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Development and Evaluation of an mHealth based Multi-Intervention Service for Adolescent Sexual and Reproductive Health Promotion

BY:

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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Dr. Samuel Rutiru	14/09/2020	

DEDICATION

To Parents, you denied yourself to ensure I went to school. Your Labor was not in vain.

ACKNOWLEDGEMENT

To God Almighty, “He is before all things, and in him all things hold together”

My lecturers at the University of Nairobi, Professor Wagacha, Dr. Orwa, Dr. Muchemi. You are a well of great knowledge.

My Supervisor and lecturer, Dr. Samuel Ruhiu. For the Insight and Motivation that made the completion of this project possible.

ABSTRACT

Background Young people are exposed to cultural content (from advertising to entertainment), that is highly sexualized, through the freely accessible World Wide Web. This has played a part in stirring up sexual curiosity and experimentation, leading to early sexual debut. The traditional cultural education and support system involving extended family and community has been severely eroded leaving the young people vulnerable to making inappropriate sexual choices, with accompanying negative Sexual and Reproductive Health (SRH) outcomes. mHealth provides a good global approach to health by the use of Mobile Phones; this links the young individuals to information concerning health and services.

Objective This study seeks to explore the feasibility and acceptability of a multi-intervention approach based on Mhealth to promote SRH among young people.

Methods A Persuasive System Model was used for developing a multi-interventional mHealth ASRH service. A prototype was developed that provided the following services: Adolescent Sexual and Reproductive Health (ASRH) education, Progress Track, Link to ASRH Service, Peer Support and Motivation. An online cross-sectional study was conducted with adolescents and young smartphone users aged between 14 to 24 years evaluate the acceptability and feasibility of the intervention. A link to the mHealth prototype is was sent to the participants who were required to interact with it for a period of 21 days.

Results A total of 78 responses were received from the survey. Of the 85 participants recruited, 78 completed the survey. A majority of the participants noted that the intervention has a good design and that the information provided would help them make positive SRH choices.

Conclusion The results show the feasibility and acceptability of the intervention and its ability to influence adolescents SRH choices. More research is needed to test the intervention for actual behavior change.

Keywords: *mhealth, adolescents, ASRH, persuasive design, multi-intervention, behavior change*

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CHAPTER ONE - INTRODUCTION

1.1 Background

Ensuring healthy lives and promoting wellbeing of people at all ages is the progress of Sustainable Development Goal (SDG) 3. One specific target within this goal is to achieve universal access to sexual and reproductive health-care services such as family planning, information and education, and to integrate reproductive health into national strategies and programs (SDG 3.7). Globally, Sexual and Reproductive Health (SRH) for young people is considered an important public health issue. This is because young people account for 16% of the world's population or 1 in 6 people worldwide (United Nations, 2018). The WHO defines adolescence as a period of between 10 and 19 years, characterized by a series of major physical and psychological changes affecting their sexual and reproductive health (SRH). It is a stage in the transition between childhood and adulthood with major changes in social interaction and relationships. It also describes a young person as someone between the ages of 15-24. These two age groups are included in the 'young people' group, which includes 10–24 years of age (WHO, 2017).

Some of the SRH problems facing adolescents worldwide include unplanned pregnancies, sexually transmitted infections (STIs) and HIV (Chandra-Mouli & Bloem, 2013). 42% of HIV infections globally and 80% of people living with HIV in sub-Saharan Africa are young people (UNAIDS, 2020). According to the 2018 Kenya Aids Response report by the Ministry of Health/National Aids Council, young people aged between 15-24 years accounted for 51% new HIV cases reported.

Adolescents in developing countries including Kenya face the challenge of poor access SRH information (Hindin & Fatusi, 2009). This is can partly be attributed to the failure of guardians, teachers and healthcare workers in discussing SRH issues with them in the developmental stage. Social and cultural practice around chastity and shift in responsibility are some of the reasons this failure. As a result, adolescents have been left to make poor SRH choices leading to negative health outcomes. Behavioral interventions for SRH among adolescents aim to improve SRH outcomes for adolescents by empowering them with the necessary information and skills that will enable them avoid engaging in sex at an early age, promote safe sexual behavior and SRH seeking behavior (PRB, 2016).

The use of mobile devices to support public health (mHealth) - which is also referred to as mobile health – is being applied in modern day interventions for providing SRH information and services to young people. The confidentiality and accessibility that comes with mHealth is particularly appealing to young people. Reproductive health programs worldwide are incorporating mHealth to support the health of young people in both urban and rural settings through different communication platforms that link them SRH information and services (Ippoliti & L'Engle, 2017). In developing nations mobile devices provide an economical, efficient, appropriate platform for reaching out and engaging young people on SRH issues.

1.2 Problem Statement

Young people aged below 25years account for 66% of the Kenya's population while adolescents constitute 24% (9.2 million) of the country's population. This is according to statistics from the 2019 Kenya Population and Housing Census (KPHC). In spite of this, this group has very poor reproductive health outcomes in the country.

Adolescents and youth negative health outcomes are caused by engaging in sex at an early age; unsafe sex with multiple partners; poverty; gender and sexual violence; and harmful regressive traditional practices (MOH, 2016).

Prevention has been underlined as a key factor of adolescent health with evidence that many problem behaviors are can be corrected by intervention (Catalano, et al., 2012).The increased penetration of mobile devices among young people (Lenhart, 2015), presents an opportunity for their use in behavioral interventions.

Mobile technologies have increasingly become accessible and provide a good opportunity for delivering health interventions that are interactive and can engage young people. 90% of Kenya population have access to a mobile phone (CA, 2017).The accessibility and affordability of smartphones has led to an increase in their use (GSMA, 2020). Smartphones can be used to reach young people with significant information and skills in interactive ways. The potential of mobile technologies has seen the development of different mobile based interventions addressing health issues including sexual and reproductive health.

A review of existing mHealth interventions reveals that studies on Smartphone based interventions for ASRH Promotion are limited, and while those that exist are mostly SMS based, the use of a multi-intervention approach has not been used in order to produce desired behavior change. The focus of this study is to explore the possibility of a multi-intervention strategy in SRH promotion.

1.3 Research Objectives

Main Objective

Design, Develop and evaluate a mHealth based multi-intervention service for adolescent sexual and reproductive health promotion

Specific Objectives

i. Develop a model for the multi-intervention service
ii. Validate the model through the design, development and evaluation of a prototype based on the model
iii. Evaluate the prototype for feasibility and acceptability

1.4 Research Questions

i. What are the limitations of existing m-health Adolescent Sexual Reproductive Health solutions?
ii. How a model for mHealth can based multi-intervention service for adolescent sexual and reproductive health promotion be developed?
iii. How can a prototype be developed based on the model?
iv. How can the prototype be evaluated for feasibility and acceptability?

1.5 Significance

There is a need for an efficient, and suitable communication channel to reach and engage adolescents on SRH issues. Having healthy adolescents is important to a country's economic growth as it translates to a productive population, reduced spending on health, and reduces the transmission of poor health to next generations in addition to helping combat poverty and inequality. This research project aims to develop and evaluate a mHealth based multi-intervention service for ASRH promotion to improve the SRH outcomes of young people.

1.6 Scope and Limitation

This research project will be limited to young people aged between 15 – 24 years. Data Collection for the purpose of testing the prototype will be done with participants in the above age bracket. Due time constraints, the outcome of this research project is limited to a prototype. In addition, the project will be limited to the use of mHealth for information gathering, dissemination and sharing.

CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature review on topics that are pertinent to this research project. A Conceptual Model is also presented to guide the research project.

2.2 Adolescent SRH needs and challenges of access

2.2.1 Sexual and reproductive health information

The Convention on the Rights of the Child (CRC) guarantees the health rights of adolescents and the youth. According to the CRC, adolescents and the youth have a right to health and development, right to access information that includes reproductive health; and the right to privacy and confidentiality. Nations that are party to the CRC are under obligation to provide adolescents and the youth with reproductive health treatment and information to enable them to take full charge of their lives. Countries still face challenges in adequately addressing the ASRH needs. The result that adolescents are exposed to the risks of negative health outcomes.

2.2.2 Use of Contraceptives

Female adolescents between 15-19years account for the highest number of unmet needs for family planning (UNFPA, 2012). Many developing nations are still facing challenges in providing quality contraceptive products to their women and the result is that adolescent girls, like older women, are unable to access family planning services (Marshall and Jones, 2012). Laws that prohibit, restrict access or require women to seek get spousal or parental consent and the wrong belief that family planning will encourage irresponsible sex also stand in the way of adolescent girls accessing contraceptives (UNFPA, 2013).

2.2.3 Antenatal, Delivery and Postnatal Services

Antenatal and postnatal care are not only essential for the health of the girl and her pregnancy, but they also present opportunities to provide information and contraception that may help an adolescent prevent or delay a second pregnancy (UNFPA, 2013). A study by Kothari et al. (2012) revealed that in some countries, including Brazil, Bangladesh, India and Indonesia, adolescents were less likely than women to obtain skilled care before, during and after childbirth. This, according to UNFPA in 2013, is because adolescents have the extra burden of being unfavorably judged by healthcare providers, the community and family (UNFPA, 2013). Compared to any other age group, adolescent mothers and children do not receive the healthcare they need. The

KDHS 2014 reports that 40% of adolescent mothers gave birth out of a health facility without the health of a trained birth attendant

2.2.4 STI Prevention, Control and treatment

According to the WHO, STI incidence is highest among adolescents compared with any other age group. Factors that contribute to this include having the wrong view of HIV risk, unsafe sex in addition to alcohol and drug abuse (WHO, 2019).

2.2.5 Sexual abuse and violence

Sexual abuse exposes adolescents to unintended pregnancy, unsafe abortion and STIs including HIV. Statistics from KDHS 2014 indicate that 7% and 3% girls and boys respectively between 15-19 years experienced sexual violence. 32% and 42% of girls and boys respectively reported cases of physical violence. While 33% of girls reported the cases of sexual and physical violence, only 20% of boys sought help.

2.3 Status of Adolescent Sexual and Reproductive Health in Kenya

24 % of Kenya's population are adolescents and thus their SRH outcome is of national importance. About 1 out of every 5 adolescent girls in Kenya has given birth, or is expecting her first child. This can be attributed to failure to meet their SRH needs such as providing SRH information, lack of access to contraceptive services, or in some cases failure to use them consistently and correctly. Many adolescents seek help of unqualified health providers leading to poor treatment thus increasing their risk negative health outcomes. There is a rate of HIV infection among young people that calls for the need to focus on their SRH.

2.3.1 Adolescent Sexual Behavior

Age at which adolescents first engage in sex affects is linked to the risk of negative ASRH outcomes. The average age of first sexual intercourse in Kenya is about 18 years and 17 years for women and men respectively. There is also an increase in the number of young people with multiple partners and transactional sex (KDHS, 2014). These risky sexual behaviors increase the risk of negative SRH outcomes due to compromised power relations that result in inconsistent condom use. These calls for a need for behavioral interventions to address such risk behaviors.

2.3.2 Adolescent SRH knowledge/information

Adolescents face major challenges in accessing accurate SRH information. According to KDHS (2014) for instance, only 52% of adolescent girls and 58% of adolescent boys between 15-19 years have comprehensive knowledge of HIV. The National ASRH Policy (2015) and the Education Sector Policy on HIV and AIDS (2013) call for the provision of SRH information and sexuality education including life skills to adolescents in and out of school. This is further emphasized in the Eastern and Southern Africa Ministerial Commitments (2013). Empowering adolescents with the right information on their sexual reproductive health and rights will improve their capacity to make informed decisions about their SRH and to protect themselves against SRH risks.

2.3.3 Policies and guidelines on Adolescent Sexual and Reproductive Health

Kenya has developed a number of policies and legal frameworks to promote adolescent SRH and rights. Constitution of Kenya 2010 guarantees all Kenyans the right to health and forms the backbone of all legislation related to health. It also provides that all international treaties (including those related to health) that Kenya signs and ratifies will form part of Kenyan law.

Kenya developed the National ASRH Policy (2015) guide national and county governments, non-governmental and the civil society on how approach ASRH issues. In order to give life to this policy, the National Adolescent Sexual Reproductive Health Policy Implementation Framework (2017 - 2021) was developed with strategies and interventions for achieving specific goals outlined in the policy. An intervention area in the policy that of concern to this research project is to "equip adolescents with the right knowledge, attitudes and skills to make informed decisions about their sexual reproductive health and to protect themselves against SRH risks".

2.3.4 Approaches to improve access and utilization ASRH services

The four service delivery models for ASRH interventions specified by the Ministry of Health in Kenya are outlined below (MOH, 2016):

i. **Community - based:** Young people access SRH services and information from within the community including youth centers, community based outreaches, churches, etc.
ii. **Clinical based**: Services are offered within a health setting such as public, private or faith based health facilities.
iii. **School based:** Health promotion and education services are offered to adolescents with a school setting. School activity leaders, teachers and coaches that interact with students can

take the place of mentors and help promote positive SRH behavior and also guide them to available SRH services

iv. **Virtual based:** This includes services offered within virtual or digital platforms e.g. in eHealth, mHealth, tele-medicine, warm/ hotlines.

2.6 mHealth and SRH

Cases of stigma, discrimination, lack of privacy and confidentiality, cost constraints and transport challenges in getting to health facilities have been reported by young people seeking SRH services. (Chandra-Mouli, et al., 2014). mHealth enables young people to access SRH services outside health facility settings in a discreet, timely manner without fear of stigma, judgment or discrimination. Evidence suggests that using mobile phones to provide SRH information is highly attractive to young people and led to positive SRH outcomes including increasing awareness, reducing irresponsible sexual behavior, and improving utilization of health services (Vahda, et al., 2013).

Evidence from Studies conducted in Kenya and Tanzania have demonstrated the feasibility of delivering sexual and reproductive health services young people through mobile phones (L'Engle,et al., 2017). A majority of the users accessing the content were under 30 years of age. And preferred using this mode as it was understandable and offered confidentiality (Vahda, et al.,2013). mHealth depends on prevailing health programs such as health education to fill the void around access to and quality of SRH education, behavioral change communication and ASRH services information (Mehl, et al., 2014).

2.2 Review of Related Work

Researchers and IT professionals from different parts of Sub-Saharan Africa have developed various kinds interventions aimed at promoting ASRH. This review focused on web and mobile based interventions as summarized below

Table 1: A Summary Review of Related Work

No.	Study Name and Country	Details	Strategies Used	Focus
1.	InfoAdo, Senegal (Oxfam, 2012)	Trained counsellors offering prompt and non-judgmental answers on adolescent issues for youth aged between 11-34 years through mobile phones.	Accessible via SMS and through the Web	Health Promotion
3.	Bila7araje, Morocco (http://oneworld.org/2013/09/19/bila7araje-morocco/)	Trained counsellors offering prompt and non-judgmental answers on adolescent issues for youth aged between 11-34 years through mobile phones.	SMS, Email, Facebook and Web-based service	Health Promotion
4.	m4RH, Tanzania, Kenya, Uganda. (https://m4rh.fhi360.org/)	SRH and family planning for people aged 29 years and below.	Opt-in, menu-based, two-way SMS service, includes role model stories of Family Planning use.	Health Promotion & Links to Services
5.	m4Youth, Ethiopia (Pathfinder, 2016)	Customized SRH, HIV and family planning information for college students and peer educators.	Menu-based SMS service, students send a short code to receive SRH information	Health Promotion

6.	m-ASSIST, South Africa. (Constant, et al., 2014)	Mobile phone intervention enable access to medical abortion, post-abortion and family planning to youth aged 18–29 years.	SMS based.	Links to Services

The following are findings from the studies reviewed above.

- Most of the studies reviewed above relied SMS to relay SRH information. Though interventions that use SMS have recorded positive outcomes among the participants, they are not the best intervention mode when it comes to reaching young people.
- Most of the interventions used mHealth to facilitate sharing of knowledge promote behavior change. Young people were given a platform to consult a health professional on SRH issues and also download SRH content. In addition SRH content was "pushed" to their mobile devices via SMS on a regular schedule.
- In a few of the interventions, mHealth was used to link the users to required SRH services.
- Though a few smartphones based apps have been developed to promote ASRH, there is little evidence on the outcome of these interventions due to limited studies on the same.
- Mobile phones based interventions were found to be low cost, have a better reach especially amongst the young population.

2.3 Identified Gaps

The following gaps were identified from the works reviewed:

Limited studies on Smartphone based interventions for ASRH Promotion – Smartphones can be used to deliver multiple interventions yet very few studies have been conducted on the same. Furthermore, SMS based interventions require users to subscribe using their phone numbers which may not achieve the privacy requirements of young people. In smartphone based interventions SRH information can be accessed anonymously without need to provide personal information.

Lack of Design Framework for behavior change services - The quality of mHealth interventions are highly dependent on the quality of the design, yet most of the studies reviewed paid little emphasis to this.

Multi - intervention services – Limited studies on the use of multi-intervention approach for behavior change using mobile devices. This has the potential of producing positive outcomes.

2.4 Theoretical Framework

This section discusses the theories and models that have been considered in the development of the framework for the multi-intervention mHealth system. This helps in answering research question one; that is how to develop multi-intervention mHealth based model for ASRH promotion. This section also provides a brief of the contribution of the behavior change theories and the Persuasive System Design model including its features in detail that has been adopted for developing the mHealth model.

2.4.1 Behavior change theories

Behaviour Change Theory (BCT) explores the relationship of how a person's behavior can be influenced and changed by external and internal factors, and what motivates the person to maintain the change. Different forms of BCT explore different modes of what can drive behaviour change such as social influences, environmental factors, or personal reasons.

Some of the behavior models and theories have been adopted from different disciplines for designing and developing mHealth interventions include Theory of Planned behavior, Health Belief Model, Theories of Reasoned Action, Protection Motivation Theory and Social Cognitive Theory. When designing mHealth applications, it is important to understand mechanisms that are the most effective at driving change, and how these mechanisms translate to features in an application. The theories that have been used for developing the initial framework are described below.

2.4.2 Information-Motivation-Behaviour Skills Model (IMB)

This model was developed by Fisher, J. D., and Fisher, W. has been applied extensively to its effectiveness in modifying risky sexual behaviors in adolescent and adult populations. The model states that information or motivation alone does not result in behaviour change, but together can influence behaviour (Fisher., et al, 2002). An individual that has information about HIV transmission and prevention, motivated by personal or social reasons, and has the skills to make

safe decisions is more likely to make and sustain behaviour change related to risky sexual activity (Fisher J. , et al., 2002). Information is required so the person is aware of the medical condition and has an understanding of how the condition can occur, progress, and what techniques can be used to manage or prevent the condition from occurring. Motivation refers to a person's attitude and perceived social support for the behaviour they need to change. Behaviour skills are the tools and strategies the person requires to make the behaviour change (De Geest & Sabaté, 2003).

This model has been used for motivating SRH content for the proposed intervention, giving progress motivation and awarding users who complete given tasks.

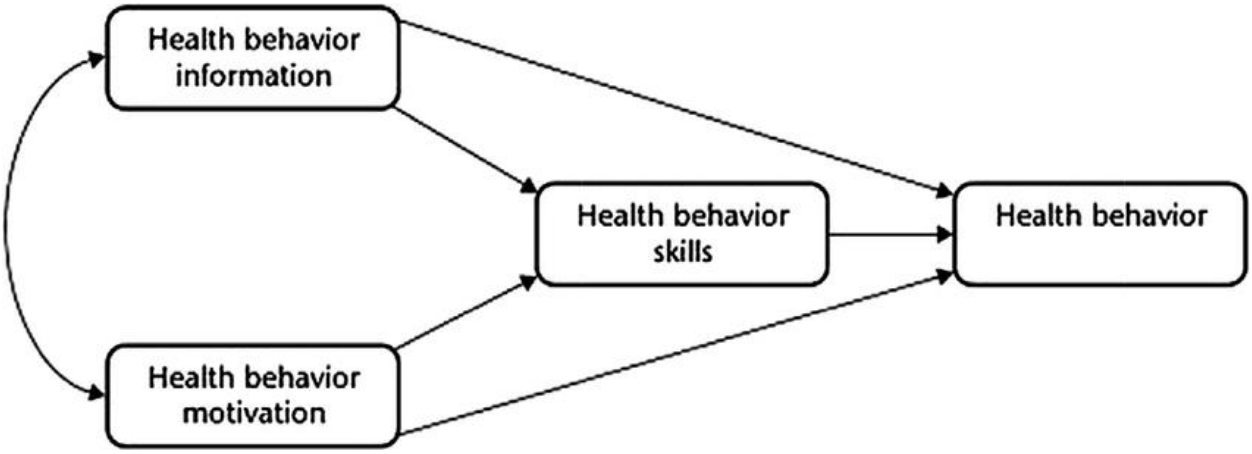

Figure 1 Information-Motivation-Behaviour Skills Model (IMB)

2.4.3 Social Cognitive Theory

Social Cognitive Theory (SCT) explains that people learn behaviour through observation of models, personal experiences or media influences, and that it may take time for behaviour to be learned. SCT states that a person will be more likely to make a behaviour change if they believe the action will solve a problem or result in a specific outcome. Goal setting is also a construct of SCT. A person would form a goal as they attempt to make the behaviour change. SCT outlines that goals should be specific and dependent on the conditions, health systems, and environmental systems the person is encompassed in (Conner & Norma, 2005).

Interventions that involve SCT could include encouraging the person to set a goal or make an action, help identify and overcome barriers, provide encouragement, set attainable goals, and provide instruction on how to perform a behaviour (Abraham & Michie, 2008). Social cognitive theory has been widely used for designing various behavior change interventions in the public health care domain. Self-efficacy, which is one of the key features of this theory, has been widely used to predict behavior in various health related situations.

Social Cognitive Theory was selected for this for this research as it deals with goal setting and self-efficacy behavior change. Self-efficacy is an important consideration in the field of ASRH; empowering adolescents' self-efficacy to have protected sex and decline unwanted sex is a central goal of most health interventions (Gloppen, David-Ferdon, & Bates, 2010).

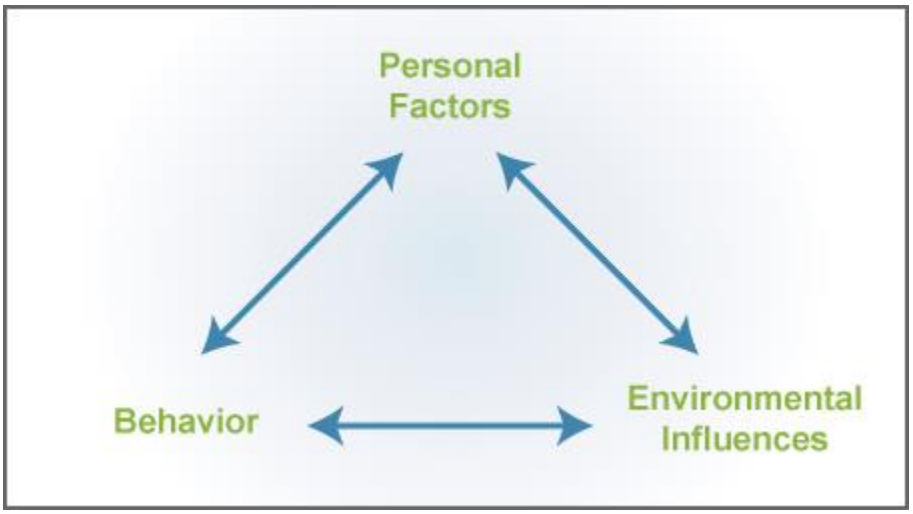

Figure 2 : Social Cognitive Theory

2.5 Persuasive Technology

Persuasive design is a method for building systems and constructing products that have persuasive features to change default behavior or attitudes. B.J. Fogg defined persuasive technologies as "interactive computing systems designed to change people's attitudes and behaviors" (Fogg, 2003). These systems combine behavioral theories with system design models for effective behavior changes. These systems have been used across various fields like marketing, healthcare, sales, politics etc. These focus on interaction between computational technologies like mobiles and humans based on psychological theories for studying behavior change issues.

The Persuasive System Design model by (Oinas-Kukkonen & Harjumaa, 2009) provides a framework for designing IS services that can be used in the context of healthcare and disease management. The model talks about factors to be considered while designing a system but does not explain the software requirements and implementation features.

Persuasive System Design has been used in this research to develop the mHealth intervention framework. A brief description of the Persuasive System Design model and its application in the development of the mHealth intervention is described below.

2.5.1 Persuasive System Design (Oinas-Kukkonen and Harjumaa, 2009)

According to the PSD model by Kukkonen, there are three major phases in the designing of a persuasive system for behavior change. The first stage consists of analyzing the persuasion context and identifying various design principles that will be used. This stage is followed by the identification of various requirements for software quality. Software implementation is covered in the third stage of the development process.

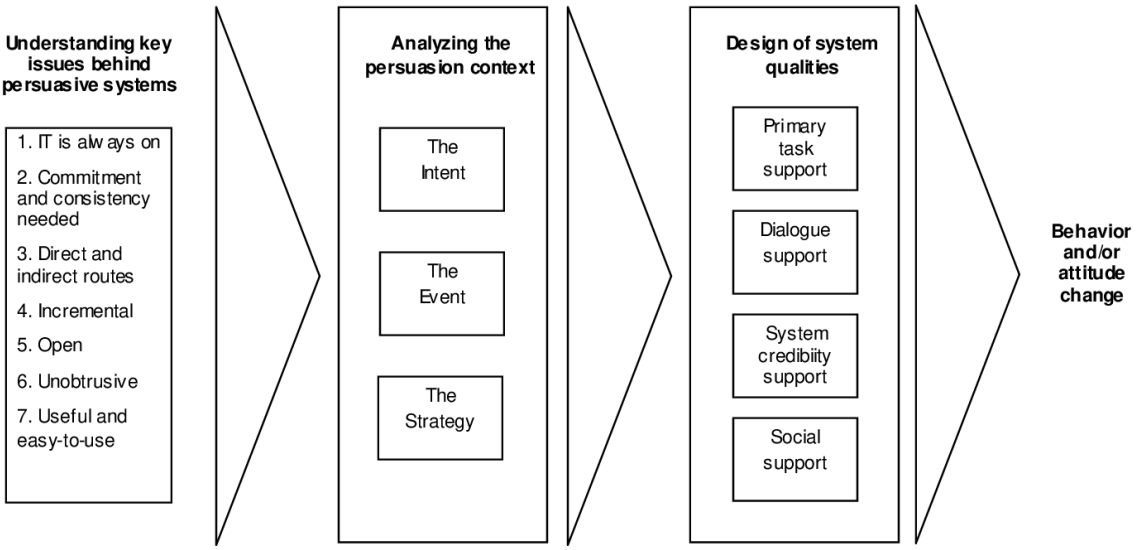

Figure 3: Persuasive System Design (Oinas-Kukkonen and Harjumaa, 2009)

2.5.2 Applying the PSD model to the development of the mhealth model

Phase 1

The first phase of the PSD model involves understanding the key issues.

- **Adaptability**: The intervention should have the ability to adapt with changes in user behavior.
- **Commitment and consistency**: Intervention should provide consistent feedback to users. With support of consistent upgrading and keep up to date information.
- **Direct & Indirect strategies**- Should use a combination of strategies.
- **One step at a time**- Maintain gradual progress through system
- **Open**- ASRH information provided should be true and verified

- **Unobtrusive**: Should not disturb the user through notifications, unplanned downtime or upgrades.
- **Useful and easy to use**: the intervention should be simple and effective

Phase 2

- **The Intent**: Create a mHealth based multi-intervention service for ASRH promotion.
- **The Event**: Promote behavior change
- **The Strategy:** A combination of interventions for providing ASRH education information through text and video, real time peer chat, a link to ASRH services, motivating users through rewards when they complete weekly quizzes and a progress tracker for users to compare their progress against others.

Phase 3

- The final phase involves identifying the features of system design.
- PSD model by Kukkonen provides a set of persuasive strategies for the system design, namely Primary task support, Dialogue support, System credibility support and Social support. Each category has been divided into 7 features. A few of the features and how they can be applied in our intervention are described below.

Table 2 Features from PSD Model applied to the Intervention

Strategy	**Features**	***How it can be applied to the proposed intervention***
Primary task support	Reduction Personalization	Makes tasks simple for users Provide personalized content
Dialogue Support	Praise Reminder	Congratulate users on completing tasks Remind users of rewards for completing
System Credibility Support	Expertise Verifiability	Avoid app downtime and regular updates
Social Support	Social Learning Social comparison Normative influence Social facilitation	Provision for comparing progress against those of other , real time chat groups and awards for successful completion of tasks

2.5.3 Conceptual Model

Drawing from the reviewed literature, a conceptual model is derived based on the persuasive system design model to guide this study.

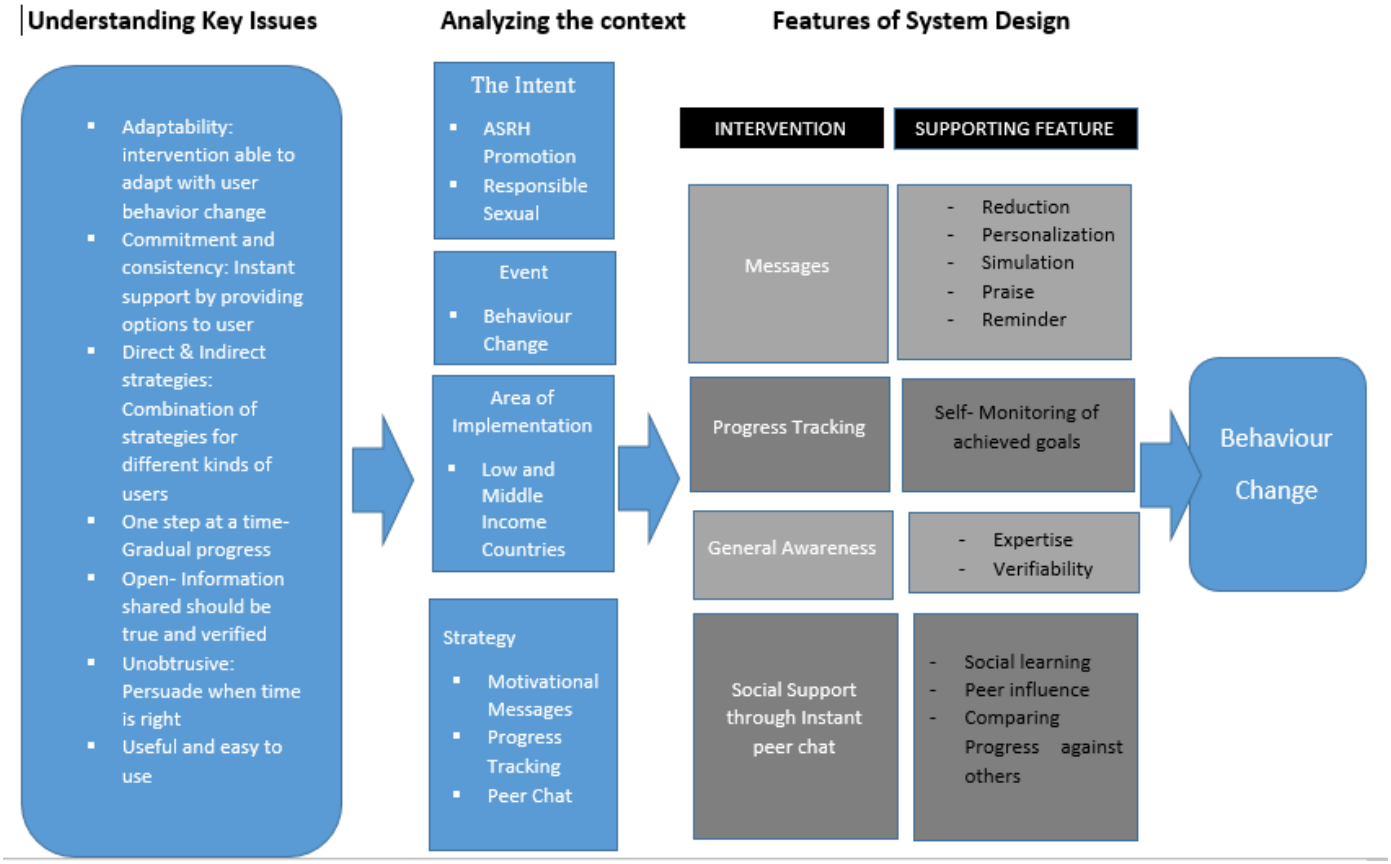

Figure 4: Conceptual Model adopted from the Persuasive System Design by (Oinas-Kukkonen and Harjumaa, 2009)

CHAPTER THREE - METHODOLOGY

This chapter provides an outline of the methodology used to answer the research questions.

3.1 RESEARCH FRAMEWORK

Choosing a correct design method is important for carrying out the research in a planned and systematic manner. (Hevner, et.,2004) design science framework will be applied in this study. Hevner's framework is structured and fits the criteria, standards and guidelines of design science studies (Venable, Pries-Heje, & Baskerville, 2012).

The study follows the following steps adapted from Hevner's framework:

i. *Obtaining awareness of the problem from the environment*
ii. *Putting forward suggestions for solving the problem*
iii. *Contributing to the pool of study through publications*
iv. *Evaluating the solution to validate the generalizability and correctness of the solution*

The follow figure describes the steps followed in this study based on Hevner's Framework

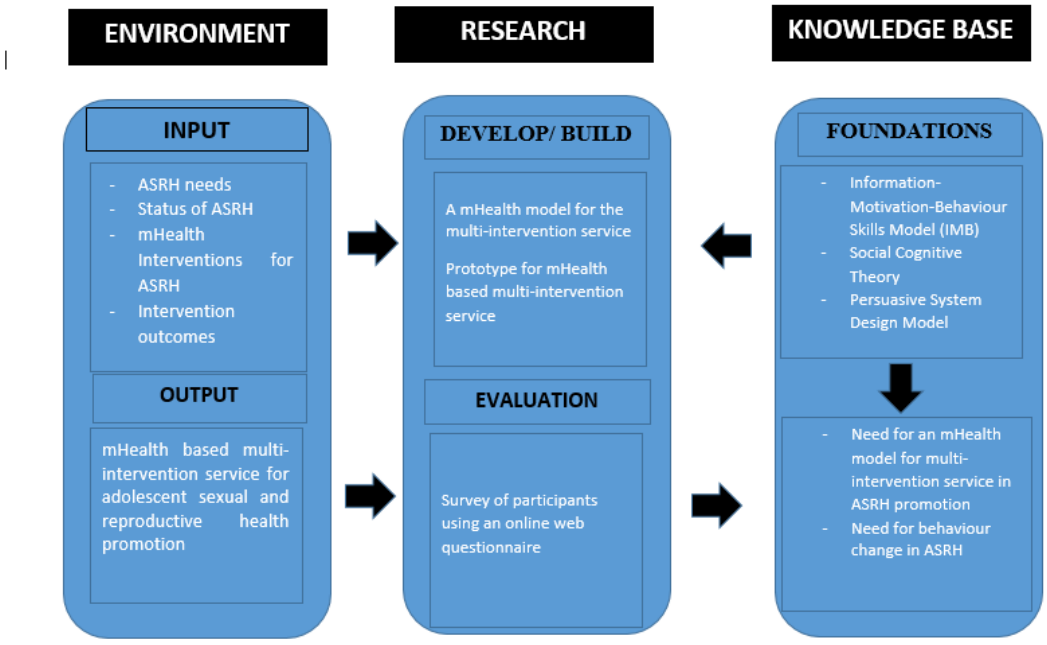

Figure 5: Steps adapted from Hevner's Framework

The first step involved the Identification of the problems in the environment – mHealth interventions on adolescent sexual and reproductive health were reviewed and gaps identified. This lead to the development of a model for a multi-intervention service as an answer to the following research questions:

Research Question 1: How can a model for an mHealth based multi-intervention service for adolescent sexual and reproductive health promotion be developed?

Persuasive system design model and two behavior change theories; Information-Motivation-Behaviour Skills Model (IMB) and Social Cognitive Theory were used to develop the above model. The model was used to develop a prototype mHealth application for adolescent sexual and reproductive health promotion using multi-intervention strategies.

Research Question 2: How can a prototype be developed based on the model? Answered through the development of the prototype.

The next step in the framework is the evaluation of the prototype - this involved an online survey helped highlight several factors that affect the user acceptance of a mHealth based multi-intervention service for adolescent sexual and reproductive health promotion. This helped to answer the third research question:

Research Question 3: How can the prototype be evaluated for feasibility and acceptability?

3.1 RELIABILITY OF METHODOLOGY

Guidelines by (Hevner et al., 2004) were used to evaluate the validity and reliability of the chosen methodology. The Guidelines are described below.

3.1.1 Guideline 1. Design as an artefact

Hevner's guidelines, states that *"design science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation" (*Hevner et al., 2004). The constructs, models and instantiations produced from this study are described in the table below.

Table 3 Constructs, Models and Instantiations

1.	Artefact	Description
2.	Construct	This are represented by the various features of the mHealth model for the multi-intervention service for adolescent sexual and reproductive health promotion.
3.	Model	mHealth based multi-intervention service for adolescent sexual and reproductive health promotion is developed through the framework
4.	Instantiation	Based on the model, a prototype mHealth application is developed that incorporates the various features listed in the model.

3.1.2 Guideline 2. Problem relevance

According to Hevner, solving a real life problem should be the aim of any design science research. This research project aims to develop and evaluate a mHealth based multi-intervention service to improve adolescent sexual and reproductive health outcomes.

3.1.2 Guideline 3. Problem relevance

According to Hevner (2004), utility, quality and efficacy of a service design must be validated using well executed methods. For this study an online survey was conducted to evaluate the acceptance of the multi-intervention service model. Details of the evaluation process are provided in Chapter 4.

CHAPTER FOUR – IMPLEMENTATION

4.1 PROTOTYPE DEVELOPMENT

The multi-intervention service brings together several interventions employed ASRH promotion and provides a model for developing an mHealth intervention according to the PSD model by Kukkonen. The service provides ASRH education information through text and video, real time peer chat, a link to ASRH services, motivating users through rewards when they complete weekly quizzes and a progress tracker for users to compare their progress against others.

The muti-intervention service adheres to 23 of the 28 features suggested in Kukkonen's PSD Model.

4.1.1 Service Design

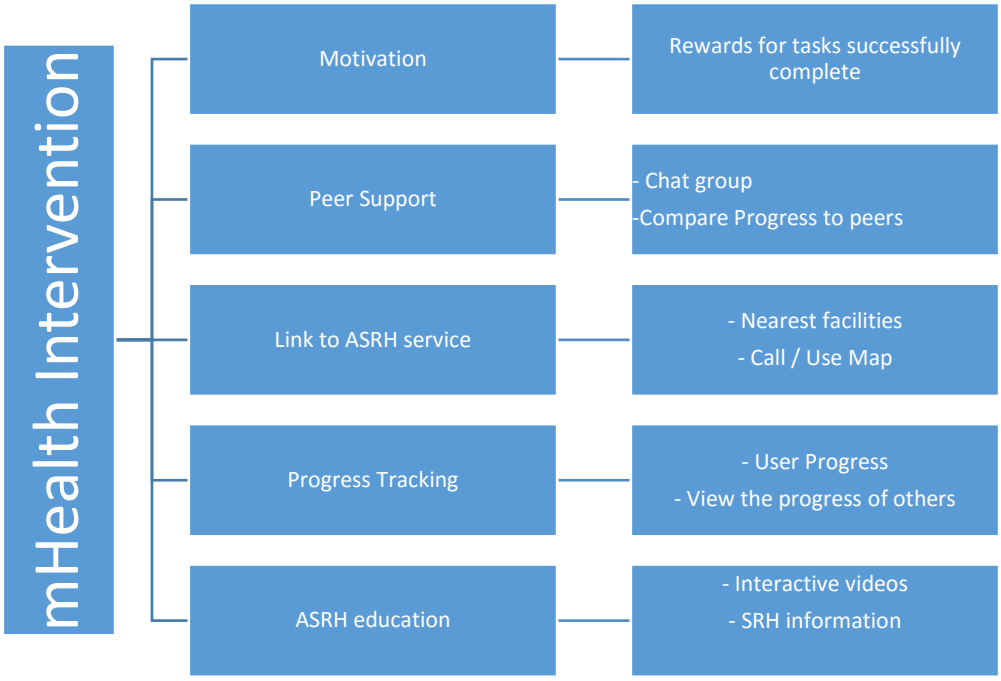

Figure 6: mHealth Intervention Service Design

4.1.2 System Architecture

The components of the system architecture are described below:

i. **Database:** The database stores user information, their achieved points, quizzes and SRH information, Sent and received Chats information

ii. **System Logic**: Representational State Transfer (RESTful) API has used for pushing app content. This is because the client and server are decoupled for mobile applications and also due to its properties such as simplicity, infrastructure friendliness, cache ability, scalability, statelessness or tastefulness and efficiency, all of which are highly relevant and necessary for the given situation. In addition to the REST API, Real time chat works on

iii. **User Interface**: Mobile phone app has been tested on Android devices running OS version 5.0+

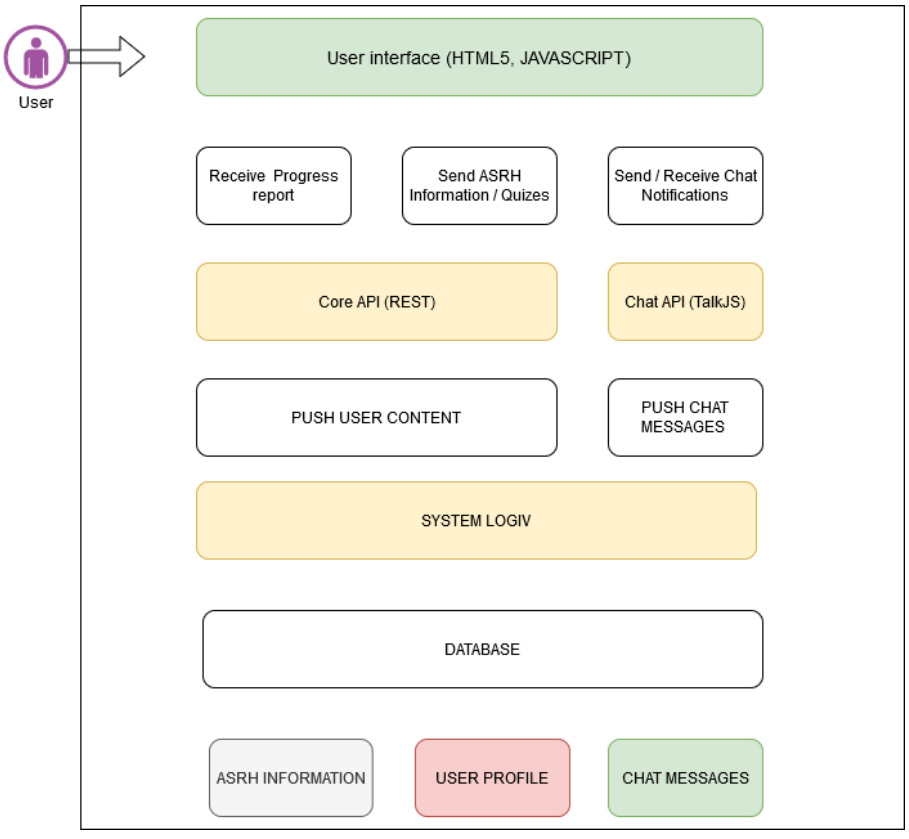

Figure 7: System Architecture

4.1.3 Features of the Multiintervention service

The multiintervention service revolves around five interventions:

- ASRH education
- Progress Tracking
- Link to ASRH Service
- Peer Support
- Motivation

ASRH education - The users are provided with SRH information on one to one basis using videos and texts. Relevant topics included include: Understanding puberty, relationships, HIV and other STIs, Use of Contraceptives and link to SRH services.

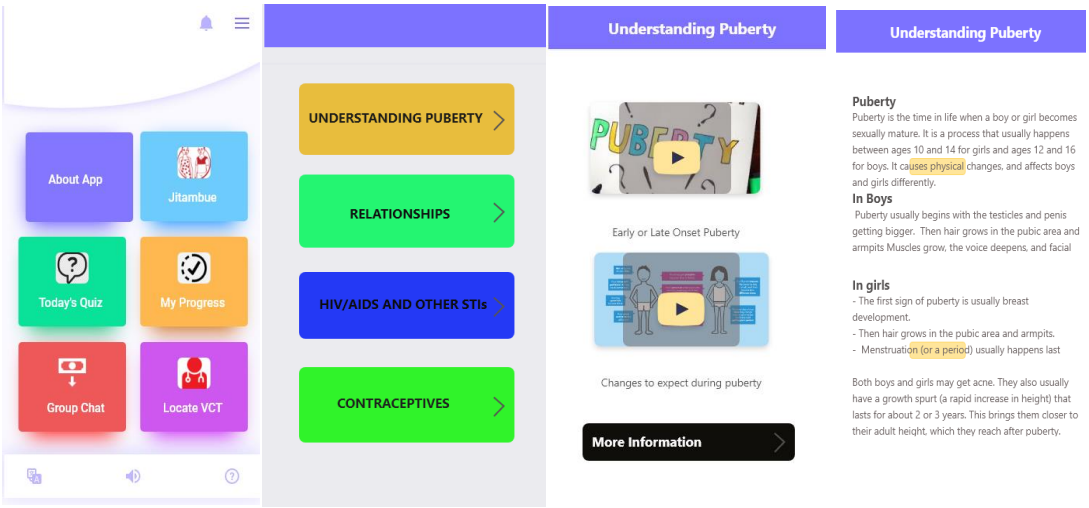

Figure 8: ASRH education feature in intervention

Progress Tracking - Users are provided with weekly targets of quizzes to do and are graded based on successful completion. They can view their performance against other users in the system.

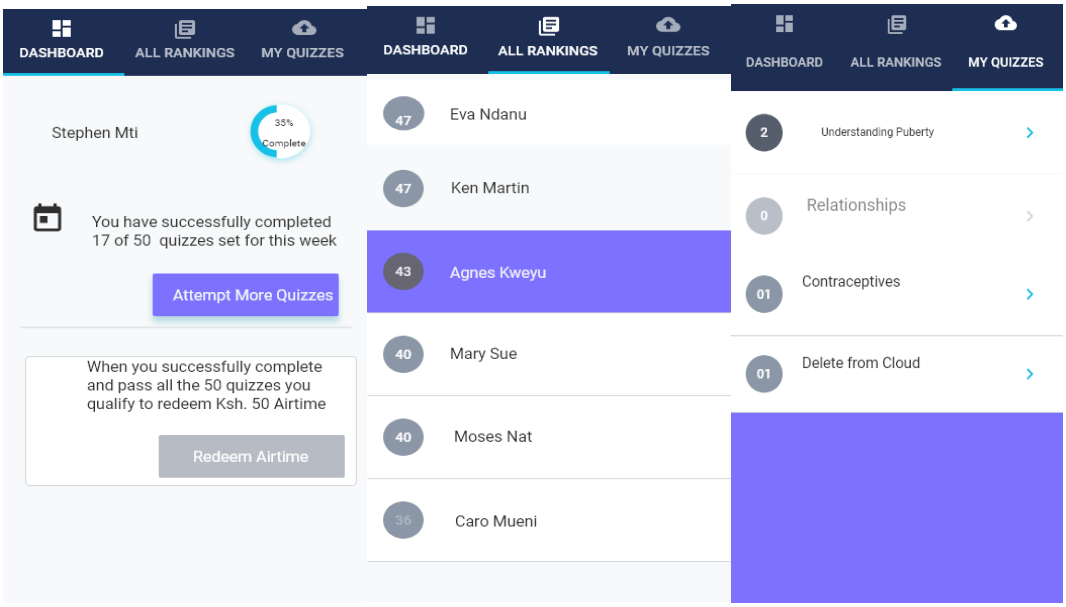

Figure 9: Progress Tracking feature in intervention

Link to ASRH Service - Users can call the nearest health facility providing ASRH services and also be directed there using location based services.

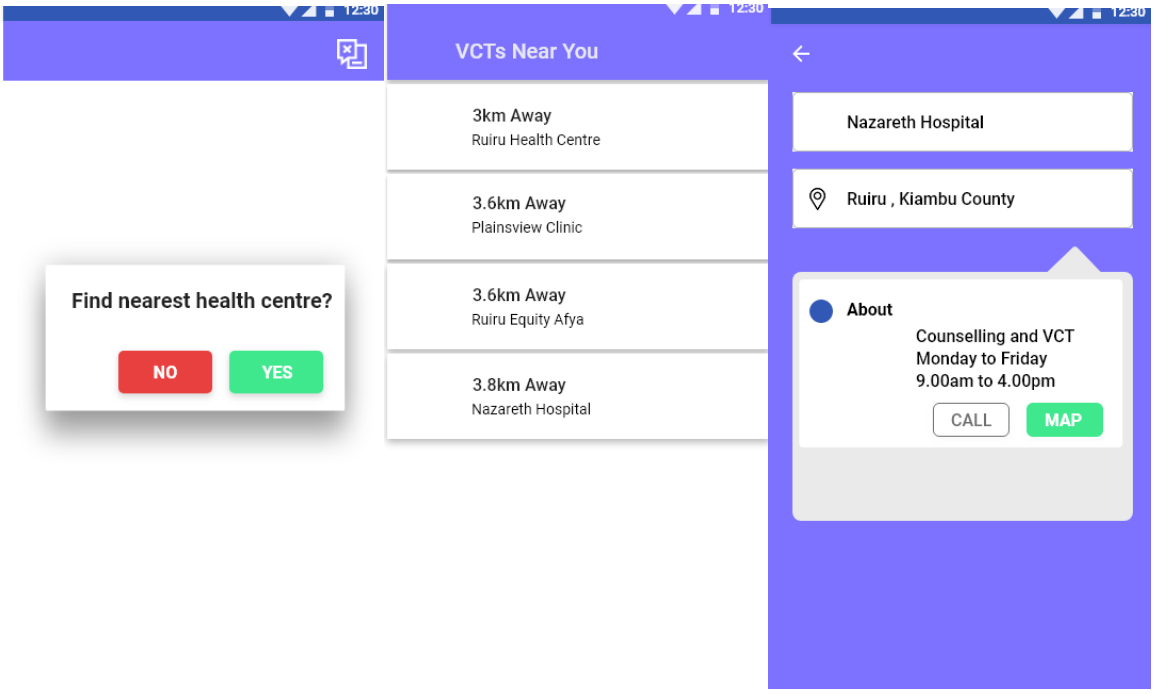

Figure 10: Link to ASRH service feature in intervention

Peer Support – Users can follow and also start conversations on various topics through the chat group. In addition, they can also compare their progress against that of others.

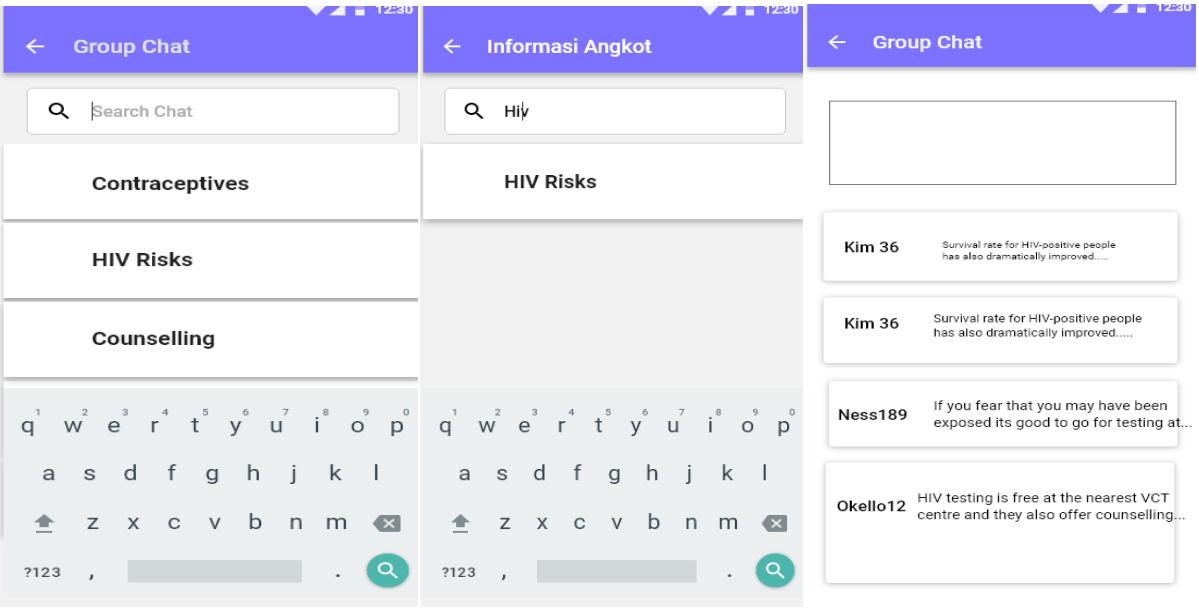

Figure 11: Peer Support feature in intervention

Motivation – Users earn points upon successful completion of weekly quizzes drawn from topical issues. The points can be redeemed for airtime upon meeting the weekly target. In addition, users are ranked according to the number of points achieved at any given time.

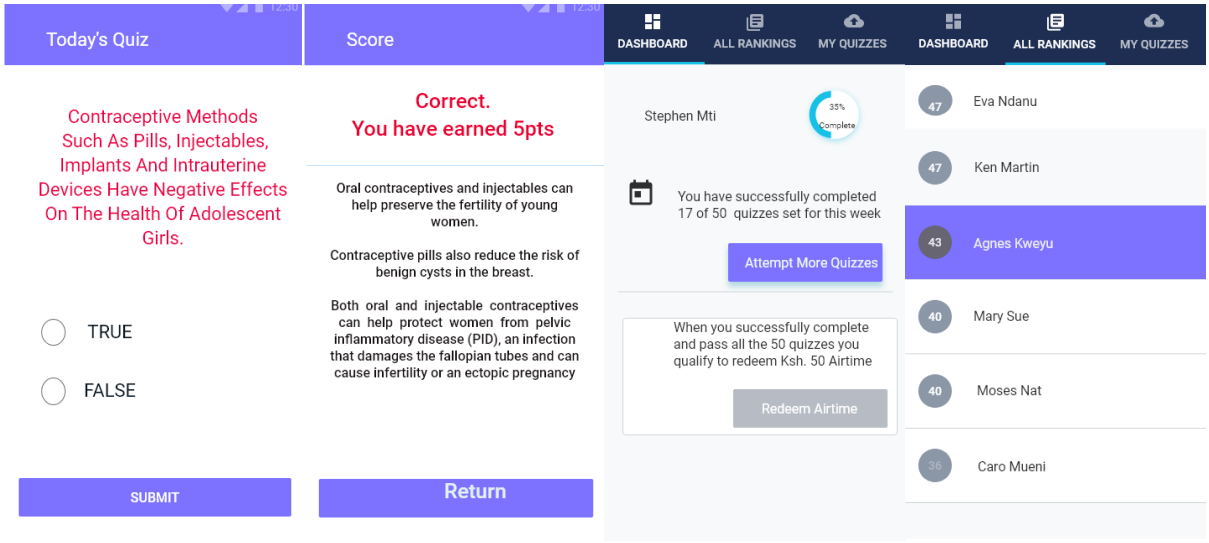

Figure 12: Motivation feature in intervention

CHAPTER 5 EVALUATION OF PROTOTYPE

This section deals with the third research question

Research Question 3: How can the prototype be tested for feasibility and acceptability?

We explore the factors that affect the user acceptance of a mHealth based multi intervention service for ASRH promotion. Success of product or technology is depended on the acceptance of the user although it is difficult to predict how a new service or technology will be adopted by the users. It is however important for product designers and developers to comprehend the users' expectations for developing an application in order to meet their needs.

The following constructs were used in the design of the questionnaire to evaluate the mhealth intervention.

Feasibility

Feasibility refers to "the extent to which a new treatment or innovation can be successfully used or carried out within a given agency or setting" (Proctor, et al., 2011). For this study the feasibilty of implementation was measured to establish whether adolescents would use the intervention and the specific features of the intervention they would use. Measures to assess feasibility of the intervention included:

i. The proportion of participants who created a user profile.
ii. The proportion of participants who used the intervention for one week, two weeks and three weeks;
iii. Proportion of participants who completed the online questionnaire

Acceptability

Assessing acceptability is a necessary component in determining the effectiveness of an intervention. Acceptability of a health intervention is determined by the content, context and quality of care received. People are more likely to adhere to recommendations and experience improved health outcomes if they consider an intervention acceptable (Sekhon et al., 2017).An intervention with low acceptability will therefore result into a low overall effectiveness. (Proctor et al., 2011) defines acceptability as "the perception among stakeholders that a given treatment, service , practise or innovation is agreeable , palatable or satisfactory.

The following topics were used to determine the intervention's acceptability.

i. How helpful are the intervention components?
ii. Satisfaction with the intervention
iii. Whether the design of the program was likeable and
iv. Whether the users would recommend the intervention to their friends
v. Likes and dislikes about the intervention
vi. Suggested changes to the intervention.

Cognitive outcomes

Constructs from behaviour change theories used to design the intervention and which have shown to be determinants of adolescent sexual and reproductive health were also assessed. Self-efficacy, motivation, outcome expectancies were measured using the online questionnaire.

5.2.1 Survey Design

The evaluation of the multiintervention service was based on an online questionnaire developed using Google forms. The following steps were involved in conducting the survey:

- The survey has been divided into four sections. The first section confirms whether the participants meet the selection criteria. This is followed by the introduction of the mHealth intervention through a link to an online video description sent to selected participants. The link to the mHealth prototype is then sent to the participants at the end of the description who are required to interact with it for a period of 21 days.
- The second section of the survey examines the constructs that measure feasibility, acceptability and cognitive outcomes of the intervention.
- The third section includes questions on demographic information as well as experience in using mobile phones.
- The final questionnaire has a total of 50 questions.

5.2.2 Data Collection

An online cross-sectional study was conducted with adolescents and young adults residing in Ruiru constituency in Kiambu County. Participants were recruited if they met the following inclusion and eligibility criteria:

i. Aged between 14 to 24 years' old
ii. Must be a smartphone user
iii. Have social media account to invite their friends/relatives.

Respondent-driven sampling technique (RDS) was utilized to recruit participants. First, a core group was purposively invited that reflected the diversity of sample in consideration of the adolescents' age, gender and education (primary school, secondary school, college or university). A total of 20 participants were recruited in the core group representative of the diversities of age, gender and education. Convenience sampling was used to select the 20 participants in the core group. Each participant in the core group was asked to recruit up to five peers or relatives via social media. Each of the participants in the core group however recruited between 2 – 4 participants resulting into a cumulative total of 85 participants. Participants were required to provide their answers using Google Forms.

5.3 Data Analysis: Results

Feasibility and acceptability measures were collected through qualitative and quantitative methods. Descriptive statistics were used to analyze and report quantitative data for both feasibility and acceptability. Responses to questions with the 5-point Likert scale were analyzed using means and standard deviations. Frequencies were used to analyze and report responses to questions with multiple choice and yes/no answers.

5.2.1 Respondent Characteristics

A total of 78 responses were received from the survey. While each of the respondents selected for this study owned a smartphone, a majority of the (~ 69%) had no previous experience using any other apps for accessing SRH information. A summary of their demographic information is as shown in the table below.

Table 4: Respondent Characteristics

Variable		Scale	Frequency	Percent
Age		15 – 17	33	42.2
		18 – 21	11	40.0
		22 – 24	34	17.8
		Total	**78**	100
Gender		Male	47	60
		Female	31	40
		Total	**78**	100
Access to Smartphone		Yes	78	100
		No	0	0
		Total	**78**	100
Level of Education		Primary School	9	11.5
		Secondary School	37	47.4
		College/University	32	41.0
		Total	**78**	100
Previous experience using other app for SRH		Yes	19	24.4
		No	59	75.6
		Total	**78**	100

5.2.3 Reliability Testing

Reliability testing was done to check the extent to which the instrument is free from error and to ensure consistency and stability. Each of the five constructs used measured in the survey had Cronbach's Alpha value > 0.70. According to (Nunnally, 2010), the Cronbach's Alpha should be greater than 0.70 for a construct to be considered reliable. The Cronbach's Alpha for the three constructs is show below:

Table 5: Reliability Testing

Construct	No.	Cronbach's
Feasibility	4	0.766
Acceptability	4	0.737
Motivation to change behavior	3	0.844

5.2.4 User responses on identified constructs

i. Feasibility

Of the 85 participants recruited, 78 created a profile and also completed the survey, the others 7 did not complete the survey. 53.7% of those who completed the survey stated that they interacted with the app for the three weeks, while 36.1 % interacted with the app for at least one weeks' while 10.2 % interacted with the app for less than a week.

ii. Acceptability

The majority of participants (74.1%) stated that the app is a good source of SRH information, 76. 2 % believe the app will help them make positive SRH choices and 82.6 % stated that they would recommend the app to friends. When asked why they would recommend the app to friends, many stated they *"enjoyed using it"*, they found it *"easy & useful"*, and *"my friends need to know more about sexual health"*. Participants were also asked about suggestions to improve the intervention. One-third (33.2%) of said they would not change anything on the app.

A couple of participants mostly men wanted the app to incorporate games. About half of participants (49.6%) stated that what they liked most about the app was the information provided. Participants liked that it, *"is relevant to my age group"* and that, *"the information was good for teenagers".* Others noted that, *"the information not hard to understand"* and that *"the awards at the end of tasks motivates me to use the app often".*

iii. Motivation to change behaviour

A majority of the participants (74%) stated an intention to continue using the app on their phones. Asked why they think they intend to continue using the app on their phones, participants noted that *"it would help them in making good choices in life"* and that *"it will help them get answers without feeling embarrassed".* Others noted that the awards and quizzes given at the end of completing tasks will *"keep the engaged"*

5.2 DISCUSSION

Evidence from this study demonstrate the potential for knowledge and behavior change among adolescents. Smartphone based mHealth interventions are more interactive and engaging and are likely to be more appealing to young people. The intervention has a good acceptability among adolescents as demonstrated by user responses. Acceptability is based on emotional and cognitive responses to an intervention (Sekhon et al., 2017). A majority of the participants noted that the intervention has a good design and that the information provided would help them make positive SRH choices. In addition, the feasibility of using the multi-intervention service for ASRH promotion has been demonstrated by the completion rate of the survey. Out of 85 participants recruited for the study, 78 created a profile in the intervention app and interacted with the app for at least one week in addition to completing the online survey. The motivation of awards at the completion of tasks might have motivated some to interact more with the app. This demonstrates the Information-Motivation Behaviour Skills Model adopted for this study – a person with information is likely to act based on motivation or the social support they receive to act on that information. A majority of the participants demonstrated an intention to continue using the app on their phones to stay informed on SRH issues and participate in the online forums and weekly quizzes.

With smartphone penetration in Sub-Saharan Africa expected to rise to 52% by 2025 and 67% of connections expected to be via smartphone (GSMA, 2020), there is a great potential for the use of smartphones in ASRH promotion. Existing evidence reveals the need for designing accessible, appropriate and effective sexual and reproductive health programs for young people (Chandra-Mouli.,et al, 2014). The challenges faced by young people in low-income nations including Kenya include lack of knowledge on SRH and lack of privacy while accessing SRH services (Déglise, Suggs, & Odermatt, 2015). A review of existing mhealth interventions revealed that most were SMS based thus the limitation on the length of content that can be disseminated and lack of a two-way communication. SMS based interventions do not help achieve the privacy requirements of young people as they require users to subscribe using phone numbers. This study reduces these barriers to accessing SRH information and services by providing SRH information via a smartphone.

5.2.1 Answering Research Objectives

Research Objective 1: Develop a model for an mHealth based multi-intervention service for adolescent sexual and reproductive health promotion?

This research reviewed several mHealth interventions on adolescent sexual and reproductive health identified existing gaps. Persuasive design, which is a model for building systems and constructing products that have persuasive features to change default behavior or attitudes was selected to develop a model for a multiintervention service. Two behaviour change theories Information – Motivation Behaviour Skills Model (IMB) and the Social Cognitive Theory. The multiintervention service combines several strategies employed in mHealth for adolescent sexual and reproductive health promotion using persuasive technology.

Research Objective 2: Validate the model through development of a prototype based on the model

Based on the model, a prototype mobile application for adolescent sexual and reproductive health promotion was developed using multi-intervention strategies. Features included in the app include ASRH education, Progress Tracking, Link to ASRH services, Peer Support and Motivation.

Research Objective 3: Evaluate the Prototype for Feasibility and Acceptability.

85 participants were recruited to interact and give feedback to access the feasibility and acceptability of the app and its potential for behavior change. Responses from 78 participants were received and analyzed.

5.3 LIMITATIONS OF THE STUDY

The current study has several limitations. First, while a majority of participants stated that the intervention will help the make positive SRH choices, this does not translate to actual behaviour change. It will require a longer period of study with a large scale randomized control trial (RCT) on how the intervention will lead to actual change of behaviour. Secondly, the study is limited to users with smartphones only with access to internet and thus it may not be ideal for those in rural areas that are mostly faced with challenges of internet access and where smartphone penetration may be low.

CHAPTER 6 CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter presents the conclusion and recommendations arising from the study.

6.2 Conclusion

This study reviewed existing mHealth interventions and demonstrated the existence of limited study on Smartphone based interventions for ASRH Promotion. While most of those that exist are SMS based, the use of a multi-intervention approach has not been used in order to produce desired behaviour change. The possibility of developing an mhealth based multi-intervention service was explored resulting into the development of a mHealth app using multiintervention strategies. Feasibility and acceptability of this intervention among adolescents has been demonstrated. Several strategies used by Mhealth apps for SRH promotion can be combined to provide a multi-intervention platform for adolescents to access, interact and increase their SRH awareness and thus lead to positive SRH outcomes. The findings were based on studies from adolescents based in Kiambu County. This study can be replicated to other parts of the country and also with a larger sample in order to study its full potential in bringing about positive SRH outcomes. The study has several limitations such as the inability to demonstrate actual behaviour change in addition to being limited only to smartphone users. Further research is needed on the success and effectiveness of mHealth as a standalone intervention in addition to how mHealth interventions can be used to interact effectively with health care providers for increased service uptake.

6.2 Recommendations

Future work can involve evaluating the multi-intervention service with users over a longer period of time for actual behaviour change. In the current study, the users used the multiintervention service for not more than 3 weeks. The possibility of incorporating games as part of the intervention can also be explored.

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APPENDIX A - ONLINE QUESTIONNAIRE

Survey on Adhealth Mobile App

* Required

Demographic Information

Gender *

- ○ Male
- ○ Female

Age *

- ○ 15 - 17
- ○ 18 - 21
- ○ 22 - 24

Do you have access to a Smartphone *

- ○ Yes
- ○ No

What is your highest level of education *

- Primary School
- Secondary School
- College / University

Have you used other apps that provide sexual and reprodutive health information *

- Yes
- NO
- Other:

For how long did you use the AdHealth app? *

- Less than one week
- One to two weeks
- Atleast three weeks

How helpful were the following features in the app *

	Very Helpful	Helpful	Somewhat Helpful	Slightly Helpful	Not at all Helpful
The App in general	○	○	○	○	○
ASRH education	○	○	○	○	○
Progress Tracking	○	○	○	○	○
Link to ASRH Service	○	○	○	○	○
Peer Support	○	○	○	○	○
Motivation	○	○	○	○	○

Attitude toward using the app *

	Strongly Disgree	Disagree	Neutral	Agree	Strongly Agree
The app makes the process of learning more interesting	○	○	○	○	○
Using the app was fun	○	○	○	○	○
I liked using the app	○	○	○	○	○
The app is appropriate for my age group	○	○	○	○	○
I enjoyed interacting with other adolescents through the peer support forum	○	○	○	○	○

Self-Efficacy *

	Strongly Disgree	Disagree	Neutral	Agree	Strongly Agree
Using the app will influence my sexual and reproductive health decisions	○	○	○	○	○
Have help incase i am stuck with the app will help me use it better	○	○	○	○	○
I dont need anyone to show me what to do in the app	○	○	○	○	○

Behaviour Intention *

	Strongly Disgree	Disagree	Neutral	Agree	Strongly Agree
I intend to be using the app for next 6 months	○	○	○	○	○
I dont intend to uninstall the app	○	○	○	○	○
The app will help me make positive SRH choices	○	○	○	○	○

Would you recommend the app to your friends? *

- Yes
- No

Why would you recommend or not recommend the app to your friends? *

Your answer

What in the app did you find difficult to understand or follow, if any?

Your answer

Do you have suggestions on how to make this app better?

Your answer

Development and Evaluation of an Mhealth based multiintervention service for adolescent sexual and reproductive health promotion.

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