a pop-up box.

9.3.11.3 GAIN CREATORS

Digital education through using the solution will enhance students' preparedness for a career in this digital age.

Although contents of a textbook are non - rival, the physical material is. Unlike printed textbooks, one digital copy of an E-textbook (an information good) can be bought and downloaded by so many students due to its non-rival nature.

Many students who previously couldn’t have access to textbooks due to logistical challenges can now have access through the internet and therefore will increase profits for some publishers. Lower digital production cost also gives room to make more profit even though prices of the E-textbooks will also be low.
Since all SHS students will be using the service, the long-term benefit for the economy will be a digitally educated population. The more students are exposed to devices, the service and internet, the more they become digital savvies and improve the economy. Their knowledge and skills in I.T will lead to the development of effective solutions for sectors of the economy such as health, transportation, agriculture etc.
Research shows that in general, printed textbooks have a large environmental footprint than E-textbooks regarding the way that it will be used by students (Dowd-Hinckle, 2012; Ethical Consumers, 2016). When all publishers will publish digitally in order to reach students, there will be significant improvement in environmental sustainability because they will stop traditional printing.

The next chapter of this project consists of discussions around the relevance of the research question and methodological approach. The findings from the analysis are also discussed.

10. DISCUSSION

The significance of the findings and new insights obtained in this research will now be discussed. The point of departure in this discussion is the research question restated below:

"Which E-textbook solution is optimal for SHSs in Ghana considering measures critical to stakeholders' adoption and ecosystem conditions in Ghana?"

The importance of the research question and the study in general is in two dimensions. These are the purpose for which this project report is presented and the contribution to the overall academic field.

This report is presented as a Master's Thesis where there is an expectation to design, develop or analyse a comprehensive service or solution that is solidly technically founded, meets end-user requirements and is validated from a market and business perspective. The use of relevant theories and methods in a way that underlines important properties and shows the knowledge about the applied theories, methods and delimitations within the problem field is also required. A specific requirement for this long Master's Thesis is for it to include aspects of the 3rd semester theme for the business development track which is '*Governance and Strategies*' (Aalborg University, 2015).

The research question largely encompasses the above-mentioned points. The solution includes both technical and business aspects with an outlook of constant growth of the E-book market. The end-user requirements are appropriately captured in the design as the opinions of the relevant stakeholders including students, publishers and government are included.
The critical measures of stakeholders are arrived at by applying the relevant theories at both the personal adoption of technology level and at the wider ecosystem level. Finally, the inclusion of the government and legal systems with respect to the copyright and the strategy for production and distribution of textbooks in Ghana appropriately serves the requirement for the 3rd semester theme.

The use of ICT to improve various sectors including education has been studied and written about previously. In the education sector and particularly with respect to E-textbooks, minimal work has been done in developing countries such as Ghana where economic and infrastructural conditions hinder the delivery of textbooks to all students. Even studies in developed countries although many, very few focus on the use of E-textbooks in pre-tertiary education. This research

embeds all these seeming deficiencies in previous studies with added technical and business model designs.

Although the methodological approach used in this research helped to answer all the research question and sub-questions, it is not perfect. The motivation for adopting aspects to the methodological approach was the fact that similar frameworks have been used in other researches which produced good results. The research setting and other inconvenient circumstances led to differences in the data scale and analysis approaches. For instance, obtaining data from students in just one school out of about 863 schools is an underrepresentation of the SHS student population of Ghana. This resulted because authorities of two other schools which showed initial interest later declined citing a clash with other school activities. It is important to point out that even with the other two schools on-board, it would still be an underrepresentation. Financial and time constraints, including time needed to type all entries into Microsoft excel couldn't have allowed a wide scale study.
Other additions which extend beyond the scope of this project which could have enhanced the findings and made them well-grounded is if the development process of the website and software for the solution was followed to the end. That is to say, if all design aspects were made, developed and tested by the potential users.
On the side of business, a cost analysis of the actual possible cost savings on using E-textbooks instead of printed textbooks for SHS education would have influenced some key business decisions such as prices to set for the E-textbooks in the brokerage business.

Although previous studies had hypothesized social influence to have no influence on intention to use E-textbooks, this research discovered otherwise. Students were found to be influenced by the recommendation from their parents or wouldn't generally resist government's decision for it to be mandatory. Perhaps, this can be attributed to the fact SHS students in Ghana have much dependency on their parents and government for almost all their educational needs including textbooks. They therefore see that whilst they want to have an E-textbook service which will come at a price, they don't bother about the monetary aspect very much. It is easy for them to assume that the cost of the devices and E-textbooks will be borne by either the government or parents or both and therefore offer no resistance.

As expected throughout the course of the project, copyright protection which is a worry for all digital content owners around the globe was found to be a vital factor

for the E-Textbook solution in Ghana. Other papers have pointed out the importance of internet connectivity to the success of an E-textbook solution and therefore that wasn't a surprise factor as well. An unexpected revelation however, was the fact that the device provision mechanism to the students would have ramifications on which technical solution best fits as well as the revenue generation model.
Normal with the operation of some multi-sided platforms, support for different customer segments was found to be necessary in this project. Support for publishers to publish their works and students to read the E-textbooks after purchase. With respect to the reading, the usage of ICT devices and systems in Ghana had an impact on choices made for the service. For example, previous exposure of the students to Android operating system gave it an edge over other operating systems.

It was found that although cost savings is generally seen as a leading motivation for the acceptance of an E-textbook service, data gathered seem to show other factors can override its significance. For instance, it was revealed that the Government of Ghana will not support a platform which does not embed the cultural and value systems of Ghana. In order words, books on the platform must be written with inspiration from economic, social, geographic and other conditions in Ghana. This situation automatically rules out the success of the various Open Educational Resources which might have better content and comes at near zero price.

All in all, the cost savings offered by E-textbook usage seem to be beneficial if the users already have devices on which to read them. However, the ecosystem conditions in Ghana with respect to student ownership of personal devices doesn't look promising. The Government of Ghana may therefore be faced with a dilemma in choosing to make the service mandatory. The service may succeed in making the prices of E-textbooks very low but then funds will be required to get all students to have devices to read on. Nonetheless, with other benefits such as environmental sustainability, digital literacy of the population and health implications of carrying heavy backpacks loaded with printed textbooks, going electronic seems to be rewarding.

11. CONCLUSION

The continuous usage of printed textbooks comes along with problems in the area of environmental unsustainability and high prices. Other problems with printed textbooks has to do with delays in the textbooks in reaching remote destinations and the health implications of carrying heavy backpacks loaded with printed textbooks. There is therefore the need for a shift in the way in which academic content is delivered. The use of E-textbooks is seen as the replacement for the printed textbooks. Although the use of electronic books in general is on the increase, its use in the school system is relatively low, even lower at the High School level in a developing country such as Ghana. The purpose of this project therefore has been to find out which E-textbook technical and business solution fits the situation in Ghana. To do this, the measures critical to stakeholders' adoption and ecosystem conditions in Ghana regarding the use of E-textbooks at the Senior High School (SHS) level were assessed.

The project began with an introductory chapter which outlined the motivation behind the project. A background including the definitions of E-books, E-textbooks, E-readers and a brief description of SHS educational system and textbook delivery model in Ghana was also done as part of the introduction. A problem definition then led to defining the research questions of this project.

Following the research questions and the description of methodological approach was the investigation of the theoretical frameworks used. The Unified Theory of Acceptance and Use of Technology (UTAUT) and Rogers' Diffusion of Innovation theories were proposed for determining the critical measures based on stakeholders' data obtained relating to E-textbook usage in Ghana. Based on prevalent E-book revenue models, a Multi-sided platform business model was also suggested. Finally, a combination of the Business Model Canvas and Value Proposition Canvas was seen as the appropriate tool for designing the business model for the E-textbook service.

Several factors were critical to the stakeholders as revealed from the empirical data. Topmost of these critical factors were copyright issues and internet connectivity which were prevalent across all stakeholder groups. Other factors such as compatibility of content with the culture and other conditions in Ghana as well as government policy for local participation made a good option of Open Educational Resources (OER) less a viable choice. In the technical design, functional requirements led to some use cases and key amongst these use cases relating to the critical factor of copyright was followed with activity and sequence diagrams.

There is no doubt the support of the government is key to the success of the E-textbook service in Ghana. This is in the area of making the service mandatory to all SHS students and also having a mechanism to provide devices to students. The way students obtain devices determines whether the technical solution will best be a web-based, reading software-based or dedicated device-based. This project worked with the option of government providing devices to all students and hence a dedicated device-solution was the best fit. An evaluation of the non-functional requirements and other conditions in Ghana also makes the Android operating system and Android version of ePub the best software for the device. The revenue model practiced by major E-book players which was also found appropriate in the Ghanaian SHS context is the brokerage model.

A stable internet connectivity across the SHS campuses in Ghana in the future will have implications on both the technical solution and the business model. The same is with the device provision mechanism to the students. In future, when it is clear whether every student will be asked to bring their own devices or the platform provider will be asked to sell devices as part of the service or government provides for all students as envisioned in this report, then a strong case for a technical solution can be made. Further to this, the business model of the platform provider made in this project can then be modified to include asset sales.

There were some obstacles encountered along the course of this project. A not so surprising problem which had a negative impact on this project is the same issue this project somehow seeks to offer a solution to. Students were not using digital devices in the schools and therefore the data was collected using printed papers whose contents were later entered into Microsoft excel. This, together with the decline from some school authorities were limiting factors to the scale of observations obtained for this project.

Future works that can be done on this project can be in the area of cost analysis to determine a pricing scheme for the E-textbooks as well as following on the technical development aspect into making it a full-blown service. This can be followed by a proof of concept in one of the SHSs in Ghana.

In totality, the technical and business solution offered in this project are seen to be optimal for SHSs in Ghana. Further to this, they are based on stakeholder inputs or expectations and ecosystem conditions emphasizing the importance of users in the development of any ICT solution.

12. REFERENCES

Aalborg University, (2015). Curriculum for the Master's programme in Innovative Communication Technologies and Entrepreneurship. Retrieved 20 May, 2016, from http://www.icte.aau.dk/infoglueDeliverWorking/digitalAssets/146/146277_icte-curriculum- 2c-fall-2015-revision.pdf

ACEP (2016, November). Beyond the 2016 elections: energy sector priorities for the next government of ghana. Retrieved March 14, 2017, from https://s3.amazonaws.com/acep-static/publications/Ghana Energy Sector Outlook Final-1 (1).pdf

Amazon (n.d.). Rent Kindle Textbooks. Retrieved April 26, 2017, from https://www.amazon.com/gp/help/customer/display.html?nodeId=200690040

Amenyedzi, F. W., Lartey, M. N., & Dzomeku, B. M. (2011). The use of computers and internet as supplementary source of educational material: A case study of the senior high schools in the Tema metropolis in Ghana.Contemporary Educational Technology, 2(2), 151-162.

Apple (2017, March 22). Publish and sell books with iBooks Author. Retrieved March 27, 2017, from https://support.apple.com/en-us/HT201183

Apple Education. (n.d.). Retrieved March 26, 2017, from http://www.apple.com/education/real-stories/burlington/

Asante, E., & Owusu-Ansah, S. (2015). One laptop per child policy in Ghana: any impact on teaching and learning?. *Library Philosophy and Practice*, 1.

Badkar, M. (2014, April 24). College Textbook Inflation Is Out Of Control. Retrieved May 13, 2017, from http://www.businessinsider.com/textbook-price-inflation-2014-4?r=US&IR=T

Baglione, S. L., & Sullivan, K. (2016). Technology and Textbooks: The Future. *American Journal of Distance Education*, *30*(3), 145-155.

Bannister, D. (2015). Exploring the Creative Use of Tablets in Schools. *Creative Classrooms Lab*. doi:http://fcl.eun.org/documents/10180/275738/CCL_Observation Report_FINAL-for web.pdf/603a278f-6c13-4911-a0a1-744913f1e6d0

Blank, S. (n.d.). Business Model and Value Proposition. Retrieved May 11, 2017, from https://steveblank.files.wordpress.com/2014/10/bus-model-and-value-prop-map.jpg

Cafescribe (2007). Save A Tree Per Year using E-textbooks. Retrieved from http://immagic.com/eLibrary/archives/general/frtn40us/f070801f.pdf

Carrenho, C. (2014, December 17). Educating Amazon: Brazil Gov't Seeks Suitors for School Ebooks. Retrieved March 27, 2017, from http://publishingperspectives.com/2014/03/educating-amazon-brazil-govt-seeks-suitors-for-school-E-books/

Cartwright, S. (2015). Diffusion of E-textbooks in K-12 Education: A Delphi Study.

Catalano, F. (2016, July 10). Amazon's Rising Edtech Play (EdSurge News). Retrieved March 27, 2017, from https://www.edsurge.com/news/2014-03-25-amazon-s-rising-edtech-play

Chowdhry, A. (2015, February 03). Average iPhone Price Increases To $687 And Android Decreases To $254, Says Report. Retrieved April 20, 2017, from https://www.forbes.com/sites/amitchowdhry/2015/02/03/average-iphone-price-increases-to-687-and-android-decreases-to-254-says-report/#6dd1f920539e

ChromE-books. (n.d.). Retrieved March 27, 2017, from https://help.overdrive.com/customer/portal/articles/1501749

Classroom Aid (n.d.). Open Textbooks and Materials for Open Source Education – Classroom Aid. Retrieved March 20, 2017, from http://classroom-aid.com/open-educational-resources/curriculum/

CK-12 Foundation. (n.d.) Mission. Retrieved March 20, 2017, from https://www.ck12info.org/about/mission/?_ga=1.21651323.1951131898.1490003183

Costello, S. (2017, March 23). How Does the iPad Stack Up Against the Kindle and Nook? Retrieved April 20, 2017, from https://www.lifewire.com/ereaders-ipad-vs-kindle-nook-1999855

CourseSmart :No Web Connection, No Problem. (n.d.). Retrieved January 12, 2017, from https://web.archive.org/web/20150905053502/http://www.coursesmart.com/learnmore

Cutler, J. (2015). Royalty percentage. Retrieved April 24, 2017, from https://productforums.google.com/forum/#!topic/books-on-google-play-partner/jRsatE_Jxv8;context-place=forum/books-on-google-play-partner

Darkey, E., & Akussah, H. (2009). Academic Libraries and Copyright Issues in Ghana: The University of Ghana in Focus. *International Journal of Legal Information*. doi:http://scholarship.law.cornell.edu/cgi/viewcontent.cgi?article=1152&context=ijlli

Da Silva, I. (2014, July 09). Digital publishing: Ghana, Africa lagging behind. Retrieved April 24, 2017, from http://www.biztechafrica.com/article/digital-publishing-ghana-africa-lagging-behind/8421/

Diaz, J. (2012, January 19). Apple's iPad Textbooks: Everything You Need to Know About iBooks 2. Retrieved January 13, 2017, from http://gizmodo.com/5877500/apples- ipad-textbooks-everything-you-need-to-know-updating-live

Ditzler, C., Hong, E., & Strudler, N. (2016). How Tablets Are Utilized in the Classroom. *Journal of Research on Technology in Education*, *48*(3), 181-193.

Dowd-Hinkle, D. J. (2012). Kindle vs. Printed Book An Environmental Analysis.

E. (2016, March 10). Your Guide to Buying a Wi-Fi Capable e-Reader. Retrieved June 04, 2017, from http://www.ebay.com/gds/Your-Guide-to-Buying-a-Wi-Fi-Capable-e-Reader-/10000000177629748/g.html

Eben (n.d.). High school(Ghana). Retrieved May 07, 2017, from http://yfughana.webs.com/highschoolghana.htm

Eicker-Nel, S., & Matthee, M. (2014). The adoption of tablet based E-textbooks in a South African private school. In Proceedings of the e-skills for knowledge production and innovation conference 2014.

Eikebrokk, T., Dahl, T. A., & Kessel, S. (2014). EPUB as publication format in open access journals: Tools and workflow.

Embong, A. M., Noor, A. M., Hashim, H. M., Ali, R. M., & Shaari, Z. H. (2012). E-Books as Textbooks in the Classroom. Procedia-Social and Behavioral Sciences, 47, 1802-1809.

EMIS (a) (2015). Report on Basic Statistics and Planning Parameters for Senior High Schools in Ghana 20 1 4 /20 1 5 (Rep.). doi:http://www.moe.gov.gh/emis/EMIS%20BASIC%20EDUCATION%20DATA/Secondary/2014-2015/SHS%20Report%202014-2015%20No.1.pdf

EMIS (b) (2015). Report on SHS National Parameters - 2014 / 2015 School Year Data. doi:http://www.moe.gov.gh/emis/EMIS%20BASIC%20EDUCATION%20DATA/Secondary/2014-2015/SHS%20National%20Parameters.pdf

Ethical Consumer (2016, November). Product Guide. Retrieved May 10, 2017, from http://www.ethicalconsumer.org/ethicalreports/buyingbookswithoutamazon/environment.aspx

Evans, D. S. (2003). Some empirical aspects of multi-sided platform industries. *Review of Network Economics*, *2*(3).

Falcone, J. (2010, July 06). Kindle vs. Nook vs. iPad: Which E-book reader should you buy? Retrieved January 13, 2017, from https://www.cnet.com/news/kindle-vs-nook-vs-ipad-which-E-book-reader-should-you-buy/

Flexbook (n.d.). Retrieved January 12, 2017, from http://www.ck12.org

Ghana Schools Net (October 27, 2014) Ghana education service approved fees structure (2014/2015) shs 1 - 1st term. Retrieved february 13, 2017, from http://www.ghanaschoolsnet.com/forum/topics/ghana-education-service-approved-fees-structure-2014-2015-shs-1-1

Giammatteo, G. (2015, February). Self Publishing Advice Center. Retrieved April 15, 2017, from http://selfpublishingadvice.org/alli-watchdog-amazon-vs-apple/

GIFEC (2016a). Gifec fact sheet 2016.

GIFEC (2016b, December). Gifec launch satellite hub to bridge rural-urban divide. Retrieved February 7, 2017, from http://www.gifec.gov.gh/content_news.php?id=11

GNA (2013, December 10). Government distributes 40,000 laptops to schools. Retrieved April 22, 2017, from https://www.modernghana.com/news/507614/government-distributes-40000-laptops-to-schools.html

GNA (2016, March 14). Free SHS education to cover boarders. Retrieved May 06, 2017, from http://www.ghananewsagency.org/education/free-shs-education-to-cover-boarders-101507

Google (n.d.). Google for Education: Save time and stay connected. Retrieved March 27, 2017, from https://edu.google.com/products/productivity-tools/

Google support(a) (n.d.). Add a single book. Retrieved March 27, 2017, from https://support.google.com/books/partner/answer/3289675?hl=en

Google support(b) (n.d.). Rent textbooks & books. Retrieved April 26, 2017, from https://support.google.com/googleplay/answer/3260366?hl=en

Goundar, S. (2011, December). What is the potential impact of using mobile devices in education. In *Proceedings of SIG GlobDev Fourth Annual Workshop* (pp. 1-30).

Grajek, S. (2013). Understanding What Higher Education Needs from E-textbooks: An EDUCAUSE. Internet2 Pilot.

Grigson, A. (2011). An introduction to E-book business models and suppliers. E-books in libraries, ed. Kate Price und Virginia Havergal, 19-36.

Gu, X., Wu, B., & Xu, X. (2015). Design, development, and learning in E-textbooks: What we learned and where we are going. Journal of Computers in Education, 2(1), 25-41.

Hagiu, A. (2014). Strategic decisions for multisided platforms. *MIT Sloan Management Review*, *55*(2), 71.

Hartmann, P. M., Zaki, M., Feldmann, N., & Neely, A. (2014). Big data for big business? A taxonomy of data-driven business models used by start-up firms. *A Taxonomy of Data-Driven Business Models Used by Start-Up Firms (March 27, 2014)*.

Hasbrouck, E. (n.d.). MalayBook. Retrieved January 06, 2017, from https://hasbrouck.org/netbook/index.html

Haverfordmfc (n.d.). Mapping MFIs: Ghana. Retrieved March 08, 2017, from http://haverfordmfc.org/wp/projects/mapping-mfis/mapping-mfis-ghana/

Hsiao, C. H., & Tang, K. Y. (2014). Explaining undergraduates' behavior intention of E-textbook adoption: Empirical assessment of five theoretical models. Library Hi Tech, 32(1), 139-163.
http://www.emeraldinsight.com/doi/pdfplus/10.1108/LHT-09-2013-0126

IDPF (2014). EPUB : Trade and standards organization for the digital publishing industry. Retrieved January 12, 2017, from http://idpf.org/ePub

Jeswani, H. K., & Azapagic, A. (2015). Is e-reading environmentally more sustainable than conventional reading?. *Clean Technologies and Environmental Policy*, *17*(3), 803-809.

Jiang, Y. (2012, January). e-Book platform competition in the presence of two-sided network externalities. In *System Science (HICSS), 2012 45th Hawaii International Conference on* (pp. 4777-4783). IEEE.

Ji, S. W., Michaels, S., & Waterman, D. (2014). Print vs. electronic readings in college courses: Cost-efficiency and perceived learning. The Internet and Higher Education, 21, 17-24. doi:10.1016/j.iheduc.2013.10.004

Jung, J., Chan-Olmsted, S., Park, B., & Kim, Y. (2012). Factors affecting E-book reader awareness, interest, and intention to use. *new media & society*, *14*(2), 204-224.

Knight (n.d.). How to Rent or Borrow eBooks Online. Retrieved April 15, 2017, from http://www.moneycrashers.com/rent-borrow-E-books-online/

Kudler, D. (2015, October 16). Preparing Images for Your e-Book by David Kudler. Retrieved May 06, 2017, from https://www.thE-bookdesigner.com/2015/10/preparing-images-for-your-E-book/

Laary, D. (2016). The Africa Report. Retrieved April 22, 2017, from http://www.theafricareport.com/West-Africa/ghana-mobile-phone-penetration-soars-to-128.html

Lee, H. J., Messom, C., & Yau, K. A. (2012). E-textbooks: Types, characteristics and open issues. Journal of Computer, 4(9), 2151-9617.

Leng, O. T. S., & Khan, S. (2011). Copyright Protection in Malaysia and the End UsersPerspective in E-Book. *International Journal of e-Education, e-Business, e-Management and e-Learning*, *1*(2), 121.

Lim, E. L., & Hew, K. F. (2014). Students' perceptions of the usefulness of an E-book with annotative and sharing capabilities as a tool for learning: A case study. *Innovations in Education and Teaching International*, *51*(1), 34-45.

Lourdusamy, A., Hu, C., & Wong, P. S. K. (A) (2001). Impact of a hand-held wireless electronic device (eduPAD) on science and mathematics teaching-learning environment. Journal of Science and Mathematics Education in Southeast Asia, 24(2), 51-66.

Mahama, J. D. (2016). State of the nation Address. *A national address given by the president at the Ghana, Parliament House, Accra*. http://agricinghana.com/wp-content/uploads/2016/03/state-of-the-nation-address-2016.pdf

Mardis, M., Everhart, N., Smith, D., Newsum, J., & Baker, S. (2010). From Paper to Pixel: Digital Textbooks and Florida's Schools. A White Paper.Online Submission.

MIDA (2014). Millennium Challenge Compact. Retrieved March 14, 2017, from http://www.mida.gov.gh/pages/view/A_GH_CompactII.pdf

Midberry, C. (2011). The Effectiveness of Digital Reading Devices in a College Setting. Retrieved from http://www.usma.edu/cfe/Literature/Midberry_11.pdf

MoC Ghana (2015). Greenbook Ghana, Accounting to the people. doi:http://tech.ghanaweb.com/docs/Greenbook-accountingtothepeople.pdf

MoE Ghana (a) (n.d.). Textbook Development & Distribution Policy For Pre-Tertiary Education in Ghana. Retrieved February 1, 2017, from http://gbdc.gov.gh/sites/default/files/Textbook%20Development%20and%20Distribution%20Policy%20.pdf

MoE Ghana (b) (n.d.). MoE Divisions. Retrieved February 16, 2017, from http://www.moe.gov.gh/site/divisions

MTN Ghana (n.d). Coverage Map. Retrieved February 06, 2017, from http://www.mtn.com.gh/personal/internet/coverage-map

Murray, M. C., & Pérez, J. (2011). E-textbooks are coming: Are we ready.Issues in Informing Science and Information Technology, 8(6), 49-60.

Nakajima, T., Shinohara, S., & Tamura, Y. (2013). Typical functions of E-textbook, implementation, and compatibility verification with use of ePub3 materials. *Procedia Computer Science*, *22*, 1344-1353.

NCA Ghana (2016). Data Statistics in Ghana. Retrieved February 6, 2017, from http://www.nca.org.gh/industry-data-2/market-share-statistics-2/data-3/

Ncomputing (n.d.). Ministry of Education Deploys 800 Virtual Desktops for Schools in Ghana. Retrieved April 22, 2017, from https://www.ncomputing.com/en/resources/customer-success/883545/ministry-education-deploys-800-virtual-desktops-schools-ghana

Nelson, M. R. (2008). E-Books in Higher Education: Nearing the End of the Era of Hype?. *Educause Review*, *43*(2), 40.

News Ghana (2014).Copy Ghana worried over massive photocopying on campuses. Retrieved March 18, 2017, from https://www.newsghana.com.gh/copy-ghana-worried-massive-photocopying-campuses/

Nyirenda-Jere, T., & Biru, T. (2015). Internet development and Internet governance in Africa. ISOC Report.

Noble, B. &. (n.d.). Textbooks | Save Up to 90% on New, Used, Rentals. Retrieved January 12, 2017, from http://www.barnesandnoble.com/nookstudy/features/index.asp

OER Commons (n.d.). Retrieved March 03, 2017, from https://www.oercommons.org/about

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation*, *14*(1), 110-121.

Open Textbooks Library(n.d). Make a difference in your students' lives with free, openly-licensed textbooks. Retrieved February 25, 2017, from https://open.umn.edu/opentextbooks/

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.

Overdrive (n.d.). Adobe Digital Experience Protection Technology. Retrieved April 18, 2017, from http://www.mobileread.com/forums/attachment.php?attachmentid=23955&d=1235077245

Parliament of Ghana (2005). The Copyright Act 2005. http://portal.unesco.org/culture/en/files/30226/11416586343gh_copyright_2005_en.pdf/gh_copyright_2005_en.pdf

Pata, K., & Väljataga, T. (2016, October). A Framework for Mapping E-textbooks as a Socio-Technical Regime. In *International Conference on Web-Based Learning* (pp. 215-224). Springer International Publishing.

Polin, M. J. (2014). On the relevance of cultural intelligence to technology acceptance.

Rappa, M. (2000). Business models on the web. *North Carolina State University (ecommerce. ncsu. edu)*, *13*.

Read, T. (2015). Where Have All the Textbooks Gone? Retrieved April 22, 2017, from https://books.google.dk/books?id=CwQ7CgAAQBAJ&pg=PA253&lpg=PA253&dq=students%2Bin%2BGhana%2Bdo%2Bnot%2Bhave%2Baccess%2Bto%2Bcomputers%2Bafter%2Bschool%2Bhours&source=bl&ots=I-

4InSw90D&sig=wqwmsjjZO5EpMlV5_IQKWN-Rvd0&hl=en&sa=X&ved=0ahUKEwih8LK28rfTAhXGCiwKHWE4BaYQ6AEIJDAA

Schaffhauser D. (2015, April). 3 Reasons ChromE-books Are Shining in Education. Retrieved March 27, 2017, from https://thejournal.com/Articles/2015/04/14/3-Reasons-ChromE-books-Are-Shining-in-Education.aspx?Page=1

Scott, J. (2012). Books and Digital Publishing in Africa: What Does the Future Hold? *Africa Bibliography,2011*, Vii-Xvii. doi:10.1017/s0266673112000025

Statista. (2017). Global E-book revenue by region 2009-2016 | Forecast. Retrieved May 13, 2017, from https://www.statista.com/statistics/280249/global-E-book-revenue-by-region/

St. Louis (n.d.). ST Louis Senior High School, Kumasi. Retrieved May 06, 2017, from http://stlouisshs.edu.gh/

Strategyzer (n.d.). Retrieved May 11, 2017, from https://strategyzer.com/canvas/value-proposition-canvas

Taylor, H. (2015, December 09). Google is crushing Apple, Microsoft in US schools. Retrieved March 26, 2017, from http://www.cnbc.com/2015/12/03/googles-chromebooks-make-up-half-of-us-classroom-devices.html

Trip (2010, August 01). Plagiarism Lines Blur for Students in Digital Age. Retrieved March 18, 2017, from http://www.nytimes.com/2010/08/02/education/02cheat.html

Vasileiou, M., Hartley, R., & Rowley, J. (2009). An overview of the E-book marketplace. Online Information Review, 33(1), 173-192.

Vasileiou, M., Hartley, R., & Rowley, J. (2012). Choosing E-books: a perspective from academic libraries. Online information review, 36(1), 21-39.

Vidyarthiplus. (n.d.). E-book management system. Retrieved January 18, 2017, from https://www.vidyarthiplus.com/vp/attachment.php?aid=24328

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly, 36(1), 157-178.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478.

VitalSource (n.d.). Retrieved January 13, 2017, from https://myaccount.vitalsource.com/#/login

Vogt, N. (2016). How Much Power Does a Phone or Tablet Use While Charging? Retrieved April 23, 2017, from https://www.h3xed.com/mobile/how-much-power-does-a-phone-or-tablet-use-while-charging

WAEC (n.d.). Retrieved May 07, 2017, from http://www.ghanawaec.org/EXAMS/WASSCE.aspx

Waller, D. (2013). Current Advantages and Disadvantages of Using E-textbooks in Texas Higher Education. Focus on colleges, universities, and schools, 7. Retrieved from http://www.nationalforum.com/Electronic Journal Volumes/Waller, Darlene Waller Current Advantages and Disadvantages of using E-textbooks in Higher Education FOCUS V7 N1 2013.pdf

Wikipedia (2017, April 05). Retrieved April 15, 2017, from https://en.wikipedia.org/wiki/E-reader

Wiley, D., Iii, J. L., Ellington, S., & Hall, T. (2012). A preliminary examination of the cost savings and learning impacts of using open textbooks in middle and high school science classes. *The International Review of Research in Open and Distributed Learning,13*(3), 262. doi:10.19173/irrodl.v13i3.1153

Wilson, K. B., Tete-Mensah, I., & Boateng, K. A. (2014). Information and communication technology use in higher education: Perspectives from students. *European Scientific Journal*, *10*(19).

Wilson, V. (2016). Research methods: triangulation. *Evidence Based Library and Information Practice*, *11*(1 (S)), 66-68.

Wong, K., Liong, C., Lin, Z. X., Lower, M., & Lam, P. (2011). EBooks as teaching strategy–preliminary investigation. In *Changing Demands, Changing Directions, Proceedings of Ascilite2011 Conference, Hobart, Tasmania* (pp. 1343-1352).

Worldreader, I. L. C. Africa, & USAID (2012). IRead Ghana Study: Final evaluation report. Washington, DC: USAID.

Yates, B. L. (2001). Applying Diffusion Theory: Adoption of Media Literacy Programs in Schools.

Yfuusa (n.d.). Student Life Cultural Profiles by Country. Retrieved April 2, 2017, from

http://www.bing.com/cr?IG=8B9C34D6537747A6BCC3DF1CA263D075&CID=1E6296960B24668A24BA9CCE0A1567F8&rd=1&h=4HQxY6HScJojw0kRJpX-J5__Ywuj1TNkF-md_Ql8hsA&v=1&r=http%3a%2f%2fonline.yfuusa.org%2fmedia%2fyes_lounge%2fGhana.pdf&p=DevEx,5063.1

Yoo, D. K., & Roh, J. J. (2016). Use and uptake of E-books in the lens of unified theory of acceptance and use of technology. http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1116&context=pacis2016

Zell, H. (n.d.). Print vs Electronic, and the 'Digital Revolution' in Africa. Retrieved April 24, 2017, from https://www.academia.edu/2514725/Print_vs_Electronic_and_the_Digital_Revolution_in_Africa

APPENDIX A

EVALUATION OF E-TEXTBOOK REQUIREMENTS

Category	#	Item	ibooks3/ iPad2	Himawari Reader/ Android	eBook Reader/ Android	Kindle reader / Kindle	Readium/ Windows	Calibre/ Windows
Authenti-cation	1	Authentication (enrollment) of LMS	TBE	TBE	TBE	TBE	TBE	TBE
	2	Online authentication	TBE	TBE	TBE	TBE	TBE	TBE
	3	Offline authentication	TBE	TBE	TBE	TBE	TBE	TBE
Copyright	4	Digital right management	Δ	Δ	Δ	Δ	Δ	Δ
	5	Usage restriction in case of copyright violation	X	Δ	Δ	O	X	X
Contents Represen-tation	6	Text size arrangement	O	O	O	O	O	O
	7	Language specific text representation	O	O	Δ	X	O	Δ
	8	Table support	O	O	X	O	O	O
	9	Multimedia replay (picture, movie, 3D)	O	O	Δ	Δ	O	Δ
	10	Audio replay	O	O	X	X	O	O
	11	Interactive media operation	O	O	X	X	O	O
	12	Page movement	O	Δ	X	O	Δ	O
	13	TOC, move from TOC to Target Page	O	O	O	O	O	O
	14	Footnote, move from Body Text to Footnote	Δ	Δ	Δ	Δ	Δ	Δ
	15	Word index, move from/to body text and index	Δ	Δ	Δ	Δ	Δ	Δ
	16	Search text	O	X	O	Δ	X	O
	17	Print page	X	X	X	X	X	O
	18	Copy text	O	X	X	X	O	O
Related Information	19	Dictionary, linkage from/to body text	O	X	X	O	Δ	O
	20	References books, linkage from/to body text	X	O	X	X	O	X
	21	Selection of reference books	TBE	TBE	TBE	TBE	TBE	TBE
	22	Linkage to Web pages	O	O	O	O	O	O
Added Information by Learners	23	Note to add, modify, delete, and move to body text	O	X	X	Δ	Δ	X
	24	Include picture in note	Δ	X	X	X	Δ	X
	25	Note windows to move and resize	X	X	X	X	Δ	Δ
	26	Search text in note	O	X	X	X	X	X
	27	Print note	O	X	X	X	X	X

	28	Add and delete linkage to references	O	X	O	O	X	O
	29	Bookmark to add, index, delete, or move to body text	O	X	O	O	X	O
	30	Add and delete underline and highlight	O	X	O	O	X	X
	31	Add and delete linkage to Web	X	X	X	X	X	X
	32	Add, replay and delete audio memo	X	X	X	X	X	X
	33	Index of added information	Δ	X	Δ	O	X	Δ
	34	Timestamp of added information	Δ	X	X	X	X	X
Learning Support	35	Data transfer to server	O	O	X	X	O	O
	36	User specified Window configuration	X	X	X	Δ	Δ	Δ
	37	Sensor data utili-zation in tablet PC	O	X	X	X	Δ	X
	38	Link or call another application	Δ	X	X	X	X	X
	39	Screen image capture	O	O	O	X	O	O
	40	Automatic or manual update of eText contents	TBE	TBE	TBE	TBE	TBE	TBE
	41	Notice Board	TBE	TBE	TBE	TBE	TBE	TBE
	42	Discussion Board	O	O	X	X	O	O
	43	Q&A Board	O	O	X	X	O	O
	44	Time Table	O	O	X	X	O	O
	45	Automatic Judgment of Quiz	O	O	X	X	O	O
	46	Study History Management	TBE	TBE	TBE	TBE	TBE	TBE
	47	Database Management	TBE	TBE	TBE	TBE	TBE	TBE
Restriction of Contents and Platforms	48	File Format	O	O	O	Δ	O	O
	49	Size and Weight	O	O	O	O	--	--
	50	Battery	O	O	O	O	--	--
	51	User Interface	O	O	O	Δ	--	--
	52	Network	O	O	O	O	O	O

Table 10: Evaluation of E-textbook requirements (Nakajima et al., 2013)

KEY

- "O" shows that it works and has a grade of "3"
- "Δ" shows that it partially works and has a grade of "1"
- "X" shows that it doesn't work and has a grade of "0"
- "TBE" shows that the authors couldn't find a working implementation way and also has a grade of "0".

(Nakajima et al., 2013).

STUDENTS' QUESTIONNAIRE

This questionnaire will provide inputs to my Master's Thesis about the behavioral intentions and technical issues relevant to the uptake and use of electronic textbooks for SHSs in Ghana.
Any information you provide me herein will remain completely confidential and will be used for the purposes of my Thesis ONLY.

Q1. E-textbooks will be productive in my studies.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q2. E-textbooks will enhance my effectiveness with respect to speed of task completion in my studies.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q3. I am worried about the potential to lose my notes and highlighted text should my E-device get missing or corrupted.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q4. I think E-textbooks will be easy to use by me.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q5. I think I will need some form of training before I can use an E-textbook.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q6. I will use E-textbooks if my teachers or parents recommend it.

Q7. I don't think the use of E-textbooks by other students will influence my decision to adopt it too.

Q8. Unreliable systems (e.g. internet and electricity) will sometimes restrict the effective use of E-textbooks in Ghana.

Q9. I will choose E-textbooks over printed textbooks if it's an option in future.

Q10. Apart from reading from the E-textbook platform, I think the platform can be used for other services to enhance my education.

Q11. I will choose an E-textbook if ONLY it costs less than its printed counterpart.

Q12. I will prefer some academic interactivity (audio and video) introduced into an E-textbook for my studies.

Q13. I am willing to pay more for an E-textbook with interactivity. Skip this question if you chose disagree or strongly disagree to (12).

Q14. There will be a lot of copyright issues (illegal copying and sharing) if textbooks are made electronic.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

Q15. I will be willing to pay more to keep my E-textbooks after school

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

TEACHERS' QUESTIONNAIRE

This questionnaire/Interview will provide inputs to Master's Thesis about the behavioral intentions and technical issues relevant to the uptake and use of electronic textbooks for SHSs in Ghana.
Any information you provide me herein will remain completely confidential and will be used for the purposes of my Thesis ONLY.

Administrator Details (Optional) *Respondent Details*

Name: Gabriel Bampoe
……
School: Aalborg University (Denmark)
……
Telephone: +233 553139919
Date:……...

1. I think E- textbooks will make the delivery of lessons very effective and efficient.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

2. I will require some form of training before I can use an E-textbook.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

3. The use of E-textbooks by colleague teachers for teaching will influence my decision to use it too.

4. I will use E-textbooks if the Ghana Education Service (GES) recommends it.

5. Unreliable systems (e.g. internet and electricity) will sometimes restrict the effective use of E-textbooks in Ghana.

6. I will support the idea of use of E-textbooks in SHSs by students and teachers in future if it turns out to be cheaper than their printed counterparts.

7. It will be helpful to deliver other academic services such assignments, notes, terminal reports etc. via an E-textbook platform.

8. There will be a lot of copyright issues (easy copying and sharing) if textbooks are made electronic.

PUBLISHERS' QUESTIONNAIRE

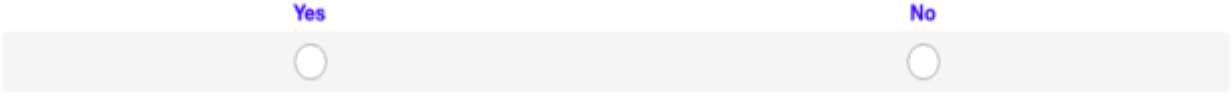
This questionnaire/interview will provide inputs to my Master's Thesis about the behavioral intentions and technical issues relevant to the uptake and use of electronic textbooks in Ghana.
Any information you provide me herein will remain completely confidential and will be used for the purposes of my Thesis ONLY.

Expected date of collection**: 28th November 2016**

Administrator Details (Optional)
Name: Gabriel Bampoe
……
School: Aalborg University (Denmark)
……
Telephone: +233 553139919
Date:……...

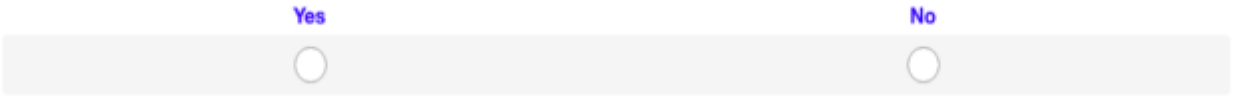
Respondent Details

1. Considering the numerous benefits presented by E-textbooks (environmental sustainability, easy update, low cost etc.) do you think it's the way to go for textbooks delivery in Ghana in future?



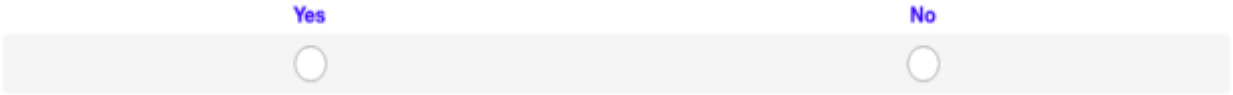
2. Going electronic will reduce your operational costs.

3. Some of our textbooks are already in the electronic format?



4. We are concerned about copyright issues and fear our work will be illegally duplicated or sold if we go fully electronic.

5. If you agree or strongly agree to Que (4), will you go electronic then if there is assassurance of digital right protection and therefore prevention of illegal duplication or sale of your work?



6. We will be willing to co-exist with other publishers on the same platform in future when E-textbooks are widely adopted in the country.

7. We will think about investing in interactive features (audio and video) to our textbook should we go electronic.

8. Which will you prefer, a one-time purchase of each E-textbook or a subscription service to give subscribed students access to all your textbooks for their program? Any reasons for your choice?

9. The decision by other competing publishers to go electronic will influence our decision to go electronic as well?

10. The technical conditions (e.g. internet, electricity etc.) are ready for the take off of an E-textbook service for SHSs in Ghana now.

Strongly disagree	Disagree	Neither agree nor diagree	Agree	Strongly Agree
○	○	○	○	○

11. Any other general concerns about E-textbooks you will like to share?

MINISTRY OF EDUCATION (MoE) QUESTIONNAIRE

This questionnaire will provide inputs to my Master's Thesis about the behavioral intentions and technical issues relevant to the uptake and use of electronic textbooks for SHSs in Ghana.
Any information you provide me herein will remain completely confidential and will be used for the purposes of my Thesis ONLY.

Administrator Details *Respondent Details (Optional)*
Name: Gabriel Bampoe
……
School: Aalborg University (Denmark)
……

Telephone: +233 553139919
Date:……...

1. What is the current state of ICT deployment in SHSs in Ghana- Do SHSs have desktops, laptops, tablets, Internet access etc.?

2. What is being done by MoE to get SHS teachers trained in ICT use in this digital world?

3. E-textbooks are gaining grounds the world over. What is MoE assessment of the use E-textbooks for SHSs Ghana?

4. The ministry is concerned about copyright issues that surround the use of E-textbooks.

5. The technical situation on the ground makes it possible for E-textbook deployment for SHSs in Ghana.

6. The economic situation on the ground makes it possible for E-textbook deployment for SHSs in Ghana.

7. Do you think Government of Ghana will be willing to pay for the use of E-textbooks by students on a neutral platform for the core subjects in future?

8. Will the Government of Ghana be willing to pay for E-textbooks for core subjects even if it turns out to be more expensive than the printed counterparts due to added interactivity (audio and video features)?

9. Any other general concerns about the possible use of E-textbooks for SHSs in Ghana in the near future.

GHANA INVESTMENT FUND FOR ELECTRONIC COMMUNICATION (GIFEC) INTERVIEW QUESTIONS

This questionnaire/Interview will provide inputs to my Master's Thesis about the technical issues relevant to the uptake and use of electronic textbooks in Ghana.
Any information you provide me herein will remain completely confidential and will be used for the purposes of my Thesis ONLY.

Administrator Details *Respondent Details (Optional)*

Name: Gabriel Bampoe
……
School: Aalborg University (Denmark)
……
Telephone: +233 553139919
Date:……...

1. What is the current state of Internet infrastructure in SHSs in Ghana?

2. I gather there is a project by GIFEC to give Internet access to SHSs in Ghana. What is the motive behind this?

3. Can you give a brief technical description of the project (i.e. technology deployed, data rates, power issues).

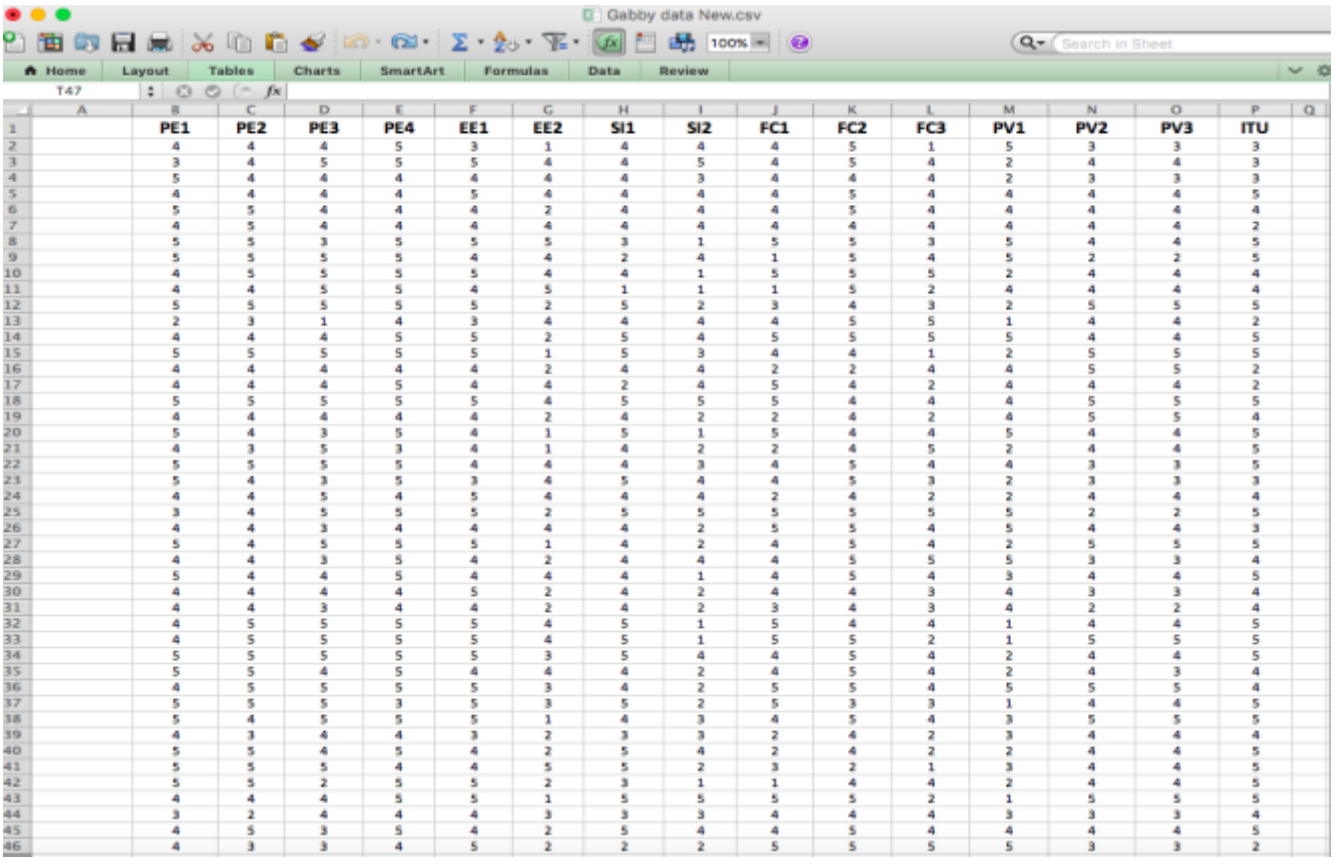
4. Will students and teachers be given unlimited access to the Internet?

5. How is it funded and will the cost be transferred to the students?

6. When is the expected project completion date for the nationwide SHS coverage?

7. Any other general concerns about the project note worthy?

STUDENTS' DATA



	PE1	PE2	PE3	PE4	EE1	EE2	SI1	SI2	FC1	FC2	FC3	PV1	PV2	PV3	ITU
MEAN	4.35	4.34	4.17	4.62	4.34	2.65	4.13	2.96	3.86	4.37	3.54	3.36	4.03	4.02	4.34
VARIANCE	0.3593	0.464	0.8524	0.346	0.485	1.671	0.8007	1.654	1.2817	0.6018	1.4121	1.6957	0.6979	0.7092	1.066
S.D	0.599	0.681	0.923	0.589	0.696	1.293	0.895	1.286	1.132	0.776	1.188	1.302	0.835	0.842	1.032