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Design Considerations framework for mobile based service to promote reproductive health information for the youth-at-risk in Addis Ababa

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Abstract

It is common for teenagers to face many puberty-related challenges as they transition to adulthood, and these challenges are worsened by a lack of access to reproductive health information. Youth are the most affected in current times because of various health disturbances. For youths to make better choices, they must be informed about critical life issues, including reproductive health information. Mobile technology is now a vital part of everyday life and is increasingly popular among younger generations, opening new possibilities for providing relevant mobile-based services for obtaining information. Mobile platforms have recently made health information more accessible and shared. The research project aims to improve the development of reproductive health information services for youth aged 15-24 in Addis Ababa through mobile-based services with an emphasis on design considerations.

Most of the solutions and mobile-based services based on mobile technology are copied from elsewhere, with little or no consideration for the communities and individuals who will use these services. Throughout the process of creating the model and the prototype for mobile-based reproductive health information service, youth were engaged in different activities as part of the design process as design partners. In a systematic manner, design science methods were used as the methodology. The design science research phases guided the design process of the service prototyped here, from ideation to co-design. The different methods youth-at-risk use to access information, especially reproductive health information, were identified. Technology and existing practices for accessing reproductive health information were also identified.

According to the results, the youth use mobile phones for sharing and receiving health-related information. In the current day and age, youth have access to reproductive health information and services, but they must travel long distances to reach some services by foot or by vehicle.

It is recommended that when developing any community-based solution, all stakeholders need to be included in the co-design process to ensure an ideal solution for users that is useful and relevant. By involving the user in the design process, innovations become more easily adopted by the user and technology is easy to adopt. User contributions are needed since they contribute

knowledge, experiences, and ways of doing things that improve the solution. The study recommends that services be developed in the future based on the findings herein.

Acronyms

AIDS Acquired Immunodeficiency Syndrome

ASRH Adolescent Sexual and Reproductive Health

AYC African Youth Charter

BEmONC Basic Emergency Obstetric and New-born Care

CA Content Analysis

CAC Comprehensive Abortion Care

CHIS Community Health Information System

CPR contraceptive prevalence rate

CSA Central Statistical Authority

DHIS District Health Information Software

DKT is named in honour of D.K. (Deep) Tyagi

DSR Design Science Research

DSRP Design Science Research Process

e-HMIS Electronics Health Management Information System

EDHS Ethiopian Demographic and Health Survey

EMDHS Ethiopian Mini Demographic and Health Survey

EMR Medical Records Tracker

EPHI Ethiopian Public Health Institute

FDA Food and Drug Administration

FDREMOH Federal Democratic Republic of Ethiopia Ministry of Health

FP Family Planning

GPS Global positioning systems

HEP Health Extension Program

HEW Health Extension Worker

HEWs Health Extension Workers

HITD Health Information Technology Directorate

HIV Human Immunodeficiency Virus

HMIS Health Management Information System

HRIS Human Resources Information System

HSDP Health Sector Development Program

HSTP Health Sector Transformation plan

ICPD International Conference for Population and Development

ICT Information and Communication Technology

ICT Information and Communication Technologies

ICT4D Information and Communication Technology for Development

iOS iPhone Operating System

IS Information Systems

LMICs Low to Middle Income Countries

MDG Millennium Development Goal

MNCH Maternal, New-born/Neonatal and Child Health

MOH Ministry of Health

M-DHS Mini-Demographic and Health Survey

NGO Non-Governmental Organization

PASDEP Plan for Accelerated and Sustained Development to End Poverty

PDAs Personal Digital Assistants

PFSA Pharmaceuticals Fund and Supply Agency

PSI Population Services International

RCH Reproductive and Child Health

RH Reproductive Health

RHBs Regional Health Bureaus

RQ Research Question

SMS Short Message Service

SRH Sexual & Reproductive Health

STD Sexually Transmitted Disease

STI Sexually Transmitted Infection

STIs Sexually Transmitted Infections

TB Tuberculosis

UN United Nations

UNDP United Nations Development Program

UNESCO United Nations Educational, Scientific and Cultural Organization

UNFPA The United Nations Fund for Population Activities

USAID United States Agency for International Development

WHO World Health Organization

WoHO Woreda Health Offices

ZHDs Zonal Health Departments

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Design Considerations

Things to be considered when designing a mobile app, in this research paper it refers to things to consider when designing a mobile app to promote information about RH among youth at risk in Addis Ababa. An app must be designed to meet the needs of the users while providing an easy and enjoyable experience for them (https://www.hanekedesign.com/top-design-considerations-for-mobile-apps-in-2019/).

Chapter 1. Introduction

1.1. Background

The provision of reproductive health services is the responsibility of the federal and regional governments. In Ethiopia, a series of governance reforms has improved efficiency, collaboration, and coordination of the RH program (FDREMH, 2016). There are many governmental and non-governmental organizations that are active in giving RH service to list some; MOH, USAID, Clinton foundation, PSI, DKT, Mari-Stopes Ethiopia, etc.

Reproductive health is a key component of overall health. As defined by the World Health Organization (WHO), reproductive health includes physical, mental, and social considerations throughout the life course in relation to the reproductive systems and their functions. Reproductive health, therefore: "entails that people have a responsible, satisfying, and safe sexual life as well as the freedom to decide whether, when, and how often to reproduce" (WHO, 2010).

The adolescents experience trouble in getting relevant sexual and reproductive health services. Major physical, cognitive, emotional, sexual, and social changes occur during adolescence and affect young people's sexual behaviour which in turn compromises their health-seeking behaviour. Among the top morbidities affecting this age group are consequences of the vulnerability associated with their age, specifically lack of information on sexual and reproductive health rights (FDREMH, 2016).

There is therefore a need to promote this information and making a choice to live healthily. Services for the youth should be the focus so as to manage this sexual and reproductive health issue. These services empower the youth to acquire the necessary tools, medication, and education to protect themselves from sexual and reproductive health issues.

Ethiopia's vision of health policy is to improve the health of women, children, adolescents, and youth through access and quality reproductive health services, integrated with the prevention and control of sexually transmitted infections including HIV, as well as good clinical services and

a steady flow of life-saving supplies and health-promoting commodities; and measures that increase social and economic participation (FDREMH, 2016).

According to (FDREMH, 2016),

Strategic Objective 8: Enhance the use of Technology and Innovation

Strategy 18: Improving the use of technologies and innovation for better Reproductive Health outcomes

Performance targets by 2020:

The second point states the need to Provide need-based in-service training on BEmONC (Basic Emergency Obstetric and New-born Care), CAC (Comprehensive Abortion Care), FP (Family Planning), and youth-friendly service as temporary solutions to improve the quality of RH services.

This research project focuses on how to develop a model to design mobile-based services to promote reproductive health information for the group youth at risk considering the various/diverse religious, cultural, and language aspects of the society. According to (Whiteley, 2001), a youth-at-risk is one who is neither employed nor enrolled in further studies after finishing school, as well as having difficulty choosing a career path. Since different definitions can be explored on the meaning of at-risk, for the purpose of this thesis, youth-at-risk will be referred to as a youth.

The way in which information is provided is important. Today mobile technologies have become part of our daily lives and it is in demand due to their affordability and availability (Thomas, 2012). Young people use mobile-based services extensively to gather and share information, as well as to stay in touch with their peers and others worldwide (Levine, 2011).

Mobile technology comprises mobile devices (also referred to as hand-held devices) such as ipads and smartphones (Mayisela, 2013).

1.2. Statement of the problem

Youth reproductive health is well supported by the government, and the policy and legal framework are positive. The Ministry of Health and the National Office of Population both have programs dealing with youth reproductive health (USAID, 2004). Despite efforts by government and non-government organizations to increase the uptake of reproductive health services by youth in Ethiopia, little literature shows its use remains low. In married women aged 20-24, the contraceptive prevalence rate (CPR) increases from 37% among women aged 15-19 to 52%. Compared to the 2005 EDHS, skilled providers delivered 11% of live births in 2011, 28% in 2016, and as high as 50% in the 2019 EDHS. Similarly, from 2005 to 2019, the EMDHS found that 48% of people born in health facilities were live births (EPHI, 2019).

According to (FDREMH, 2019) the following three cases related to reproductive health in Addis Ababa needs special consideration; Contraceptive Acceptance rate of 30%, Abortion Care Rate of 52%, and Proportion of children under 2 years of age who participated in Growth Monitoring and Promotion 29%. There were an estimated 89 million unintended pregnancies in developing regions in 2017, i.e., pregnancies that occurred too early or were unintentional (Darroch, et al., 2017).

A large majority of youth have heard about AIDS and the most common source for AIDS information is community meetings, followed by schools/teachers, radio, and friends/relatives (USAID, 2004). Recently some technological strategies, especially in mobile innovation, have been planned and developed to ease communication to advance and educating individuals on reproductive health.

Young people ages 15–29 can get subsidized vouchers to access and choose contraceptive methods through a program called Marie Stopes E-vouchers. Vouchers may be redeemed at any of the health facilities that are associated with the program for free counselling on all contraceptive methods to ensure informed and voluntary choices, and Pathfinder’s m4Youth provide tailored SRH, family planning, and HIV information to university students and peer educators (Ippoliti and L’Engle, 2017). However, these structures don't totally address the issue, as they don't consider the resources and environment unto where they are proposed. Wave

Consultancy (2011) emphasizes the need for consideration of the socio-cultural context of new technologies in health care delivery before performing a situation analysis. There are many proposed solutions and initiatives by the government and other non-governmental organizations to mitigate or solve all or some of these challenges, particularly the issue of access to relevant health information and services. However, the existing services are inadequate to meet the heterogeneous and complexity of providing health support to youth at every location and when needed.

Though the SRH indicators for 15-19-year-olds in Ethiopia and Rwanda have improved significantly over the past decade, adolescents still face significant challenges in addressing the socio-cultural drivers of, and providing services for, SRH. (Ernestina, et al., 2019). Even if there is success in reducing the number of victims related to RH there is still a lot to do to meet the goals to be achieved. It is evident because there are still a high number of unwanted pregnancies, low birth weights, postnatal stress, infertility, HIV/AIDS, and natal fatality issues. The lack of information on sexual and reproductive health rights significantly increases the risk of sexually transmitted infections like HIV, unwanted pregnancies, unsafe abortions, teenage pregnancy, and fistulas. The major supply-side constraints for this age group are the lack of wider community mobilization to inform and attract the youth to health service facilities and the lack of tailored and affordable services that encourage utilization. Cultural norms and stigmatization of sexual and reproductive health services were also major stumbling blocks on the demand side (FDREMH, 2014). In order to empower youth with mobile based service, one solution is to research the design considerations to develope a mobile app. There is, therefore, a need to investigate the effectiveness of existing methods/techniques of communicating health-related information and services amongst this group of youth.

1.3. Research questions

The research questions for this study are derived as follows:

RQ1. What design considerations must go into a mobile or web-based service to promote reproductive health Information for the youth-at-risk with?

RQ2. For youth at risk, what reproductive health information is needed?

RQ3. Currently, which mobile technology is available for at-risk youth?

RQ4. How can mobile-based services be used to promote reproductive health among youth-at-risk?

1.4. Objectives of the study

1.4.1. General Objective

The general objective of this research is to identify and or understand the design considerations to develop mobile based service that promote RH information.

1.4.2. Specific Objectives

- To understand present ways by which the youth-at-risk get RH information, what's more, recognize the difficulties faced with the ways and means of accessing RH information
- To identify the available technology as well as the reproductive health information needs of the youth-at-risk.
- Aims to address the challenges youth-at-risk face in accessing information due to cultural norms stigmatizing sexual and reproductive health services.
- Moreover, to design a framework for design consideration of a mobile-based service to access RH information.

1.5. Scope and Limitations of the Study

The study was completed within two years. Considering the Covid-19 pandemic and other situations within the country the researcher faced hard time specially during the data collection phase. Thus, considering available time and resources and to make the study manageable and controllable the study was focused mainly on developing the model, to achieve this the researcher developed a website-based prototype and left mobile based app development to the future and for those who will use this framework to develop a mobile app in RH.

In addition to the above-mentioned points, this research has some limitations. Due to financial and time constraints the student researcher was forced to focus the data collection only on youth at Addis Ababa and those who use Marie-Stopes Ethiopia to get the RH information and service. Marie-Stopes was chosen because it is a major provider of reproductive health services in Addis Ababa, offering services at seven RH and SRH clinics as well as working with government health centers.

1.6. Significance of the study

Currently, the service provided to promote RH information is mainly based on visiting the health care sites, though it's important to contact the health promoter physically, for most youth in Addis Ababa the online method is more preferable due to the familiarity with the technology and other privacy and financial issues, To achieve these, this study Model to Design Mobile Based Service to Promote RH Information help us understand the design consideration to develop mobile-based services.

Youth in Addis Ababa has a way of accessing RH information mainly from families and friends, but mostly the information from these sources is not complete so they have to visit the health centres to see health promoters, the study aims to reduce the time between youth and health promoters by utilizing a mobile application that both youth and health promoters are active on the platform.

The present study is design-based; therefore, the methodology used in this study might be helpful for those who are working on providing RH services with special consideration of youth and this research work serves as an example of how design considerations are employed to develop a mobile-based service to promote information regarding reproductive health.

Chapter 2. Literature Review

The purpose of this chapter is to provide a contextual understanding of youth access to reproductive health information through mobile technology.

Given the subject of this research, areas like innovations and technologies, youth and technology, mobile technology for development, mobile application development, mobile phones and reproductive health, reproductive health with emphasis on mobile technology are essential to the subject at hand and are hereby explored.

2.1. Innovations and technologies

In this thesis, the definition of ICTs by Chetley et al. (2006) and USAID (2011) will be used, where it is defined as "tools that facilitate communication and the processing and transmission of information and the sharing of knowledge by electronic means". This definition includes a wide range of technologies such as radios, televisions, telephones (mobile or fixed), computers, and the internet. ICTs are viewed as having a great deal of potential to address many of Africa's challenges including the health sector. For sub-Saharan Africa, healthcare is one of the fundamental needs and ICTs can offer many benefits towards health. Although the ICTs have the potential of greatly benefiting health practitioners, it is evident that the patients and other users benefit from accessing the right health information in order to make informed decisions.

It is clear from Chetley et al. (2006) that information and communication technologies have impacted healthcare. These examples include that they have:

Increased public discussion and debate on major public health threats by improving the dissemination of information about public health

- Enabled remote consultation, examining, and treatment through telemedicine
- Facilitated collaboration and cooperation among medical experts, as well as the sharing of learning and training approaches
- Supported more effective health research and the dissemination and access to research findings

- Strengthened the power to monitor the incidence of public health threats and respond in a more timely and effective manner
- Improved the efficiency of administrative systems in healthcare facilities

On the other hand, USAID (2011) reports that the use of ICTs in health is not just about technology but rather to achieve a series of desired outcomes, such as:

- Health workers making better treatment decisions
- Hospitals providing higher quality and safer care
- Governments becoming more responsive to health needs
- National and local information systems assisting the development of effective, efficient, and fair health systems
- Policymakers and the public are more aware of health risks
- People having better access to the information and knowledge they need to make informed choices for their own better health

Conventional ICTs in health interventions, including radio, television, computers, Internet, email, fixed land-line telephones, and fax are popular and used by most people. Radio and television, for example, have been used for generations with varying results to promote family planning/reproductive health, HIV/AIDS, and other health initiatives (USAID, 2011).

In regard to the adopted policy a "one plan, one budget, and one report" policy, since 2004 Ethiopia implemented two types of electronics Health Management Information System (e-HMIS) as HIS provides fundamental information for monitoring the health system. An assessment conducted by the Ethiopian Federal Ministry of Health (MOH) e-HMIS showed that despite intensive efforts to enhance efficiency, data quality and information use had been challenges for the past few years. In these circumstances, existing e-HMIS may be incompetent to come across with high demand information so as to create impressive gains and phenomenon advancements on major health outcomes within the new approaching Health Sector Transformation Plan (HSTP). The second District Health Information System (DHIS-2) is an open-source program designed to collect, validate, analyze, and present information to ensure that integrated health care is administered (Thangasamy et al., 2016). DHIS2 is the largest HMIS (Health Management

Information System) used by 67 low- and middle-income countries. In countries where DHIS2 is used, 2.28 billion people (30% of the world's population) live (Available on: www.dhis2.org.).

ICT4D

The ICT4D researchers (Colle & Roman, 2003) agree that each project of this nature requires user participation from all affected within a particular community. This helps and contributes to technological innovation or innovations that can benefit all participants and all intended users. ICT4D is articulated by Toyama (2010) who explains that it "considers how technologies such as the personal computer, mobile phone, and the internet can contribute to the global socio-economic development of economically impoverished communities". Almost every development initiative has some level of information technology whether it is the mobile phone or the internet in order to make life easier for people or for economic advancement.

Global development initiatives involve projects where deliberate attempts are made in order to alleviate poverty and to improve other situations including poor health and lack of education in communities around the world (UNDP, 2010). However, some failures of such initiatives are a result of a lack of user participation. Benefits of user participation in ICT4D projects include (Maail, 2011):

- Better understanding of the community context
- Better understanding of community needs and requirements
- Knowledge sharing
- Faster adoption of technology
- Increase in the likelihood of project sustainability
- Sense of ownership of the solution/project

A number of ICT4D project's successes are measured according to their sustainability. The ability of the project innovation or intervention to survive beyond the initial phase and continue to have an impact in the community is the main goal (Peña-López, 2010). The ICT4D projects face several challenges despite their successes. The challenges include are poor infrastructure as well as the inability to afford hardware (Peña-López, 2010). These physical constraints are obstacles for some ICT4D projects to begin. It is advisable for the ICT4D projects to make use of already existing

infrastructure and networks for better project success. It is also without a doubt that the mobile phone is the most visible ICT4D technology (Heeks, 2008). There are many benefits attached to mobile phones such as availability, portability, mobility, accessibility, and affordability (Tenhunen, 2008). As a result, without a doubt, it's the most visible ICT4D technology.

The use of ICTs, especially mobile technologies, can also help women, men and youth gain access to information and services about family planning and reproductive health, as well as increase their economic opportunities, improving their health and quality of life (USAID, 2011).

ICTs now mentioned by key global health documents as a means to support strategic development goals. Millennium Development Goal number 8 (MDG 8) of the United Nations calls specifically for increased access to new technologies (USAID, 2011).

ICTs are recognized in USAID's High Impact Practices in Family Planning as recommended and emerging categories of high-impact service delivery practices based on the strength and consistency of the family planning and reproductive health evidence (USAID, 2011).

The term "information and communication technology" refers to tools that enable communication, information processing, data transmission, and knowledge sharing using electronic channels. Among these are radio, television, telephones (fixed and mobile), computers, and electronic media such as digital text and audio-video recordings, as well as the Internet, including Web 2.0 and 3.0, social networking, and web-based communities (GAID, 2010).

ICT is unquestionably revolutionizing the way we live and work, and touching health profoundly. When effectively used, ICTs can increase information flow, disseminate evidence-based knowledge, and empower citizens. (Chetley et al., 2006).

2.2. Youth and technology

Young people represent the highest proportion of global consumers of mobile technology. Globally, more than 101.6% of the world's population is covered by mobile phone networks, and more than 74.4% of people living in the Sub-Saharan Africa are mobile phone subscribers (World Bank, 2018).

The declining cost of mobile phones and the increasing importance of mobile phones as essential commodities have led to a rise in the use of mobile phones, even in resource-poor settings. In

low- to middle-income countries (LMICs), young mobile phone users are increasing, but the penetration is limited in young populations (Hightow-Weidman et al., 2015). Among young people in 24 emerging nations, a survey published in 2014 revealed that between 53 and 95% owned a mobile phone. The average was nearly 83% among the 18-29 age group. (Hightow-Weidman et al., 2015).

A 2014 survey of 24 emerging nations revealed that between 53 and 95% of people aged 18–29 owned mobile phones; the overall average was nearly 83% ownership among young (Wike & Oates, 2014). Text messaging is found to be the most popular form of mobile phone communication, particularly among young people (Wike & Oates, 2014).

2.3. Mobile Technology for development

Mobile apps were estimated to be worth $25 billion in 2015 (Barnett et al., 2015), and there are more than a million apps available on each platform. New apps are released daily. App stores deliver mobile apps, unlike traditional methods of software distribution(Barnett et al., 2015). To create an app with a positive first impression, developers must satisfy the functional and non-functional requirements specific to mobile platforms (Barnett et al., 2015). Current models of software architecture highlight the stakeholders as being the primary influence on the quality attributes for a system (Barnett et al., 2015). The popularity and usage of mobile technology continues to boom (research2guidance, 2014). Increasingly people inclined to seek guidance from smart phones than from other persons (Elias, 2015). Smart phones ascendance to this level is highly associated to its practicality in communicating, information resourcefulness, portability and flexible costs for most people, regardless of their economic status (Silow-Carroll & Smith, 2013). Its affordability and availability make the mobile technology of great use today. Different forms of mobile technology like mobile phones, palmtops or personal digital assistant (PDA's), laptop computers, global positioning systems (GPS) and wireless card payment terminals are comprised as mobile technology (Sheng et al., 2005).

Low income communities are faced with a number of challenges concerning mobile technology, these being cost and accessibility as well as network coverage (Hamade, 2012). Hamade further recommends that mobile service providers should also provide better services to low income communities to mitigate these challenges and to provide opportunities.

Nowadays SMS become very popular as a form of mobile based service to distribute information, communication and interaction. SMS also becoming popular “to successfully deliver clinical care and preventative health interventions related to disease self-management, smoking cessation, diet and physical activity” (Gold et al., 2011). (Heeks, 2008) focuses on deciding what development will be achieved using calls and SMS and probably older technologies. However mobile phone users prefer the SMS service as a result of its affordability and (Leon & Schneider, 2012).

2.4. Mobile application development

Major mobile Operating Systems (Platforms)

The operating systems that run the mobile devices are called Mobile Operating Systems (Platforms). Mobile devices consist of various features such as touch screen, cellular, Bluetooth, Wi-Fi, GPS navigation system, camera, speech recognition, voice recorder, music player and so on (RAM, 2016).

As of their market share 95% is to Android and iOS, Android is developed by google and has the biggest market share (Divyap & Venkata Krishnakumar, 2016). Android includes an operating system, middle ware and a key mobile application which makes it a complete set of software or software stack for mobile devices (RAM, 2016). iOS is one of the best Operating System created and developed by Apple Inc. and its native language is Objective-C and is used in iPhone, iPad, and iPod touch.

Vendor	Operating System	Programming Language	Development Environment	Application Store
Google and Open Handset Alliance	Android	Java	Eclipse	Google Play
Apple	iOS	Objective-C	Xcode	iPhone App Store
Microsoft	Windows Phone	Visual C#C++	Visual Studio	Windows Phone Marketplace
RIM	Blackberry OS	Java	Eclipse	Blackberry App Word

Table 1. Major Mobile Platforms (Ribeiro & Da Silva, 2012)

2.5. Mobile phones and reproductive health

Different definitions of mHealth put forward by scholars. Germanakos et al., (2005) describe m-Health as "medical and public health practices carried out using mobile devices to collect healthcare data, make it accessible to practitioners, researchers, and beneficiaries, and to monitor vital signs and provide direct healthcare."

Of the million apps in circulation, about 45000 are mHealth apps (research2guidance, 2014). The use of mobile phones for improving health behaviours and services is becoming increasingly prevalent in global health, particularly among young people. Privacy, convenience, and access—hallmark of mobile phones—-make them especially appealing to adolescents. Several global reproductive health programs use mobile phones (including all mobile phones, not just smart phones) to support adolescents' health, via various communication formats that link young people to information and services on a wide-range of sexual and reproductive health (SRH) topics. In low- and middle-income countries (LMICs), mobile phones provide a cost-effective, efficient, and highly effective channel for reaching and engaging youth around SRH issues (Ippoliti & Engle, 2017).

Young people experience many problems when seeking SRH information and services which are mostly overcome by mHealth. Along with cost prohibition and transportation challenges in reaching health facilities, youth commonly report stigma and discrimination from health care workers when seeking SRH services (Ippoliti & Engle, 2017). It has never been more crucial to provide alternative, but complementary, ways of reaching young people in this challenging landscape of information provision. By using mobile health programs, you can offer relevant and timely information and engage young people without stigmatizing or criticizing them.(Ippoliti & Engle, 2017).

In resource-poor settings, the provision of SRH information via mobile technologies is becoming accepted, feasible, and promising. Besides, global research suggests that providing SRH information via mobile phones is highly attractive to young people and can positively influence their SRH outcomes including improving knowledge, reducing sexual risk behaviour, and increasing utilization of health services. Costing studies also suggest that mHealth program expenses are within reach, and that text messages are more cost-effective than other communication methods (Ippoliti & Engle, 2017). As a result of the attractive nature of mHealth interventions, it is increasingly recognized that mobile phones provide a promising platform for reaching large numbers of adolescents in diverse settings with essential, high-quality, and comprehensive SRH information and support.

The many benefits of mobile phones are also recognised in the field of health with regards to them being used as tools to ensure effective healthcare and service delivery. The use of ICTs for health is therefore referred to as eHealth (WHO, 2015). Web-based health interventions are also referred to as eHealth. These kinds of interventions allow for healthcare and service delivery to be given via the internet or via the networked electronic intervention. It is noted that mobile platforms are enabling easy access to the internet, which therefore leads to a conclusion that all health-related services provided via the mobile platforms are included in the definition of web-based health interventions, which can also be referred to as mHealth (G Eysenbach, 2001).

mHealth can therefore be looked at as mobile health interventions or the rather provision of health via mobile interventions or platforms especially the mobile phone. Web-based and mobile

health interventions make it easy to track large numbers of participants/patients, especially in behavioural change interventions for quitting bad habits such as smoking or losing weight. These interventions are also used to track the patient's follow-ups and send reminders for follow-ups and for taking medicine (G Eysenbach, 2001) (G Eysenbach, 2011).

2.6. Reproductive Health

An estimated 89 million pregnancies occurred unintentionally in developing regions in 2017; these are pregnancies that happened too soon or unintentionally (Mccarthy et al., 2018). There are many adverse health and social consequences associated with unintended pregnancies, such as a lack of access to antenatal care, an increased risk of low birth weight and premature birth, and delays in women's educational and career development (Mccarthy et al., 2018). There are more than 2 million unsafe abortions performed on adolescents each year, and adolescents are more likely than adult women to seek abortions later in pregnancy for a variety of reasons (Mustafa, Challi, & Fikru, 2013).

(Mccarthy et al., 2018), on their paper shows an estimated 6 million unintended pregnancies reduce by meeting adolescents unmet need for modern contraception each year.

Worldwide about one half of all HIV infections occur among people aged 25 years and under, up to 100 million youths become infected with a curable sexually transmitted disease (STD); best estimates show that about one out of 20 youths in the world contract an STD each year (Kirby, 1994).

In Africa, 500,000 young people are infected with an STI every day, and WHO estimates that 60% of new HIV infections occur among youth aged 15-19 years (Nwobodo, 2002).

As the 1994 International Conference on Population and Development (ICPD) established a foundation for adolescent sexual and reproductive health (SRH) as a priority area and the conference applauded the fact that existing health, education, and social programs had generally ignored the needs of young people when it adopted a plan of action that is now used to develop programmes addressing the SRH needs of adolescents around the world. (UN, 1994).

A later review conducted ten years later (ICPD + 15) showed that teen births were still a serious concern, particularly in Sub-Saharan Africa where rates of over a hundred and twenty births per a thousand women aged 15–19 years are recorded and young people continue to be in danger for HIV infection, particularly adolescent girls (UNFPA, 2009; Ringheim, Gribble, 2010).

The definition of reproductive health (RH) adopted at the 1994 International Conference on Population and Development (ICPD) represented a significant success in current thinking about human sexuality and reproduction. Whereas previous views had turned around demographic goals and programmatic targets, ICPD placed people's needs at a centre stage. Not only did it extend the domain of RH beyond the years of reproduction, it situated it inside a broader Socio-cultural context that enclosed gender roles respects, and protections of human rights (FDREMH, 2006).

Global health and development organizations have necessitated action to boost Adolescent Sexual and reproductive Health (ASRH) to reinforce a healthy transition into productive adulthood. the first purpose of this demand action is to reduce adolescent pregnancy and childbirth with all its attendant complications (Darroch et al., 2016).

Yet, various data and research gaps impede these efforts. Teenagers face an array of sexual and reproductive health issues, including unplanned pregnancies and sexually transmitted infections (STIs), such as HIV infection. Despite the fact that these conditions can be prevented with increased access to preventive reproductive health care, adolescents often lack information about and options for contraception; so, these young people frequently engage in risky sexual behaviour and develop complications related to sexual health issues.

Research suggests that stereotypes and discriminatory practices, linked to "gender and age," negatively affect not only the lives and prospects of many adolescents on the short-term, but also on the long-term (Harper et al., 2018; Patton et al., 2018).

The use of mobile phones to transmit health information and provide links to services to improve health behaviours among hard to reach populations has gained increasing attention in recent years (Ippoliti & Engle, 2017).

2.7. Reproductive health in Ethiopia/Addis Ababa

As early as 1997, the govt of Ethiopia began addressing the problems associated with complexity of RH needs and also the multiple factors that give rise to them by conducting a national RH needs Assessment to guide the country's implementation of the new RH paradigm (WHO, 1999).

According to the report, the "Fitun Warmline AIDS" Hotline provides health care professionals with free access to information on HIV/AIDS in Ethiopia to keep them up to date and ensure that they make the best use of the latest technology and improve the quality of their care. (HEART, 2016).

As stated in the statement of the problem the diverse social and cultural aspects of our community needs to be addressed in order to achieve the intended goals of the FDREMOH; the following points on (FDREMH, 2016) are highlighted as a way to respond to diverse social contexts, human resource development and capacity building, health management information systems (HMIS), monitoring and evaluation (M&E), and research are other areas of work highlighted in the document.

In order to meet the health needs of all Ethiopians, the National RH Strategy builds on a number of notable initiatives. These include the 1993-health policy, followed by a comprehensive Health Sector Development Program (HSDP) in 1998, as well as the recently launched Health Extension Program (HEP). HSDP is a long-term strategic framework for implementing the health policy, built on the principles and concepts of the Sector Wide Approach. The HEP is an innovative community-based approach directed at availing preventive, promotive and some curative services near the household (FDREMH, 2006).

Several interventions related to RH are implemented by the Ethiopian Ministry of Health. According to (FDREMH, 2016) the following six priority areas are identified from the large scope of service under RH umbrella as intervention: the social and cultural determinants of women's reproductive health; fertility and family planning; maternal and new-born health; HIV/AIDS; RH of young people; and reproductive organ cancers.

Several achievements are gained due to the interventions applied on different areas of RH. To reduce unwanted pregnancies and enable individuals to achieve their desired family size, the

strategies outlined are to create acceptance and demand for FP, to increase access to and utilization of quality FP services and to delegate the service delivery to the lowest level possible without compromising safety or quality of care. The main targets set to measure the progress toward this goal are reaching contraceptive coverage rate of 60% by 2010, ensuring awareness and increasing demand satisfied to 80%, and level of inclusion of long-term FP service in the job description of mid-level health care providers (FDREMH, 2016).

Several strategies are recommended by (FDREMH, 2016) to enhance the reproductive health and well-being of the country's diverse populations of young people the strategies to be followed includes segmenting the design and delivery of all youth RH-related interventions and policies by gender, age cohort, marital status, and rural/urban residence; addressing the immediate and long-term RH needs of young people; and strengthening multicultural partnerships to respond to young women's heightened vulnerability to sexual violence and non-consensual sex. As an immediate action developing a comprehensive adolescent's reproductive health strategy is recommended to achieve this goal.

2.8. Youth

Youth should not be defined as a fixed age group as it is rather fluid and is best defined as the period of transition from childhood to adulthood, when one becomes independent and is aware of his/her interdependence as a member of his/her community. However, age is the easiest way to define this group, for statistical purposes.

For statistical consistency, the UN defines youth as persons between the ages of 15 to 24 across regions. The African Youth Charter on the other hand, defines youth as those persons between the ages of 15 to 35 (AU, 2006).

Major physical, cognitive, emotional, sexual and social changes occur during adolescence and affect young people's sexual behaviour which in turn compromises their health seeking behaviour. Among the top morbidities affecting this age group are consequences of the vulnerability associated with their age, specifically lack of information on sexual and reproductive health rights.

As a result, the risk of sexually transmitted infection including HIV, unwanted pregnancy, unsafe abortion, teenage pregnancy and fistula significantly increases. The major supply side constraints for this age group are lack of wider community mobilization to inform and attract the youth to health service facilities and lack of tailored and affordable services that encourage utilization. On the demand side, cultural/societal norms and stigmatization of sexual and reproductive health services were also the major constraints (CSA, 2014).

Population censuses and projections conducted in Ethiopia in different years show that youth and adolescents represent a high proportion of Ethiopian population. The 2012 population projection put the population at 83.75 million and the youth population at 8.3 million (9.9%). Adolescents reached 20.19 million (24.1%), and secondary school age students reached 7.4 million in 2011. (CSA, 2014).

2.9. "Youth-at-risk"

At-risk is an ambiguous concept and there are many definitions according to literature. Generally, individuals are considered to be at risk when they do not have some form of income, they abuse alcohol and drugs, and they are also exposed to illnesses such as HIV/AIDS and other sexually transmitted diseases. At risk individuals could also be regarded as those that are facing a future that is uncertain because of the many occurrences happening today like poverty, global warming and the many other issues around the world. However, it could also mean that everyone in this world faces a risk of some sort, especially the young people, for they still have a long future ahead. If the many challenges being faced today are not dealt with in a creative and sustainable way, the future remains bleak for everyone, which could increase the risk factor. There are many definitions of youth-at-risk but any youth growing up in this world is at risk in one way or the other. The young people are exposed to a lot of negative influences at such a young age; thus, they are at risk regardless of their backgrounds (Youthreach, 2013).

2.10. Health Information Technology in Ethiopia

Through Health Information Technology Directorate (HITD) and partners The Federal Ministry of Health (MOH) to support the health information system (HIS) at different levels of the health system hierarchy has been developing and implementing eHealth applications. Thus far, MOH,

other government agencies, implementing partners, universities, and private health care providers have been developed and implemented various desktop, web, and mobile applications, as well as MS-Excel or Access-based systems. The applications vary from patient/client registry to data aggregation and analysis platforms. These eHealth applications currently are implemented at health facilities, Woreda Health Offices (WoHO), Zonal Health Departments (ZHDs), Regional Health Bureaus (RHBs), MOH directorates, other government agencies (i.e. Pharmaceuticals Fund and Supply Agency (PFSA), Food and Drug Administration (FDA), and Ethiopian Public Health Institute (EPHI)), universities, and so on (FDREMH, 2018).

The number of mHealth applications has grown significantly over time, often resulting in an overly complex system of services. Therefore, mHealth and its ability to deliver solutions are severely limited by the fragmentation of services across geographic regions, health service levels, and health care continuums. From the total of 228 operational mHealth systems identified throughout the country only 77 are unique the others are redundant. Applications are characterized into HMIS (n= 14, 18%), CHIS (n=6, 8%), EMR (n=16, 21%), HRIS (n=10, 13%), MNCH (n=12, 16%), Immunization (n=12, 16%), HIV (n=15, 19%), TB (n=13, 17%), health logistics (n=17, 22%), and others – including clinical laboratory systems to demographics and research tools (n=28, 36%) – were identified (Federal Democratic Republic of Ethiopia Ministry of Health, 2018).

During the assessment 84% or 65 of the mHealth systems were in use 12% were under development and 3% were deployed but not functional and 1 application was deployed and had previously been functional (FDREMH, 2018).

From platform perspective 44 out of the 77 are web based which is the majority 32 are desktop apps and only 6 are mobile based, few run on more than one platform (FDREMH, 2018).

In general application development must take into account the existing telecommunication and infrastructure. Ethiopia has, over six years, developed an unusual but extensive mixed-capability ICT infrastructure that provides a blended coverage of 85% of the country's population, with the potential to serve 90% of its population (Vital Wave Consulting, 2011).

2.11. HEW information and communication flow

In Ethiopia primary health system HEWs stood in the “front line”. HEWs are responsible both for providing information and services to families and communities and for collecting and transmitting data on health needs to higher levels of the health system (Vital Wave Consulting, 2011). Vital Wave further depict HEWs information communication relationship in the graphic as follows.

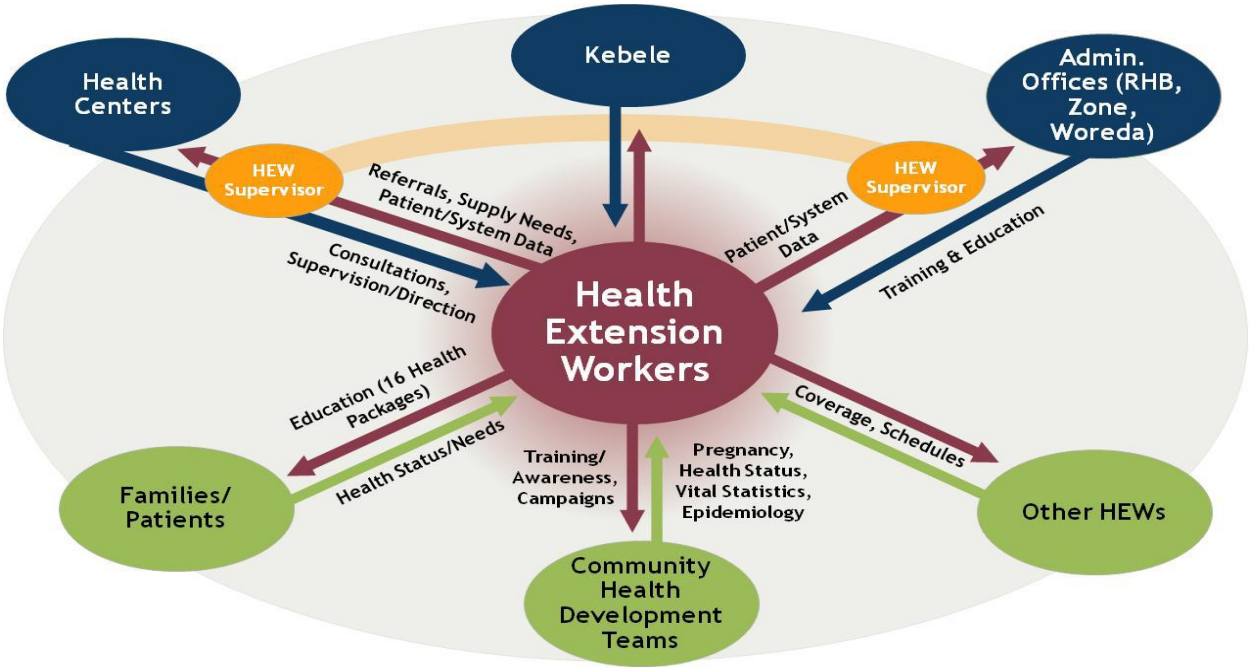

Figure 1. Source: (Vital Wave Consulting, 2011)

2.12. Related Frameworks and/or Models

Thobias & Kiwanuka(2018) in their study designed and implemented a mHealth data model that would improve mothers' knowledge of reproductive and child health (RCH) services in rural environments, and could remind those without mobile access to receive antenatal care. On this study, using mobile phones for spouses and relatives of mothers was seen as a practical solution for mothers who did not possess their own.

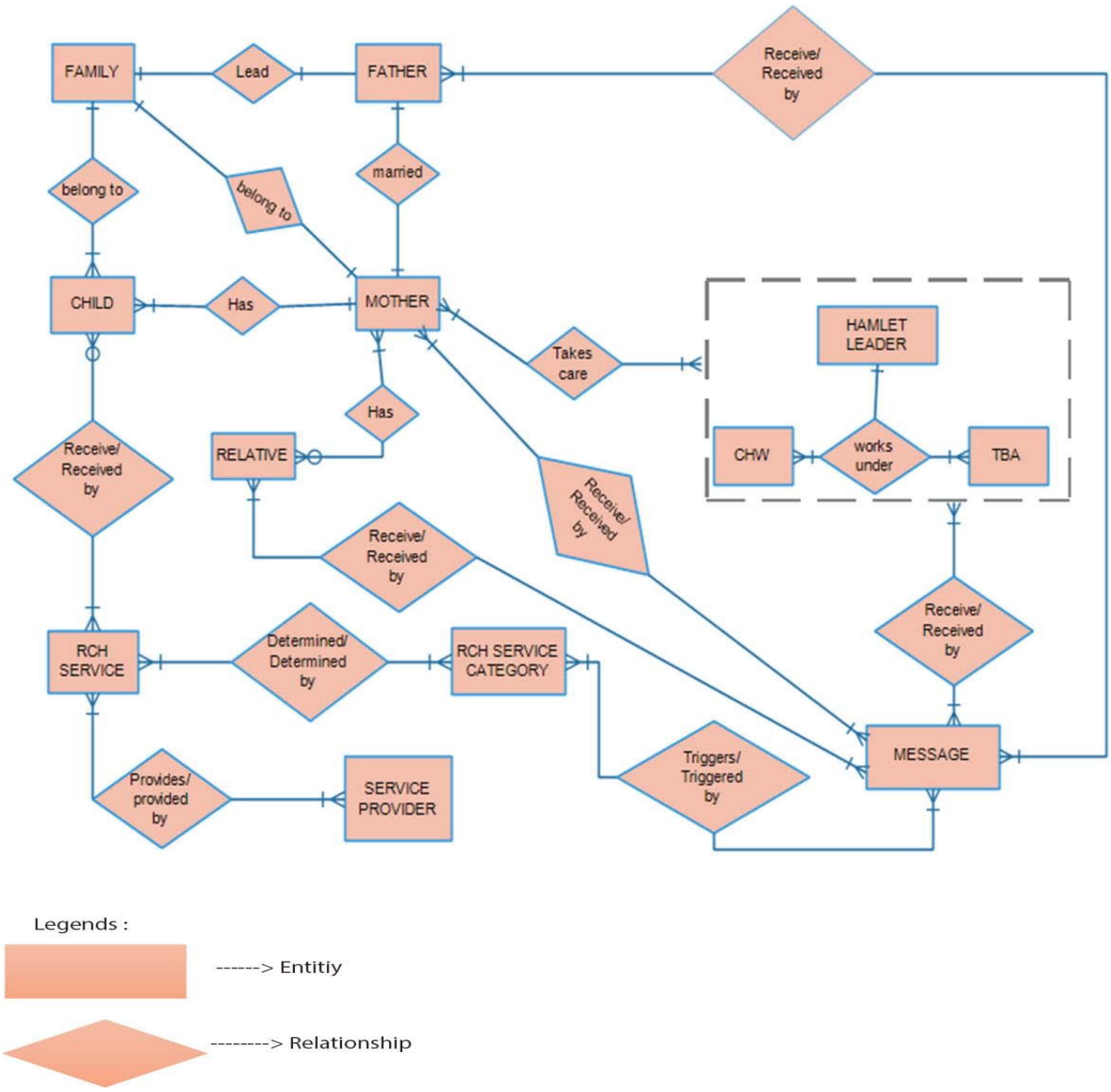

Figure 2. Data model: Description of relationships between entities and proposed relationships

In their article, Banos et al. (2014) outlined the following essential requirements for designing an mHealth framework:

- There should be a level of abstraction of heterogeneous resources that makes hardware and communication transparent to the developer.
- For the sake of interoperability, the framework should define a unified model for multimodal health data.

- In order to ensure persistence, health data needs to be stored securely, both locally and remotely.
- The framework should provide methods for extracting information about health from raw physiological and medical data.
- Users and specialists should have access to mechanisms to visualize medical and health information in an easy-to-use manner.
- In addition to healthcare services, intelligent recommendations, personalized guidelines, and health delivery are also required. Additionally, the framework should support future sensor technologies and application needs by being modular and extensible.

With the above requirements in mind, a novel framework to facilitate the development of mHealth applications leveraging heterogeneous wearable biomedical devices is developed. The mHealth Framework includes elements for resource and communication abstraction, information retrieval, health knowledge extraction and storage, adaptive visualization, system management, and value-added services.

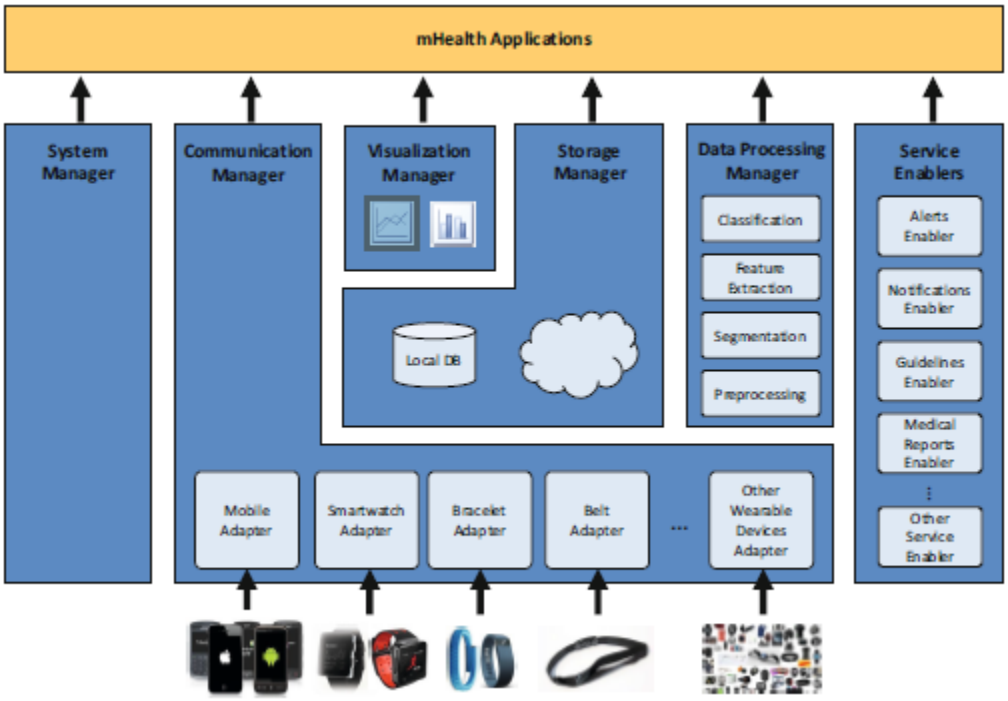

Figure 3. mHealth Framework architecture

2.13. Conceptual framework

The framework below is adopted from (Iipito, H.N., 2015) with some modification from literature review and my experience. This framework was designed by the author to develop a prototype for mobile based service to promote reproductive health information. As my aim is to develop a framework for design consideration to develop mobile based service to promote reproductive health information, this model with little modification from literature review will guide me in identifying the gaps that exist on the services available and in developing a framework for design consideration of these services. The selected model was studied in a context that is closely similar to the study area in terms of the existence of various languages, religions, and culture among the community to be studied on thesis project, in addition the way the model organized is in the interest of the researcher to do the study it is mainly focused on the design considerations to develop a mobile based service to promote RH information.

The framework as presented feeds into the ICT4D domain. The figure below illustrates the relationships between the different variables derived from the literature review. Each variable is represented with its characteristics as described in the literature. It points out which variable informs what and how they relate to each other in order for e-service to be designed for the purpose of promoting reproductive health information for youth-at-risk.

ICT4D Domain

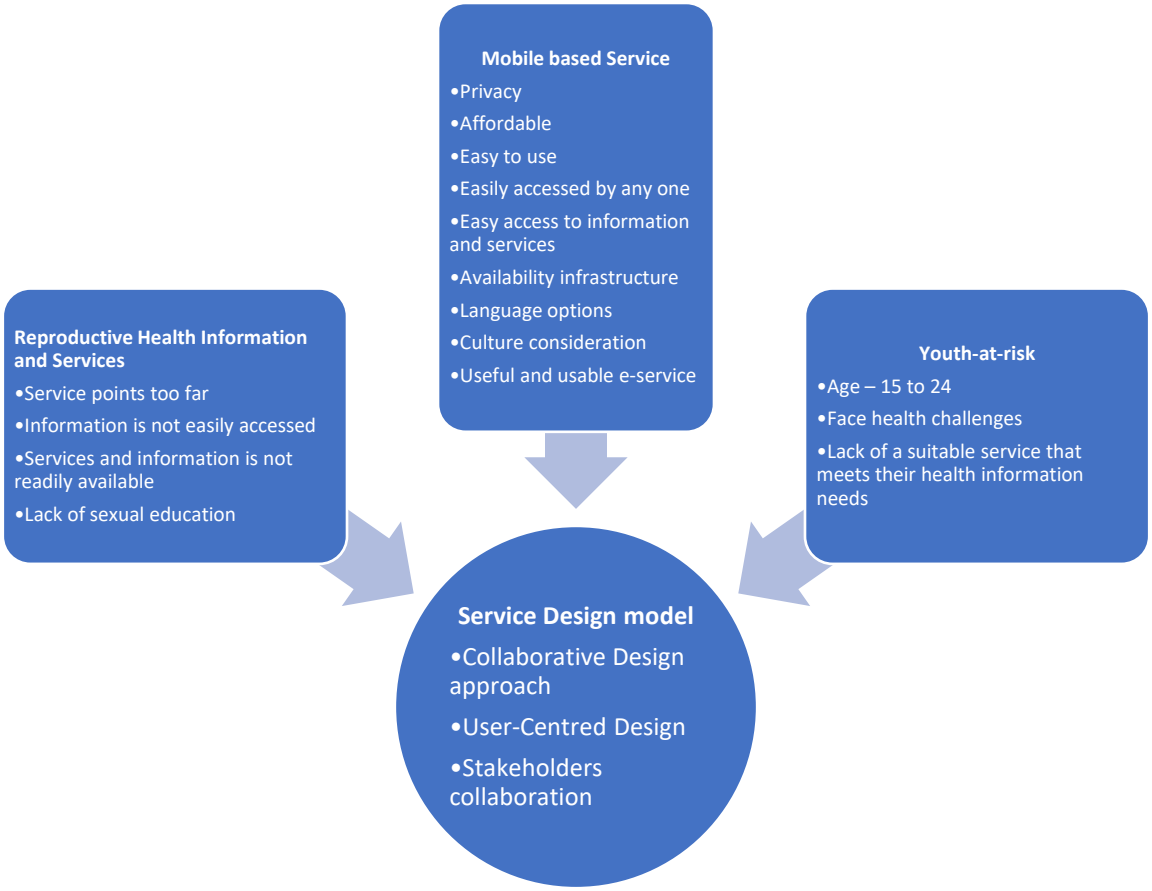

Figure 4. Source: (Iipito, H.N., 2015)

The relations between the components of the above conceptual framework are outlined as follows:

1. Reproductive health information and mobile based service inform service design model process about all the necessary information needs and the availability of services that are pertinent to the youth-at-risk in the community of interest.
2. Youth-at-risk and service design models have a relationship whereby the youth-at-risk is part of the co-designing process of the suitable solution using service design methods and tools to access reproductive health information via mobile technology.
3. The relationship between service design model and mobile based service is the outcome of this whole project. Service design model will be developed to assist the development of mobile based services.

2.14. Theoretical Framework

The theories explained below are closely related and were seen fit for this study to explain the real-world occurrences of the phenomenon under study.

2.14.1 Diffusion of innovation

Similarities from diffusion of innovation theory and domestication of technology theory were used in order to argue certain occurrences. It is clear that once an innovation is introduced in a community, there are certain things that need to be considered. These things include the adoption of the innovation and or technology, the different types of adopters and how fast or slow they adopt it is clearly explained by the diffusion of innovation theory. This study thus contributes to the diffusion of innovation theory. Other things to be considered are how the innovation is appropriated in our environment and how it becomes part of our daily lives and practices, this is detailed by the domestication of technology theory below. Domestication of technology is mostly used to explain the innovation, which is an outcome of this study.

2.14.1.1 Innovators

According to Roger (2003), innovators are those that are willing to experience new ideas. He also added that innovators are the gatekeepers who are bringing in the innovations from the outside. They are sometimes not the favourites of other community members and may even be disliked because of their adventurousness. However, it is their adventurousness that brings in innovations and they tend to be faced with uncertainty, as well as unsuccessful and unprofitable innovations.

2.14.1.2 Early adopters

Roger (2003) argues that early adopters are those who are likely to hold leadership roles in the community. As leaders, they are more like role models and other community members come to them to seek for advice on the innovations. Their attitudes towards the innovations are important as their leadership in adopting the innovations decreases uncertainty for other community members. Once the early adopters adopt an innovation or a new idea, they somewhat give a sense of approval to the rest of the community members.

2.14.1.3 Early Majority

The early majority are the ones with good interaction with others in a community, but they do not hold any leadership roles. They are claimed to adopt the innovation before the other half of other community members. Their decision to adopt an innovation is after some time unlike for

innovators and early adopters. They are not the first to adopt and therefore not the last to adopt either.

2.14.1.4 Late Majority

Somewhat similarly to the early majority, the late majority wait for most of the other community members to adopt the innovation for them to adopt it too. They are usually sceptical about the outcomes of the innovation, but because of certain factors such as economic necessity or even peer pressure, they often feel obliged to adopt the innovation.

2.14.1.5 Laggards

The laggards are more sceptical about innovations and their outcomes more than the late majority. They do not hold leadership roles either and they always want to make sure that the innovation works well before they can adopt it. Their decision to adopt is rather long, as they want to make sure that the innovation has been successfully adopted by others in the community.

Innovations introduced to different communities are designed and developed from outside these communities. This leaves the community members with difficulty in deciding whether to adopt the innovation, or not. Often, once the innovation is adopted, it is possible that the outcomes do not necessarily meet the needs of the community members who adopted the innovation with certain expectations. It is imperative that the design and development of any innovation should be designed with the intended users in order to rid them of any sceptical thoughts or adopting because of peer pressure and economic necessity.

This study focuses mainly on how the e-services perceived by the users regarding sense of ownership of the innovation and easiness to adopt the innovation as they know the exact outcomes and benefits of the innovation. This study also informs the diffusion of innovation theory, that for every innovation introduced in any community, a proper study of who the stakeholders are needs to be done.

2.14.2 Domestication of technology

Traditionally, the word domestication refers to taming a wild animal to be more domestic to the one taming. However, in the use of the same metaphor, “the domestication of technology refers to the process where users bring an artefact from the public realm to the private and tame, gain control, shape or ascribe meaning to the artefact in users’ lives” (Lee et al, 2009). The

domestication of technology theory provides a theoretical lens that is useful to address the issue of user participation in design and the development of services, solutions, and innovations. The domestication of technology theory highlights the role of the user in innovation, most especially the work done by the individuals of a community towards a technology or innovation. This process involves the users as participants to manipulate technology from outside of their community to do practical and meaningful work that makes sense in the community (Williams et al., 2004). This will range from the adoption, use, functionality and even detailed user interface design (Lee et al., 2009) to address positive user experience, ensure that user needs are met and for the proper understanding of user context.

Domestication is the process by which a technology or innovation adapts to a household or community and its social settings. The users also adapt as the environment in which they are, and where the technology was introduced, changes with the technology or innovation. In this way, one is able to understand the relationships between technology and culture as they emerge. Domestication deals with culture, social and technological networks of the everyday life of households. The participation of the user is what defines the meanings and significance of all the media and information products (UTwente, 2014). There are 4 segments that describe domestication; these are appropriation, objectification, incorporation, and conversion.

2.14.2.1 Appropriation

A technology or innovation is first introduced into a setting. It is as if the technology is removed from the public setting to the private setting where it acquires meaning. Meanings in these two settings are not the same. Private settings could be a home or a household. Appropriation in other words could also be described as a process of bringing a technology in another local cultural context.

2.14.2.2 Objectification

The technology is then displayed or arranged in a private setting. In this setting, the user then identifies him/herself with the technology and starts to feel comfortable with the technology. However, it is important to remember that the environment or household already had meaning for the existing objects before the technology was introduced.

2.14.2.3 Incorporation

This is the phase which describes how the technology is used in the household and how contextual factors influence this use. The contextual factors could be culture, gender, and status.

2.14.2.4 Conversion

In this phase, new meanings are created, as well as norms and values associated with the technology. Thereafter, the new meanings are transferred back to the outside world.

Chapter 3. Methodology

3.1 Research Design

3.2.1 Target Population

In this study, only youth living in Addis Ababa who use mobile-based services to access reproductive health information and who are aged 15-24 were included. Since Addis Ababa is the capital of Ethiopia and a center for most RH services, the research project focused on the city as a study area.

3.2.2 Sampling

The number of focus groups and the number of participants depend entirely on the researcher, the sort of data generated and collected as well as how the researcher plans to analyse the information (Barbour, 2007). Within the non-probability sampling technique, purposive sampling to settle on enough youth participants to participate within the interviews, focus groups, and observations.

The participants were selected based on criteria's set by the researcher like age 15-24, practice of use of RH services at least they are active on using the service for a year, education level youth at the university or college level. Based on the criteria's five participants were participate on the focus group sessions as well as for the group interviews. From the e-voucher of Marie-Stopes users who are frequently using the service for the last one year, four youth were interviewed to know information access and use. And two health promoters were interviewed to understand information dissemination, access, and use.

3.2.3 Data Collection

Generally, there are two types of interview for collecting data, i.e.:

1. Standardised – interviewer-administered questionnaires
2. Non-standardised
    - One to one [face to face, telephone interview and internet and intranet-mediated (electronic interview)]

- One to many (Group interviews, e.g. focus groups; internet and intranet medicated (electronics) group interviews, e.g. focus groups)

(Saunders et al., 2009) explains that interviews can also be categorised into to three (3) types namely, structured interviews, semi-structured interviews and in-depth interviews which is described in detail below based on the information collected from (Saunders et al., 2009) and Creswell (2007).

A. Structured interviews

Structured interviews use questionnaires based on a predetermined and 'standardised' or identical set of questions and that we see them as interviewer-administered questionnaires. The interviewer reads out each question and then record the response on a standardized schedule. Usually with pre-coded answers. While there's social interaction between the researcher and therefore the participant, like during the preliminary explanations that require to be provided, the researcher should read out the questions exactly as written and within the same tone of voice, so no bias is indicated. This type of interview is used to collect quantifiable data and they are also referred to as 'quantitative research interviews.

B. Semi-structured interviews

For this sort of interview, a list of questions must be prepared earlier by the research before conducting the interview. Some questions that might not be relevant in particular interviews will be omitted, and additional questions may be required to explore the research question and objectives given the nature of events within particular organizations. The order of questions asked may also be varied depending on the flow of the conversation. The data received from the interviewee was recorded by audio-recording the conversation or perhaps note taking. This type of interview is additionally labelled as participant interview.

C. In-depth interviews

It is an informal process. These are accustomed explore thorough a general area of interest. there's no predetermined list of questions to run through during this situation, although one must have a clear idea about the aspect or about events, behaviour and beliefs in relation to the

subject area. Sometimes it's called ‘non-directive’. it's also labelled as the informant interview since it's the interviewee’ perceptions that guide the conduct of the interview.

For two primary reasons semi-structures interview is preferred as a means of data collection. First, they're suitable for the exploration of the perceptions and opinions of respondents regarding complex and sometimes sensitive issues and enable to search for more information and clarification of answers. Second, the various professional, educational and personal histories of the sample group make the utilization of a standardized interview schedule impossible (Louise & Alison, 1994).

Inaddition to interview, questionaure survey is also used to collect data to evaluate the prototype developed (Appendix B).

3.2.4 Unit of Analysis

The unit of analysis depends on the collected data aggregation. If the phenomenon being studied at hand is related to the effectiveness of a group, then the unit of analysis is at group level, otherwise it is at individual level (Sekaran & Bougie, 2009). It is with this background that the individuals comprised the youth-at-risk community of Addis Ababa, and these were the unit of analysis and would jointly design a mobile-based service model for the purpose of this research.

3.2 Methodology

3.3.1 Introduction and definition of Design Science Research

DSR is a research procedure for producing innovative construction intended to solve problems faced in the real world and, by that means, to contribute to the theory of the discipline in which it is applied (Lukka, 2003). Saunders et al. (2009) explained that from the design science perspective, the main purpose of academic management research is to develop valid knowledge to support organizational problem solving in the field. In design sciences knowledge is produced through the creation and implementation of a solution that can manipulate or alter a particular phenomenon (Vaishnavi and Kuechler, 2007).

For IS researchers, DS research offers an important perspective for conducting applicable, yet rigorous, research, i.e., research that is closer to IS’s applied aim. A conceptual process could help researchers with a conceptual process for successfully carrying out DS research and a mental

model for its presentation (Peffers et al., 2006). This research focus is on developing model for design consideration to develop a mobile based service to provide RH information for youth and DSR helps to innovate or improve services to make them more useful, usable, desirable for clients, and efficient as well as effective for organisations.

To justify further the importance of DSR for this research study the following characteristics described by different scholars is presented as follows. The first important characteristic of DSR is that is motivated by problem-solving and the second distinguishing characteristic is the prescriptive nature of the outcome of a research program.

An approach to constructive research according to Luka (2003):

1. Focuses on real-world problems felt relevant to be solved in practice
2. Achieves a real-world solution to an initial problem by means of an innovative construction
3. It includes an attempt to implement the developed construction and a test of its practical applicability
4. Research and practitioners must work together in a team-like manner in order to achieve experiential learning
5. Links explicit prior knowledge to theory, and
6. Relates empirical findings to theory with particular attention.

Design science strategy was used to examine the research issue. Design science research (DSR) approach is chosen during this research for locating and identifying opportunities and problems relevant to RH services and for directly inventing or creating new or improved conceptual means to deal with those problems.

There are many excellent models of the research process of DSR (Jarvinen, 2004, Lukka, 2003, Peffers et al., 2007, Kasanen et al., 1993, March and Smith, 1995, Vaishnavi and Kuechler, 2007, Hevner, 2007) being reported in high impact journals. A comparison of research steps among those models is shown in the next table. As stated on the table, it can be argued that the core

process involved in DSR are 1) establishing awareness of problem – as highlighted in blue colour; 2) DSR (development of the artefacts and evaluation) – as highlighted in green colour; and 3) theory building – as highlighted in purple colour. Therefore, in the following section a detail discussion on these three steps is explained.

(Note: 1. Establishing Awareness of Problem- blue colour; 2. Design Science Evaluation–green; 3. Theory Building-purple)

Lukka (2003)	March and Smith	Kasanen et al (1993)	Vaishnavi and Kuechler (2007)	Hevner (2007)
Find a practically relevant problem with potential for theoretical contribution		Find a problem with practical relevance and that also has research potential	Awareness of the problem	Problem and opportunities
Assess the likelihood for long-standing research collaboration with the target Organisations				
Obtain an understanding of the problem from a practical and theoretical perspective		Obtain an understanding of the topic		
Innovate a solution idea and develop a solution that solves the problem at hand	Create things that serve human purposes	Innovate, namely construct a solution	Suggestion of a tentative design Further development of the entative design and implementation	Build, design artefacts and processes
Implement the solution and test how it works	Evaluate the performance of things in use	Demonstrate that the solution works	Evaluation of the design against previously defined criteria	Evaluate
Identify and analyse its theoretical Contribution		Present its connection to heory and the research contribution	Conclusion	Additions to knowledge base
		Assess the scope of application of the solution		

Table 2. A Comparison of DSR Steps According to Literature (Source: adapted from (Rocha et al., 2012))

3.3.2 Research Approach

An expanded “understand, build and evaluate” DSR approach was used in this research. Design science research approaches for developing Information System research artefacts focus on first clarifying the goals of the artefacts (constructs, methods, models, or instantiations) (Baskerville et al. 2009; Gregor 2006) then on building and thoroughly evaluating the utility of the artefacts, and to some degree, their reliability and validity (Hevner et al. 2004; Venable 2006). A model of the overall design science process is presented in this section.

Using influential prior research and current thought, Peffers et al. (2006) designed a DSRP to determine what common processes could be found in the literature. As shown in the following table, they summarize the components of an IS design science research process as derived from seven representative papers and presentations.

Objectives for a design science research process model	Archer (1984)	(Takeda et al. 1990)	Eekels and Roozenburg (1991)	Nunamaker et al (1991)	Walls et al (1992)	(Rossi et al. 2003)	(Hevner et al. 2004)
1. Problem identification and motivation	Programming Data collection	Problem enumeration	Analysis	Construct a conceptual Framework	Meta-requirements Kernel theories	Identify a need	Important and relevant problems
2. Objectives of a solution			Requirements				Implicit in "relevance"
3. Design and Development	Analysis Synthesis Development	Suggestion Development	Synthesis, Tentative design proposals	Develop a system architecture Analyze and design the system. Build the system	Design method Meta design	Build	Iterative search process Artifact
4. Demonstration			Simulation, Conditional Prediction	Experiment, observe, and evaluate the system			
5. Evaluation		Confirmatory evaluation	Evaluation, Decision, Definite Design		Testable design process/ product hypotheses	Evaluate	Evaluate
6. Communication	Communication						Communication

Table 3. Design and design science process elements from IS other disciplines and synthesis objectives for a design science research process in IS. (Source: adapted from (Peffers et al., 2006))

Based on the above process model my research activities are described as follows:

1. **Problem identification and motivation**. Since the matter definition are going to be used to develop an effective artefactual solution, it should be useful to understand the matter conceptually in order that the solution can solve the problem's complexity. Justifying the worth of an answer accomplishes two things: it motivates the researcher and also the audience of the research to pursue the answer and to only accept the results and it helps to understand the reasoning associated with the researcher's understanding of the matter (Peffers et al., 2006). Studying the design considerations to design a mobile-based service could be one of the solutions to help empower the youth in this regard. There is, therefore, a need to investigate the effectiveness of existing methods/techniques of communicating health related information and services amongst this group of youth youth-at-risk.

2. **Objectives of a solution**. The objectives should be inferred rationally from the problem specification (Peffers et al., 2006). The objectives of this study are:

- To identify the present ways which are mostly SMS, and some are mobile applications developed for specific projects by which the youth-at-risk get RH information, what's more, recognize the difficulties faced with the ways and means of accessing RH information.
- Additionally, to identify the available technology as well as the reproductive health information needs of the youth-at-risk.
- Moreover, to design a model for design consideration of a mobile-based service to access RH information.

3. **Design and development**. Create the artefactual solution. In broad terms, these artefacts include constructs, models, methods, or instantiations (Hevner et al., 2004). In this activity, you determine the artefact's desired functionality and its architecture, and then you create it. As a means of moving from objectives to style and development, knowledge of theory is needed. (Peffers et al., 2006).

Prior selecting the adopted model the researcher reviewed other related models like (Thobias & Kiwanuka, 2018) which develop an mhealth data model with an intention of improving mothers' knowledge of Reproductive and Child Health (RCH) services in rural environments and Banos et al. (2014) list essential requirements needed in the design of a mHealth framework. After reviewing these models, the researcher adopted model from (Iipito, H.N., 2015) refer figure 4, with little modification from literature review and interview with related experts, due to the similarity of the intended outcome of the research or identified problems and the similarity of the environment setup which the study is going to be conducted.

4. **Demonstrate the efficacy of the artefact to solve the matter**. this might involve its use in experimentation, simulation, a case study, proof, or other appropriate activity. Resources required for the demonstration include effective knowledge of the way to use the artefact to solve the matter (Peffers et al., 2006). Here the capacity of the model on how to solve the matter related to the problems identified were discussed by developing a prototype on how to provide RH information to the youth-at-risk.

5. **Evaluation**. Observe and measure how well the artefact supports an answer to the matter. This process mainly involves comparing the objectives of an answer to actual observed outcomes from use of the artefact in the demonstration. It requires knowledge of relevant metrics and analysis techniques (Peffers et al., 2006). At the end of this activity the researchers can decide whether to iterate back to design and Development step to try to enhance the effectiveness of the artefact or to continue on to the final step communication and leave further improvement to subsequent projects (Peffers et al., 2006). For this research study the researcher followed expert's evaluation method and questionnaire survey to get the idea of participants about the prototype.

6. **Communication**. Communicate the matter and its importance, the artefact, its utility, the rigor of its design, and its effectiveness to researchers and other relevant audiences when appropriate (Peffers et al., 2006). The prototype was presented to experts and possible users who participate on this research study and the description was included in the thesis.

3.3 Data Analysis

The type of data collected for this research study was qualitative data which refers to any or all non-numeric data or data that haven't been quantified. based on Saunders et al (2009), there's no standardised procedure for analysing qualitative data. However, it's still possible to group those data into three main kinds of processes, i.e. summarising of meanings, categorisation of meanings and structuring of meanings using narrative. For this research study, all of those three processes were employed in combination for supporting the interpretation of the information collected.

Qualitative research, which is only involved non-numerical data, requires the data to be classified and analysed through the employment of conceptualisation. All of the processes and aids involved during this process allow the researcher to interact with the data so as to grasp them, integrate related data drawn from different transcripts and notes, identify key themes or patterns from them for further exploration, develop and/or test theories supported these apparent patterns or relationships and draw and verify conclusions (Saunders et al., 2009). All of the steps are precise procedures to be followed in respect to each of the stages of the general processes of analysing qualitative data mentioned earlier. This precise procedure was then grouped to the three general processes of analysing qualitative data to differentiate the interlinkage between them.

The process of analysing the data occurs during the collection of data as well as after it (Kvale, 1996) as it involved generating categories and reorganising data according to them or designing an appropriate matrix and placing the data gathered within its cells. This process continues and will cause revising the predetermined categories and continue to rearrange as the searching of meaning within the data set continues until key themes and patterns or relationship are found from the rearranged data.

A. Summarising of Meanings

In exploratory and in-depth interviews, the interviews are audio-recorded and subsequently transcribed to reproduce as a written (word-processor) account using the actual words. Next, the process of Summarising of meanings started after the process of transcribing the interview

transcripts have finished. It involves a production of a summary of the key points that emerge from the interview transcripts. It summaries long statements into briefer statements in which the main sense of what has been said or observed is rephrased in a few words (Kvale, 1996).

B. Categorisation of Meanings

Two activities are involved in the process of categorising data, i.e. developing categories and attaching these categories to meaningful chunks of data (Saunders et al., 2009). The later activity is also called the process of unitising data. It involved attaching meaningful 'bits' or 'chunks' from the data collected to the appropriate category or categories that have been devised earlier. Based on (Saunders et al., 2009), the unit of data was referred to as a number of words, a line of a transcript, a sentence, a number of sentences, a complete paragraph or some other chunk of textual data that fits the category. Three main sources are suggested by (Strauss and Corbin, 2008) to derive names for these categories which includes the following:

- Utilising terms that emerge from data collection
- Based on the actual terms used by respondents.
- Derive from terms used in existing theory from the literature.

C. Structuring of Meanings Using Narrative

Here a decision is made to understand the meaning what the data brings and give a conclusion. It actually starts from the beginning of the process of qualitative data analysis and at the final stage of the process, a final conclusion was made and it is usually a conclusion that the researcher has been predetermined earlier at the start of the research study. There are many strategies to generate meaning from the data which include noting patterns, themes (1), seeing plausibility (2), clustering (3), making metaphors (4), counting (5), making contrast/ comparisons (6), partitioning variables (7), subsuming particulars into the general (8), factoring (9), noting relations between variables (10) and finding intervening variables (11) (Miles and Huberman, 1994).

For this research study the researcher use content analysis (CA) to analyse the large amounts of data that this study produced. DSR methods, produce a large amount of rich textual data and the

researcher chose CA as the data analysis technique that is most suitable. Flick (2011) defined CA as “a classical procedure for analysing text material of whatever origin”. Sekaran and Bougie (2009) further support this definition by explaining that a researcher can analyse textual information and establish its properties in a systematic manner.

D. Coding and Analysis

The analysis of data in this research was done following the CA method that was explained by Sekaran and Bougie (2009), as a method to enable the researcher to analyse large amounts of textual data and identify its properties systematically. The presence of certain words, concepts, characters, themes and even sentences could be the properties. Braun & Clarke, (2006) explained CA is closely related to thematic analysis as a method used to identify, analyse, and report themes from within qualitative data.

Chapter 4. Design Science Research Process

4.1. Introduction

This chapter consists of the findings and the analysis of the data collected. The data in this chapter will be presented with the use of DSR elements. Thereafter the research question will be outlined and all the evidence that leads to the answering of the questions is clearly explained.

The research process that was made by the researcher is explained below.

The researcher corresponded with Marie-Stopes international, a non-governmental organization with six RH and SRH centres or clinics in Addis Ababa, in order to arrange for the participants that would take part in the interview. The researcher interacted with the youth in several service design activities in a focus group setting. The NGO also helped with arranging for the venue, accommodation, and catering services. Marie Stopes Ethiopia has provided quality family planning, maternal and child health, and HIV/AIDS services throughout the country since 1990 (Marie Stopes).

There are many governmental and non-governmental initiatives or programs developed to provide interventions that would address the many challenges that the youth faces. Through its centres and its social franchise network, BlueStar, Marie Stopes provided family planning, safe abortion, and maternal health services to approximately 912,000 clients in 2015. (Marie Stopes).

4.2. Problem identification and motivation

In the initial stages of the project, the researcher visited Marie Stopes clinics in order to investigate and understand the community as well as to observe with regards to the project. The researcher observes how the health promoters' approach and consult for those in need of the service, once he participated in the coffee ceremony organized by Arada RH Centre. After greeting the client, the health promoter identified himself and explained what his role was. Because of their uniform, it was very easy to have confidence in them. Clients are reasonably familiar with the organization that is running the service cause most of them came to the centre with information from satisfied clients or from health professionals who understand the reputation of the clinics.

According to the gender of the community member, the health promoter then asks if he/she is aware of some reproductive health issues and the services available in the community. The health promoter has some pamphlets that he/she shows to the client to support his arguments. Due to the sensitivity of reproductive health information and conditions, some of the clients especially the women are shy and uncomfortable to do a further discussion or to actively engage in that conversation or even to ask for the information they need. However, some male clients are free to discuss these issues and they even refer to the people they know like their friends and family. They ask questions and they make suggestions of how the health promoters should go about discussing these reproductive health issues.

4.3. Objectives of a solution

4.3.1 Stakeholder Mapping

The researcher was engaged in identifying all the stakeholders that would be directly affected and or indirectly affected by the envisioned solution, which would be a mobile-based service to promote reproductive health information. The core target stakeholders are the stakeholders who are targeted because they are the first-hand users of the service and therefore, they are the ones who have been considered within the co-design process of the model. The directly affected stakeholders are the stakeholders who will interact with the service or its users. The indirectly affected stakeholders are those who will either benefit or not from the service without even knowing it.

This activity aids in the understanding of various groups that are related to the community of interest. It also enables the look of the service to confirm that every one of the stakeholders is positively addressed by the model being designed and developed. This exercise also informs the participants that the model they're co-designing isn't only beneficial to them but to the groups at large. Also, it informs the participants that some group members are full of the envisioned model be it directly or indirectly.

Indirectly Affected Stakeholders	Directly Affected Stakeholders	Core Target -Stakeholders
Police	Health center	Youth-at-risk
Municipality	Health Promoters	Youth
Businesses	Social Workers	Designers
Children	Parents	Developers
People with no access to technology	Libraries	Users in and outside the community
Homeless people	NGOs	
Old people	Cell Network Operators	
	Users	
	Community	

Table 4. Stakeholders

4.3.2 Context mapping

4.3.2.1 Existing practice in Addis Ababa

Currently, the youth of Addis Ababa accesses reproductive health information from different sources. At times, one needs to travel long distances to go to the clinic to get the information. They need or even must pay for transport in order to get to the clinic for specific information. This is discouraging as the youth might find it too far to walk, and therefore would prefer not to go to the clinic and miss important information that they might need. Marie-Stopes has much information available, even if a lot is done to reach the youth in Addis Ababa it can be done more to increase the coverage by developing interactive websites and mobile apps dedicated to avail RH information. For one to get this information one is required to go to the RH/SRH centres or call hotline 8044 or visit their Facebook page which is not as convenient as the online technologies in consideration. At times, the Marie Stopes hosts campaigns for the community at the Sub-city level and inside the compound of the clinics and the youth can then receive the information. The health promoters' approach different age groups to inform them about health information. They also provide print media for further reading.

Schools and Universities in collaboration with different governmental and non-governmental organizations also try to give health information to their students and the same information can be found in the libraries around the students and the community. The one challenge about the libraries is that there is no one to ask for further information and advice regarding the specific health information needed as the information is mostly provided in the form of print media or users can browse the internet to look for information. The church also provides some health information but at times not as often as needed.

Family guidance association which is a governmental organization that is also working on providing RH and SRH information via hotline and community education but just as Marie-Stopes, FGA also lacks the online information delivery mechanism specific to RH and SRH wich is associated with other systems.

Religious institutions and elders in the neighbourhood are also willing to share the information and give education on this matters but due to the sensitivity of the topic, many youths are shy and embarrassed to ask for information from priests or elders, because culturally it is a taboo to ask and even talk about sex when you are young. When the youth cannot get the information they need, they turn to Google, social media, and their friends. The information acquired in this manner isn't always relevant to them within the environment within which they live. The youth feel that there's a good need for one to access relevant health information at any time without feeling shy or embarrassed which the data should be specific to their community.

4.3.2.2 Triggers to seeking information

There are triggers that push the youth to look for reproductive health information. Most of the respondents mention two things “Either in your peer group you heard about it, or either you're feeling that something is wrong with you”. Simplified, the two triggers are yourself, and friends. Once there's a desire to look for information, the youth then seek information from the sources that are known to them or that are easily accessible by them, depending on where they're located.

Therefore, they look for information from sources available or from the internet. When they fail to get the sort of data that they're searching for, they look for more information from the clinic

or from the health promoters or health workers that they know. Most of the time they are challenged by the reasons that they're shy and are embarrassed by several conditions. Finally, once they go to the clinic, the condition has become very serious, and needs lots of care which they may have prevented by having access to the knowledge. Once they get the correct information, they then use the knowledge for themselves or they inform their friends and family about it. The simpler you have got access to information the more proactive you'll be and stop conditions within the first place and this might mean a healthy and informed community.

The participants mentioned several information needs as explained here. The number one on the list is Preventive information for unwanted pregnancy, which is a big concern, because there are still some people in the community who practice unsafe abortion. As highlighted by one of the interviewees, “Teenage Pregnancy and HIV/AIDS or sexually transmitted disease. Why it needs focus on these is because we have our underage children becoming pregnant and then ending up with HIV/AIDS and other related sexually transmitted diseases”. Unwanted pregnancy was highlighted as a pressing challenge as many of the young people are starting to engage themselves in sexual activities at a very young age. There is, therefore, a necessity to educate young people on the problem of teenage pregnancy, and to teach them the ways to prevent early and unwanted pregnancies. This education also must focus on the available options of planning and safe abortion. There's a necessity for proper sex education for the youth, as many folks get the information from their peers and at times it's not all the information. There's a necessity for correct awareness of sex and its consequences and people should be afforded the chance to make the correct decision with the proper information.

On the other hand, government and other initiatives produce RH information to the youth and to the community at large. These initiatives avail the needed RH information through posters, pamphlets, books pictures, plays, and discussion with health promoters who explained what all this information means to the community.

4.3.2.3 Limitations to information dissemination

There is however a limitation regarding information dissemination because one visits the clinic or facilities when there is only a need. Usually, people go to the clinic or visit or attend related events when they find it difficult to discuss the matter at hand with relatives or friends or when

they are not satisfied with the information they get regarding their issue, mainly this is because of the shame attached to the topic. The way the information was provided proved difficult for some. The information most of the time is textual and needs for someone to read and comprehend, and some cannot read or write. The information's provided includes sex education which educates people on HIV/AIDS, teenage pregnancy, condom use in addition to other family planning methods. There is also health information regarding cervical cancer testing and substance abuse such as drug abuse and alcohol abuse.

4.3.2.4 Mobile technology for information access

Most youth owns mobile technology but even those that do not have get information from family or friends. Most of the respondents and participants prefer mobile technologies especially mobile phones because of its various benefits. Mobility or portability is the main reason that mobile phone is preferred as a means of accessing this information. In addition to mobility, the user can easily communicate and keep in touch with friends and families. Mobile phone can also be used as a learning platform due to its capability to gather information easily, seek advice from others, and share information as well.

Most of the participants points that it's easy to get access to mobile phones as a result of the availability of many outlets that sell mobile phones. For most the problem is getting the kind of accessory that can give all the above-mentioned services related to mobile phones (mobility, communication, information gathering, seek advice and share information) with affordable price. "the problem is cost of the accessories and cost of internet service" stated one of the participants. Even if it's easy to get access to mobile phone the cost for internet is not affordable for most.

To get the service youth load airtime to their mobile phone, for this they get the money mainly from family and friends and some look for small jobs or temporary jobs to earn the money they need.

4.3.3 How the youth are currently accessing information

Journey Map

This part highlights clearly how the youth access reproductive information in Addis Ababa without a design intervention. First, the youth try to get the information from home or members

of their family but due to the sensitivity of the information and the topic is culturally taboo they sometimes find it difficult to discuss. Then when they cannot get what they are looking for from their family, they look for the information from their friends, this is also not easy for most youth as their friends might tell their story for someone they know. So, once they fail to get the information from their families or friends then they go to clinics or health facilities. This is also not easy for most as there are just too many people at the clinic or at times it is not private enough to get the information or consultation. The youth then start to look at the information using modern technologies which gives them a lot of information. This information may not directly address their issue as it is not relevant in the context of the environment they live in, mostly it's even difficult to filter for the right information. Once they get the right information, they share it with their relatives and friends or keep it themselves.

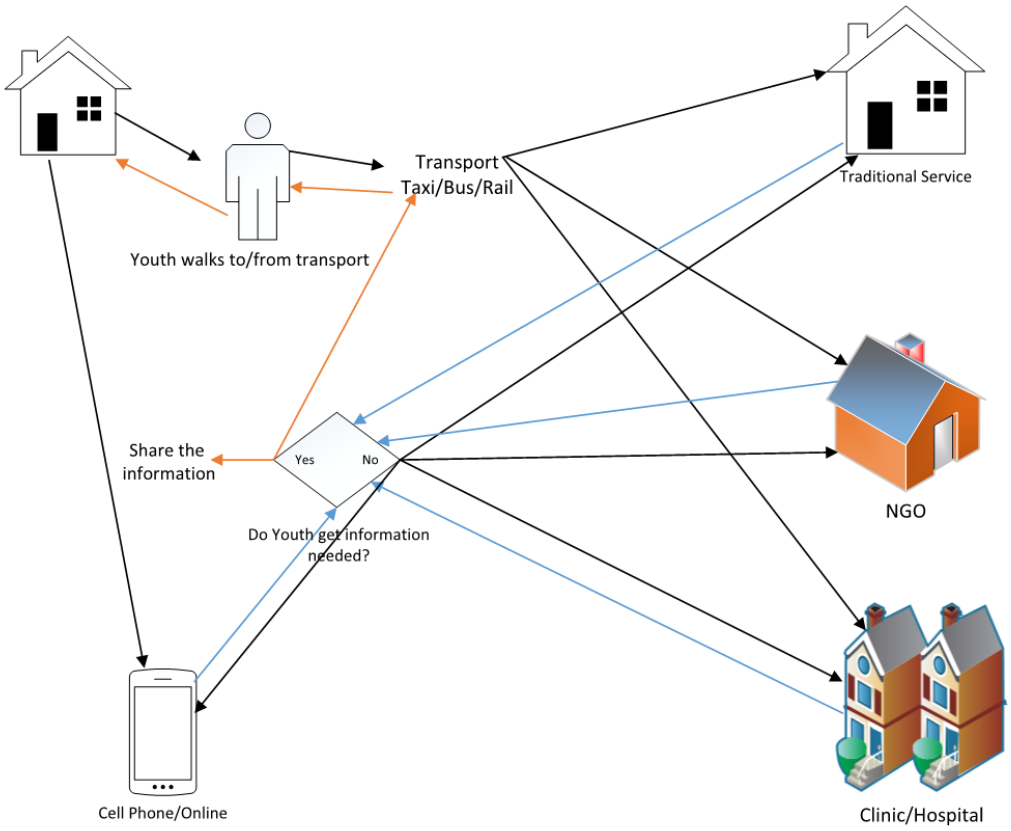

Figure 5. Journey Map

4.4. Design and development

4.4.1 First Ideation

This activity is concerned with engaging participants in brainstorming sessions, where together with the researcher are expected to come up with several ideas on how to disseminate the information on the platform. This platform is supposed to provide/promote RH information using mobile technology. Here there are several ideas raised by the participants and these ideas are arranged based on their importance and discussed in detail. The ideas raised during the brainstormed in the ideation session are:

1. Cell phone/Website
2. Schools
3. Libraries
4. Youth Centres

As most of the participants suggested and we put cell phone and website as number one means, the solution will be a platform that's accessible via cell phones and computers. This platform should have an interface that's user-friendly and is web-based and responsive depending on the screen size and orientation of the device being used to view it. It's should have also the capability of accommodating different language services, from the interview I made language is one of the challenges for both service seekers and service providers or health promoters as the number non-Amharic speakers who seek the service grows rapidly. The platform should also be password protected for the health promoters or related professionals to maintain the data and ensure the integrity and reliability. The consumers will then view the information provided and interact with other users using available platforms like discussion, chat, and document libraries. The platform should also have the capability to register users to keep track of their activity and to allow health promoters to provide the needed service specific to the user's need and to build trust between users and professionals. To facilitate all these operations the platform should also incorporate the email notification functionality to alert health promoters of new information or consultation requests or the upload of new material or information, etc. for users alert for response to their information request or the upload of new material or information, etc. The users will have an option to remain anonymous if they choose to.

Other ways of getting information from this platform which is discussed with participants of the group discussion are through the form of videos and pictures, apart from the information that is provided in the form of text. The health workers or professionals registered on this platform should be able to give advice through posting articles on the platform and by responding to questions directed. This platform will provide a very interactive environment for the youth to communicate with other youth and other community members. This is possible because the content will be provided in the languages (Amharic, Oromiffa, Tigrigna, and Guragigna) that they understand apart from English.

4.4.2 Service expectation

A service expectation map examines what intended users expect to receive from service during interaction with the service (McGrath, 2013). The following figure shows in detail what is expected of the mobile-based platform/service.

Consumer: - Mainly consumers will be youth in Addis Ababa others like young children, schools, NGOs, city administration, and users outside of Addis Ababa.

Content: - From interviews with participants most liked content types are video, cartoon, and images. The contents will be produced and uploaded to the platform mainly from the following entities.

a. Volunteers from the community, in the form of stories, pictures, and even short videos.
b. Trained health workers,
c. Health Organizations,
d. NGO's

System: - Functionalities of the platform will be

a. Database of registered users, such as health workers and youth
b. Database of content, in the form of text, image, audio, and video,
c. Discussion forums,
d. Calendar to advertise events,

e. Email alert, both for health workers and youth

f. Accessible via mobile application and website

It's recommended and agreed in my discussion with participants that each content to be submitted needs to be reviewed by the assigned or responsible individual or group before its uploaded. And each health workers' or health promoters' actions need to be reviewed and discussed to run the platform up to the standard.

System Architecture

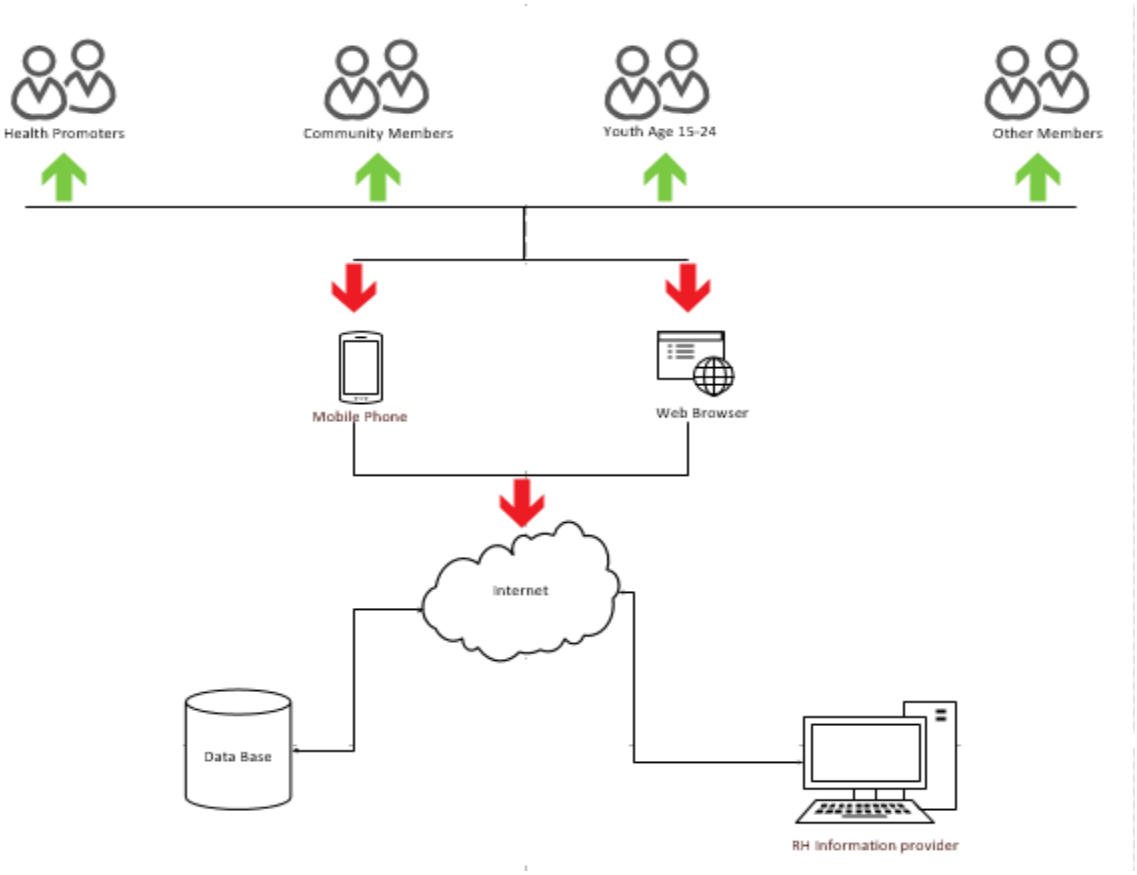

Figure 6. System Architecture

4.5. Demonstration

From the response gathered via interview and group discussion the new framework designed is presented in the next section below.

After the study had been completed, it was clear that the design science model is the centre of the concepts into which all the other concepts fed to own a mobile-based service as an outcome. As indicated, it's vital for the iteration (Stickdorn & Schneider, 2011) to take place so as to make sure that the service being designed takes into considerations all the aspects and concerns of the users.

Using the model which was initially adopted from (Iipito, 2015), and modified according to the interview results, future eHealth application developers can understand the design considerations to develop a mobile-based application to promote RH information. The model adopted as it was studied in a context that is closely similar to the study area in terms of the existence of various languages, religions, and cultures among the community to be studied on the thesis project, in addition, the way the model organized is in the interest of the researcher to do the study it is mainly focused on the design considerations to develop a mobile-based service to promote RH information.

For the mobile-based service to be created there are several aspects to be considered during the design stage. The first thing we need to consider are list of actors and policies which are important aspects when we consider developing the applications, developers can find most of the information and guidelines regarding the development of the service from these sources and are considered as a base for the model.

The ICTs for Health shows us the available technology and infrastructures that support the existing technologies as described in the model which are hotline, social media, and online access. The extent to which the technology is employed, and the way the existing technology is utilized is relevant information for the design process for better and improved access to reproductive health information and services.

The audience otherwise called the intended users inform the design process of their requirements of the service in conjunction with their contexts. Additionally, the users are a part of the design process and have a stake within the decision-making for the duration of the process. The design process indicated here is tailored from design science which emphasizes involving the

intended users and valuing their contributions and concepts. For this research purpose, the intended users are of the age group of 15-24 years which are described here youth-at-risk.

The other aspect is RH information and services, the characteristic's that are explained in the design are:

- information is not easily accessed youth face many troubles in accessing the RH information and services,
- information and services are not readily available here the main problem is the presentation of the data is not up to the standard and in the way the users like to access,
- lack of sexual education and
- service points too far.

The above three aspects contribute to the service design model which will include, collaborative design approach, user-centered design, and stakeholder collaboration.

Finally, the service design model contributes to the development of a mobile-based service with the intended or proposed features which are:

- Privacy and confidentiality – the service should be available privately to the users for them to access the information at their own time and place. Their personal information should remain confidential for their protection,
- Affordable – the service should work offline for those who use the mobile apps, and can sync when needed and when access to the internet is available,
- Easy to use – the service should be easy to navigate through the page and easy to browse the information,
- Easily accessed by anyone – the service should be accessed easily whether it's as a mobile app or as a web-based,
- Easy access to information and service – Information presented should be straightforward and simple yet interesting. The content should be relevant and other information related to reproductive health can be presented,

- Language options – the users should have an option to translate the languages they can speak and understand. The languages that are mainly spoken are: Amharic, Oromiffa, Tigrigna, Somalia, Guragigna, and
- Culture – the service should respect the cultural values and ways of doing things within the community.

The technology will be employed considerately to contextual factors (Williams et al., 2004; UTwente, 2014). This can be done within the development phase of the design process. The new design needs to incorporate the customs of the people and must consider their traditional and cultural values. All these are contextual factors. This is mainly done to make sure that the intended users as partners in design will have a way of ownership of the new design intervention and to confirm easy adaptation. It's easy to include the new design in their way of doing things, especially knowing that they're already using the mobile technology. Hence developing a system or service which will make use of the already existing technology makes it easy for adaptation (Heeks, 2008) and positive user experience (Ouma et al., 2010).

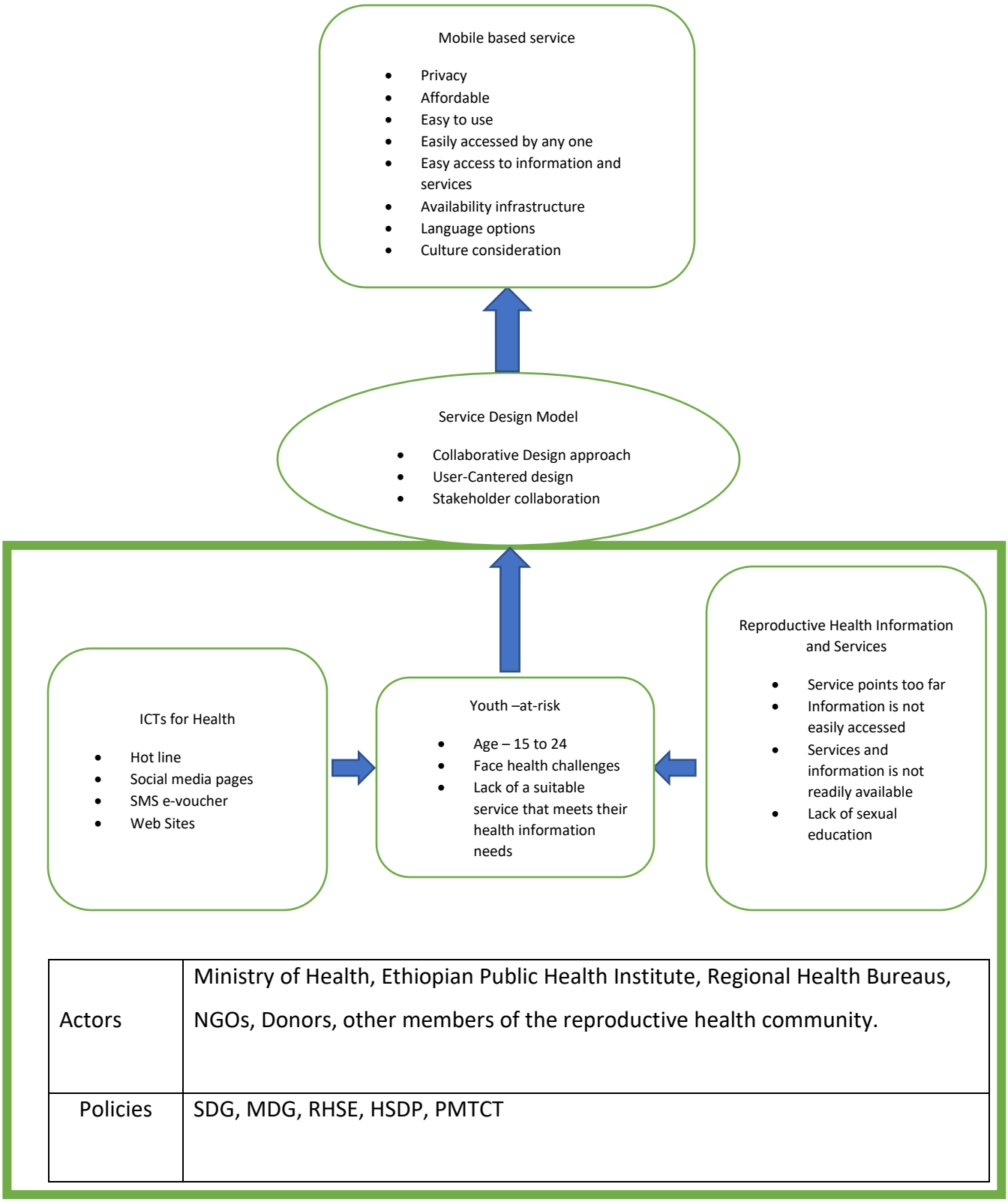

Figure 7. New Design Model

Based on the above model the researcher tried to develop a prototype with the collaboration of the youth identified during the interview and discussion, the design or prototype highlights the important features the youth prefer to see on the platform. As indicated above the platform needs to be user-friendly or easy to use and interactive. The upper part of the site as shown in the figure below includes:

- social icons,
- language,
- related logos and
- menu

The Knowledge Gateway menu holds links to different portals related to this site like,

- link to Marie-Stopes Website
- link to Family Guidance Association Website

and the collaborate menu will redirect us to the Alfresco platform which is an integral part of this website. As a collaboration platform the researcher from his experience and discussion with youth and health promoters decide to integrate or link Alfresco document collaboration platform, Alfresco is a commercial, software company that offers a better way for people to work, ensuring they have the right information at their fingertips, exactly when they need it (https://www.alfresco.com/company/about-alfresco). With Alfresco we can collaborate on documents shared in the platform, we can do a discussion on selected topics, we can view events related to RH, etc.

Then trending present currently popular and widely discussed issues. Just like trending the slider banner also display selected stories and events, besides the slider banner twitter feed from selected sources that are relevant will hold a space on the site and stories.

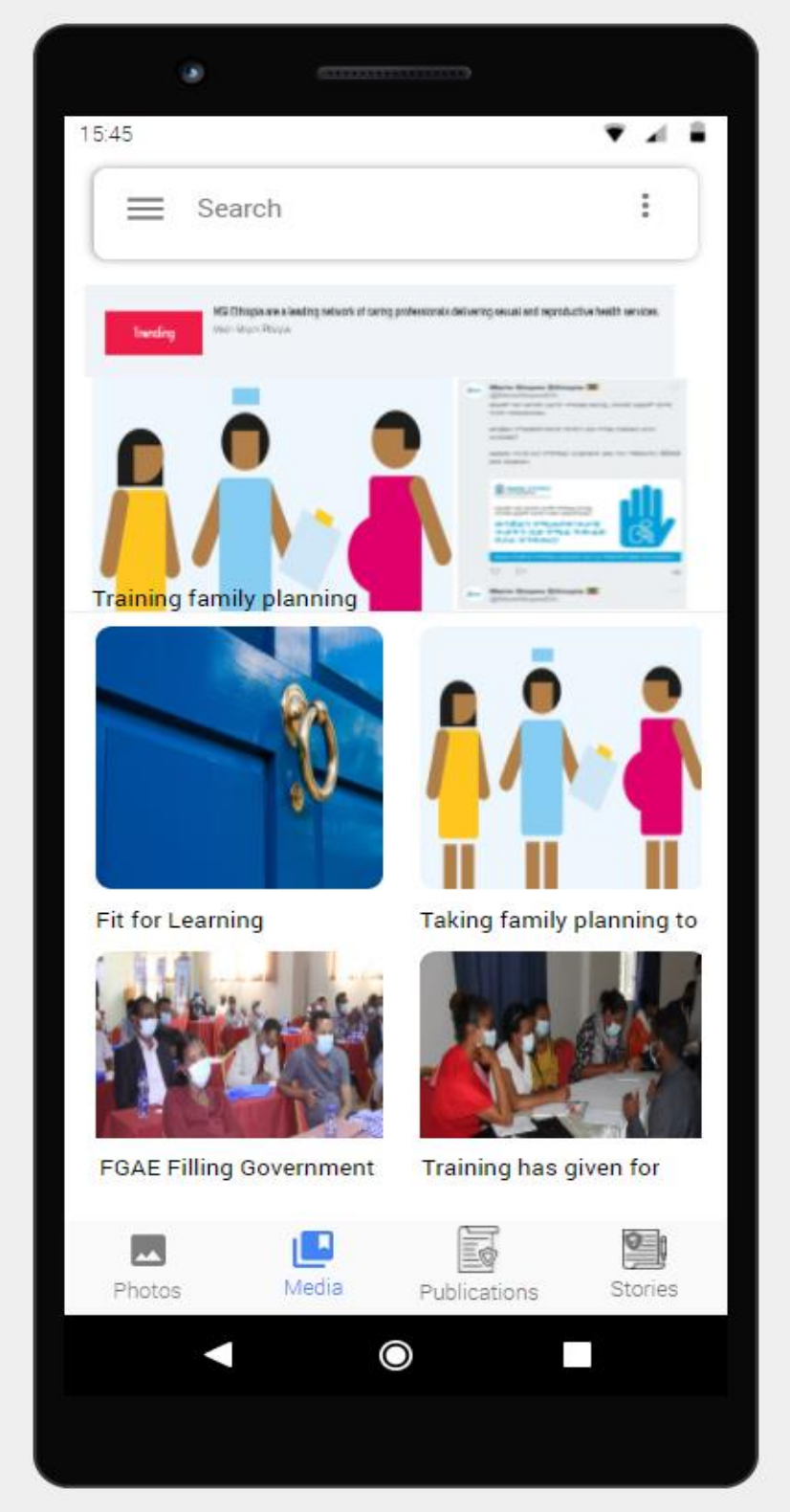

Figure 8. Home Page

The next section is for publication and events, which publications from different sources organized for the youth and others who are affiliated on providing different services and support for the youth on matters related to RH information. Additionally, events related to the youth and RH will be promoted on the site.

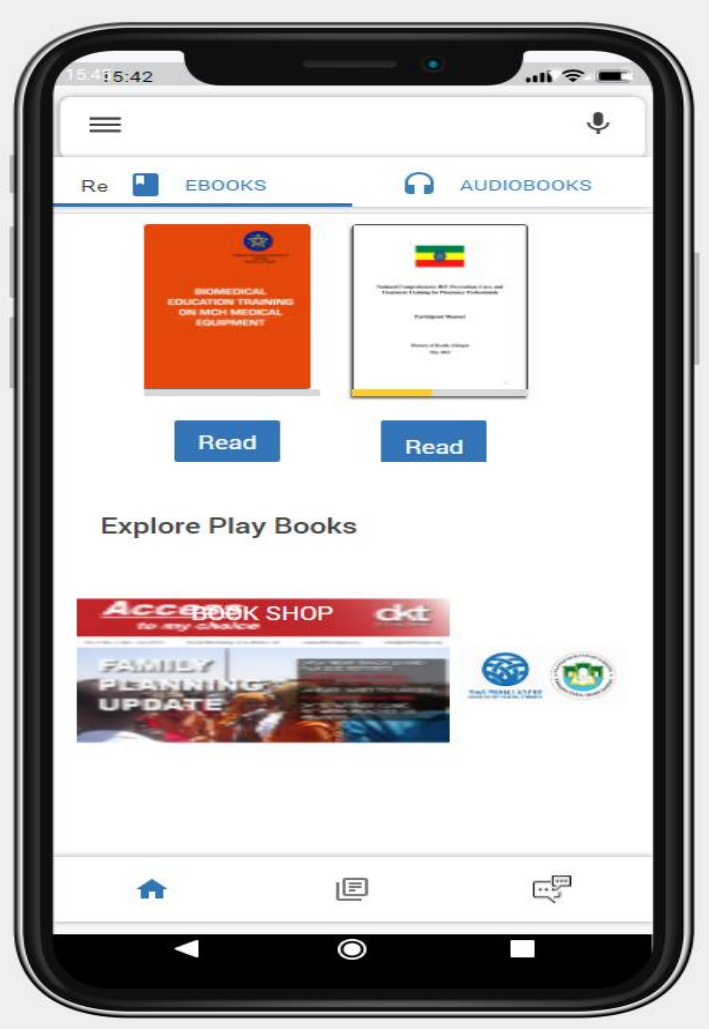

Figure 9. Publications Section

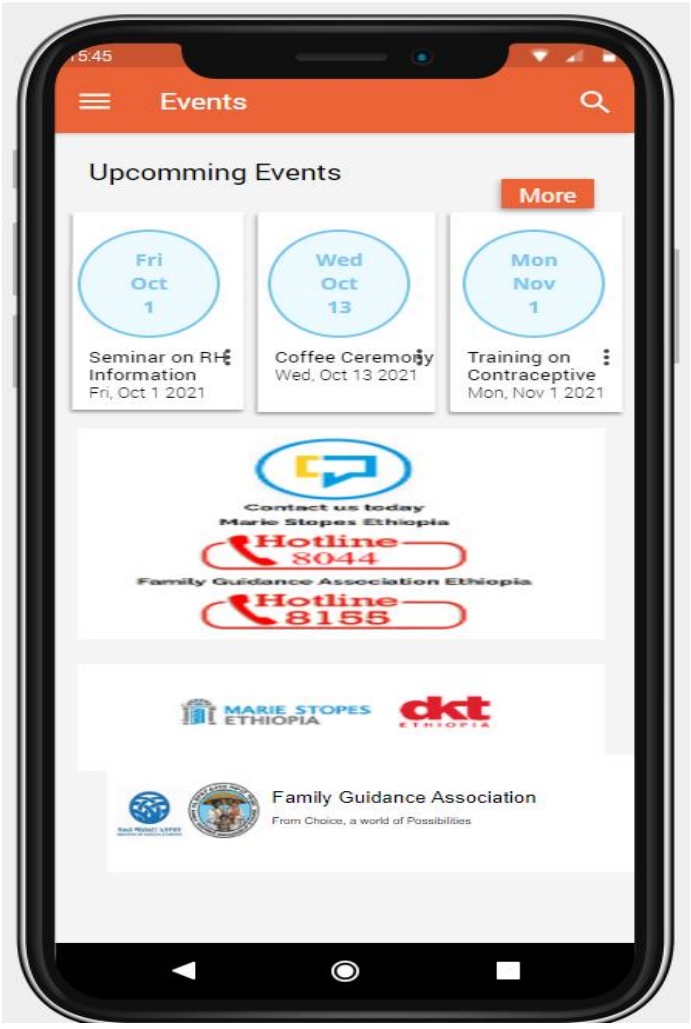

Figure 10. Events

The fourth section will be Videos, video's which are selected by professionals from different sources are the main component of the site as the target population is youth who prefers video from other kind of educational materials.

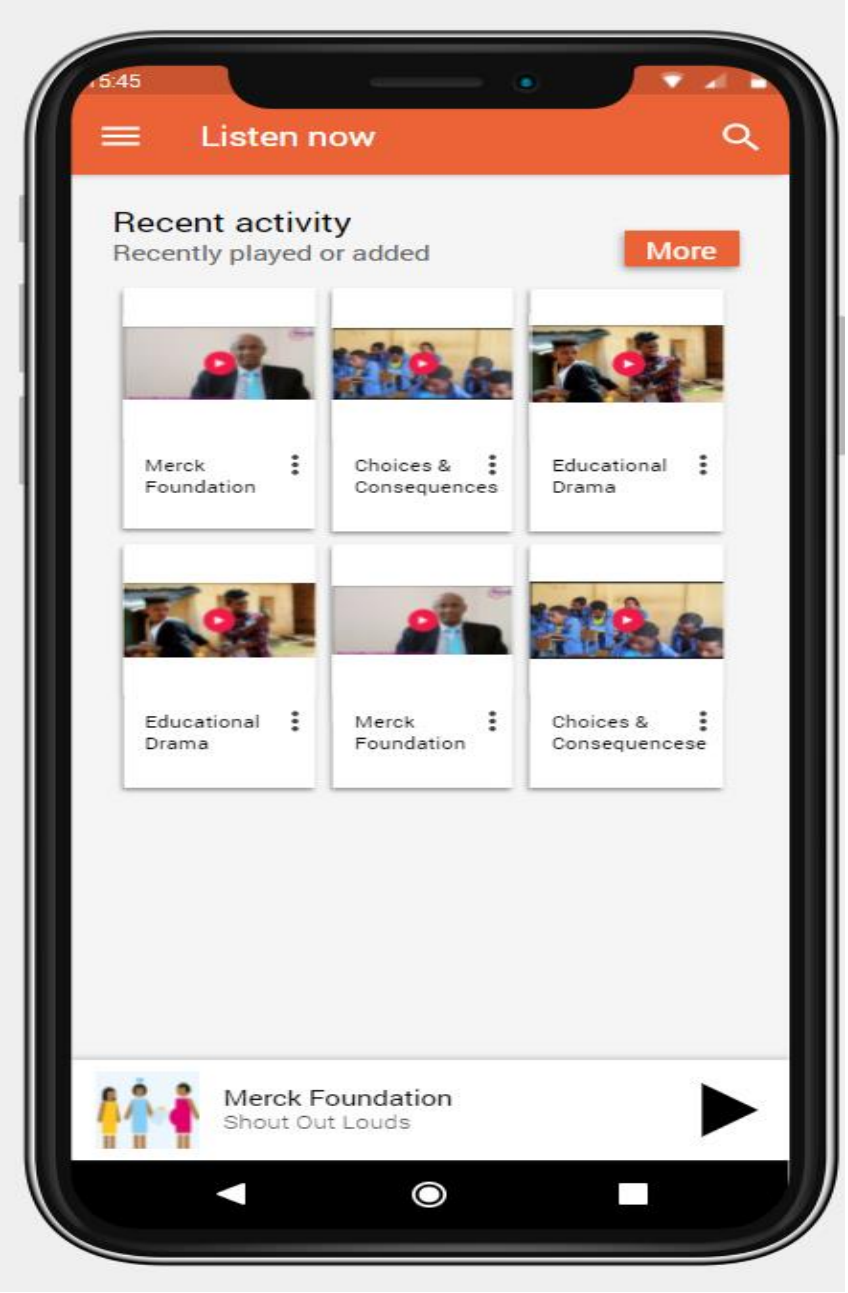

Figure 11. Media Section

The last section of the website will promote the best contraception methods with a link to detail information for each method and the final section will be footer, commonly footer will hold some information about the site, menus, social icons, and copyright information.

During our discussion and interview, most youths recommend graphics and videos for those who can't read, and the content should be localised so that it is relevant to the users. The user is able

to translate the page into the languages English, Amharic, Oromiffa, Tigrigna, Somalia, and Guragna and most of the content that the users are able to upload is the content of relevance to the community and its members. The youth also mentioned the site should be fun and colorful to attract the site viewers. The site should also include the newsletter subscription service for those who want to receive recent developments uploaded on the site via their email address.

The result of this research project is a web-based prototype that highlights features or services and design considerations for future designers or developers, and proposed flow of data as well as system architecture. Further research is required so as for testing and service implementation, which will lead to an actual service that may serve the aim for reproductive health information access by the youth of Addis Ababa. A variety of aspects should be taken into accounts like cost, content, environment, and time for the success of the service implementation. Additionally, to the web-based prototype, a list of things to think about when designing and developing a mobile-based service to promote reproductive health information for youth in Addis Ababa is additionally an outcome of this research.

4.6. Evaluation

The website is presented and evaluated by selected youth and health promoters in addition to application developers close to eHealth. The response collected from the youth and health promoters was mainly on the content or services included and site structure, mainly the issues raised were,

- The site needs space for RH related promotion like space to promote hotline services, space to promote RH and SRH centres located in Addis Ababa
- Why the site doesn't have a forum page instead of using the Alfresco collaboration portal.
- The site should consist of information mainly in formats that attract youth like cartoons, videos, games, etc.

Questionnaire survey

The most common methodology was the use of questionnaires (37/69, 54%), including questions on how to rank or rate attributes, as well as open questions to allow for feedback and suggested

improvements. For purposes of assessing usability and overall user experience, questionnaires were used in conjunction with usability testing. (Allison et al, 2019).

A questionnaire survey of eight participants both health promoters and youth respond to the questions to collect feedback. The aim was to identify usability problem areas of the website. Usability is a multidimensional construct that can be examined from various perspectives. The term usability has been used broadly and means different things to different people. Some relate usability to ease of use or user-friendliness and consider from an interface effectiveness point-of-view (Judy Jeng, 2005).The questionnaire consisted of 12 Likert items on a five-point rating scale to make the qualitative data quantifiable. The questions were related to three usability attributes: usefulness, efficiency, and satisfaction. The questionnaire was pre-tested with two users.

The qualitative data gathered through the Likert items in the questionnaire survey were analysed using the five-point rating scale, with 5 points given to the most positive response. Mean and standard deviation were calculated for each individual question. The number of respondents for each question is represented by 'N'. Four usability attributes: usefulness, efficiency, effectiveness and satisfaction, were analysed based on participant responses. Results are summarised in Tables 2 to 5.

Usefulness

Three questions related to website usefulness were asked of the users. Table 5 shows the means and standard deviations calculated for each question based on user responses. All questions mean fall between 3.25 and 3.875 that is close to good. Most of the user's 62.5 percent rated the overall resources provided through the website as either very good or excellent, the rest 37.5 percent rated the resources as good with a mean score of 3.875 and standard deviation 0.756.

The other question which is information given about the website gets the lowest point with a mean score of 3.25 and standard deviation 0.463, with 75 percent rated it as good and only 25 percent rated as very good.

Statement/Question	N	Mean	SD
Overall services provided through the website	8	3.875	0.756
Information given about the website	8	3.25	0.463
Relevant information is available on the website	8	4.125	0.641

Table 5. Questionnaire results for questions related to the usefulness attribute

The last question about relevancy of the information available on the website with mean score of 4.125 and 0.641 standard deviation was rated as excellent by 25 percent of the respondents and the rest 75 percent rated it as vaery good.

Efficiency

Seven questions related to the website efficiency were asked of the users. Table 6 shows the means and standard deviations calculated for each question based on user responses. All questions mean fall between 3.375 and 4.5 that is either good or very good. The question I do not need any guideline to use this system is rated as very good with mean score of 4 and standard deviation of 0, 100 percent rated it as 4. The lowest rating is on question number one, that is I can perform task/s easily on the website with mean score of 3.375 and standard deviation of 0.517.

Statement/Question	N	Mean	SD
I can perform task/s (search, filtering search results, etc.) easily on the website?	8	3.375	0.517
The website layout (Information Architecture) help you to easily find what you are looking for?	8	4.25	0.707
I get the results of searches quickly when using the website.	8	3.875	0.353
The website is easy to use in general.	8	4.5	0.534
It is time saving when I am using it.	8	3.75	0.463
I do not need any guideline to use the website.	8	4	0
I find no/minimal obstacles while searching through the website.	8	3.625	0.517

Table 6. Questionnaire results for questions related to the efficiency attributes.

The highest score found on the fourth question which is the website is easy to use in general with a mean score of 4.5 and standard deviation of 0.534, and the highest standard deviation 0.707 is found on the second question which is ther website layout help you to find what you are looking for with mean average 0f 4.25. The last question which is I find no/minimal obstacles while searching through the website rated with mean score of 3.625 and standard deviation of 0.517 with 62.5 percent rated the question as very good and the rest rated it as good.

Satisfaction

Two questions related to user satisfaction were asked of the users. Table 7 shows the means and standard deviations calculated for each question based on user responses. All questions mean fall on 4.375 and standard deviation of 0.517 that is either very good or excellent.

Statement/Question	N	Mean	SD
Overall, I am satisfied with this website?	8	4.375	0.517
How well does this website meet your expectation?	8	4.375	0.517

Table 7. Questionnaire results for questions related to the satisfaction attributes.

For both question number one and two the same response found with 62.5 percent rated the as very good and the rest 37.5 rated as excellent.

The overall evaluation shows the website with the addition of the above mentioned points can address the problems related to RH information promotion but needs special consideration on the recruitment of professionals both from the consultants side and the administrator or administrators who will run the application to meet the objectives intended for the application. There might be a need for future developers to consider these points during the design and development stages.

4.7. Communication

This paper will be the mode of communication as it's based on personal wish to do this research work.

Chapter 5. Conclusioins And Recommendations

A review of the chapters is shortly summarized and discussed to conclude the thesis document. Some conclusions and proposals are made for future research and others are discussed in this chapter.

This research informs the body of knowledge that if service design methods and tools are combined with mobile technology, a mobile-based service may be designed for information access for a selected community. a new design and development process must concentrate on the details of the context within a community that the service is supposed to. this can make sure that the knowledge disseminated or accessed through the service has relevancy for the end-user and is sensible to the community at large.

From the research process, it has been observed that culture plays a vital role within the design, especially in system design. Considering interface, some elements, as a result of design, might work and be appropriate for one culture but might not be appropriate for another. Choi et al. (2005) make a point by saying that “user interface elements require localized designs for cultural groups”. Lederach, (1995) defined culture as follows: “Culture is that the shared knowledge and schemes created by a group of individuals for perceiving, interpreting, expressing, and responding to the social realities around them”.

For the designers who intend to design such a service, there are many points to consider. Culture is one of the major issues that need to be considered. In addition to culture, the circumstances of the community need to be fully understood for one to identify the relevant methods and tools that are appropriate to the interaction with the participants like languages that are mainly used among the community. Mostly, many designers have a strict plan of what to do when consulting with the community for a certain service design and development and mostly do not meet all the user needs, which consequently have a negative user experience. Once the designer is in the community, he/she needs to act as a participant and create an environment for everyone to contribute equally. In addition, ideas about the methods can also emerge from all involved participants. The iteration process, for missed ideas or points and refinement of the service being developed, should have to take place.

The prototype that was designed may be used, not just for reproductive health information access but also for any kind of information access as per the requirement. The prototype highlights design considerations that require to be understood by developers. These considerations happen as a result of proper investigation and interaction among the participants including the researcher. For any health-related services that are to be designed and developed, it's best to involve the users through the whole process as active participants and to value their contributions.

The prototype is used not only in Addis Ababa but also by any community that shares the same profile. Transferability must be considered after proper investigation and context study of the community where the service is to be transferred. This research also informs scholars and other researchers of what to consider when designing with the youth, for the youth, using design science.

Addressing the research questions

RQ1- What design considerations must go into a mobile or web-based service to promote reproductive health Information for the youth-at-risk with?

In order for the service to be fully accepted by the community especially by the youth, the following useful design considerations are identified by the participants.

Clarity and readability- The content should be clear and easy to understand considering the user's ability to comprehend, this will ensure the same understanding of the content of different kinds of reads. The fonts for the text used should also be readable and the service should provide the ability to zoom in or out.

Colourful- In website design colour is one amongst the most powerful tools. You can use it to attract attention, express meaning, create desire, drive conversions, and even earn a customer's loyalty (https://studio1design.com/how-important-is-color-in-website-design/). Since the targeted users are youth the mobile app or the website should be colourful. The participants suggest colour would help to attract the attention of users while browsing.

Fun and entertaining- Most of the content provided should entertain and educate at the same time. Mainly youth is targeted by this service, considering this for the service to achieve the intended outcome the presentation of the contents should attract the reader especially the youth by using music and related videos to make the reading entertaining.

Language- Due to the high number of youth flow from different corners of the country to Addis Ababa, you can easily find non-Amharic speakers everywhere in the city, keeping in mind this fact the service to be developed should at least consider the major languages used within the city. From the interview conducted health promoters emphasized considering language when developing such a service since the number of such users increases day by day and they have difficulty finding translators to give the service.

Privacy and confidentiality- Since this point is one of the areas of concern that shows the importance of this service. During our discussion, most of the participants stressed keeping the user's profile confidential is important for those who want to hide their information. By doing this the service can provide the mechanism for users to discuss openly with health promoters or health workers.

Cultural- Cultural values and customs of the community should be considered when providing the information to the youth, for these, there should also be an option to choose to read censored or not censored information since the service has to provide as much information as it could. The content editors are responsible to make sure there are no offending items included in the content to be released for viewing.

The following points are discussed in relation to the research question discussed above.

RQ2- For youth at risk, what reproductive health information is needed?

The participants mainly discuss the need for Sexuality information

a. Preventive information for unwanted pregnancy
    i. Family planning
    ii. Menstruation cycle

b. Abortion

   i. Unwanted pregnancy
   ii. Safe abortion
   iii. Consequences of unsafe abortion, etc.

The participants highlighted the following points during our discussion on focus group and individual interviews conducted both with service providers and with those who seek the service. The participants mentioned several information needs as explained above. The number one on the list is Preventive information for unwanted pregnancy, which is a big concern because there are still some people in the community who practice unsafe abortion. Unwanted pregnancy was highlighted as a pressing challenge as many of the young people are starting to engage themselves in sexual activities at a very young age. There is, therefore, a necessity to educate young people on the problem of teenage pregnancy and to teach them the ways to prevent early and unwanted pregnancies(ibid).

The other point mainly mentioned by the participants is the need for information related to safe abortion and the consequences of unsafe abortion. There's a necessity for correct awareness of sex and its consequences and people should be afforded the chance to make the correct decision with the proper information(ibid).

RQ3- Currently, which mobile technology is available for at-risk youth?

The mobile technologies available for the youth at Addis Ababa includes mobile phones, tablets, laptops, etc. From the response of the participants, the most preferred technology is a mobile phone.

The following points are the reason respondents prefer mobile technology:

Portability- all respondents agreed and describe portability as one of the reasons to pick mobile technology as their preference. Communicative affordances can be within the range of high to low (Treem & Leonardi, 2012). A devices' affordance of portability similarly ranges from high (smartphone) to low (laptop).

Affordable Cost- relatively mobile phones are cheaper than the other mobile technologies. You can get simple mobile devices from around 200 birrs to the latest device available.

Easy to get access- as there are many shops everywhere in the city that give different services related to mobile technology like selling, maintenance, installation of applications, etc. most of the respondents agreed this is another reason for selecting mobile technology.

Familiarity with the device- most youths are familiar with the functionalities and operations of mobile technologies as they are in use of the technology for their daily activities. Most of the participants respond that they are familiar with the functionalities and use of mobile technology.

Communication at all times- mobile technologies allow one to connect to his/her contacts whenever he/she likes, as mobile technology's main feature is to allow voice and text communication between users via sim card provided by the service provider in our context its Ethio telecom.

Privacy- mobile technologies allow us to keep our profile, documents, browsing history, etc. private. For this, there are different kinds of privacy and security functions like using passwords, patterns, pins, biometrics, etc.

RQ4- How can mobile-based services be used to promote reproductive health among youth-at-risk?

A mobile-based service is suitable to provide reproductive health information for any group of youth, especially for the youth at risk. Mobile technology provides a range of benefits that were highlighted in the previous question, such as mobility, affordability, and privacy. Once the service is available as mobile-based anyone can access the service anytime anywhere. As most youth has already access to mobile technology, this makes it easy to promote RH information. It is clear that the youth have the need for RH information. However, the way in which the information is currently being promoted or disseminated is clearly not effective. Therefore, a mobile service would be ideal to promote reproductive health for youth-at-risk in Addis Ababa with the participation of the stakeholders and the intended users in the design and development of the service.

5.1 Conclusions

This study stressed the importance of including the intended users in the development process when developing a solution for a group or community of individuals. By using design science research methods, one can attempt this and help the development process reach co-design objectives.

The intended users participate in the development and design of the solution so that it is useful and usable. This reduces the risk of failure as well as avoids an imposed solution that doesn't serve the intended purpose.

It is important to consider many factors when developing solutions with the intended users, such as cultural and religious values and practices. Other factors to consider are language options, the economic status of the target population, the already existing infrastructure and knowledge, as well as local customs.

Despite not being motivated or involved in activities to improve their lives, most youth-at-risk in Addis Ababa has some good thoughts. In the meantime, they work any jobs to meet their demand. Rather than focusing on taking care of their present to have a better future, they live for the moment. They are influenced by the lifestyle they lead and how they perceive challenges in the community, especially when it comes to access to reproductive health information, which is the focus of this study.

Everyone in any community needs access to reproductive health information since it contributes to the well-being of the community as well as their social and economic development. This study described some of the challenges that need to be overcome in order to facilitate easy access to reproductive health information for young people. These challenges need to be addressed in a creative manner in order to meet the needs of young people. To handle these challenges creatively, technology is needed to facilitate access to information.

Mobile technology can be used to ease access to reproductive health information. It is fortunately already within reach of this community and almost everyone has access to this technology, or else they live or know someone who has access to it. In addition to the technology, the infrastructure to support it is also available in the community. Therefore, in order to meet

the current challenges, it is appropriate to use existing technology and infrastructure to facilitate access to reproductive health information.

It is necessary to conduct further research to enhance the design experience, particularly when employing design science and when designing for communities in need. It is vital that researchers in the field of design science work closely with their communities throughout the design process and after the implementation of a service or solution. A community's contextual factors can play a significant role in driving the process to create positive change and in improving quality of life.

Despite its many benefits, the prototype presented here requires resources to make it a reality. As shown above, it will benefit the community in a number of ways. To ensure that it was developed according to users' requirements, skilled developers of mobile apps and websites are required. Funding for the development and coding of the service was also required, as well as time for testing, implementation, and iteration. To ensure the success of this service, the participants must continue to participate to ensure that all requirements are met to meet their initial goals.

5.2 Recommendations

By analyzing and collecting data, the researcher arrived at some recommendations. As outlined below, the observations made contributed to the recommendations.

- In the development of a solution that affects a particular community, it is recommended the community's stakeholders be involved. The intended users should be well represented because they have better insights into how they want to use or how the solution should operate.
- Once stakeholders and participants have been identified, it is recommended that the participants study and reach the same understanding of the community's context, although most of them are community members. Exercises such as this help participants realize something; they previously took for granted and did not realize was important.
- The development process can then be informed of the already existing solutions and how they can be complemented or improved.

- Using the framework, developers can identify and understand the existing situation and the way forward on the development.
- The app to be developed should be able to learn from the user's behavior to suggest stories, publications, events, contraceptives, etc.
- Users of the app should be able to receive email notifications whenever new information becomes available of interest to them.

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Appendix A: Interview Guideline

ADDIS ABABA UNIVERSITY

College of Natural Science and Computational Sciences

School of Information Science

Interview guideline

Dear Respondent

I am a post graduate student at School of Information Science and am doing this research as part of the requirement to complete my study. The purpose of this interview is to develop a model for design consideration to promote reproductive health information system development for youth. The data to be collected through this interview will be used only for the purpose of the educational research. Your responses will be kept confidential and you will not be asked to disclose your identity.

The success of this study largely depends on your honest and sincere responses that you make to each question items. Therefore, I kindly request you to provide the required information as much as possible.

Yonas Hagos
Information Systems Assistant
UNECA, Knowledge Management Section

Thank you in advance for your cooperation!

Reproductive Health

1. Why do you need reproductive health information? Here the user must explain why they need the information or why they think it is needed by everyone
2. How do you access reproductive health information? Here, explain step by step what happens for one to get the information?
3. What triggers you or anyone to get RH (reproductive health information)?
4. How would you prefer to access reproductive health information? Here the user must explain what they would change in the current process.
5. What reproductive health information is important and is needed by the youth in Addis Ababa?
6. How do youth in Addis Ababa currently access reproductive health information in general apart from how you do it? This will help us to understand the respondents' way of accessing from accessing way of other youth in Addis Ababa.
7. Who provides reproductive health information in Addis Ababa and would you prefer otherwise?
8. How do they provide reproductive health information, and do they have supporting material, and do you think it is effective?
9. Do they only provide reproductive health information or other information as well?
10. Are there any cultural and religious influences you observe in the way the information shared? What aspects of the information need especial consideration regarding religious and cultural realities of our society?
11. Can you get the reproductive health information in the language you prefer?
12. Do you think the government is adopting appropriate RH (reproductive health) system policies?
13. What is your opinion about government support regarding RH services?

Mobile Technology

1. Do you have access to mobile technology like mobile phone, tablet, personal computer, etc. and what are the benefits to you?
2. Do you have a cell phone and what kind of phone do you have?
3. What do you use your phone for?
4. Is it expensive to have a phone? Why?
5. Do you wish you had a better phone? Why?

Appendix B: Standard Questionaire

ADDIS ABABA UNIVERSITY

College of Natural Science and Computational Sciences

School of Information Science

Questionnaire

Dear Respondent

The purpose of this questionnaire is to test the usability of the website and to identify usability problem areas of the website, that was designed and developed in collaboration with the intended stake holders as a prototype to promote RH information for he youth at risk in Addis Ababa to complete my thesis project. The data to be collected through this questionnaire will be used only for the purpose of educational research. Your responses will be kept confidential and you will not be asked to disclose your identity.

The success of this study largely depends on your honest and sincere responses that you make to each question items. Therefore, I kindly request you to provide the required information as much as possible.

Thank you in advance for your cooperation!

Questionnaire Survey

The questionnaire consists of 12 items on a five-point rating scale to make the qualitative data quantifiable. The questions were related to four attributes: usefulness, efficiency, effectiveness and satisfaction of users on the developed website.

Part I: Demographic information

1. Sex: ☐ Male ☐ Female

2. Age: ☐ 20 and below ☐ 21-30 ☐ 31-40
☐ 41-50 ☐ 51 and above

3. Educational Level:

☐ Below College/Diploma

☐ Certificate/Diploma ☐ BA/BSc/BA/BEd

☐ MA/MSC and Above

Part II: General Instruction

The section consisted of 12 Likert scale items on a five-point rating scale and is expected to take approximately 5 to 10 minutes to complete. Please provide your responses to the questions based on the instructions under each section. If you have comments or if you want to provide further explanations, please use the space provided at the end of the questionnaire.

Note: 5- Very High, 4- High, 3- Medium, 2- Low and 1- Very Low

Or 5- Excellent, 4- Very Good, 3- Good, 2- Satisfied and 1- Not Satisfied

Here below the researcher grouped all 12 questions in four groups such as questions related to Usefulness, Efficiency, and Satisfaction to understand the purpose of visit to the website and additional features required by the users on the website.

Please indicate to what extent you agree with the following expressions. Please put tick mark (√) on the spaces that specify your choice from the options that range from “1” to “5“.

Part III. Usefulness

Statement/Question	Not Satisfied	Satisfied	Good	Very Good	Excellent
Overall resources are provided through the website					
Information given about the website					
Relevant information is available on the website					

Part IV. Efficiency

Statement/Question	Not Satisfied	Satisfied	Good	Very Good	Excellent
I can perform task/s (search, filtering search results, etc.) easily on the website?					
The website layout (Information Architecture) help me to easily find what I am looking for?					
I get the results of searches quickly when using the website.					
The website is easy to use in general.					
It is time saving when I am using the website to get the information I need.					
I do not need any guideline to use the website.					
I find no/minimal obstacles while searching through the website					

Part VI. Satisfaction

Statement/Question	Not Satisfied	Satisfied	Good	Very Good	Excellent
Overall, I am satisfied with this website?					
The website meets my overall expectation?					