Design and Evaluation of Sex-Educated: A Persuasive
Application for Promoting Sexual Health Awareness
among Indians

by

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To every resilient person, and the mothers who inspire them.

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Abstract

Sex education plays a crucial part in fostering individuals' understanding of sexual health, promoting healthy sexual behaviour, and enabling informed decision-making. In countries such as India, however, sex education is often overlooked due to societal stigma surrounding discussions of sex. This deficit in proper sexual health knowledge frequently results in people making risky sexual choices. To address this issue, the application of Persuasive Technologies (PTs) has proven effective in raising awareness and encouraging desired behaviours. Despite this success, most PT interventions have been developed for populations in developed countries, highlighting a significant need for targeted solutions in developing regions. To address this gap, this thesis presents *Sex-Educated*, a persuasive mobile application (app) specifically designed to enhance sexual health awareness among Indians. The purpose of *Sex-Educated* is to increase knowledge about healthy sexual behavior, promote safe sex practices, and heighten awareness regarding risky sexual behaviors. Employing a User-Centered Design (UCD) approach, the app ensures that it meets the specific needs and preferences of the Indian audience. The app was developed in three phases: phase 1 focused on identifying the design frameworks and theories and approaches that were found successful in previous works and creating an initial design of the app. In the 2nd phase, a prototype was created, and the design was evaluated with 57 participants. The final app was developed in phase 3, and to evaluate the effectiveness of *Sex-Educated* to educate about sexual health and promote healthy sexual behaviour, a user study was conducted with 46 participants. The findings from the study revealed a significant positive change in sexual behaviour and knowledge of sexual health. The app was shown to be highly persuasive and useful for imparting sexual health knowledge and promoting awareness of sexual health*. Sex-Educated* exemplifies the potential of persuasive mobile applications to address critical public health issues in underserved populations by making sexual health education more accessible and engaging. The app not only enhances learning and awareness but also fosters positive behavioural changes, underscoring the effectiveness of PTs in promoting sexual health awareness among Indians.

List Of Abbreviations Used

App	Application
STI	Sexually Transmitted Infections
SRH	Sexual and Reproductive Health
UCD	User-Centred Design
UI	User Interface
HCI	Human-Computer Interaction
HCI4D	Human-Computer Interaction for Development
mHealth	Mobile Health
PT	Persuasive Technology
PSD Model	Persuasive System Design Model
RO 1	Research Objective 1
RO 2	Research Objective 2
RQ 1	Research Question 1
RQ 2	Research Question 2
RQ 3	Research Question 3
RQ 4	Research Question 4
RQ 5	Research Question 5
RQ 6	Research Question 6
RQ 7	Research Question 7
ARCS	Attention, Relevance, Confidence, Satisfaction
PPS	Perceived Persuasiveness Scale
UEQ	User Experience Questionnaire
SUS	System Usability Scale

WHO	World Health Organization
NHFS	National Family Health Survey
HIV	Human-Immunodeficiency Virus
PrEP	Pre-exposure prophylaxis
nPEP	Nonoccupational postexposure prophylaxis
SUS	System Usability Scale
UEQ	User Experience Questionnaire
PPS	Perceived Persuasiveness Scale

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Chapter 1

Introduction

Sex education is a broad program and set of instructions that aim to convey the issues relating to human sexuality and acquiring information, attitudes, beliefs and values about one's identity, relationships, and intimacy [31]. It is essential for understanding sexual relationships and managing sexual health [54]. As defined by the World Health Organization (WHO), sexual health is "a state of physical, emotional, mental and social well-being in relation to sexuality" [79]. It does not only include disease prevention and treatment, reproductive and sexual problems but also encompasses respectful relationships, safe sexual activities, protection and fulfilment of the sexual rights of all individuals [79].

1.1 Problem

Every year more than 1 million people get affected by Sexually Transmitted Infections (STIs), which are curable but often go unnoticed and untreated as they could be asymptotic [80]. Even though there has been substantial growth in the use of contraception for the last two decades, the growth has slowed down due to various reasons such as limited access to services and products, fear of side effects, gender-based bias to accessing resources, and most importantly cultural, social and religious stigma. The reluctance to discuss sexual health and the absence of comprehensive sex education result in uninformed and frequently risky sexual decisions.

In India, discussions surrounding sex and related subjects have long been fraught with discomfort and deeply rooted in socio-cultural conservatism. Different social, economic, political, legal and technological factors affect the lack of sex education in India [12]. The education system in India further exacerbates this issue. The sex education curriculum in schools is often superficial and inadequate, failing to address the complexities and nuances of sexual health [12]. The curriculum is typically limited to basic biological aspects, such as reproduction and menstruation, with little to no emphasis on topics like consent, safe sex practices, and emotional aspects of sexual relationships. In many states, even the

introduction of sex education in schools has faced opposition from parents, teachers, and politicians, who argue that it contradicts Indian morals and values, potentially corrupting children's minds and promoting experimentation and irresponsible sexual behaviour [31]. However, inadequate exposure to proper sex education leaves students ill-equipped to make informed decisions about their sexual health.

This cultural stigma also creates a significant gap in open communication between parents and children. Consequently, many adolescents turn to unreliable sources to answer their questions about sex, including the internet, pornography, word of mouth, and friends. For instance, a study found that 88% of male students and 58% of female students in Mumbai universities reported receiving no sex education from their parents, instead relying on social media, magazines, and online content for information [31]. This lack of proper guidance results in widespread misinformation and risky sexual behaviours.

In 2017, estimates from the 4th National Family Health Survey (NFHS-4) cite that there were 11.8 million adolescent pregnancies in India. Around 34% of adolescent married women reported being assaulted and abused physically or emotionally [12]. The use of contraceptives is also considered to be less pleasurable, so more and more men refuse to take preventive measures during sex. Due to the discomfort and social taboo, women in India, especially in rural areas do not seek any kinds of contraceptive methods. Almost 50% of the adolescent maternal deaths are caused by unsafe abortion methods [12]. STIs are also an important public health problem in India. In India, around 6% of the adult population has one or more STIs which amounts to the occurrence of about 30–35 million episodes of STI every year [56]. The knowledge about HIV was found to be relatively good in a survey, however, knowledge about other STIs was found to be poor [41].

For generations, discussions about sex have been a source of discomfort in India, resulting in a notable lack of conversation about sexual safety. Nevertheless, the engagement of youth in sexual activities is on the rise [57], underscoring the increasing need to educate them about safe sex practices. This has been a major cause of gender-based violence, sexual abuse and psychological problems. Several misconceptions like contraception can compromise their partner's pleasure or affect fertility permanently still prevail, due to the lack of access to correct

information [12]. Despite increased access to education and technology, India still remains significantly behind in providing effective sex education.

1.2 Motivation

India, ranking second in the world with 659 million active smartphone users, represents a fertile ground for leveraging mobile technology to bridge the gaps in sexual health education [81]. The country's rapid smartphone adoption and the affordability of data plans—among the lowest in the world at USD 0.21/GB—provide an ideal platform for mobile-based educational interventions [29,82]. The Digital India initiative has further accelerated the penetration of smartphones, making them an integral part of daily life for a vast segment of the population. This widespread use of smartphones presents a unique opportunity to deliver sexual and reproductive health (SRH) education effectively and discreetly.

Given India's demographic composition, with the largest adolescent population in the world, the urgency for effective sex education cannot be overstated [31]. Mobile Health (mHealth) apps offer a practical and cost-effective means of disseminating vital health information, allowing users to access educational content anonymously and independent of time and place. They are particularly valuable in contexts where direct discussions about sex and sexual health problems are considered taboo.

Despite the potential of sexual health apps, most existing apps are designed for users in western countries, failing to consider the unique cultural, social, and economic contexts of developing nations like India. This oversight leaves a significant gap in the availability of comprehensive and culturally sensitive sex education tools tailored to the needs of young Indian adults.

Although it is widely recognized that considering the requirements and viewpoints of target users is vital to the success of any intervention, the User-Centred Design (UCD) approach has not been commonly employed in the development of sexual health mobile apps [83]. Involving the target users in the design process is essential for gaining insights into their needs and preferences, which in turn, enhances the usability and effectiveness of sexual health apps.

Persuasive technology (PT) is a form of interactive systems designed to change users' behaviour in the field of Human Computer Interaction (HCI) [23,48]. PT can

be in the form of apps, games and other forms of digital interventions. Persuasive apps can be developed with the goal of altering users' behaviours or attitudes in a positive manner. Previous research has demonstrated that persuasive apps can effectively motivate individuals to adopt healthier behaviours and attitudes [1,33,47]. PTs have also been used in some interventions for Sexual and Reproductive Health (SRH), however, most existing persuasive SRH mobile apps are not targeted at the Indian audience.

This research endeavours to address these gaps by developing a sexual health app integrating PT using a UCD methodology. The goal is to ensure that the specific informational needs of Indian young adults regarding sexual health are comprehensively addressed and embedded within the app design.

1.3 Solution

To address the deficiencies in sexual health apps in India, this research presents the design, development, and evaluation of a persuasive smartphone app named '*Sex-Educated*'. This app aims to provide comprehensive sexual health education through an engaging and interactive platform, utilizing the Persuasive System Design (PSD) [46] framework to incorporate a variety of persuasive strategies that motivate users towards healthier sexual behaviours.

'Sex-Educated' offers a range of features designed to make learning about sexual health both informative and enjoyable. The app includes gamified quizzes, and trivia-style information, overall creating an interactive interface to educate users on safe sexual practices and the avoidance of risky behaviours. These features are designed to engage users in a manner that is both educational and entertaining, ensuring that the learning process is enjoyable as well as effective. The app ensures privacy and anonymity, allowing users to learn without fear of judgment or stigma, which is particularly important in the context of Indian society.

The development process of *'Sex-Educated'* involved three phases. In phase 1, through a systematic literature review, I identified the design frameworks like PSD, behaviour change theories, and other design approaches that were found successful in previous works and created an initial persuasive design of the app, based on that. In Phase 2, I created a medium-fidelity prototype using Proto.io [84] and then the design was evaluated by 57 Indian participants in a user study.

Feedback from surveys and interviews informed the refinement of the app's design and features. The participants provided valuable insights into the cultural sensitivities and their needs in a sexual health app, which were incorporated into the final design of the app. In Phase 3, I developed the final app, implementing the user suggestions and considering the findings from the Phase 2 evaluations. The app was evaluated in a study where it was used by 46 participants over a week-long period, with behaviour change measures recorded before and after the evaluation. The app's design incorporates 10 persuasive strategies from the PSD framework, aimed at motivating users to gain knowledge about sexual health, adopt healthy sexual practices, and recognize risky behaviours.

1.4 Contributions

The thesis made three major contributions to the field of HCI and sexual health intervention:

1. I developed a persuasive mobile application '*Sex-Educated*' using the UCD approach to promote sexual health awareness and motivate change towards healthy sexual behaviours among Indians. The effectiveness of the app was evaluated in a 7-day-long study with the target users.

2. I offer qualitative insights into the needs and requirements of a sexual health app for the Indian audience.

3. I offer design recommendations for sexual health apps for low-resourced and underserved populations.

1.5 Thesis Overview

The rest of this thesis is organized as follows:

- Chapter 2 contains a review of research related to this thesis. It presents a review of 49 papers on persuasive apps on sexual health, over the span of 10 years (2014-2024). It also presents a detailed analysis of these apps by year, country of research and their study details.

- Chapter 3 describes the steps taken in the design and development of *Sex-Educated*, from the early development process to the actual design and development of the app. The chapter highlights the integration of

underlying theories and models, the meticulous design and implementation strategies employed, the architectural structure of *Sex-Educated*, and an in-depth analysis of its various features.

- Chapter 4 contains details about the evaluation process of *Sex-Educated*. It also presents the primary research question, secondary research questions and the detailed user study process.

- Chapter 5 presents detailed data analysis and results from the study.

- Chapter 6 presents a discussion of the results from the user study, recommendations, limitations and implications for future work.

- Chapter 7 summarizes the entire work and presents a conclusion.

Chapter 2

Background and Related Works

In this chapter, I discuss persuasive technology and mHealth apps and also present a comprehensive literature review of sexual health-related apps. In the discussion of the literature review, I describe the approaches used in the sexual health apps, the theoretical bases of the reviewed related works and the persuasive strategies used in the existing sexual health apps.

2.1. Persuasive Technologies

"The focus of any persuasive system must be a technology-mediated transformation of either attitudes or behaviours, including a transformation by bolstering or reinforcing existing attitudes or behaviours [72]. In recent years, the application of PT to foster positive changes by shaping and reinforcing behaviours and attitudes has seen significant growth. It has been contended that information and communication technologies are inherently non-neutral, possessing the capacity to influence individuals in various ways [46]. However, persuasive technologies (PTs) are purposefully designed to foster positive changes that can benefit both the user and their community.

Research has shown the possibility of PT in promoting users' behaviour in various domains. In particular, the domain of health and wellness is considered a significant, important, and challenging domain that deserves special attention in the field of HCI. Moreover, it has been stated that most of the health challenges people face today are due to their choices and can be solved by motivating them to change their behaviour and lifestyles [4,45]. Therefore, researchers believe that "designing persuasive systems that could resolve even some small parts of these problems and aid in true long-term sustainable change would be very valuable" [72]. In recent years, PTs have been employed in several health and wellness interventions to promote various health and wellness objectives, including promoting physical activities [4], encouraging healthy eating choices [52], reducing alcohol consumption [27], and improving mental health and emotional well-being [5].

2.2 mHealth Apps

Health apps can be used to disseminate health information effectively, practically and cost-effectively via computers, mobile phones or tablets. Mobile health (mHealth) interventions, i.e. interventions delivered via mobile devices, can successfully improve people's health [9]. The implementation of mHealth apps can significantly enhance access to health information, increase awareness, and adherence to treatment plans, and enable timely interventions. mHealth apps are expanding vastly and have been studied in various health domains such as dental health [63], physical activity [53], nutrition [52], mental health [5], disease prevention and management [18].

For example, in the context of physical activity, *BunnyBolt* [33] is an app designed to motivate youth to stay physically active. The gamified mobile app employs an interesting story to attract a wide variety of audiences and rewards the users for reaching milestones in the app. The game in the app has four different episodes as part of the story. It includes a map and guides the users by placing carrot-shaped pins on the map and rewards the users when they reach a carrot pin. It also notifies the users to vary their walking pace accordingly to keep them active.

In the health and nutrition domain, *Balance Pass* [13] is a service design designed to motivate healthy eating behaviour among college students. Balance Pass comprises a student ID holder with a built-in display for the recommender system. Balance Pass records the student's food purchase history when they pay with their card and recommends according to their purchase history, nutritional value, and food price. The recommender system followed the food pyramid as a recommendation guide. The system rewards the users with points for each healthy meal purchase. Users can accumulate points and utilize them to purchase free ice cream or movie tickets.

SmileApp [47] is a mental health app that was developed to promote positive mood to reduce stress. It uses AI and persuasive strategies in the design. It has a feature where the users must smile to earn points. The findings from this study showed that technology can be used effectively to promote desired behaviours. This app showed that through persuasive games, reading positive messages, and just by smiling, a positive emotional state can be achieved.

Although there has been extensive research on various facets of mHealth apps in the last decade, there is still a gap in comprehensive sexual health apps, specifically for the Indian population. Therefore, the present study focuses on designing and evaluating a sexual health education app: *Sex-Educated*. The next section introduces the state-of-the-art of sexual health apps.

2.3 Literature Review

Sexual health interventions are a subdomain under the mHealth interventions. Sexual health apps allow health information to be disseminated quickly, at low thresholds and in a practical and cost-effective manner. This section will present a literature review of sexual health apps.

According to Fogg [24], one of the steps to developing an effective persuasive system is finding relevant examples of PT. These instances would aid in understanding what has worked in the past and what has not, assisting scholars in the subject in avoiding earlier mistakes. Therefore, to fully understand the research area, I conducted a systematic review of existing research in the area of persuasive sexual health apps.

2.3.1 Process

For the literature review, I extensively searched databases such as the ACM Digital Library, the IEEE Xplore Digital Library, PubMed, and the Journal of Medical Internet Research. These databases were chosen due to their wide coverage of publications and conferences in the HCI and mHealth applications, aligning with my research topic. Additionally, I searched Google Scholar to ensure comprehensive coverage of relevant papers that may not have been captured by the aforementioned databases and journals. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model [35] was employed to guide my review process, and the findings were organized into thematic categories.

To search, I used keywords such as "Sex Education," "Sexual," "Sexual health," "sexual behaviour," "Intervention," "Mobile," and "Application." I limited the search to papers published within the past 10 years (2014 to 2024) to ensure that the most relevant related works are obtained. The search results displayed a total of

1,909 papers with unique titles. I skimmed through each selected paper to eliminate papers that did not meet the inclusion criteria. The inclusion criteria were:

- Papers were written in the English language.
- The papers were not systematic review papers.
- Developed an app (identified from full text).
- If the paper is not a duplicate of an already chosen paper.

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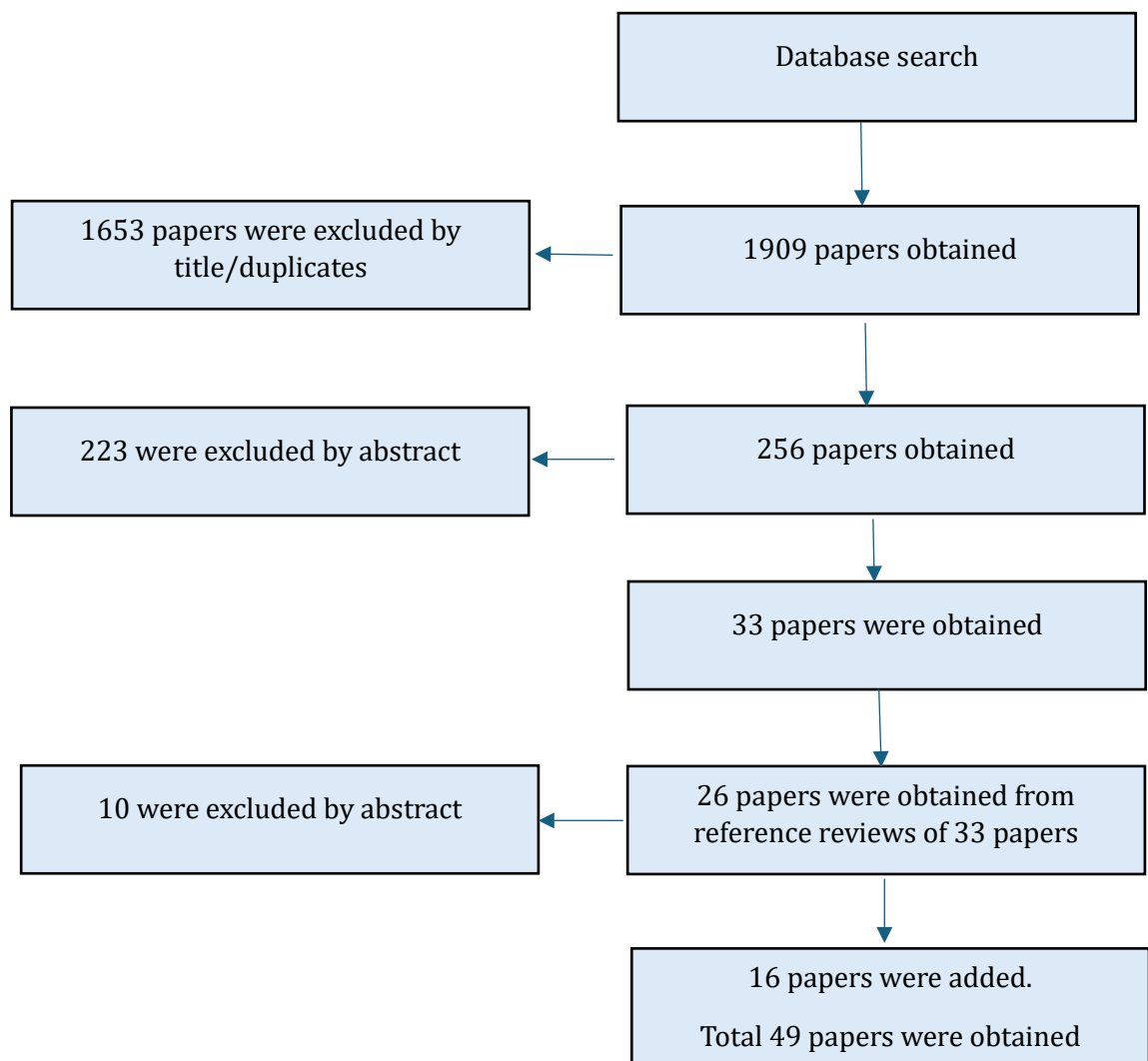
Figure 2.3.1 - Paper inclusion process

After going through all the papers, I removed the papers that did not meet the inclusion criteria or were not related to the topic, leaving us with 33 papers. From these 33 papers, I skimmed through their reference sections for papers (this is called snowballing, which refers to using the reference list of a paper or the citations to the paper to identify additional papers [74]) that also discussed the design or analysis of a sexual health app. I collected an additional 26 papers, and after applying the inclusion criteria again on these papers, I excluded 10 papers from them, leaving us with an extra 16 papers. Therefore, I reviewed 49 papers on persuasive sexual health app design and evaluation (Figure 2.3.1). I reviewed the 49 papers and coded them using the coding scheme developed and adapted from Orji and Moffat [49]. I analysed each paper under the following categories: year of the research, the venue of publication, app name, sub-domain/topic, the duration of the study, persuasive strategies used, the method of evaluation, targeted age and group, the number of participants, study country, and the effectiveness of findings. Figure 2.3.1 shows the process flow for including papers in the literature review.

2.3.2 Discussion of Related Works

The systematic literature review includes research on sexual health apps between 2014 and 2024. Figure 2.3.2.1 shows the distribution of the publications throughout the span of 10 years. with a sharp increase starting from 2020 possibly showing the adaptation of digital interventions during the time of the COVID-19 pandemic. This also indicates that sexual health apps have gradually increased their prevalence in the last 5 years.

Figure 2.3.2.2 shows the distribution of countries where the sexual health apps were developed or evaluated, with the USA leading with 41% of all the research. Followed by Indonesia with 14% and China with 8% all other countries have less than 5% of sexual health apps. Collectively 10% of the sexual health interventions are targeted towards African countries. 6% of the studies target Middle Eastern countries and another 6% target South American countries. Only 2% of the apps targeted the South-Asian population. This backs up my initial claim that sexual health interventions are not being targeted at the Indian population.
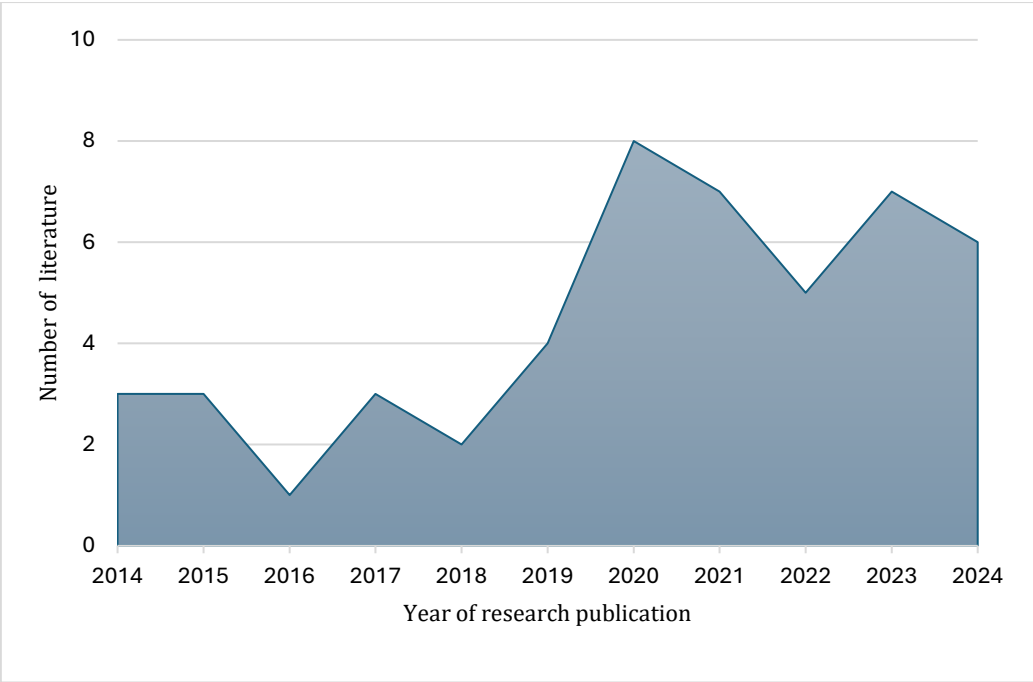
Figure 2.3.2.1: Sexual health apps by year of publication
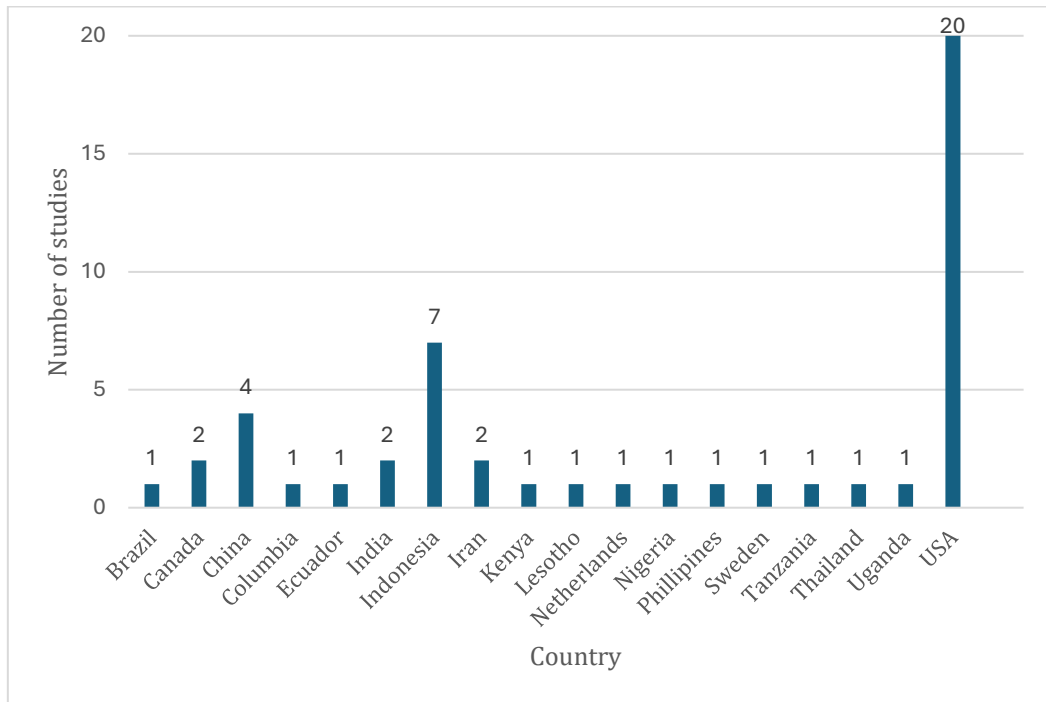
Figure 2.3.2.2: Sexual health apps by country
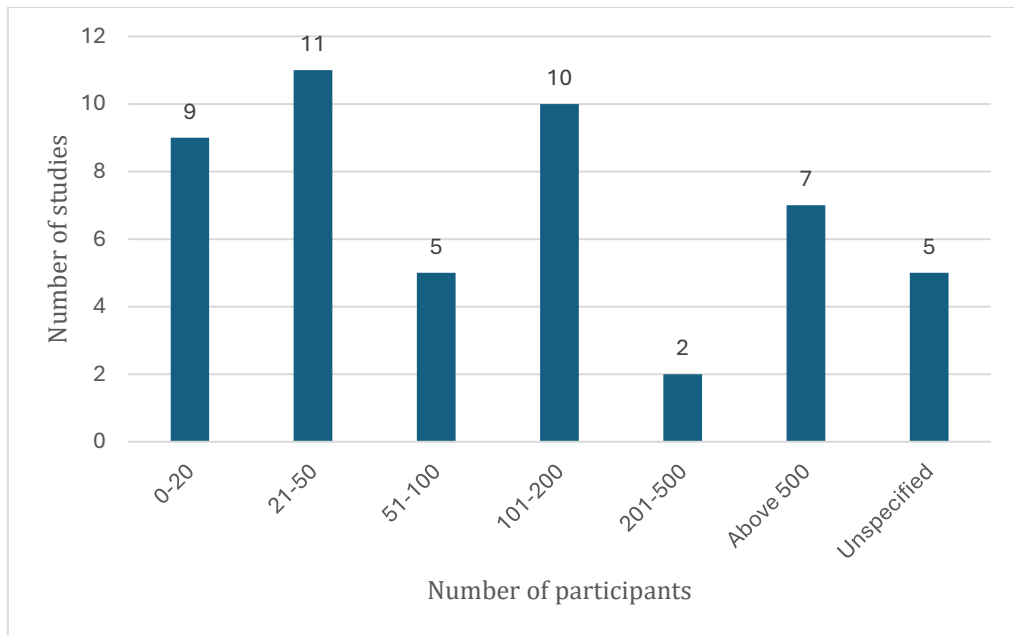
Figure 2.3.2.3: Sexual health apps by number of participants
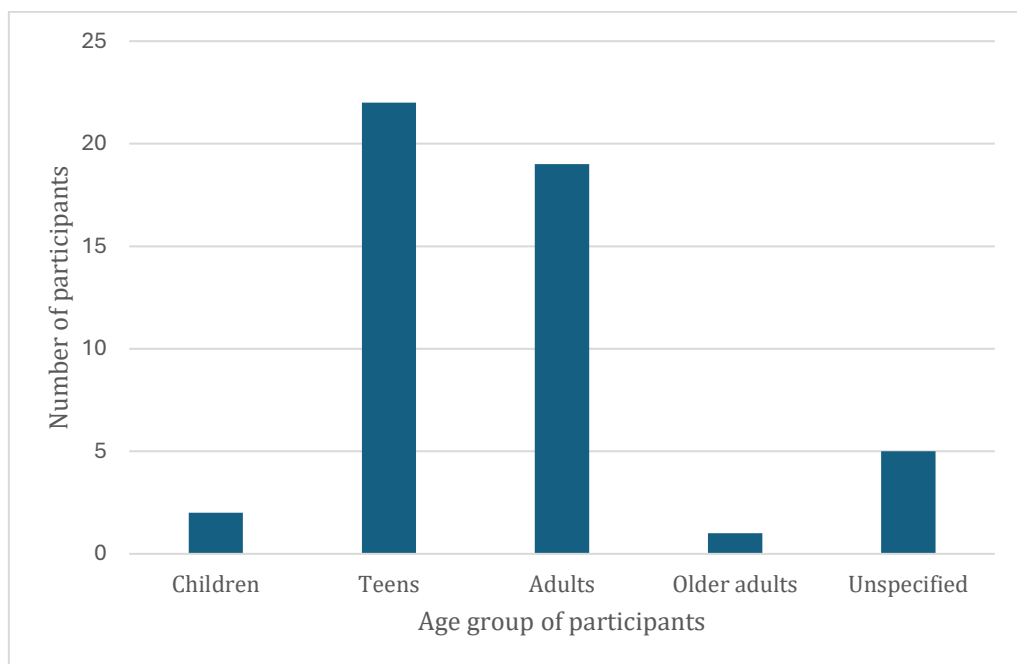
Figure 2.3.2.4: Sexual health apps by target age of audience

The sample size of the sexual health app evaluations varied significantly, ranging from 3 to 1152 participants, as shown in Figure 2.3.2.3. Only 5 of these papers reported the designs of their apps which were not evaluated. As evident in Figure 2.3.2.4, 45% of the studies were targeted at teenagers, 39% were targeted at adults, 4% targeted at young children and 2% at the elderly. 10% of the studies did

not specify their target populations. It is noticeable that teens and adults have the highest percentage of persuasive sexual health research focusing on them.
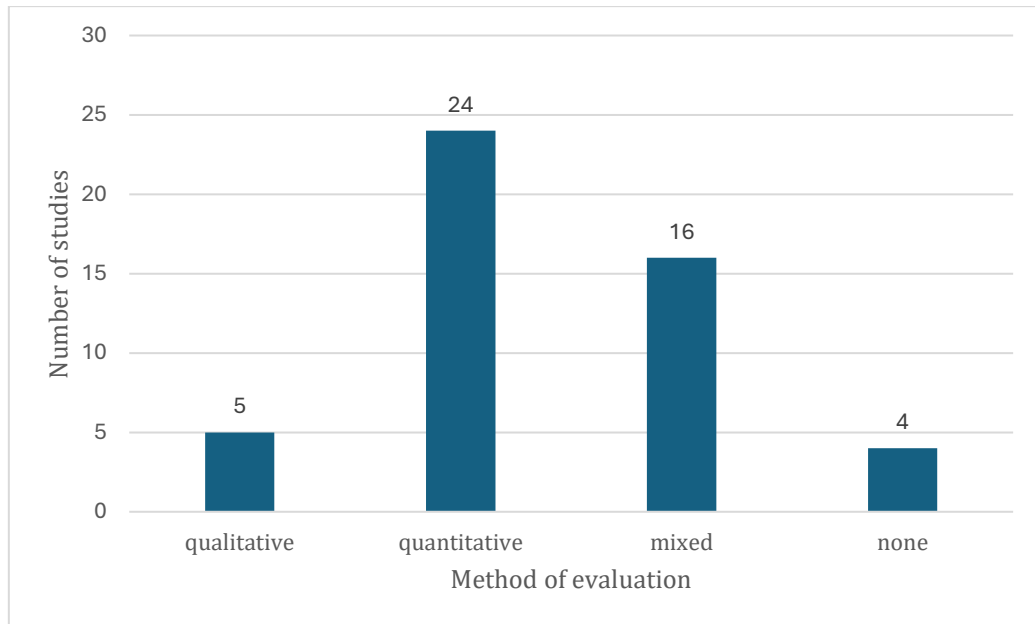
Figure 2.3.2.5: Sexual health apps by study method

Looking at the methods employed in the sexual health app evaluations (Figure 2.3.2.5), I found that 33% of the studies used a mixed approach, i.e. combination of quantitative and qualitative analysis, 49% used quantitative analysis only, 10% used qualitative only, while 8% did not do any kind of analysis. The researchers tend to prefer collecting quantitative data in the form of survey or app log data to determine the effectiveness of the system. It can also be easier to conduct a survey with a large number of participants, however, the richness of the data that can be collected through qualitative evaluation is limited here.

I categorized the results reported in the reviewed literature into four groups based on the evaluation outcome of the studies, as shown in Figure 2.3.2.6.

Positive: Out of 49 reviewed papers, 26 papers (53%) reported a positive change toward their targeted outcome. For instance, interventions like *Health-e-you* [70], and *STD Pong 2.0* [45] created a positive change in knowledge and behaviour towards sexual health.
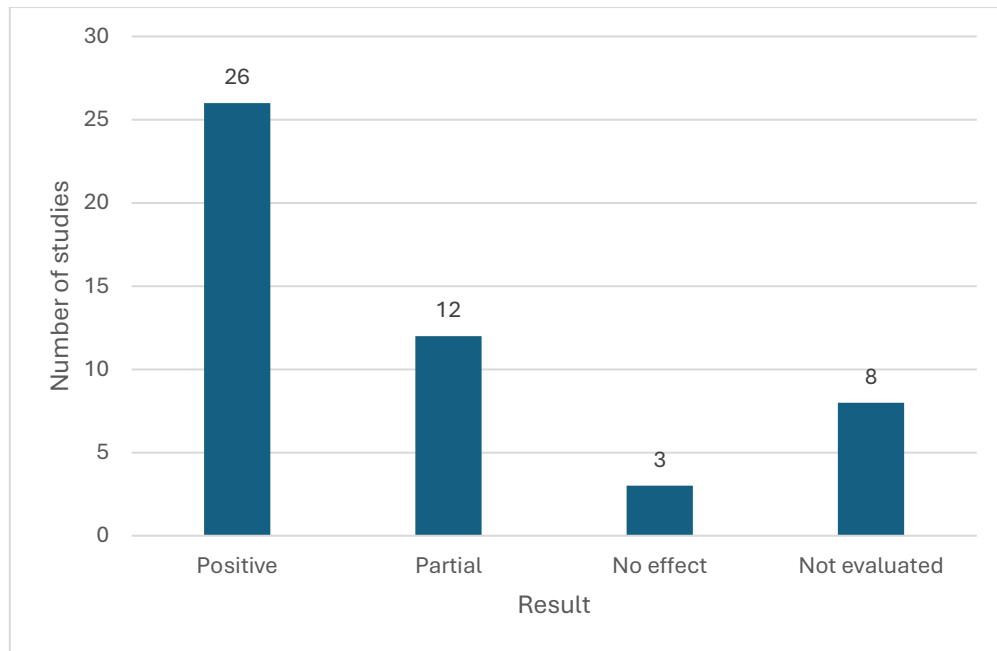
Figure 2.3.2.6 Sexual health apps by results

Partial: 12 studies (17%) reported results partially positive or a combination of positive and no effects. For example, in the study with *Pulse* app [38], an improvement in the knowledge and self-efficacy towards contraception use was noted, however, it caused no change in attitude and intentions among its participants. Apps like *miPlan* [3] and *Crush* [40] also showed partially positive results in their evaluation.

No effect: Only 3 (6%) studies reported no effects from the evaluation. These papers also noted the limitations or pitfalls of the studies [36,39,71].

Not evaluated: Out of 49, 8 papers either did not report a user study or the evaluation results were not mentioned.

2.4 Approaches Employed in Sexual Health Apps

In this section, I discuss the approaches that are most commonly used in sexual health-related apps.

2.4.1 Included Educative Content

Educating users through sexual health apps is the most commonly used yet vital strategy in promoting informed and healthy sexual behaviours. These apps

leverage the accessibility and convenience of mobile technology to deliver comprehensive and personalized information on topics such as contraception, STI prevention, healthy relationships, and reproductive health.

GirlTalk [10] is an application designed to provide adolescent girls with age-appropriate, comprehensive, and culturally relevant sexual health information. The app features visually appealing graphics and bold colour schemes, with content tailored to be understandable based on the user's age and grade level. One of the app's interactive features allows users to click on four different body parts of a character, each revealing specific information. The "head" section includes topics on mental health, body image, gender and sexuality, and relationships. The "breast" section covers breast health and self-examination. The "abdomen" section provides information on healthy lifestyles and reproductive health, including the menstrual cycle and contraception. Finally, the "more info" section addresses common misconceptions about sexual health and offers additional resources such as websites and support contacts.

I take care of myself (ITaCaS) [60] is an educational app and expert system designed to facilitate the teaching of sexual health and hygiene to young individuals with intellectual disabilities. The knowledge component of the app is divided into four categories: 'Know Yourself,' 'Love and Take Care of Yourself,' 'How Does Your Body Change?,' and 'Learn to Say No!' The expert system offers real-time feedback and personalized advice based on the user's inputs and actions. By integrating the app with expert guidance, *ITaCaS* aims to create a supportive and effective learning environment for young people with intellectual disabilities, enhancing their understanding and management of sexual health and hygiene.

2.4.2 Targeted STI Prevention

Steenstra et al. [64] developed an app with two approaches, a pedagogical agent, and a game to promote HPV vaccination in adolescents, both of which convey the same educational information about HPV and vaccination. The narrative game is called '*The Quest for HPV Vaccine*' and includes riddles and quizzes integrated into the storyline, such as challenging players to solve HPV-related riddles posed by magical creatures. The pedagogical agent is like a counselling session with a character, focusing on providing information about HPV and vaccination. Both

interventions significantly improved knowledge and attitudes toward HPV and general vaccine knowledge and acceptance.

The *Tumaini* game [73] serves as an educational tool for adolescents, focusing on HIV prevention through an engaging and interactive gameplay experience. Set within a vibrant virtual environment, participants navigate various scenarios that replicate real-life situations involving sexual health and decision-making. The gameplay incorporates role-playing elements, whereby participants assume the identities of different characters, allowing them to explore the consequences of their decisions in a secure and controlled setting. Through a series of missions, mini-games, and challenges, Tumaini imparts essential skills such as negotiating safe sex practices, comprehending the importance of HIV testing, and resisting peer pressure. By seamlessly integrating educational content with entertaining gameplay, Tumaini effectively captures the attention of its audience, thereby enhancing their knowledge and fostering positive behavioural changes in relation to HIV prevention.

AIDS Fighter-Health Defense is another preventative intervention that aims to increase knowledge about AIDS, reduce stigma and change the attitude toward risky behaviours that can cause AIDS [69]. The storyline is that HIV launches an attack on the human body and players need to control heroes to eliminate HIV. During the battle, players are repeatedly trained to take condoms and refuse dangerous sexual behaviours, avoid drugs to refuse intravenous drug use, avoid alcohol to refuse dangerous sex when drunk, and obtain antiviral drugs for PrEP. The human body system is used as the level in the game. There are seven levels in total. The difficulty of the game increases from low to high. The sequence of levels is as follows: (1) immune system, (2) blood system, (3) skin and mucosal system, (4) central nervous system, (5) respiratory system, (6) digestive system, and (7) genitourinary system.

2.4.3 Included Gamified Elements

As Deterding et al. [21] describe gamification, it is "the use of game design elements in non-game contexts". The objective of gamification is to incorporate game design elements into real-world contexts for purposes beyond gaming, to enhance human motivation and performance in relation to a specific activity [11,59]. Haruna et al. [30] examined the effects of incorporating gamification into

sexual education programs for adolescents in areas with limited technological resources. The study evaluated the effectiveness of game-based learning tools in enhancing student engagement and knowledge retention compared to traditional instructional methods. By incorporating interactive, game-like components such as challenges, rewards, and storytelling, the program seeks to make sexual education more accessible and appealing to young learners. The research demonstrates that even in low-technology environments, gamification can markedly improve students' comprehension of essential topics like safe sex practices, consent, and reproductive health. Findings from quasi-experiments comparing gamification, serious games, and traditional teaching methods indicate that gamified education not only boosts participation and motivation but also facilitates a more effective learning experience, ultimately leading to improved health outcomes for adolescents. An example of this is *Sex Talk*, a multiplayer game developed for iOS designed to be played in groups. The game utilizes a point-to-point network via Wi-Fi or Bluetooth, requiring players to turn their phones upside down until one vibrates, prompting that player to complete a designated activity. This process is repeated until all participants have completed the tasks. *The Source* [9] is an alternate reality game, which is a multiplayer game for sexual health, and sexuality education. The game tells the story of a 17-year-old girl who finds a letter from her father which presents a series of challenges, puzzles, board games, digital media tasks and treasure hunts, that can be solved by asking other game players. The findings of the game show a greater impact on the players' knowledge, attitudes, and behaviours. Collectively, the several papers mentioned in this section show that gamification in apps is often successful at delivering knowledge and is effective in improving awareness towards risky sexual behaviour.

2.4.4 Provided Access to Resources and Services

Limited access to sexual health resources, especially in low-income communities can also lead to high rates of sexual health problems. Nalwanga et al. [44] present a study where they evaluate the utilization and effectiveness of their app among university students in Uganda. The app provided access to sexual health services, information, and counselling sessions and the users could also order products like condoms or sanitary napkins through the app. Nuwamanya et al. [22] evaluated

the effectiveness of the same app, and their study shows that the easy access to sexual health information, services, and products, effectively increased STI testing, use of contraception and overall awareness about risky sexual health and behaviour. Sullivan et al. [66] conducted a study with 121 men who have sex with men (MSM) with an app for HIV prevention. The app provided preventative tips, reminders for HIV testing and screening for preexposure prophylaxis (PrEP) and nonoccupational postexposure prophylaxis (nPEP). It also allowed the users to order sexual health goods such as condoms or HIV self-test kits and provided information for treatment providers. This approach is not very common in sexual health interventions, but the apps mentioned in this section show good results.

2.5 Theoretical Bases of the Sexual Health Apps

In this section, I review the existing interventions by looking at the theories or models underpinning their implementations. I also discuss the most used and the most effective theories or models, used in sexual health apps, which are important in the development of *Sex-Educated*.

2.5.1 Persuasive System Design Model

Persuasion can be defined in simple terms as an attempt by a human being or organizational authority to motivate a target audience (human being) manually [25]. Fogg's Behaviour Model (FBM) posits that for a desired behaviour to occur, there must be sufficient motivation, ability, and an effective trigger [25]. These three fundamental components of persuasion should align concurrently to achieve significant impact. In general, the persuasive design aims to enhance motivation, simplify tasks to improve ability, and effectively trigger behaviour change. Building upon Fogg's work, Oinas-Kukkonen and Harjumaa [46] categorized persuasive techniques for developing system contents and functionalities into four main groups: (1) primary task support, (2) dialogue support, (3) system credibility support, and (4) social support.

The strategies in the primary task support category aid the user in carrying out their primary tasks. Primary task support techniques include a reduction (simplifying tasks), tunnelling (guiding users through a specific path), tailoring

(customizing content), personalization, self-monitoring, simulation, and rehearsal.

The dialogue support category strategies facilitate computer-human dialogue for the purpose of persuasion. Dialogue support techniques involve elements such as praise, rewards, reminders, suggestions, similarity, liking, and social role.

The system credibility support category includes strategies that make the system more credible and hence more persuasive. System credibility support techniques focus on establishing trustworthiness, expertise, surface credibility, a real-world feel, authority, third-party endorsements, and verifiability.

The social support category includes strategies that leverage social influence to persuade users. Social support techniques include social learning, social comparison, normative influence, social facilitation, cooperation, competition, and recognition. These techniques were identified and highlighted in the papers reviewed. The strategies in the PSD model are listed in Table 2.5.1.

Table 2.5.1: The persuasive strategies from the PSD model

Primary task support	Dialogue support	System credibility support	Social support
Reduction	Praise	Trustworthiness	Social learning
Tunnelling	Rewards	Expertise	Social comparison
Tailoring	Reminder	Surface credibility	Normative influence
Personalization	Suggestion	Real-world feel	Social facilitation
Self-monitoring	Similarity	Authority	Cooperation
Simulation	Liking	Third-party endorsement	Competition
Rehearsal	Social role	Verifiability	Recognition

2.5.1.1 Application of Persuasive strategies in Sexual Health apps

STD PONG 2.0 [45] is a mobile-based game promoting safe sexual behaviours among young adults in Africa. The game simulates various sexual risky behaviours that could lead to contracting STDs and HIV and how to avoid them. It employed rewards by allowing the players to collect powerups (e.g., condoms) to fight the STD and HIV monsters. Moreover, they also employed suggestions by providing information about the use of each powerup, self-monitoring by highlighting the health bar of the player, and competition by using leaderboard to allow players to compare their progress with others.

Survive the Party [17] is a persuasive game to educate players on healthy relationships and sexual consent. It aims to raise awareness and promote understanding of these sensitive or critical topics through interactive gameplay and decision-making scenarios. It incorporates Simulation for the narration throughout the gameplay. It also included rehearsal and real-life feel as it showcased scenarios in a party, involving situations that can occur in real life. The user must make a choice in certain scenarios to earn points. Persuasive strategies like self-monitoring, rewards, praise and tunnelling are used in the game.

PlayForward: Elm City Stories [22] is a game aimed at imparting American youths with skills and knowledge on how to avoid risky sexual behaviours that could lead to STDs and HIV. The game allows the players to choose their avatar for personalization. The player must travel through time while engaging in various risky behaviour-related activities such as pressure by friends to drink alcohol and dangerous sexual activities. With the use of the simulation strategy, the game shows the long-term impacts of various activities in the players' lives. Players also can go back in time and correct all their 'mistakes' to ensure a better future.

MyPeeps [16] is a mobile app designed to provide sexual health education and support for young men who have sex with men (YMSM). The app has sections that cover topics such as safe sex practices, HIV prevention, and relationship advice through interactive gameplay and quizzes. It implements simulation strategy to show the daily life activities and the choices the user can make and based on those choices the forthcoming future in the game. It also allows users to choose avatars and make a personalized profile. Implementation of strategies like tunnelling, self-monitoring, reminders, and social role are also seen in the design of the app.

Figure 2.5.1.1 shows the different persuasive strategies implemented across the apps from the papers reviewed and their frequencies.
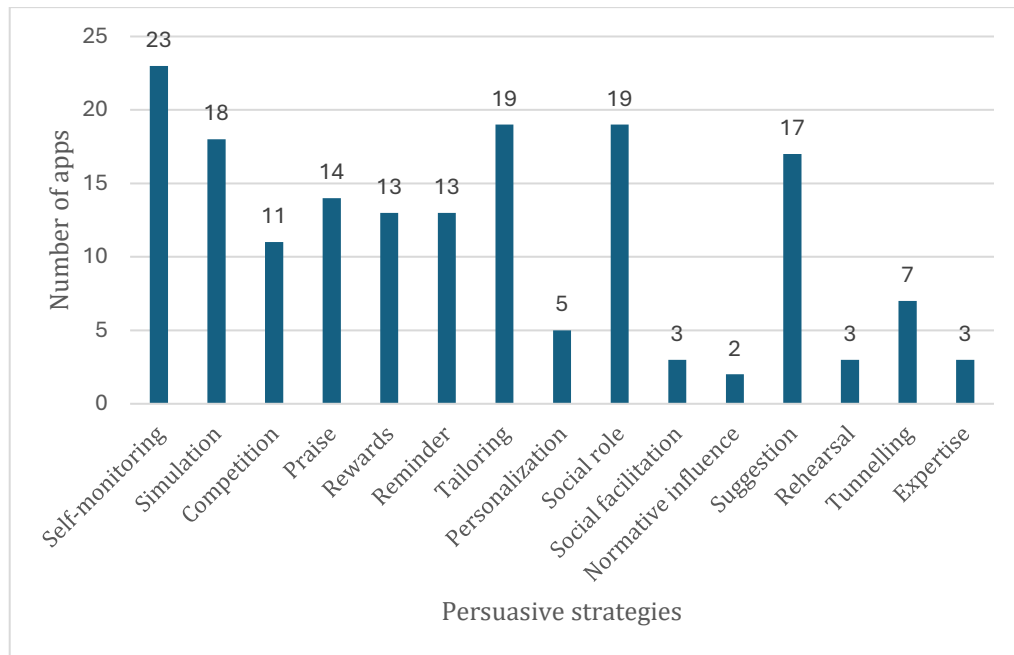
Figure 2.5.1.1: Frequency of persuasive strategies implemented in sexual health apps

2.5.2 Behaviour Change Theory

Numerous behaviour-change theories have been utilized by researchers in the field of sexual health interventions to assess motivation and quantify shifts in individual behaviour. The Theory of Planned Behaviour (TPB) [2] stands out as a prominent and effective framework employed by previous scholars [45,48] to gauge both motivation and behavioural change among individuals. According to the TPB, intention serves as the most immediate predictor of behaviour, with attitudes and self-efficacy being key cognitive factors influencing this intention. Attitude plays a crucial role in guiding thoughts and behaviours, while self-efficacy pertains to an individual's perceived competence in future actions. Orji et al. [48] assessed changes in attitude, intention, and self-efficacy through their evaluation of a persuasive game aimed at encouraging healthier eating habits among participants. Similarly, Ndulue and Orji [45] devised and assessed a persuasive game to track alterations in attitude, intention, self-efficacy, and knowledge among young Africans regarding risky sexual behaviour. Other than TPB, theories like and Trans-Theoretical Model of behaviour change (TTM) and the information-

motivation-behavioural skills (IMB) model, have also been used in the design of sexual health interventions [3,68].

2.5.3 ARCS Motivation Model

The ARCS (Attention, Relevance, Confidence, and Satisfaction) model is a well-known and widely used motivational model [32]. The model highlights four qualities that a system needs to have to motivate behaviour. The ARCS model of motivation implies that there are four main qualities of systems that build and sustain motivation in people: *Attention, Relevance, Confidence,* and *Satisfaction* [32]. It is also a simple and powerful macro theory that combines a wide range of prominent motivational theories, such as the Self-Efficacy theory [26], Expectancy-Value theory [62], Reinforcement theory, Social Learning Theory [85], and Cognitive Evaluation Theory [86]. Besides, the ARCS motivation model is associated with behaviour and behaviour change as it is a systematic approach to identifying and addressing learning motivation [28].

The ARCS motivation model is widely used to inform the design and evaluation of the motivational appeal for the persuasive and behaviour change systems in various domains, such as health [6,65] and education[61]. Abdessettar et al. [1] applied the ARCS model in developing a persuasive, innovative mobile school for children. Another group of researchers, Zulkifli et al. [78], employed the ARCS questionnaire to evaluate the motivational appeal of an interactive persuasive system. Other persuasive system designers utilized one or more ARCS motivation model constructs to inform their intervention design. For example, Stockdale et al. [65] employed the Confidence construct of the ARCS motivation model in designing a persuasive intervention aimed at promoting breastfeeding among first-time mothers by helping them to develop confidence in their ability to breastfeed, while Yusoff et al. [77] employed the Attention construct to increase the motivational appeal of the persuasive elements embedded in their persuasive game. Also, the ARCS motivation model has been used as a scaffolding tool for persuasive and behaviour change systems [19,20]. Table 2.5.3 summarizes the four constructs of the ARCS motivation model adapted from Orji et al. [51].

Table 2.5.3 ARCS Motivational Model [51]

Construct	Definition
Attention	For a system to motivate users, it must arouse and sustain their attention.
Relevance	To motivate users, a system must reflect users' interests and goals. A system must be goal-oriented, motive-matching, and use familiar concepts to be relevant. A system perceived as helpful and valuable in helping users accomplish their goals is more likely to motivate users.
Confidence	Users' confidence levels are often correlated with their motivation and the amount of effort put forth toward achieving an objective. People do not like taking on a task with little or no probability of success. Although success is never guaranteed, and people like to be challenged, a challenge beyond a user's capability could demotivate them.
Satisfaction	To motivate users and sustain their motivation, they must derive some satisfaction and reward for their effort.

2.5.4 User-Centred Design (UCD)

User-centred design (UCD) is an iterative process where the users' needs are considered in each phase of the system design [87]. UCD improves the user experience and helps to identify users' needs and preferences regarding features of a system, tasks, goals, flow of the process. The four main stages of an iteration are shown in Figure 2.5.4. The few sexual health interventions that used the UCD approach during development, showed positive or partially positive outcomes during the evaluation [67,76]. *MyLarc* [71] emphasizes the significance of incorporating the target audience in the design of technology-based health interventions. This approach aligns with best practices for creating interactive digital interventions, which advocate for user involvement throughout the design process. The two most popular game elements "SpermBusters" and "Whack-A-Cramp" were included in the app in response to phase 1 participants' feedback. This increased interest and engagement level can improve user interaction with more educational and supportive content.

The *Sexually Active Adolescent–Focused Education (SAAFE)* [55] app was also created in three phases using the UCD approach. The first prototype was created based on the advisory board's feedback. The prototype's usability was then evaluated before proceeding to the development of the app. The app was also developed using Agile [88], and focus groups' feedbacks were taken in between the development cycles. The high usability score of the app was a result of collaborating with the target users. This enabled the exchange of knowledge between the designers and the users and helped in making the design of the intervention engaging and enjoyable.
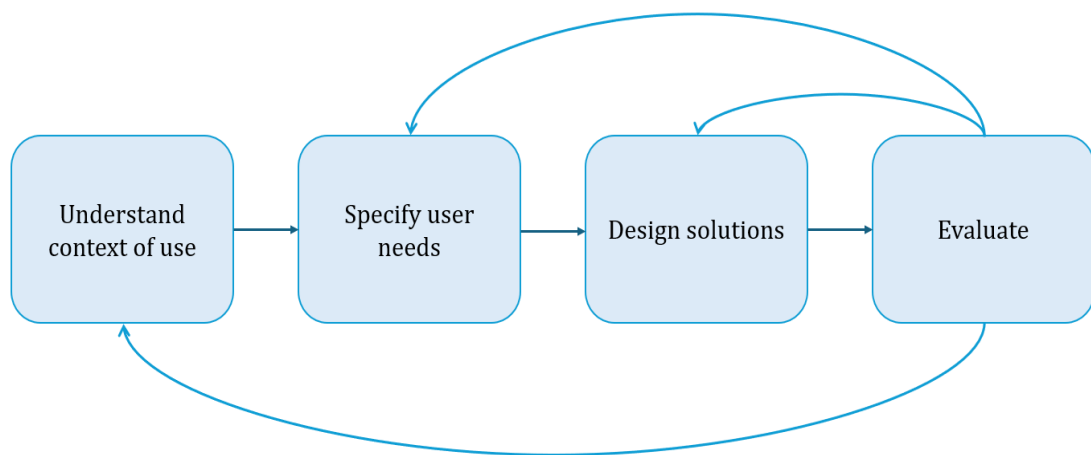
Figure 2.5.4 Stages of UCD [87]

2.6 Summary

To summarize the related works, it is evident that sexual health apps play a significant role in enhancing knowledge and fostering positive behavioural changes towards healthier sexual lifestyles. Through a systematic process of search and data extraction, I conducted a comprehensive review of 49 papers on sexual health apps. These studies incorporated a range of theoretical frameworks, including PSD, Behaviour Change Theory, game-based approaches, and the ARCS motivational model. The literature review also supports the lack of sexual health interventions in South-Asian countries like India. A critical review of the evaluation methods employed in these studies revealed a predominant reliance on quantitative methods, which provide valuable numerical data and statistical analysis. However, this emphasis on quantitative metrics often leaves a gap in

qualitative insights, which are essential for understanding the contextual factors influencing app effectiveness. The integration of qualitative methods along with quantitative results could offer deeper insights into user engagement, satisfaction, and the subjective impact of these interventions. I also identified the common design approaches used in sexual health apps, highlighting the importance of delivering information in an interactive and engaging manner. Interactive elements, such as quizzes, gamification, and user-driven exploration, have been shown to enhance user engagement and retention of information. This interactive delivery is crucial for effectively communicating complex and sensitive topics related to sexual health. Furthermore, the existing sexual health apps are often narrowly focused on specific areas, such as STIs, contraception, or particular aspects of reproductive health. There are only a few interventions that cater to broader themes like sexual hygiene, sexuality, and the relational aspects of sexual health. This presents a significant opportunity to develop a comprehensive app that addresses the full spectrum of sexual health education.

Chapter 3

Design and Implementation

In this chapter, I describe the design and development process of th*e Sex-Educated* app in detail, as well as the principles that went into consideration for the design of the app.

3.1 Stages of Development of *Sex-Educated*

The *Sex-Educated* app is a mobile app that is designed to educate people about sexual health and promote awareness about risky sexual behaviour. To develop an effective sex education app, I used an iterative user-centred design approach and applied persuasive system design strategies. The app design process was divided into three main phases as shown in Figure 3.1.

Phase 1: First, through background research and exploring related works as discussed in Chapter 2, I identified some successful design elements, approaches and topics that were important and relevant for a sex-education app. I followed a persuasive design approach to initially develop a low-fidelity prototype for the app. To refine the initial design, I took informal feedback from two researchers who could also be potential users.

Phase 2: I designed a medium-fidelity prototype to validate the design with the target audience. I conducted a user study with 57 participants. I invited the participants to complete an online survey that included the medium-fidelity prototype and questions related to the prototype. Then, I interviewed 22 of the participants and asked them why they would or would not use an app like this, what areas of sexual health they think are less known about and if they would be interested to learn more about, and any suggestions or changes they recommend for improving the app.

Phase 3: Taking into consideration the results from the Phase 2 study, I developed the *Sex-Educated* app. To evaluate the app, a user study was conducted where 46 participants were recruited. They first filled out a pre-test questionnaire and then a post-test questionnaire after one week of using *Sex-Educated*. After that, an

optional one-on-one interview was conducted for which 21 participants volunteered.
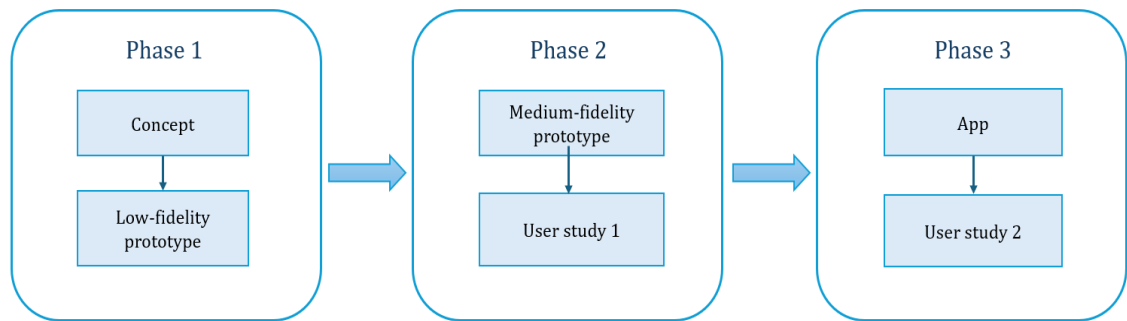
Figure 3.1: Iterative stages of development of *Sex-Educated* app

3.2 Phase 1

Phase 1 of the study is based on the findings of the literature review. Through a systematic review of the related works, I identified the approaches, theories, evaluation methods and persuasive strategies used in sexual health apps. I also reviewed the effectiveness of the apps and their limitations and identified the gaps in the existing interventions. In this section I discuss the design process of *Sex-Educated*, integrating the effective theories and approaches identified from the literature review.

3.2.1 Early Design Process

Fogg [24] recommended a process to develop an effective persuasive design. This methodical approach begins by clearly defining the objective of the intervention, which is crucial for tailoring the intervention to the specific needs and characteristics of the intended audience. By carefully matching the target audience with the appropriate technological medium, the process aims to maximize the effectiveness of the persuasive design. This ensures that the chosen technology resonates with the target audience, enhancing engagement and facilitating the desired behaviour change [24]. I adapted the 8-step design process in the early stages of the design of *Sex-Educated*. Table 3.2.1 outlines the eight-step design process and its implementation.

Table 3.2.1: Early design steps and implementation

Early persuasive design steps	Implementation
Step 1: Choose a simple behaviour to target	From the discussions in chapter 1, it is evident that risky sexual behaviours are prevalent among Indian youth. Therefore, the target behaviour chosen is awareness about healthy sexual behaviour.
Step 2: Choose a receptive audience	As discussed in chapter 1, there is a significant lack of knowledge of sexual health among Indians, and a large proportion of them struggle with sexual health problems. Thus, the target audience of the app is Indian young adults.
Step 3: Find what prevents the target behaviour	It is found from background research that lack of formal or informal sex education, cultural and social stigma, and limited access to reliable resources are some of the common reasons that lead to risky sexual behaviour.
Step 4: Choose a familiar technology channel	Considering the popularity of smartphones in India, an app for smartphones has been chosen as the technology channel.
Step 5: Find relevant examples of persuasive technology	Before starting with the app design, 49 research papers on sexual health-related mobile apps were reviewed.
Step 6: Imitate successful examples	From the literature review, some persuasive apps were found like Go Nisha Go [58], STD Pong 2.0 [45], which showed promising results in motivating the users towards the target behaviour. I imitated the key elements from the successful persuasive apps and included them in my design.
Step 7: Test and iterate	To test the persuasive design, I made a paper prototype. It was made through an iterative process with informal feedback from two researchers who were also potential users.
Step 8: Expand on success	The medium fidelity prototype was created and evaluated after which the final *Sex-Educated* app was developed.

3.3 Phase 2

In this section, I present the design of the prototype along with the findings from evaluating the design in phase 2.

Main Menu

Knowledge Corner

Quiz Menu

Level completion

My score

Leaderboard
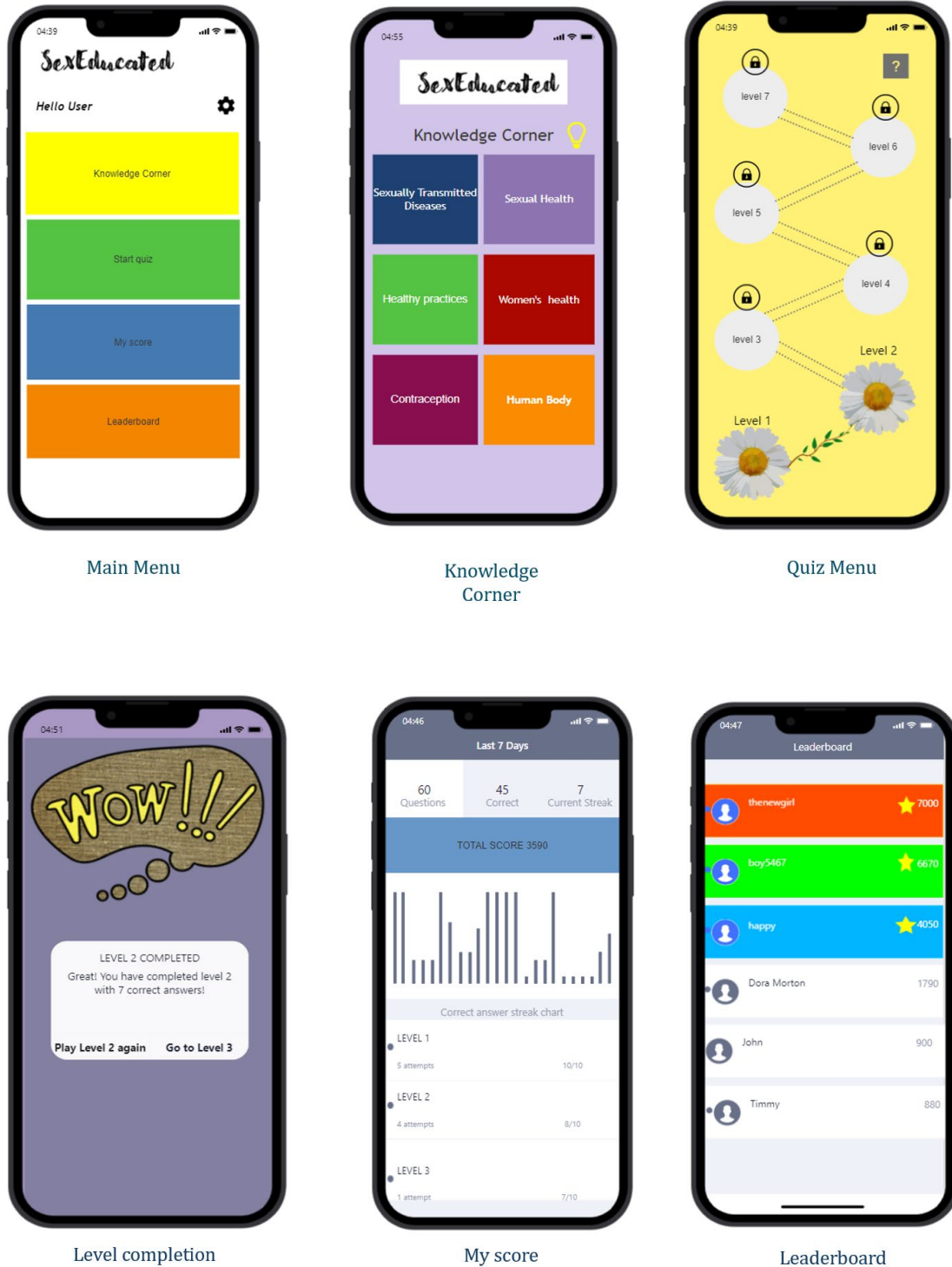
Figure 3.3.1 Screenshots of the medium-fidelity prototype of *Sex-Educated*

3.3.1 Prototype

I designed a medium-fidelity prototype using Proto.io [84]. The medium fidelity prototype was developed after two iterations of refinement of the paper prototype, based on the informal feedback on the paper prototype obtained from the researchers/potential users. The medium-fidelity prototype was created to test the validity of the design elements, and the persuasive features of the app with the target audience. Figure 3.3.1 shows the medium-fidelity prototype of *Sex-Educated.* I conducted a user study before continuing with the app development. The findings from the study are published in Bhattacharya et al. [8] and also presented in Chapter 4. Overall, the design of the prototype was well-received. However, I received suggestions for improvement, discussed in section 3.3.2, which were considered in designing the final app in the next phase.

3.3.2 Key Findings from Phase 2

Evaluating the medium-fidelity prototype helped in validating the overall design of the *Sex-Educated* app. However, there are some key findings from the evaluation, which were incorporated in developing the final app.

- **Complexity of the Visual Elements:** The evaluation phase revealed that the charts and visual elements used in the score section of the app were overly complex for some participants. Users found the visual representations challenging to interpret, which hindered their ability to easily understand their performance metrics. Based on this feedback, it is evident that future iterations of the app should prioritize simplicity and clarity in score visualization. Streamlined and user-friendly graphical elements will enhance comprehension and make it easier for users to track their progress.

- **Relevance of Knowledge Corner Topics:** Participants from the study suggested that the *Knowledge Corner* would benefit from including additional topics beyond those featured in the prototype. Specifically, users expressed interest in topics such as men's sexual health, puberty, and relationship dynamics. This feedback highlights the need to expand the content coverage to address a wider array of subjects that are pertinent to

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users' educational needs. Incorporating these suggested topics will ensure that the app remains relevant and valuable to a broader audience.

- **Ambiguity of the 'Current Streak' Feature:** The 'current streak' feature in the *my score* section was identified as confusing by participants. There was uncertainty about whether it referred to a daily quiz play streak or the highest number of consecutive correct answers. This ambiguity affected user understanding and engagement with the feature. To resolve this issue, future design updates should aim to provide a clearer and more precise explanation of the 'current streak' indicator. Improved labeling or additional contextual information could help users better grasp the significance of this feature.

- **Lack of Interactivity:** The medium-fidelity prototype was noted for its lack of interactive elements, which contributed to a decrease in user interest and engagement. Participants indicated that static content failed to capture their attention effectively. This finding underscores the importance of incorporating interactive features into the app's design. Adding dynamic and engaging elements will likely enhance user experience, stimulate greater involvement, and maintain user interest over time.

- **No need for age/gender/education-based tailoring:** Evaluation of the design also indicated that user motivation did not vary substantially across different age groups, genders, or educational backgrounds. There was also no difference in the perceived persuasiveness among the users with different ages, genders or levels of education. Hence, tailoring the design for any of these demographic groups is not required.

Incorporating these insights from Phase 2 evaluations into the final design of the app has been crucial in refining its functionality and user experience. Addressing the identified issues will contribute to creating a more intuitive, engaging, and educational tool for users.

3.4 Phase 3

Considering the findings of the phase 2 evaluation discussed in 3.3.2, I developed the *Sex-educated* app. I addressed the complexities found in the prototype and modified the design accordingly in the final app design. In this section, I will

present the app's features, highlighting the persuasive strategies implemented in the design, along with a discussion of the app's development process, and the overall flow of the app.

3.4.1 Sex-Educated App Features

In this section, I provide an in-depth overview of the *Sex-Educated* app's main features.

Knowledge Corner: It is a feature within the *Sex-Educated* app designed to enhance users' knowledge of sexual health. It provides users with easily digestible information through trivia and short-form facts, making learning quick and accessible. The content is organized into various sections, each dedicated to specific topics to ensure a well-rounded understanding of sexual health (Figure 3.4.1b, 3.4.1c). These sections include:

- *Sexually Transmitted Infections (STIs)*: Information on the different types of STIs, their symptoms, prevention methods, and treatment options are provided in this section.

- *Contraception*: Information about various contraceptive methods available in India, and their effectiveness, is provided in this section.

- *Men's sexual health*: This section provides focused information on issues pertinent to men's sexual health, such as prostate health, erectile dysfunction, etc., and preventive measures for these health conditions.

- *Women's sexual health*: This section covers a wide range of topics related to women's sexual health, including menstrual health, reproductive health and other information on women's bodies.

- *Safe-sex practices*: This section provides guidelines and tips on how to engage in sexual activities safely to prevent STIs and unwanted pregnancies.

- *Sexual hygiene*: Essential information on maintaining proper hygiene before, during, and after sexual activity to prevent infections and promote overall sexual well-being is included in this section.

- *Miscellaneous facts on sexual health*: This section includes a diverse array of additional facts and trivia that cover various other aspects of sexual health,

including sexual consent, sexuality, and sexual rights, ensuring a comprehensive educational experience.

By categorizing information into these specific sections, *Knowledge Corner* allows users to easily navigate and find the information they need, fostering a more informed and aware approach to sexual health.

Quiz: The *Quiz* is a feature in the *Sex-Educated* app designed to engage users by testing and helping them expand their knowledge on various aspects of sexual health in an interactive way. Designed with multiple levels, each level represents a flower in a blossoming garden, providing a visually appealing and motivating experience (Figure 3.4.1d). Users can only access a new level after successfully completing the previous one, ensuring a structured learning path that reinforces knowledge as users advance. Each level consists of 10 questions covering a wide range of topics related to sexual health, including STIs, contraception, sexual hygiene, and more. These questions were carefully adopted from information from renowned websites like the WHO [89], NHFS [90] and databases like PubMed [91]. To complete a level and move on to the next, users must answer at least eight out of ten questions correctly, ensuring a solid grasp of the material before progressing. Upon completing the questions, users receive their scores. Achieving a perfect score of ten rewards them with a badge and a congratulatory message, adding an element of gamification to the learning process and encouraging users to strive for excellence. If a user scores seven or below, they must retry the level, promoting better retention of information by ensuring proficiency before advancing. The levels are designed to resemble a garden of flowers, creating a metaphorical journey of growth and blooming knowledge, enhancing the user experience and making the learning process more enjoyable and memorable. Through this *Quiz* feature, the *Sex-Educated* app effectively combines education with interactive gameplay, making the acquisition of sexual health knowledge both fun and effective.

My score: *My score* feature offers users a detailed overview of their performance and progress. This feature calculates and displays the user's total score, providing a clear summary of their cumulative achievements. It also shows the most recent score, allowing users to track their latest performance and identify areas needing improvement. In addition, the *My Score* records the number of questions the user has attempted, giving insight into their engagement with the app. Users can view

scores for each completed level, enabling them to monitor progress across various topics and difficulty levels, as shown in Figure 3.4.1h. Badge rewards earned for achieving perfect scores are also displayed on this screen. These badges serve as visual indicators of the user's accomplishments, offering motivation and a sense of pride. By providing a comprehensive performance dashboard, the *My score* feature encourages users to continue their educational journey, track their progress accurately, and celebrate their successes. This precision in performance tracking ensures that the *Sex-Educated* app effectively supports and motivates users in their pursuit of sexual health knowledge.

Leaderboard: The *Leaderboard* provides a competitive and motivational aspect by displaying user rankings based on their scores. This feature shows each user's rank, allowing them to see how they compare to others using the app. In addition to individual rankings, the Leaderboard highlights the top three ranked players along with their scores, showcasing the highest achievers as shown in Figure 3.4.1i, and setting benchmarks for other users. By offering a clear view of where they stand, the *Leaderboard* encourages users to improve their knowledge and performance to climb the ranks. This competitive element not only fosters a sense of achievement but also promotes continuous learning and engagement with the app. The *Leaderboard,* thus serves as an effective tool to motivate users to enhance their sexual health knowledge while participating in a community of learners striving for excellence.
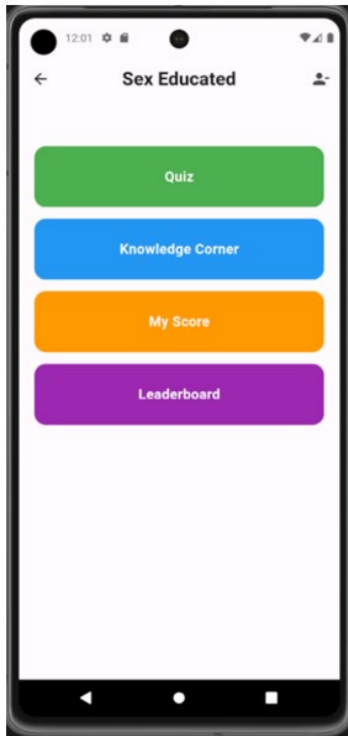
(a) Main menu
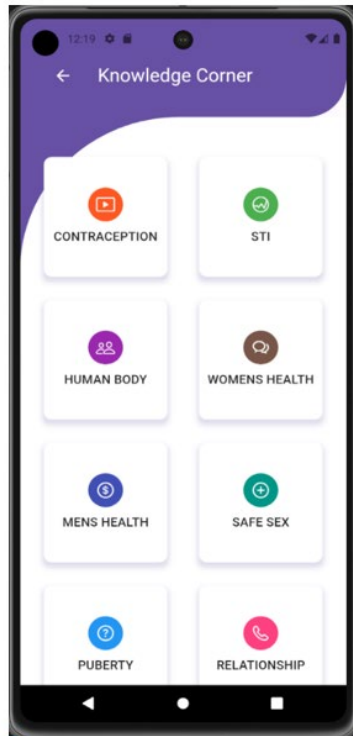
(b) Knowledge corner
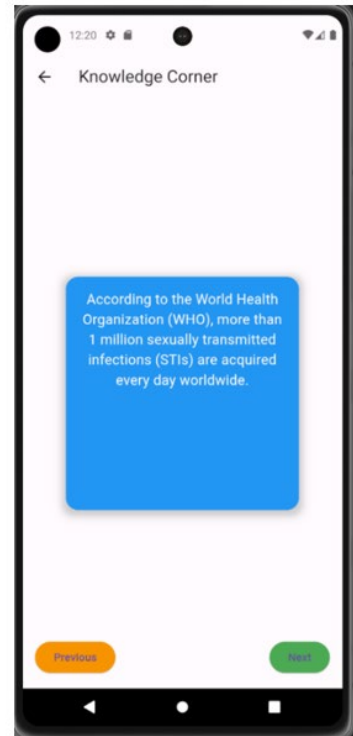
(c) Trivia
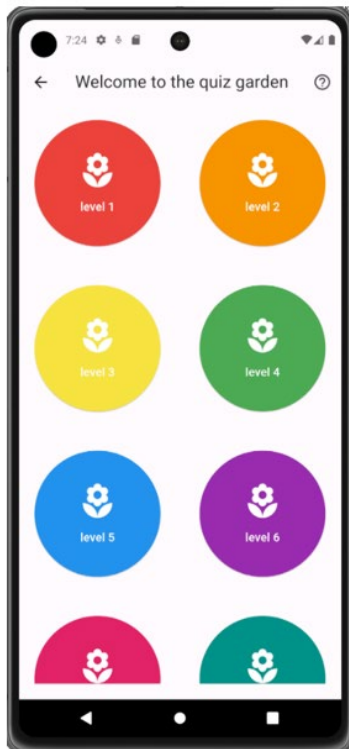
(d) Quiz menu
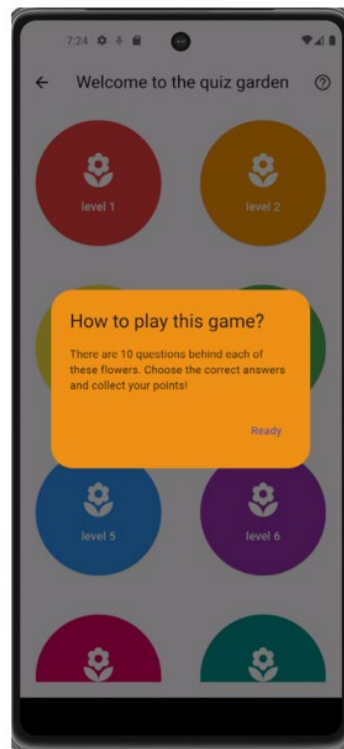
(e) Instructions to play the quiz game

(f) Quiz question screen

(g) Quiz result   (h) My score   (i) Leaderboard
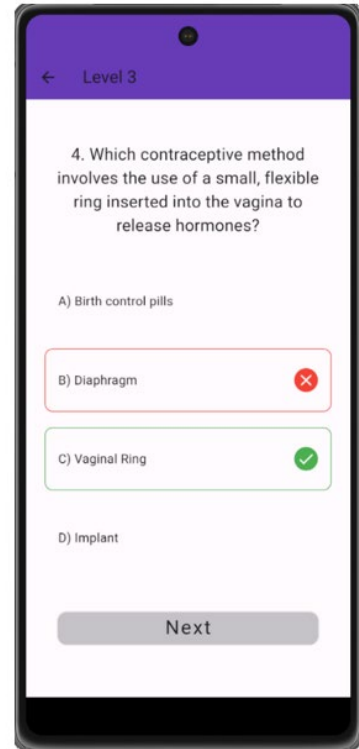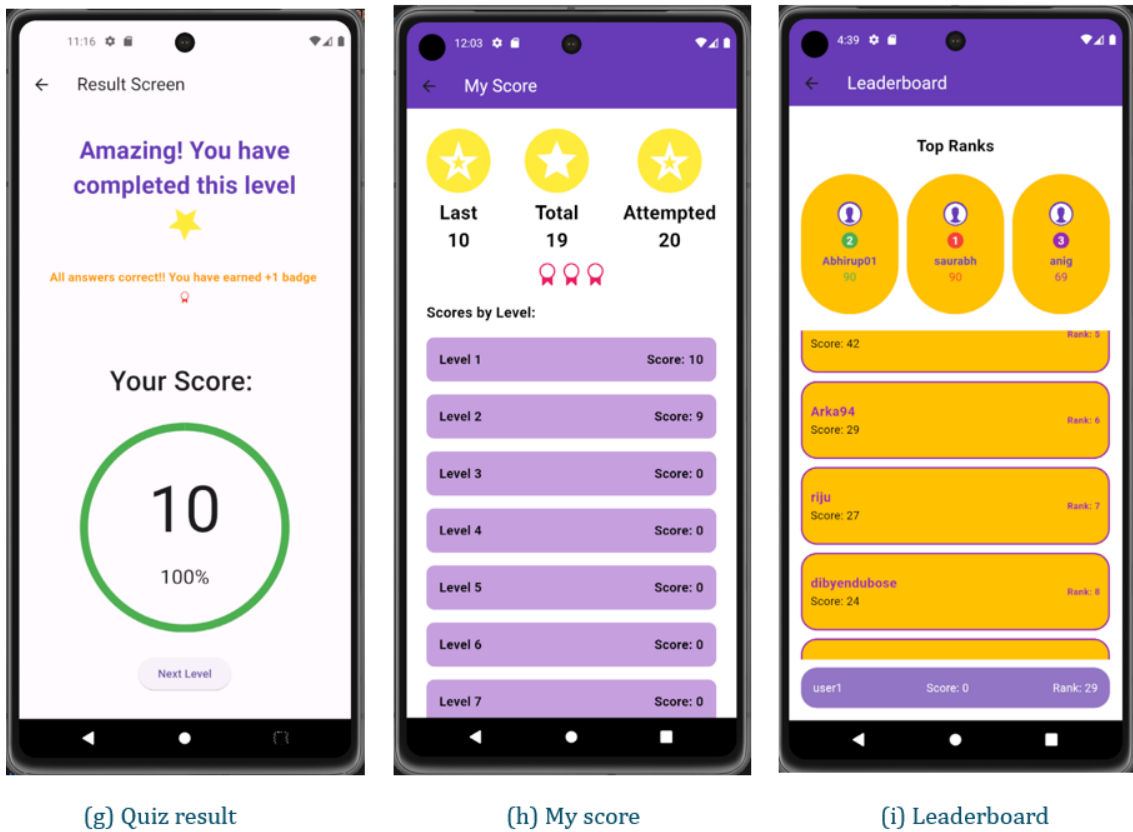
Figure 3. 4.1 Screenshots of the *Sex-Educated* app

3.4.2 Deconstructing Persuasive Strategies in *Sex-Educated*

To ensure the persuasive efficacy of the app, I incorporated some strategies from the PSD model, developed by Oinas-Kukkonen et al. [46]. The PSD model identifies various strategies that can enhance the persuasiveness of a system. A total of 10 persuasive strategies implemented in *Sex-Educated* are discussed below.

Tunnelling: Tunnelling is operationalized using a 'help' button on the *quiz* levels screen. When users encounter this button, it triggers a pop-up dialogue that provides detailed instructions on how to navigate the quiz game. This dialogue includes step-by-step guidelines on how to play the quiz, effectively guiding users through the process. By offering this guidance, the system ensures that users are not only supported in their immediate tasks but are also subtly persuaded to engage more deeply with the content.

Tailoring: The target population for the game is Indians, therefore, most of the information provided in the app is tailored towards Indian audiences. The facts presented in the *knowledge corner* and *quiz*, are related to the most common sexual

health problems in India. Before the final app was developed, in phase 2 of the study the users were asked about what kind of information they would like to see in the app. The content was curated taking the suggestions into consideration.

Self-monitoring: Within *my score*, users are provided with a comprehensive overview of their performance in the *quiz*. This feature meticulously tracks and displays several key metrics: the user's total score, the most recent score, and the total number of questions they have attempted. Additionally, it offers a detailed list of scores achieved at each individual quiz level. By presenting this data in an organized and visually accessible manner, the app empowers users to monitor their progress over time.

Praise: The player is praised for every achievement in the *quiz*. If a level is successfully completed with eight or more correct answers to the quiz questions, a congratulatory message is shown on the screen, such as "Congratulations! You did it", "Perfect score!", or "Champion, you deserve a badge". In case a user cannot answer at least eight questions correctly in a level, the level is not complete, and the results screen displays encouraging messages like, "You were almost there!", and "Let's try again".

Rewards: Users earn scores after completing each quiz level, providing immediate positive feedback for their efforts. Additionally, when users achieve the maximum score in a level, they are awarded badges. These badges serve as a form of recognition and achievement, further incentivizing users to engage with the app and strive for high performance.

Liking: The user interface of the application was designed to be visually appealing for most users to increase their liking for it. I also made sure that the application features were intuitive and easy to navigate. All these were to make sure that the user had a positive experience while using the app.

Trustworthiness: In the context of sex education, ensuring trustworthiness is paramount to its effectiveness in educating users about sexual health. To achieve this, all information presented in the *Sex-Educated* is meticulously sourced from reputable and authoritative organizations, such as the World Health Organization (WHO), the National Family Health Survey (NHFS), and the National AIDS Control Organisation (NACO), as well as other respected websites. These sources are known for their reliability and accuracy, providing a solid foundation for the app's

content. All the information selected for the app was double-checked by verifying it with a medical professional who also helped in vetting the content of the app.

Surface Credibility: Use of anything that does not logically contribute to the positive change in sexual health knowledge and behaviour has been avoided in the app. The content in the app is only related to sexual health. No advertisements or unrelated content has been included in the design.

Social Comparison and Competition: In the *Sex-Educated* app, social comparison and competition are cultivated through the implementation of a *leaderboard* feature. This *leaderboard* displays the top three users and their scores, along with the respective user's rank among all users. By appealing to users' inherent desire to outperform others, the *leaderboard* not only increases engagement with the app but also encourages continuous learning and improvement in sexual health knowledge.

Social Facilitation: The *leaderboard* in the game shows each user that other users are also playing the game and engaging with content. This would likely motivate the users to increase their knowledge and perform better in the *quiz* game.

The summary of all the 10 persuasive strategies, their definitions and their implementation in the app is shown the Table 3.4.2.

Table 3.4.2: Summary of the Persuasive Strategies implemented in the *Sex-Educated* app

Strategy	Definition	Implementation
Tunnelling	System should guide users in the attitude change process by providing means for action that brings them closer to the target behaviour.	Quiz
Tailoring	System should provide tailored information for its user groups.	Knowledge Corner, Quiz
Self-monitoring	System should provide means for users to track their performance or status.	My Score

Strategy	Definition	Implementation
Praise	System should use praise via words, images, symbols, or sounds as a way to provide user feedback information based on his/her behaviours.	Quiz
Rewards	System should provide virtual rewards for users in order to give credit for performing the target behaviour.	Quiz, My score
Liking	System should have a look and feel that appeals to its users.	Overall app
Trustworthiness	System should provide information that is truthful, fair and unbiased.	Knowledge Corner, Quiz
Surface Credibility	System should have a competent look and feel.	Overall app
Social Comparison, Competition	System should provide means for comparing performance with the performance of other users. System should provide means for competing with other users.	Leaderboard
Social Facilitation	System should provide means for discerning other users who are performing the behaviour.	Leaderboard

3.4.3 Overview and Implementation of *Sex-Educated* App

In this section, I discuss the technical flow of the app design and some of the critical technical decisions made during the development of the *Sex-Educated* app.

The development platform selected for *Sex-Educated* was Flutter [92]. Flutter is an open-source, multi-platform mobile SDK that enables the creation of applications for both iOS and Android from a single codebase. Flutter utilizes 'Dart' as its programming language, which offers a robust and flexible framework for app development. The integrated development environment (IDE) used was Visual Studio (VS) Code [93], with the Flutter plugin, which provided a seamless coding

and debugging experience. For data storage and management, I used Cloud Firestore [94], which is a flexible and scalable database for mobile, web, and server development. Cloud Firestore ensures secure handling and storage of the data collected by the app. This setup allows for real-time synchronization and seamless data management, which are crucial for the app's functionality and user experience. Figure 3.4.3.1 shows the high-level design process of the app.
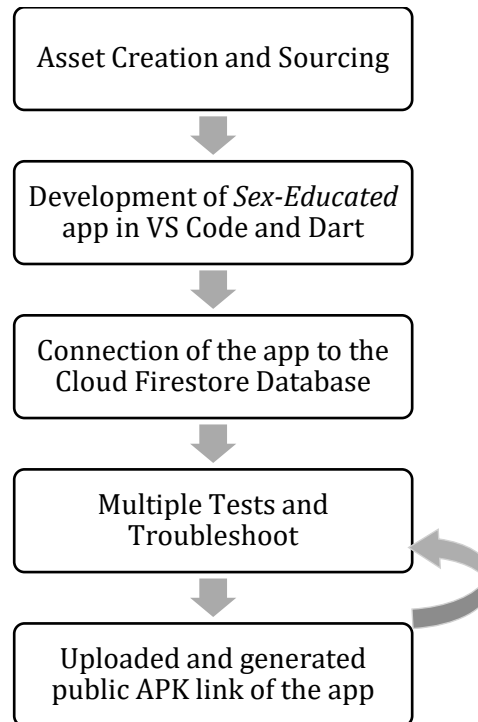
Figure 3.4.3.1: High-level design process of the *Sex-Educated* app

Upon the initial launch of *the Sex-Educated* app, users are required to sign up using their email ID and a password, and they can select a unique username. After a successful login, the main menu is displayed, presenting four primary features: *knowledge corner, quiz, my score,* and *leaderboard*. Each of these features navigates the user to its respective screen. Selecting the *knowledge corner* feature opens a menu with various knowledge sections, each containing relevant information that can be viewed. In the *quiz* feature, users are presented with a quiz menu that displays the different levels. Upon choosing a level, users enter the quiz game interface. The *my score* and *leaderboard* features display detailed score summaries and rankings of other users, respectively. The user's information and data are securely stored in the Cloud Firestore database. This data is deleted if the user

decides to delete their account, ensuring privacy and data security. This storage policy is clearly communicated to users in the consent form provided during participant recruitment (Appendix H). This process ensures transparency and adherence to ethical standards in data management. Figure 3.4.3.2 shows the high-level overview of the app.
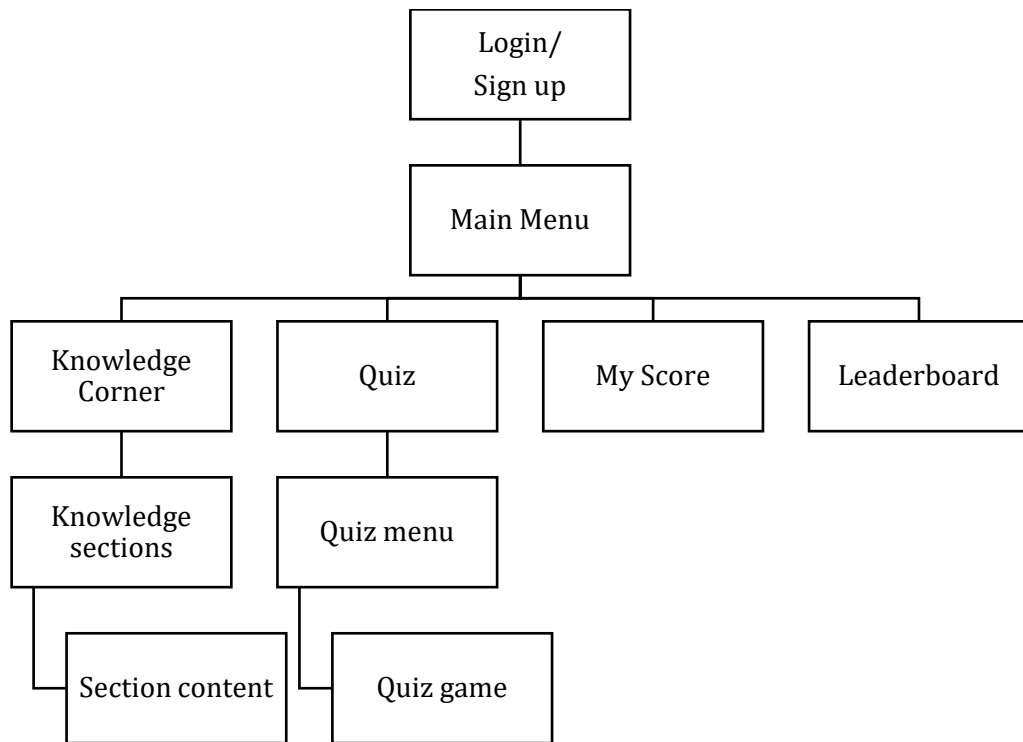
Figure 3.4.3.2: High-level overview of the Sex-Educated app

Chapter 4

Evaluation of *Sex-Educated*

I developed the *Sex-Educated* app in three phases. In phase 1, the app was conceptualized and designed. The app was then evaluated with the target users in the next two phases.

Phase 2: The user study in phase 2 was conducted to validate the design of the *Sex-Educated* app with the medium fidelity prototype of the app.

Phase 3: Based on the results collected from Phase 2, a fully functional version of the *Sex-Educated* app was developed. After developing the *Sex-Educated* app, I investigated its effectiveness with respect to positive change towards desired behaviour.

In this chapter, I discuss the research objectives (ROs), research questions (RQs), and the process of evaluation undertaken in both Phases 2 and 3 to achieve the ROs and answer the RQs.

4.1 Research Objectives and Questions

In phase 2, I formulated two ROs to guide the study. The ROs were:

- RO 1: *To understand users' needs, concerns and level of acceptance of a sexual health-related app.*

  For RO1, I conducted a one-on-one interview with the participants in the phase 2 study. The questions were designed to obtain the participants' personal opinions on the relevance of a mobile app related to sexual health in their lives (Appendix F).

- RO 2: *To validate the design and features of the prototype with the target audience with respect to its motivational appeal and persuasiveness.*

  To address the RO2 of validating the design and features of the *Sex-Educated* app before its development, a survey and interview were conducted in phase 2, to collect feedback on the design and content of the prototype. Based on the feedback, the final app would be developed.

For phase 3, I investigated the effectiveness of the app *Sex-Educated* in motivating desired behaviour change towards sexual health.

The overarching research question for the phase 3 study is:

> *Can Sex-Educated promote healthy sexual behaviour and educate about sexual health?*

To answer this research question, one would ideally monitor the sexual behaviour of Indian youths' before using *Sex-Educated* and their sexual behaviour after using *Sex-Educated,* then compare these two variables at various time points over the span of some months or more to see if there is a positive or negative change. However, this is not feasible in the context of this research for a few reasons. One reason is that it is not possible to monitor sexual behaviour in most Indian cultures due to the sacredness of and stigma associated with sex and sexual-related topics as indicated in the first chapter of this thesis. Another reason is that it is resource-intensive to carry out such research, which is beyond the scope of this work. Therefore, I explored the literature to comprehend alternate ways and other predictors of behaviour change. To effectively answer this question, it was divided into smaller questions measuring close indicators of behaviour change. The questions border around the factors that determine behaviour change.

According to Ajzen [2] and Orji [50], *Attitude, Self-Efficacy* and *Intention* are the three main predictors of behaviour change. Therefore, to determine the effectiveness of *Sex-Educated* I measured its efficacy with respect to promoting positive changes in *Attitude, Intention* and *Self-efficacy* toward healthy sexual behaviour guided by the following three research questions:

- RQ1: *Can the Sex-Educated app foster a positive shift in attitudes toward healthy sexual behaviours among Indians?*

  To answer this question, participants' attitudes against risky sexual behaviours, before and after playing *Sex-Educated* were measured, adapting the attitude change questions used by Orji et al. [48] into my pre-test and post-test surveys (Appendix J and Appendix K). Participants indicated the level of agreement or disagreement with statements using a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree. The difference between the means of the two-time points (pre-test and post-

test) was determined using a paired-sample t-test [95]. A greater post-test mean would signify a positive change in the attitudes of the participants toward healthy sexual behaviours.

- RQ2: *Can Sex-Educated motivate a positive change in the intentions of Indians against Risky Sexual behaviours?*

  To answer this question, I collected data about the participants' intentions against risky sexual behaviours, before and after playing *Sex-Educated*. I adapted the intention change questions in Orji et al. [48] into the pre-test and post-test surveys (Appendix J and Appendix K) using a 7-point Likert scale for the level of agreement. The difference between the means of the two-time points (pre and post) was determined using a paired-sample t-test. A greater post-test mean would signify a positive change in the intentions of the participants against risky sexual behaviours.

- RQ3: *Can Sex-Educated induce a positive change in the Self-Efficacy of Indians towards safe and healthy sexual behaviour?*

  To answer this question, data about the participants' self-efficacy against risky sexual behaviours were collected, before and after playing *Sex-Educated*. I adapted the Self-Efficacy change questions from Orji et al.[48] into the pre-test and post-test surveys (Appendix J and Appendix K). The self-efficacy was measured using a 7-point Likert scale ranging from 1=strongly disagree to 7=strongly agree. The difference between the means of the two-time points (pre and post) was determined using a paired-sample t-test. A greater post-test mean would signify a positive change in the self-efficacy of the participants towards healthy sexual behaviours.

Knowledge is also an indicator of behavioural change. Research has shown that people with more knowledge of the risks and benefits of a target behaviour are more likely to change their behaviour than those without any knowledge [14]. Therefore, I also investigated if there is a change in participants' *knowledge* about sexual health, with the following three additional research questions:

- RQ4: *Can Sex-Educated cause an increase in users' knowledge about sexual health: the risky behaviours, safe practices and overall knowledge about healthy sexual behaviour?*

To answer this question, participants' sexual health knowledge was measured, before and after playing *Sex-Educated*. The quiz game of the *Sex-Educated* app has questions on sexual health at each level. The first score at the game and scores from each level are stored in the Cloud Firestore database [94]. The scores in each level for the 7-day evaluation period were stored along with the number of attempts. To measure the change in knowledge, the scores from the first quiz play (pre-test knowledge) are compared with the mean of the final scores (post-knowledge score). The difference between the means of the scores (pre and post) will be determined using a paired-sample t-test. A greater post-test score would signify an increase in the knowledge of the participants about sexual health.

- RQ5: *How effective is the Sex-Educated app with respect to motivational appeal?*

  To answer this question, the participants' motivation to use the app was measured by measuring their *Attention, Relevance, Confidence,* and *Satisfaction* (ARCS) after using the app. The ARCS scale [32,51]was employed, using a 5-point Likert scale ranging from 1 being 'strongly disagree' to 5 being 'strongly agree' for each of the statements. A one-sample t-test was conducted on the means of the individual variables under the ARCS scale as well as the overall motivation by taking the mean of all four constructs. A mean greater than the neutral value of 3 signifies a positive motivational appeal towards sexual health using *Sex-Educated*.

- RQ6: *How usable and effective is the Sex-Educated app in promoting a positive user experience?*

  Data about the participants' experience using the app was collected in the post-test survey to answer this question. The usability of the app was evaluated using the System Usability Scale (SUS) [34] using a 5-point Likert scale. Also, to measure the participants' user experiences, I used the User Experience Questionnaire (UEQ) [42]. These scales were used in the post-test survey. Both the scales were measured in a 5-point Likert scale. A one-sample t-test was run on the means of the responses from the questions in SUS and UEQ. A mean greater than the test value of 3 would signify a good usability and user experience.

Finally, the *perceived persuasiveness* of the app with respect to its ability to motivate the desired change toward healthy sexual behaviour was examined. Hence, the final research question is:

- RQ7: *How persuasive is Sex-Educated with respect to its ability to motivate change toward healthy sexual behaviour and increase awareness about sexual health?*

  To answer this question, the participants' perception of how persuasive the app is with respect to motivating them to change towards healthy sexual behaviour was measured. I employed the Perceived Persuasiveness Scale (PPS) adapted from Orji et al. [51] in the post-test survey. The scale consists of 4 questions as specified in Appendix K. A one-sample t-test was done with the means of the PPS score using a neutral value of 3. A mean greater than the test value would signify a strong persuasiveness of the *Sex-Educated* app.

Table 4.1 outlines all the ROs, and RQs, along with the measures and instruments used to address the ROs and to answer each of the RQs.

Table 4.1: Research objectives/questions and their corresponding investigations

RO/RQ	Measures	Instruments
RO1	To identify users' needs, concerns and suggestions	Phase 2 interview
RO2	To validate the design and the persuasive features of the app.	ARCS, PPS and phase 2 interview
RQ3	Self-Efficacy	Behaviour Change Questionnaire
RQ4	Knowledge Change	Pre and post-test quiz score
RQ5	Motivational appeal	ARCS Scale
RQ6	User Experience	SUS, UEQ
RQ7	Persuasiveness	PPS

4.2 Phase 2

In this section, I will discuss the overall structure of the phase 2 user study, the method of data collection, and the process of data analysis.

4.2.1 Study Design

After receiving approval from my university Research Ethics Board, the process of recruitment for participants started. To recruit participants, the study was advertised on LinkedIn [96], Facebook [97], and WhatsApp [98] groups (Appendix B). Sixty-seven (67) participants completed a demographics questionnaire (Appendix I) among which 57 were complete and met the inclusion criteria. The inclusion criteria were as follows:

1. Must be an Indian resident who has resided in India for at least 10 years in the last 15 years

2. Must be of age 18 and above

I conducted a survey with the 57 participants. Before the survey questionnaire, the participants viewed the images of each screen of the app prototype with a description of the feature. Then they completed the questionnaire which included questions to evaluate the motivational appeal and the perceived persuasiveness of the proposed app design. Participants were also invited to participate in an optional one-on-one interview. I conducted one-on-one interviews with 22 participants. The interview was 20 minutes long, and the questions were divided into two parts (Appendix F). The questions in the first part were to understand the background of the participants' formal sex education and their opinions on an app on sexual health. The second part of the interview questions were about the *Sex-Educated* prototype. The participants provided detailed insights on their likes, and dislikes of the app design, and shared ideas or concerns about the app. Figure 4.2.1 show the flow of the process in the user study.
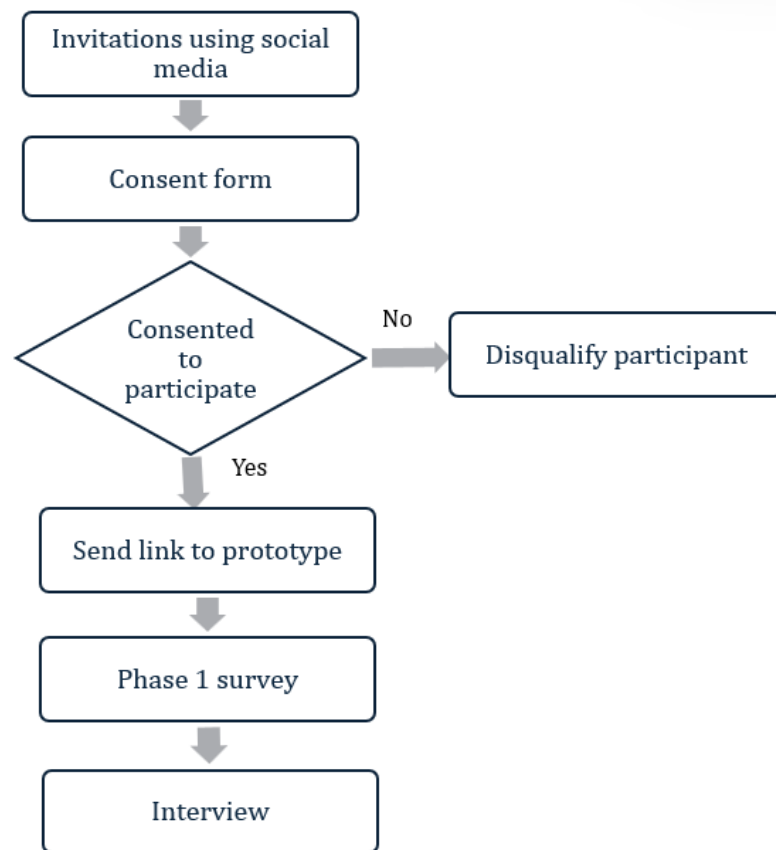
Figure 4.2.1: Flow of processes in Phase 2 user study

4.2.2 Data Collection

The purpose of collecting data in phase 2 was to get feedback on the design of the *Sex-Educated* app using a medium-fidelity prototype. The participants were sent an Opinio [99] survey link to collect their demographic data (to check if they fit the inclusion criteria or not). Participants were recruited by advertising to the public using various channels such as LinkedIn [96], Facebook [97] and WhatsApp [98]. All eligible participants were invited to complete a survey after seeing the *Sex-Educated* prototype. The survey included an ARCS scale to evaluate the motivational appeal of the app, which consists of 12 questions with a 5-point Likert scale. The perceived persuasiveness scale was also used to evaluate each of the persuasive features of the app. After that, the participants were also invited for an optional 20-minute-long one-on-one interview, and all the interviews were recorded in Microsoft Teams [100]. Based on the results obtained from the phase 2 data, the design and the features would be refined.

4.2.2.1 Study Instruments

The following are measurement instruments used to collect data for this study:

- Consent form for phase 2 (Appendix C)
- Demographic questionnaire for phase 2 (Appendix D)
- Phase 2 survey (Appendix E)
- Interview questions for phase 2 (Appendix F)

4.2.3 Data Analysis

I analysed the data using a mixed-method approach to get a complete picture of the results obtained from the collected data integrating the benefits of both quantitative and qualitative analysis.

4.2.3.1 Quantitative analysis

To analyse the survey data, I conducted descriptive statistics on the ARCS Motivation Scale [32,51] and PPS [51]. One-sample t-test was used to compare whether the ratings were significantly above the midpoint. I compared the means of the persuasiveness of each feature of the *Sex-Educated* app. I also compared the perceived motivation across demographic variables, including age, gender and education level using one-way ANOVA [101].

4.2.3.2 Qualitative analysis

To analyse the interview data, I performed a thematic analysis of interview responses [15]. Interviews were voice recorded using Microsoft Teams [100], and then manually transcribed verbatim, as interviews were conducted in English, Hindi and Bengali languages. I used an inductive approach of thematic analysis [15], following a 6-step process to analyse the qualitative data:

Step 1: Become familiar with the data: The interview responses that were in English were transcribed with the help of Teams, and I transcribed manually the responses that were in Hindi or Bengali language, as those were Indian regional languages and could not be properly transcribed. I read and re-read the transcribed notes to familiarize with the ideas.

Step 2: Generate initial codes: After reading the data thoroughly, I coded the key points across the whole data, and systematically relating similar codes together.

Step 3: Search for themes: The codes that were relevant to each other were grouped after identifying similar patterns among the codes.

Step 4: Review themes: The similar code groups were reviewed and themes were named.

Step 5: Define themes: After having distinct themes with relevant information, the themes were described for better analysis

Step 6: Write-up: the final analysis report was written based on the themes identified from the qualitative data.

The qualitative data provided deeper insights into the users' view of *Sex-Educated* and their possible recommendation(s). The results of the thematic analysis helped us gain additional insight into patterns and commonalities in users' behaviour, which reinforced the quantitative data collected from users.

4.3 Phase 3

In this section, I will discuss the overall design of the user study done in phase 3. I will describe the method of data collection and data analysis performed in this phase.

4.3.1 Study Design

For phase 3, to understand the effects of *Sex-Educated* on the target population (Indian adults), I conducted a pre-test and post-test study. The study was again advertised on LinkedIn [96], Facebook [97], WhatsApp [98] groups, and via snowball sampling [102] and word of mouth (Appendix G). 49 participants who consented to participate were sent a demographics questionnaire. The inclusion criteria are as follows:

1. Must be an Indian adult (18+).
2. Must have access to a smartphone.

Prior to beginning the 7-day study, participants completed a pre-test questionnaire (Appendix J) about their attitude, intention, self-efficacy and knowledge about sexual health. Next, participants downloaded and used *Sex-Educated* for 7 days for

at least 5-7 minutes per day. At the end of the 7 days, participants were asked to complete the post-test questionnaire (Appendix K). 46 participants completed the whole study and met the inclusion criteria, and their participation data was considered in the evaluation.

To understand the effects of the *Sex-Educated* on users' intentions, attitudes, self-efficacy, knowledge of sexual health and perceived motivation, user experience, and perceived persuasiveness of the *Sex-Educated* the participants were asked to fill out the post-test questionnaire (Appendix K). I conducted an optional one-on-one interview with 21 participants. Each interview was 15 minutes long and included questions about the participant's experience with the app (Appendix L). Figure 4.3.1 shows the flow of the process of the user study.
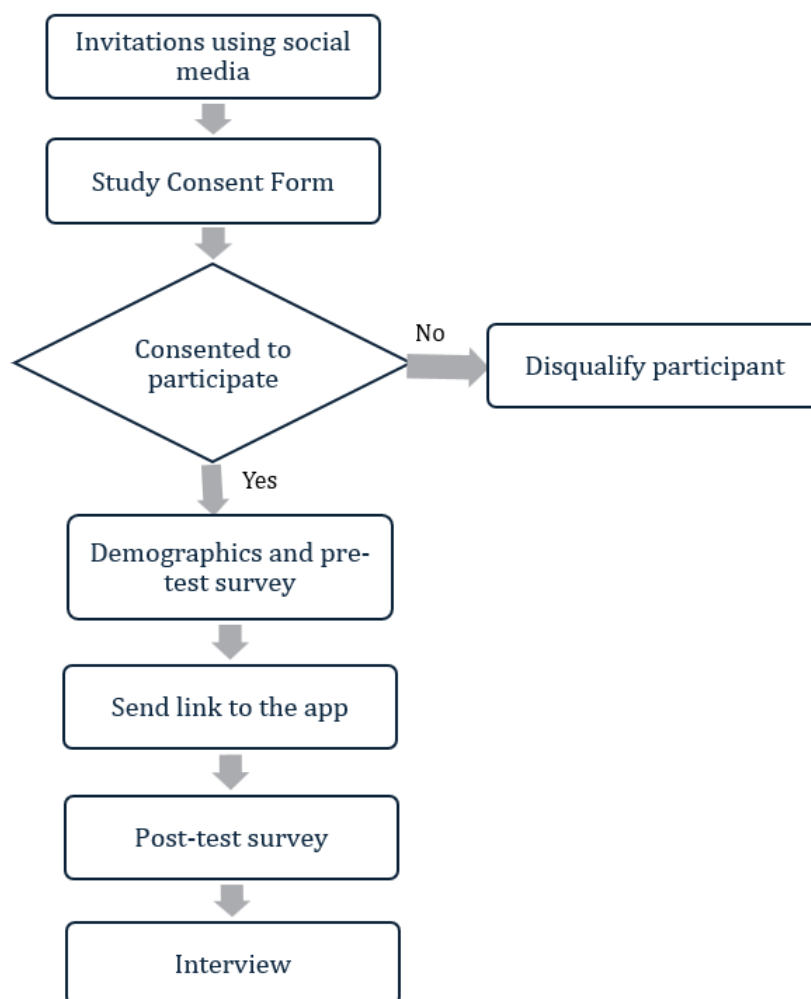
Figure 4.3.1: Flow of processes in Phase 3 user study

4.3.2 Data Collection

After phase 2 of the study with the app prototype, I refined the design based on the results from the 2nd phase and developed a fully functional app. Now, to evaluate the *Sex-Educated* app I conducted a second user study after obtaining the university Research Ethics Board's approval. Participants were recruited by advertising to the public using various channels such as Facebook[97] and WhatsApp [98]. Word-of-mouth and snowball sampling [102] techniques also helped to recruit more people to the study. Participants completed a demographic questionnaire hosted on Opinio [99]. The purpose of this questionnaire is to verify whether the participant meets the inclusion criteria. The participants were then sent a pre-test questionnaire and then they were asked to download and use the *Sex-Educated* app for 7 days for at least 5 minutes. At the end of a week, they were again sent a post-test questionnaire to evaluate the change in attitude, intention, self-efficacy, and knowledge towards sexual health. The participants' engagement was noted from the app log. The post-test questionnaire also included questions measuring Attention, Relevance, Confidence, and Satisfaction (ARCS), consisting of 12 items measured on a 5-point Likert scale (ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree") [32]. Furthermore, the post-test questionnaire measured the usability, user experience and perceived persuasiveness, of the app. Finally, the last section of the post-test questionnaire asked one open-ended question allowing the participants to provide any suggestions they might have for improving the app and a comment box to share more of their thoughts. The participants were also invited for an optional one-on-one interview. Each interview took 15-18 minutes and was recorded over Microsoft Teams [100].

4.3.2.1 Study Instruments

The following are measurement instruments used to collect data for this study:

- Consent form for phase 3 (Appendix H)
- Demographics questionnaire for phase 3 (Appendix I)
- Pre-test survey for phase 3 (Appendix J)
- Post-test survey for phase 3 (Appendix K)
- Interview questions for phase 3 (Appendix L)

4.3.3 Data Analysis

Similar to phase 2 analysis, I followed a mixed-method approach of both quantitative and qualitative analysis. This was done to gain more insight into the effectiveness of the *Sex-Educated*.

4.3.3.1 Quantitative analysis

In phase 3, the changes in behaviour and knowledge were analysed through the pre-test and post-test survey responses. I compared the means from the pre-test and post-test for each of the measures to investigate the changes. I generated the descriptive statistics of the data from ARCS Scale, SUS, UEQ, and PPS used in the post-test survey, to analyse the perceived motivation, usability, user experience and perceived persuasiveness of the overall app

4.3.3.2 Qualitative analysis

For the interview responses in phase 3, I followed the same approach of thematic analysis as discussed in 4.2.3.2 to analyse the qualitative data. I used an inductive approach to find patterns in the data and identify codes. Through an iterative process of thematic analysis, I obtained the key themes from the qualitative data.

Chapter 5

Results

In this chapter, I present the results from the evaluations of the *Sex-Educated* app carried out in phase 2 and 3.

5.1 Phase 2 Results

In this section, I provide a detailed overview of the participant demographics from the phase 2 user study. Additionally, I will present the findings from both the quantitative and qualitative analyses of the data collected during the study.

5.1.1 Participant Demographics

Out of 65 valid survey responses, 57 met the inclusion criteria and completed the survey. The participants' ages were between 18 and 34 years old, distributed as follows: 18-21 (10%), 22-25 (39%), 26-29 (39%), 30-34 (12%), and no participants above 34 (Figure 5.1.1.1).
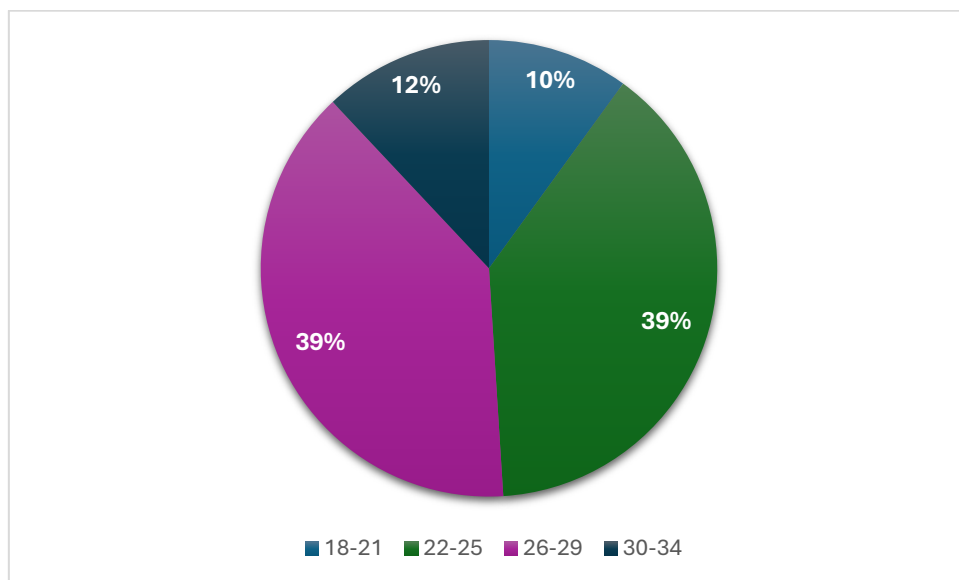
Figure 5.1.1.1: Demographics by age groups
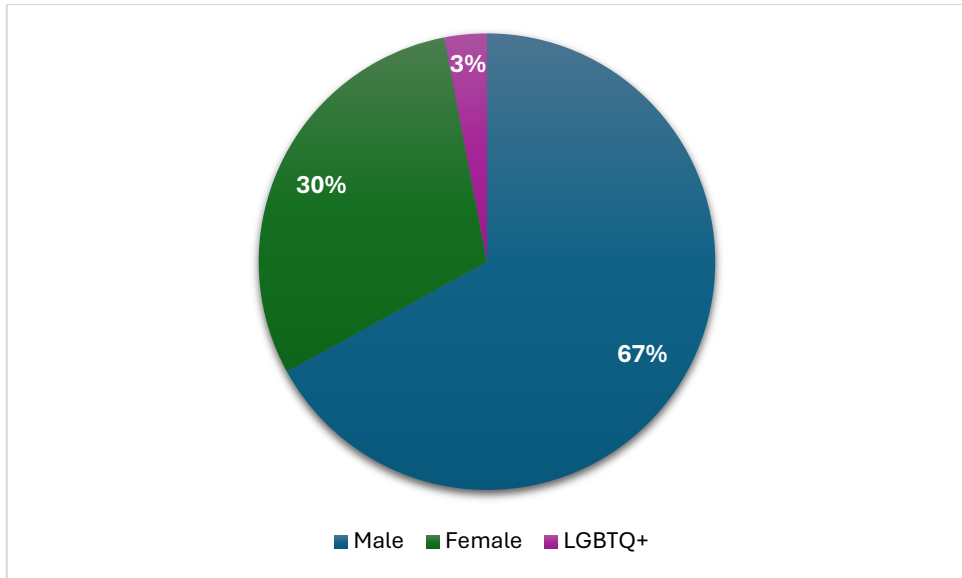
Figure 5.1.1.2: Demographics by gender

30% of the participants self-identified as women, 67% as men and 3 % identified as part of LGBTQIA+ community (Figure 5.1.1.2). The distribution of participants based on their level of education was: 2% held a doctoral degree, 31% of the participants had a master's degree, 62% had a bachelor's degree, and 5% had a high school degree (Figure 5.1.1.3). Most participants (53%) self-identified as single, while 30% were married, and 42% were in a relationship (Figure 5.1.1.4).
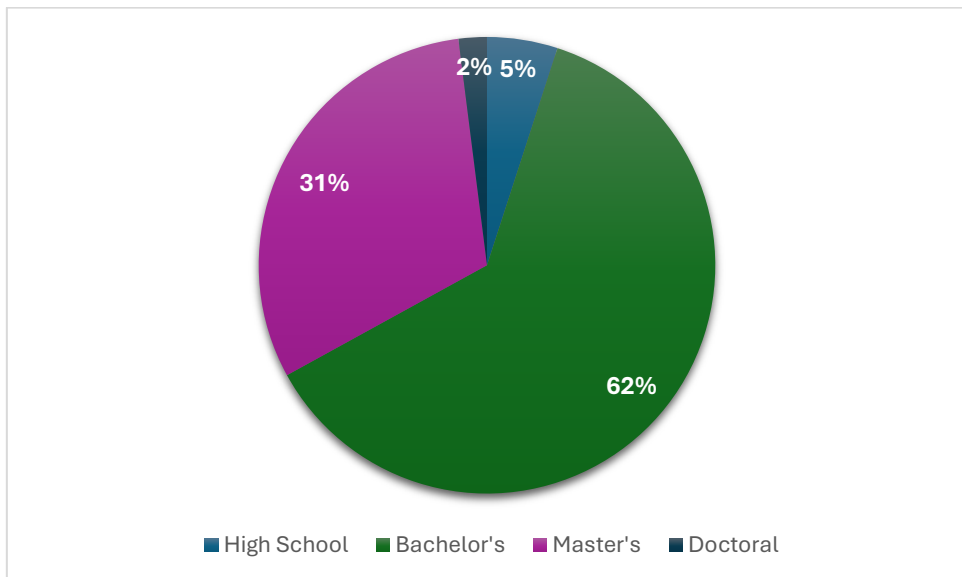
Figure 5.1.1.3: Demographics by education
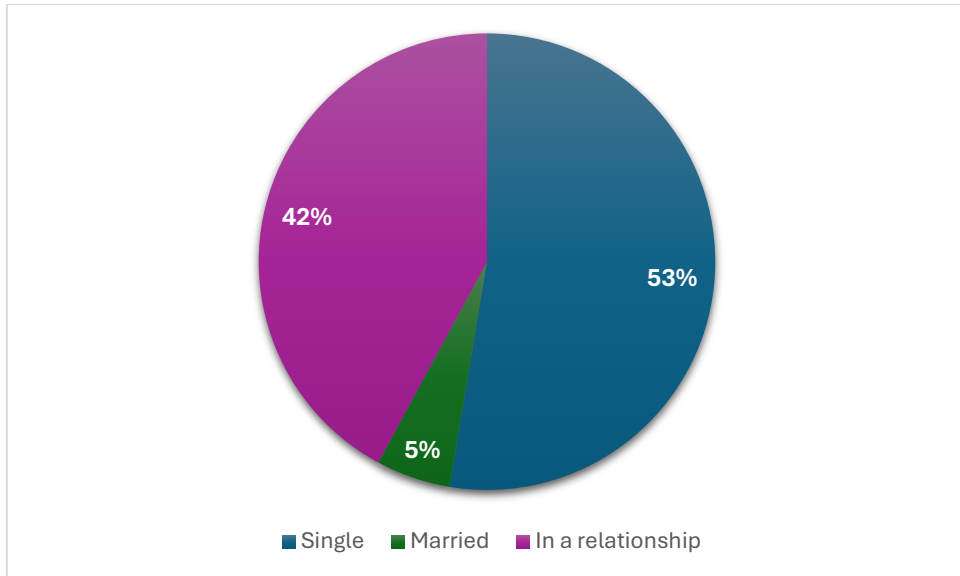
Figure 5.1.1.4: Demographics by relationship status

5.1.2 Quantitative Results

In phase 2 of the study, I evaluated the motivational appeal of the app, and also the persuasiveness of the app. For the visualization of the sample distribution, Microsoft Excel [103] and IBM SPSS [104] were used to visualize and analyse the quantitative data collected from the surveys (Appendix E) [59]. I first evaluated the perceived motivation of the app for the overall sample, followed by an evaluation based on different groups (based on age, gender, and education). I also evaluated the perceived persuasiveness of all the features of the app.

5.1.2.1. Perceived Motivation*: I investigated the motivational appeal of the *Sex-Educated* app by performing a one-sample t-test [105] on the data. I compared the data against a neutral rating of 3 on a 5-point Likert ARCS motivation scale (1 = Strongly Disagree to 5 = Strongly Agree). The one-sample t-test shows that the overall motivation (*M* = 3.96, *SD* = 0.65) was significantly higher than the neutral value of 3 (*t*[56] = 11.24, *p* = <.001). I also compared values of all four constructs of the ARCS motivational model which were also significantly higher than the neutral point (Table 5.1.2.1). The result shows that the *Sex-Educated* app is effective with respect to motivational appeal (Figure 5.1.2.1).

Table 5.1.2.1.: Descriptive statistics perceived motivation of Sex-Educated app

Measures	M	SD	MD	df	t	p
Attention	3.91	0.82	0.91	56	8.35	<.001
Relevance	4.02	0.67	1.02	56	11.54	<.001
Confidence	4.11	0.75	1.11	56	11.06	<.001
Satisfaction	3.78	0.81	0.78	56	7.21	<.001
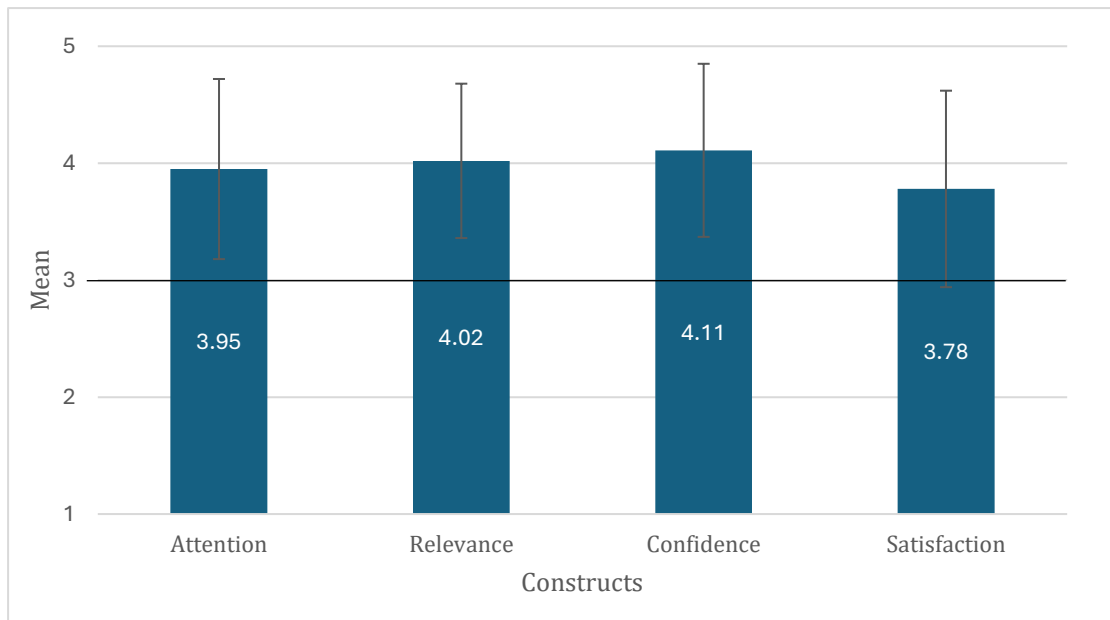
Figure 5.1.2.1: Results of the ARCS constructs for perceived motivation

5.1.2.2 Overall Motivation by Demographic Groups*:* I also wanted to find out if there is any difference in perceived motivation based on demographic factors. I conducted Analysis of Variance (ANOVA) tests to compare the perceived motivation in different groups. Particularly, I assessed the differences between the groups based on the age, gender, and education level of the participants. The value of overall motivation is calculated by the combined values of the four ARCS constructs. The results are shown in Table 5.1.2.2.

Age-based Analysis: I compared the means of perceived persuasiveness score between the age groups of 18-21 (*M*=3.92, *SD*= 0.87), 22-25 (*M*=3.96, *SD*= 0.61), 26-29 (*M*=4.12, *SD*= 0.64), 30-34 (*M*=3.42, *SD*= 0.40). There was no statistically significant difference between groups as determined by one-way ANOVA (*F* (2,54) = 2.18, *p* = 0.10).

Gender-based Analysis: Responses from the participants who identified their gender as either Female (*M*=3.91, *SD*= 0.82), Male (*M*=3.97, *SD*= 0.59) or LGBTQIA+ (M=3.98, *SD*= 0.44) show similar motivation. There was no statistically significant difference between groups as determined by one-way ANOVA (*F* (3,53) = 0.04, *p* = 0.96).

Education-based Analysis: I compared the data from participants with different educational backgrounds: High school (*M*=3.77, *SD*= 1.22), Bachelor's degree (*M*=3.95, *SD*= 0.58), Master's degree (*M*=3.99, *SD*= 0.73), Doctoral degree (*M*=3.81, *SD*= 0). There was no statistically significant difference between groups as determined by one-way ANOVA (*F* (3,53) = 0.11, *p* = 0.95).

Table 5.1.2.2: One-way ANOVA test results for group-wise perceived motivation

Measures		*N*	*M*	*SD*	*Std Error*	*df* between groups	within groups	*F*	*p*
Age	18-21	6	3.92	0.87	0.35	3	53	2.18	0.10
	22-25	22	3.96	0.61	0.13				
	26-29	22	4.12	0.64	0.14				
	30-34	7	3.42	0.40	0.15				
Gender	Female	17	3.91	0.82	0.20	2	54	0.04	0.96
	Male	38	3.97	0.59	0.10				
	LGBTQIA+	2	3.98	0.44	0.31				
Education	High school	3	3.77	1.22	0.70	3	53	0.11	0.95
	Bachelor's	35	3.95	0.58	0.10				
	Master's	18	3.99	0.73	0.17				
	Doctoral	1	3.81	0	0.00				

5.1.2.3 Perceived Persuasiveness: I used the PPS [51] as a measurement instrument to test the overall persuasiveness of the app, and to validate the persuasiveness of the four main features of the app. To test the effectiveness of these strategies I performed a one-sample t-test with a 95% confidence interval, considering 3 as the test value. The one-sample t-test results show that the results are significant ($p < 0.001$) for the overall persuasiveness (Table 5.1.2.3). The results confirmed that the prototype of *Sex-Educated* was persuasive (Figure 5.1.2.3).

Table 5.1.2.3: Descriptive statistics for overall perceived persuasiveness in Phase 2

Measures	N	M	SD	MD	df	t	p
PPS	57	3.80	0.81	0.80	56	7.50	<.001
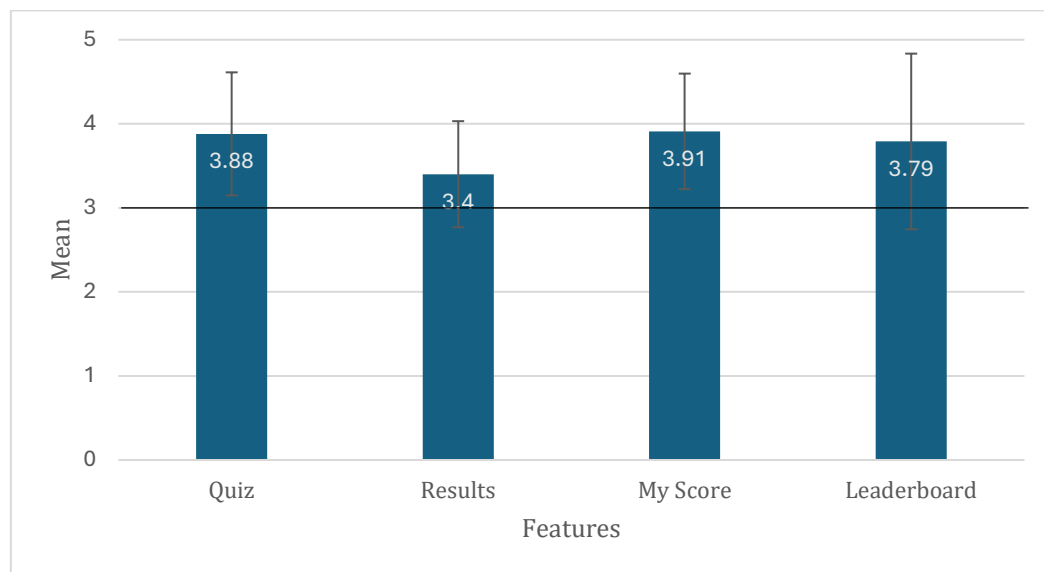
Figure 5.1.2.3: Persuasiveness of the main features

5.1.2.4 Overall Perceived Persuasiveness by Demographic Groups: I also wanted to find out if there is any difference in perceived persuasiveness based on demographic factors. I conducted ANOVA tests to compare the perceived persuasiveness in different groups. Particularly, I assessed the differences between the groups based on the age, gender, and education level of the participants. The value of overall persuasiveness is calculated by the combined values of the

persuasiveness score for all the strategies used. The results are shown in Table 5.1.2.4.

Age-based Analysis: I compared the means of perceived persuasiveness score between the age groups of 18-21 (*M*=3.96, *SD*= 0.84), 22-25 (*M*=3.89, *SD*= 0.64), 26-29 (*M*=4.02, *SD*= 0.66), 30-34 (*M*=3.46, *SD*= 0.49). There were no statistically significant differences between age groups as determined by one-way ANOVA (F (3,53) = 2.18, p = 0.1).

Gender-based Analysis: Responses from the participants who identified their gender as either Female (*M*=3.81, *SD*= 0.70), Male (*M*=3.94, *SD*= 0.67) or LGBTQIA+ (*M*=3.75, *SD*= 0.09) show no significant difference in perceived persuasiveness. There was no statistically significant difference between groups as determined by one-way ANOVA (F (2,54) = 0.04, p = 0.49).

Education-based Analysis: I compared the perceived persuasiveness data from participants with different levels of education: High school (*M*=3.83, *SD*= 1.02), Bachelor's degree (*M*=3.99, *SD*= 0.61), Master's degree (*M*=3.77, *SD*= 0.73), Doctoral degree (*M*=3.19, *SD*= 0). There was no statistically significant difference between groups as determined by one-way ANOVA (F (3,53) = 0.81, p = 0.49).

Table 5.1.2.4: One-way ANOVA test results for group-wise perceived persuasiveness

Measures	Groups	N	M	SD	Std Error	df between groups	within groups	F	p
Age	18-21	6	3.96	0.84	0.34	3	53	1.28	0.29
	22-25	22	3.89	0.64	0.14				
	26-29	22	4.02	0.66	0.14				
	30-34	7	3.46	0.49	0.19				
Gender	Female	17	3.81	0.70	0.17	2	54	0.3	0.74
	Male	38	3.94	0.67	0.11				
	LGBTQIA+	2	3.75	0.09	0.06				
Education	High school	3	3.83	1.02	0.59	3	53	0.81	0.49
	Bachelor's	35	3.99	0.61	0.10				
	Master's	18	3.77	0.73	0.17				
	Doctoral	1	3.19	0.00	0.00				

5.1.3 Qualitative Results

The qualitative data obtained from the interviews were analysed using a thematic analysis process [15]. I grouped the responses based on common or similar concepts, and did this process iteratively, to identify the final themes of the qualitative data.

I conducted interviews in phase 2 with 22 participants after the participants had viewed the medium-fidelity prototype of the app. The interview questions were divided into two categories. The first category of questions was about how the participants felt about an app on sexual health like *Sex-Educated*), and the need and relevance of the app in their lives. The second category of questions was about the design and features of the *Sex-Educated* app, where they provided feedback on the features shown in the prototype. The participants were asked to use all the features of the prototype designed before the interview; that is how they were able to report what they liked or disliked and how they needed the actual app. The interview responses were transcribed from the recordings and then employing Braun and Clarke's [15] six-step process of thematic analysis the qualitative data were analysed. The three themes obtained from the interview were: (1) Need for a Sexual-Health Information Application, (2) Likelihood of Utilizing a Sexual Health Application, (3) Perceptions of the Design and Features of the Application.

Theme 1: Need for a Sexual-Health Information Application: The study revealed a significant gap in sexual health education among participants, highlighting the necessity for a dedicated sexual health information application. Notably, none of the participants had previously engaged with such an application, and many had not received any formal sex education. One participant reported, "*I have not received any formal education regarding sexual health. I never had a curriculum on sex education in school*" [P1]. Participants primarily acquired sexual health knowledge through informal means, notably from peers, as another participant highlighted, "*All the information that I got; those were sketchy because it was all from my friends. No course in school, not even anything in my four years of college*" [P18]. Their primary sources of sexual health information were friends, the internet, articles, and social media, which are often unreliable. This is exemplified by some participant's observations such as:

> "*There were hush-hush conversations among the girl groups*" [P6]

"There was this newspaper column with question-answers related to sexual health, I used to sneakily go through it" [P12].

These insights emphasize the stigma of open discussion about sexual health. The majority of respondents concurred that a sexual health apps could serve as a convenient tool for learning about sexual health. Some of the comments were:

"*It will be really helpful for us, and also for the next generation who are more tech-friendly*" [P14].

"*An app like this will definitely be handy. Even now, when I am searching, I cannot find any good app here*" [P6]

These comments highlight the scarcity of quality sexual health apps in the Indian market and underscore the potential impact and utility of developing a comprehensive sexual health information application.

Theme 2: Likelihood of Utilizing a Sexual Health Application: Participants acknowledged the societal taboo surrounding sexual health topics but responded positively to the idea of using a sexual health app. The convenience of smartphone applications was a recurring theme. Some of the comments were like this:

"*I think because nowadays there are apps that are super helpful, and phones are very handy. So, an app would be like a go-to solution, and it just makes me wonder why I don't have a good app existing yet*" [P21]

"*It is easy to use this app, as I don't have to interact with people, and can just download the app and use it on my own*" [P7]

Some participants indicated a willingness to pay for an app if it were government-authorized and ensured reliable information, as one commented, "*I would prefer to use an app authorized by a medical board or government even if it is chargeable*" [P18]. Despite the cultural stigma, participants expressed no hesitation in using such an app, although concerns about data privacy were noted.

Theme 3: Perceptions of the Design and Features of the Application: Participants provided favourable feedback on the application's design and usability. The user interface was particularly appreciated for its simplicity and accessibility. Comments included:

"*It is very easy to use- if I want to read about it, I can go to the knowledge corner, or if I want to go to the quiz, I can find it all in one page*" [P7]

> "*The app looks pretty straightforward to use and it's not complicated, and the fact that things are simple and the features are self-explanatory. I mean, it's good that none of the buttons or none of the features is complex or that I have to think what could this mean*" [P6].

Participants highlighted specific features they found beneficial:

Quiz Feature: The quiz component was the most favoured, with participants enjoying the challenge and the flower transformation simulation. Some participants noted,

> "*The increasing quiz levels is what intrigued me*" [P15]

> "*Playing the quiz game is such a good idea- it is not important whether I am giving right or wrong answers, but what is important is that I am getting to know a lot of information while playing is the best part*" [P3].

Knowledge Corner: 7 out of the 22 participants preferred the Knowledge Corner, valuing the concise, trivia-style facts for quick consumption without the burden of complex medical terminology:

> "*I like how the trivia is short trivia only*" [P6],

> "*If you don't know about it, how will you even search for it?*" [P8].

Leaderboard: The leaderboard feature was highly rated, with participants noting its ability to increase motivation and foster a competitive spirit. One participant remarked, "*The overall position as shown here is really good- that induces my competitiveness*" [P14].

Overall, the feedback on the prototype was positive, indicating a strong potential for such an application in enhancing sexual health education.

5.2 Phase 3 Results

In this section, I discuss the demographic distribution of the participants who evaluated *Sex-Educated* in phase 3. I also describe the quantitative and qualitative results obtained from the study.

5.2.1 Participant Demographics

For the phase 3 study, 46 participants were recruited who met the inclusion criteria. Out of the 46 participants, 21% were from the ages 18-24, 72% were from the ages 25-30, and 7% from 31-35, and no participants were over 35 (Figure 5.2.1.1). 12% of the participants held a doctoral degree, 41% of the participants had a master's degree, 45% had a bachelor's degree, and 2% had a high school degree (Figure 5.2.1.2). 44% of the participants self-identified as women, 54% as men and 2 % identified as part of LGBTQ+ community (Figure 5.2.1.3). Most participants (57%) self-identified as single, while 33% were in a relationship, and 10% were married (5.2.1.4).
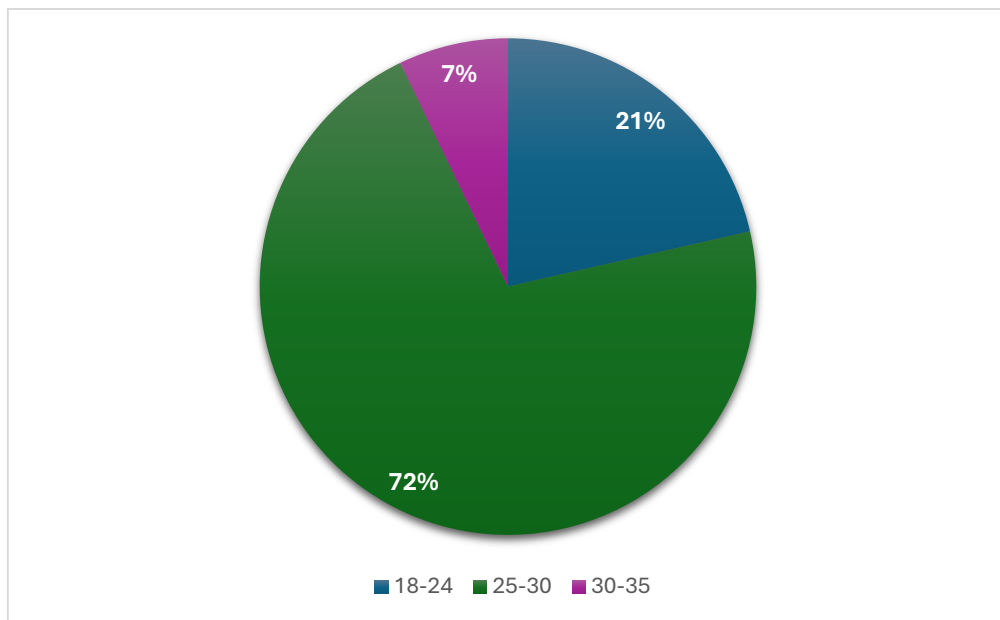
Figure 5.2.1.1: Demographics by age groups
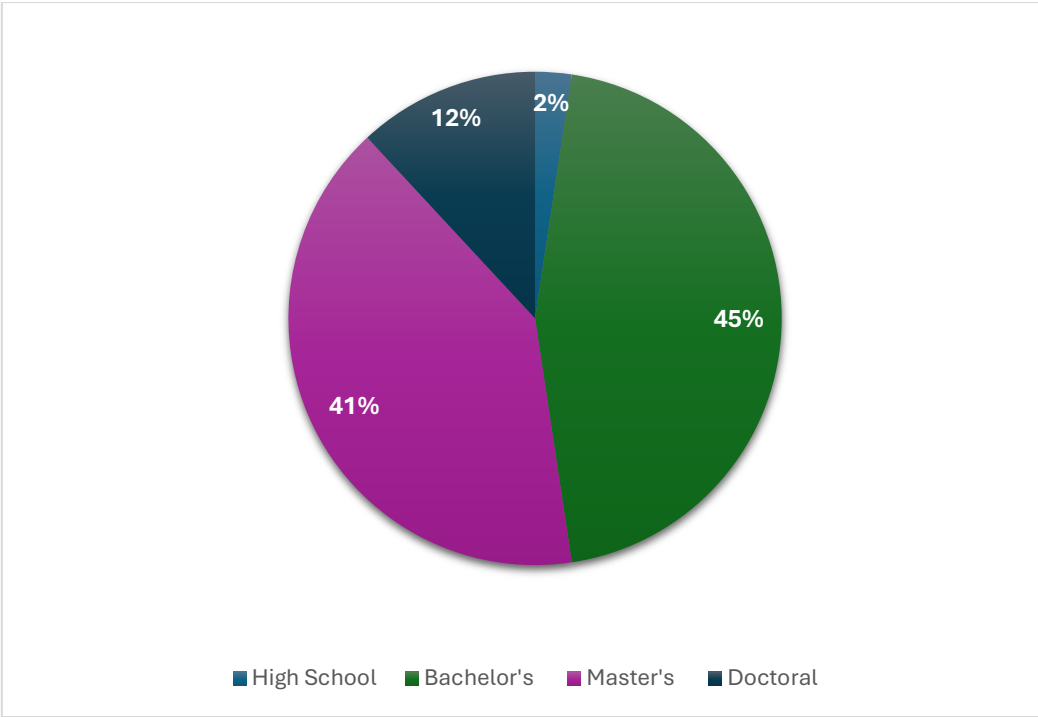
Figure 5.2.1.2: Demographics by education
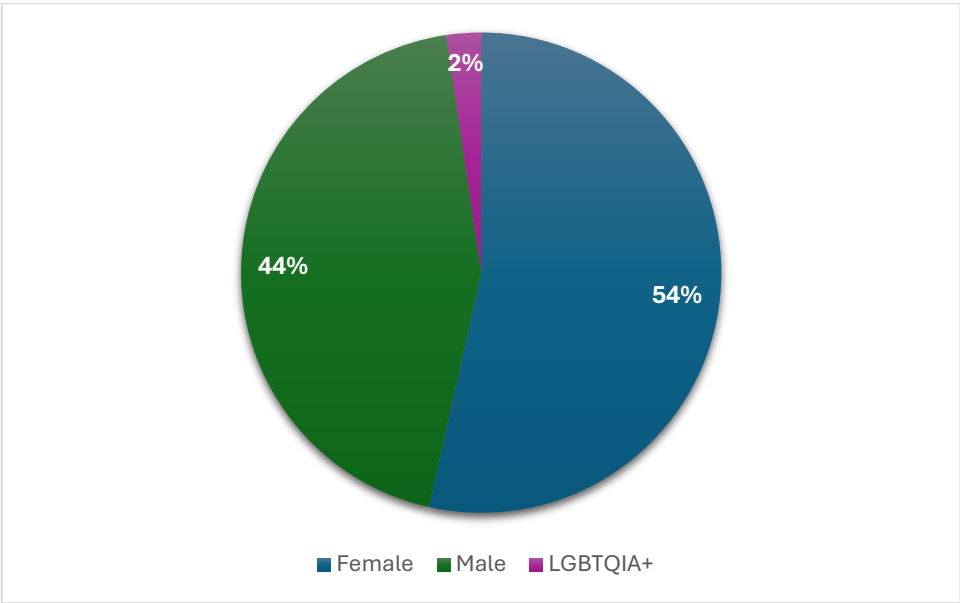
Figure 5.2.1.3: Demographics by gender
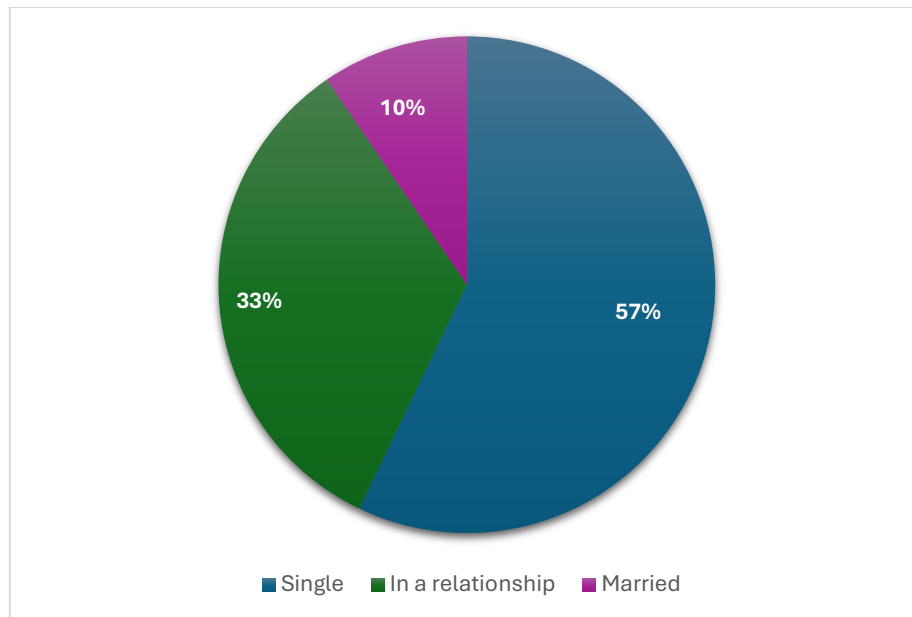
Figure 5.2.1.4: Demographics by relationship status

5.2.2 Quantitative Results

In the following subsections, I present the results of the behaviour change measured by the change in attitude, intention and self-efficacy. I evaluated the knowledge change at the start and the end of using the app, measured using the scores from the in-app quiz. I also present the motivational appeal of the *Sex-Educated* app across four dimensions of motivation (Attention, Relevance, Confidence, and Satisfaction), and the results of the overall usability, user experience and perceived persuasiveness of the *Sex-Educated* app

5.2.2.1 Attitude Change

The participants' *attitudes* against risky sexual behaviours were assessed before and after using the *Sex-Educated* app (pre and post) using a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree [2,45]. To compare the participants' intentions before (pre-test) and after (post-test) using the *Sex-Educated* app, a paired-sample t-test was conducted. The result $t(45) = -3.45$, p <0.001 suggests that there was a statistically significant increase in the attitude of participants against risky sexual behaviours, after using *Sex-Educated* from 5.85± 1.04 to 6.45 ± 0.45 (p <0.001) (Table 5.2.2.1). Therefore, this result shows that *Sex-Educated* motivated a positive change in the *attitude* of participants against risky sexual behaviour.

5.2.2.2 Intention Change

I measured participants' *intention* against risky sexual behaviours before and after using *Sex-Educated* (pre and post) using a 7-point Likert scale ranging from 1=strongly disagree to 7= strongly agree [2,45]. To analyse the data, a paired-sample t-test was conducted to compare the participants' intentions before (pre-test) and after (post-test) using *Sex-Educated*. There was a significant difference in the *intention* scores for the pre-test (*M*= 6.03. *SD*= 1.36) and post-test (*M*= 6.68, *SD*= 0.41); $t(45) = -3.22$, $p = 0.001$ (Table 5.2.2.1). Due to the significant differences in the pre-test and the post-test responses, and the direction of the *t*-value, it can be said that there was a statistically significant improvement in the *intention* of participants. This result suggests that *Sex-Educated* led to a positive change in the *intention* of participants against risky sexual behaviour.

5.2.2.3 Self-Efficacy Change

The participants' *self-efficacies* against risky sexual behaviours before and after using *Sex-Educated* were measured using a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree) [2,45]. To compare the scores of *self-efficacy* before and after using *Sex-Educated*, a paired-sample t-test was conducted. There was a significant difference in the self-efficacy scores for the pre-test (*M*= 6.12. *SD*= 1.23) and post-test (*M*= 6.62, *SD*= 0.38); $t(45) = -2.61$, $p = 0.006$ (Table 5.2.2.1). Due to the significant differences in the pre-test and the post-test *self-efficacy* scores, and the direction of the t-value, it can be said that there was a statistically significant improvement in the *self-efficacy* of participants. This result suggests that *Sex-Educated* led to a positive change in the *self-efficacy* of participants against risky sexual behaviour.

Therefore, it can be concluded that *Sex-Educated* caused a positive change in the *self-efficacy* of participants against risky sexual behaviour.

Table 5.2.2.1 - Descriptive statistics for a*ttitude, intention, self-efficacy* and *knowledge* pre and post-intervention.

	Pre-test		Post-test				
Measures	*M*	*SD*	*M*	*SD*	*df*	*t*	*p*
Attitude	5.85	1.04	6.45	0.45	45	-3.56	<0.001
Intention	6.03	1.36	6.68	0.41	45	-3.22	0.001
Self-Efficacy	6.12	1.23	6.62	0.38	45	-2.61	0.006
Knowledge	5.63	0.95	6.17	0.66	45	-6.55	<0.001

N = 46

5.2.2.4 Knowledge Change

I measured *knowledge* of participants about sexual health at the beginning of using the *Sex-Educated* app and the level of *knowledge* change after using the *Sex-Educated* app for a week. I stored the scores of the participants from their first quiz play (pre-test) and compared them with the final scores at the end of the 7-day app evaluation (post-test). I conducted a paired-sample t-test to compare the *knowledge* of the participants by comparing their pre-test and post-test scores. The result of $t(45) = -6.55$, $p < 0.001$ (Table 5.2.2.1). Due to the means of the pre-knowledge scores and the post-knowledge scores, and the direction of the t-value, It can be said that there was a statistically significant improvement in the knowledge of participants about sexual health, after using *Sex-Educated* from 5.63 ± 0.95 to 6.17 ± 0.66 ($p < 0.001$); an improvement of 0.54 ± 0.29. Therefore, it can be said that the *Sex-Educated* was effective at significantly increasing participants' knowledge about sexual health and wellness.

Figure 5.2.2.1 shows the change in attitude, intention, self-efficacy and knowledge before and after using the app for 7 days.
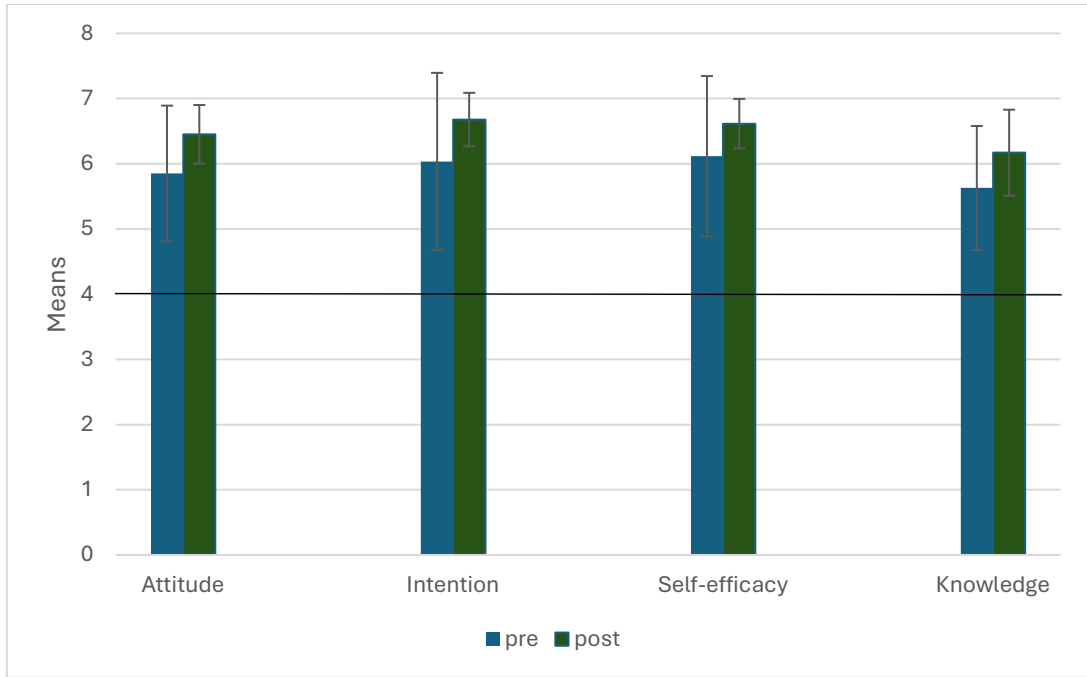
Figure 5.2.2.1: Pre and Post-test of *attitude*, *intention, self-efficacy* and *knowledge*

5.2.2.5 Motivational Appeal of the *Sex-Educated* App

I investigated the motivational appeal of the *Sex-Educated* app by performing a one-sample t-test on the data. The data were compared against a neutral rating of 3 on a 5-point Likert scale from ARCS motivational model (1 = Strongly Disagree to 5 = Strongly Agree) [32]. I performed a one-sample t-test to test if the app is effective with respect to the motivational appeal. The results show that all four constructs of the ARCS motivational model significantly differ from the neutral point of 3 ($p < .001$) (Table 5.2.2.5)

Table 5.2.2.5: Descriptive Statistics for Perceived motivation of Sex-Educated app

	N = 46					
Measures	*M*	*SD*	*MD*	*df*	*t*	*p*
Attention	4.43	0.70	1.43	45	13.98	<.001
Relevance	4.45	0.71	1.45	45	13.79	<.001
Confidence	4.47	0.71	1.47	45	14.09	<.001
Satisfaction	4.38	0.79	1.38	45	11.76	<.001

This result shows that the *Sex-Educated* app is effective with respect to motivational appeal (Figure 5.2.2.5) hence answering the RQ5: "*How effective is the Sex-Educated app with respect to its motivational appeal?*"
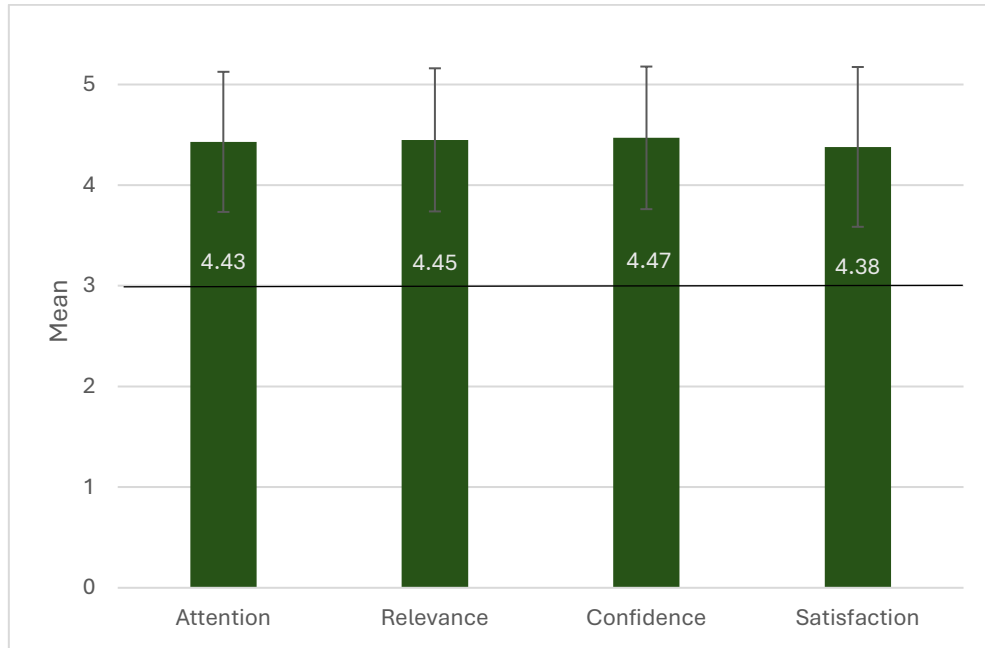
Figure 5.2.2.5.: Overall perceived motivation

5.2.2.6 User Experience and Usability of the *Sex-Educated* App

To examine whether the user had a positive experience using the app I conducted a one-sample t-test on the scores collected from the SUS [7], and UEQ [43]. I compared the data against a neutral rating of 3 on a 5-point Likert scale. In general, the results show that the app is effective in terms of usability and user experience (Table 5.2.2.6, Figure 5.2.2.6).

Table 5.2.2.6: Descriptive statistics for usability and user experience of Sex-Educated

Measures	N	M	SD	MD	df	t	p
SUS	46	4.51	0.42	1.38	45	24.65	<.001
UEQ	46	4.61	0.56	1.44	45	19.58	<.001

The results obtained from both scales (SUS, UEQ) are significantly higher than the neutral value of 3 (p <0.001) suggesting that the app has a high usability score and can create a positive user experience among its users. This answers the RQ6: *"How effective is the Sex-Educated app promoting a positive user experience?"*
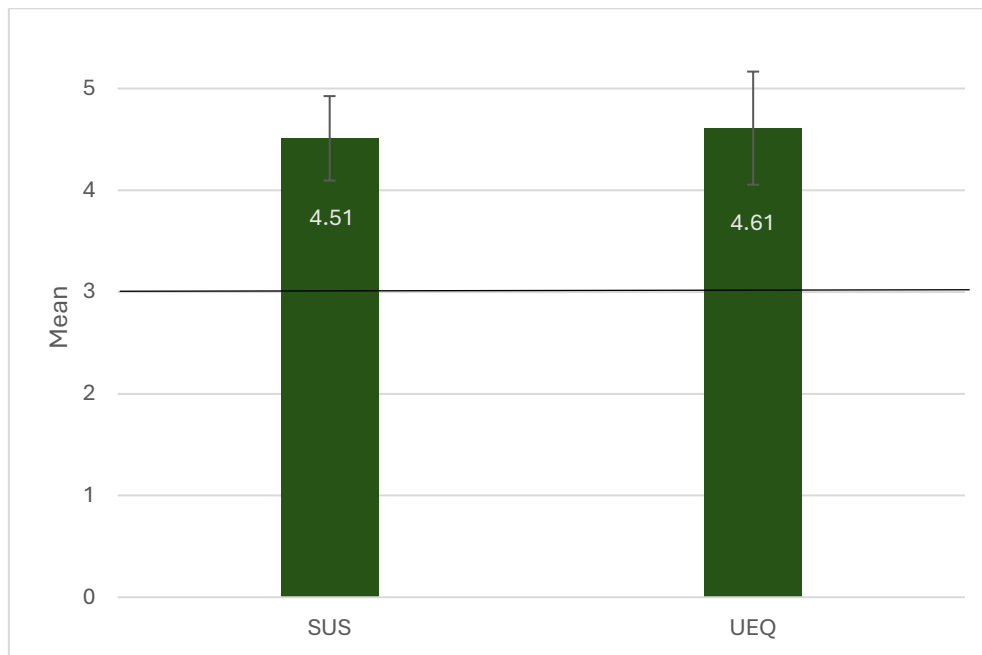
Figure 5.2.2.6: SUS and UEQ scores

5.2.2.7 Perceived Persuasiveness of the *Sex-Educated* App

To answer RQ7: "How persuasive is *Sex-Educated* with respect to its ability to motivate change in risky sexual behaviour and increase awareness about sexual health?" I investigated the persuasiveness of the *Sex-Educated* app by performing a one-sample t-test on the scale data. I used the PPS as our measurement instrument. I compared the data against a neutral rating of 3 on a 5-point Likert scale. In general, the results of the one-sample t-test show that the persuasiveness score (M= 4.16. SD= 0.83) is significantly higher than the neutral point of 3 (t [45]= 9.49, p<.001). The higher the persuasiveness of the intervention, the more the likelihood of the intervention leading to the desired behaviour change. The result showed a significant *p < .001* for the persuasiveness of *Sex-Educated* (Table 5.2.2.7*).* Therefore, I can deduce that *Sex-Educated* was persuasive with respect to its ability to promote positive change toward healthy sexual behaviour.

Table 5.2.2.7: Descriptive Statistics for Perceived persuasiveness of Sex-Educated app

Measures	N	M	SD	MD	df	t	p
PPS	46	4.16	0.83	1.15	45	9.49	<.001

5.2.3 Qualitative Results

After asking the participants to view the prototype and interviewing them in phase 2, the main suggestions were taken and implemented into the *Sex-Educated* app. I did this because it is a major step in our UCD approach, and I wanted to keep our target audience involved throughout the design and development process of the *Sex-Educated* app. After designing the app, I asked 46 Indian adults to use the app for one week, of which 21 participants agreed to participate in the optional interview. The interview questions were structured to capture the participants' overall experience with the app, design suggestions, and likes or dislikes. Some of the key questions asked were: "*What did you think about the app; Do you think you can trust the app? Why or why not?*" A thematic analysis [15] was performed on the interview responses. I conducted the thematic analysis by going through all of the interview responses iteratively and grouping similar quotes which resulted in 9 groups of quotes. In the first round of grouping, the quotes that were semantically related or having similar keywords for example mindful, aware and interactive, interesting were grouped together. By reading through the grouped quotes, the quotes were further merged based on overall thoughts and concepts shared within each quote, and that resulted in 8 themes. Finally, going through the 8 themes again resulted in combining themes as one, which resulted in 7 themes, and further merging was not necessary after going through these 7 themes. These resultant 7 themes surfaced in many aspects of the system that allow a better understanding of the effectiveness of our intervention. The extracted themes and example quotes relating to them are provided below. 7 themes were extracted from analyzing the interview data. The themes are as follows:

Theme 1: Invoking interest in learning about sexual health: The app significantly enhanced participants' understanding of various aspects of sexual

health. By presenting information in an engaging and interactive format, the app successfully captured users' attention and interest. Participants reported a marked increase in their knowledge of sexual health topics, which they attributed to the app's user-friendly design and comprehensive content. One participant remarked, *"I learnt a lot from the app. This type of app is so important because I don't usually go and search for sexual health-related information"* [P7]

This sentiment was echoed by another participant who stated, *"I did not know about these facts from school or anywhere. Not just for knowledge, I think it will be very useful in your daily life"* [P12]

The application also provided crucial information on sexual hygiene and healthy practices, as it is often neglected in regular life. One participant noted, *"What I learnt the most about is sexual hygiene. Nobody talks about it. It is awkward and even taboo to discuss about this"* [P17]

Information about diverse methods of contraception and STI protection is highlighted by the participants. Some of the comments were:

> *"In India, even in 2024, condom and contraceptive pills are most common. I had no proper idea about other forms of protection, which I first got to know from here"* [P9]

> *"All the information about signs and symptoms of STI I found to be important. I did not know such small symptoms can also indicate something like STI"* [P3]

This highlights the app's effectiveness in making sexual health education more accessible and appealing, thereby encouraging users to learn more about their sexual health, they might have otherwise overlooked. The app's ability to invoke interest and facilitate learning shows its potential as a valuable tool in sexual health education.

Theme 2: Gaming is fun!: The interactive quizzes emerged as one of the most engaging features of the app, as highlighted by multiple participants. The quizzes not only provided a fun and entertaining experience but also facilitated learning in an enjoyable manner. One participant expressed, *"The quiz was very interesting- as while playing I got to know all the information. It was fun, it was interesting and informative above all."* [P2]

The competitive element of the leaderboard was also noted as appealing. Participants appreciated the motivation that the competition provided, encouraging them to engage more frequently with the app. Some of the participants' comments were:

> *"The quiz and the competition, I found as the most appealing part. It made me open the app to get more scores."* [P14]

> *"I would go back to the quizzes again and again to get the answers right"* [P3]

The scoring feature and leaderboard motivated the participants to continually engage with the app to earn more points and achieve a higher rank in the leaderboard. Comments such as *"I wanted to see my name on the leaderboard. So I used to keep playing the quiz, which I enjoyed a lot"* [P6] indicates the effectiveness of the gamified elements in maintaining user interest and promoting continuous interaction with the app.

Theme 3: Ease of Use : The application received high praise for its user-friendly interface, which made it accessible even to individuals who are not very well-versed in technology. One participant commented, *"It is very easy to use, especially for people who are not very accustomed to smartphones, still they can understand the app"* [P3]

A participant also highlighted the straightforward setup process. *"There were no complications at all and you can just use your email ID and set a password and then you can just jump to that and that is so easy to use even for people who are not so technically adaptable"* [P5].

It was also noted that the app was considered to be appropriate for participants of a wide range of ages. *"I think this app is good for all ages. Besides people my age, I think the teenagers and even the older generation can easily use the app without any problem"* [P22]

The language of the app was also mentioned by some participants who appreciated the use of common English words, and some of the medical terms being clearly described. *"Sometimes on the internet, you can find something, but the medical terms, are way difficult to fully understand, and you again have to search for the meaning, The language used in the knowledge corner was easy to follow, and I was not bored"* [P10].

Theme 4: Confidence in Privacy: Ensuring user privacy and the credibility of the content were pivotal in gaining participants' trust. Participants appreciated the app's features that maintained their privacy and did not take or use their personal information. One participant appreciated the anonymity feature, *"I didn't use my first name as my game username. I wasn't giving any personal data and the app also did not ask any permission to access my data in my phone"* [P19].

However, opinions about anonymity varied among participants. Some enjoyed the social aspect of the app, finding it fun to see their friends' rankings on the leaderboard and compete with them. As some participants mentioned,

> *"I was playing the game and I knew my friends were also using the app. It was fun to see our ranks on the leaderboard and competing with my friends"* [P6]

> *"I do not personally care if people see my name on the leaderboard. It is a fun app, and I do not have any reservations about using a sex-education app"* [P1]

These perspectives highlight the balance the app achieved in providing a secure and private environment while also offering a competitive and engaging experience that did not compromise user trust.

Theme 5: I can talk about it: Participants expressed a willingness to continue using the app over time, appreciating its role in facilitating discussions about sexual health. Some of the comments reflecting that are:

> *"I have shared the app with my partner, and I have discussed about it after using. It has made discussion about the topic easier"* [P2].

> *"I used to talk to my friend about beating each other in the leaderboard scores. I also used to talk about if I found anything interesting in the quiz"* [P4].

Another participant reflected on the evolving nature of communication:

> *"I've also seen the subject evolving since like I was a kid. It wasn't even introduced in my school at a young age, it took some time for them to introduce it in 12th standard. I used to talk among friends about sex and sexual health as if it was such a secret. Now, I feel it is much more comfortable to talk about, especially if you are equipped with knowledge"* [P8].

Theme 6: Being mindful of sexual behaviour: The content of the application motivated users to be more conscious of their sexual health and behaviours. The statistical facts about several sexual health topics in Knowledge Corner were

appreciated. *"Things like the statistics on how effective some contraception methods are very important"* [P9].

Moreover, the app served as a crucial reminder for users to consider the implications of their actions before engaging in risky behaviour. Some of the comments about this are,

> *"I think just by seeing the app name on your phone, you might rethink before going into any risky situations"* [P22]

> "I *think I would think about protection from STIs a lot more now, after using the app. I did not have much idea about STIs before*" [P3]

A few of the participants also highlighted how they liked the information about consent and healthy sexual relationships. *"I often forget about boundaries. Some of the quiz questions made me really think, about what real consent is*" [P4].

This increased awareness is crucial for promoting safer sexual practices and reducing the stigma around sexual health topics.

Theme 7: Suggestions for improvement: Participants provided constructive feedback for app improvement. There were many suggestions for new features or some additions to the current features of the app. Some suggested adding more interactive and illustrative elements to enhance usability, as one said, *"Illustrative elements or images could have made it more visually appealing, as I am a visual learner"* [P4]

Another participant expressed a desire for enhanced connectivity with healthcare professionals, *"I think it would have been even better if the app provided contact details to clinics regarding certain sexual health problems or a way to contact professionals"* [P9].

Additionally, the leaderboard feature was discussed, with one participant suggesting, *"Right now only the top 3 ranks are highlighted. I wish there were more highlighted top rankings displayed, then it would have been easier for me to get into the top ranks"* [P6].

There were suggestions for increasing the number of quiz levels to maintain the challenge. "*Increasing number of levels is something I would like to see. Right now, it is very limited. I want more quiz levels, that would be challenging*" [P2]. Another participant suggested enhancing security with biometric features, "*It would have been great if it was just like a fingerprint feature, to just unlock the app*" [P12].

Such feedback underscores the importance of continuously evolving the app to meet user needs and preferences. The responses indicated that participants found the sexual health app to be an effective tool for enhancing knowledge, engaging through gaming features, and being user-friendly. The assurance of privacy and the credibility of the information were critical to their trust in the app. Participants were comfortable using the app in the long term and found it motivating to be mindful of their sexual behaviour. The suggestions provided indicate potential enhancements that could further improve user experience and engagement.

Chapter 6

Discussion

In this chapter, I discuss some of the insights from the results of the evaluations of *Sex-Educated* along with some recommendations for sexual health app developers. I also review the limitations of the research and explore the scope for future works.

6.1 Effectiveness of *Sex-Educated* in Promoting Healthy Sexual Behaviour and Educating about Sexual Health

The research was started with the aim to understand if *Sex-Educated* as an app is effective in promoting sexual health awareness. To understand the app's effectiveness, it was evaluated based on behaviour and knowledge change, motivation, usability and user experience with the app and the overall persuasiveness of the app. In this section, I will reflect on the findings from the evaluations and answer the research questions.

6.1.1 Impact of *Sex-Educated* on Behaviour Change

In previous research, it is seen that attitude, self-efficacy and intention are considered the three main predictors of behaviour change [2,50]. These factors were evaluated before and after using the *Sex-Educated* app and the results showed a significant positive change in attitude, intention and self-efficacy of the participants against risky sexual behaviours after using *Sex-Educated.* From the results, it can be stated, that before using the *Sex-Educated* app, the participants already had fairly positive attitudes, intentions and self-efficacies against risky sexual behaviours. This meant that the only way the *Sex-Educated* could record success with respect to these variables would be a scenario where the results of evaluating these factors after using the app are better than before using it. The initial fairly positive results are probably because of the increasing attention and awareness about sexual diseases in the media, and subsequently the open-mindedness of the current youth. The post-study results, however, show that *Sex-Educated* effectively reinforced attitude, intention, and self-efficacy change towards healthier sexual behaviour.

Since the attitude, intention and self-efficacy results were significantly better than before using the app, it implies that the participants experienced significant positive changes in their attitudes, intentions and self-efficacies against risky sexual behaviours. According to Oinas-Kukkonen et al. [46], one of the possible outcomes of persuasive interventions on a user is a reinforcement of the user's current attitudes or behaviours, making them more resistant to an opposite behaviour change. It is observed from the results that *Sex-Educated* improved the attitude, intention and self-efficacy of participants after its usage.

These results illustrate the power of persuasive apps in helping people to not only change their behaviours but also to reinforce their existing behaviour. This is very important in many cases of behaviour change since human are very susceptible to falling back to their old ways, even after successfully overcoming the undesirable behaviour. Hence, to answer RQ1, RQ2, RQ3, it can be said that *Sex-Educated* fostered a positive change in attitude, intention and self-efficacy, and resulting in a positive change towards healthier sexual behaviour.

6.1.2 Impact of *Sex-Educated* on Knowledge

Knowledge plays a crucial role in behaviour change, and extensive research has established that individuals who are well-informed about the risks and benefits associated with certain behaviours are more likely to alter their actions compared to those lacking such knowledge [14]. In the context of sexual health, this principle is particularly relevant. The more comprehensive the understanding an individual has regarding sexual health, including the distinction between risky and healthy behaviours, the greater their likelihood of modifying their risky sexual practices. The evaluation of the *Sex-Educated* app over a seven-day period revealed a significant enhancement in participants' knowledge about sexual health issues, including diseases and risky behaviours. As depicted in Figure 5.5, a comparative analysis of participants' knowledge before and after using the app showed substantial improvement. Participants themselves noted the educational impact of the app:

> "*I learned so much about sexual health in just a week*" [P12]

> "*I was surprised at how much I didn't know before. It's been eye-opening*" [P15]

Moreover, acquiring knowledge through the app appears to have a broader impact. Users are likely to discuss the information with their peers, fostering social learning and reflection within their communities. As one participant highlighted, "*I found myself talking about the things I learned with my friends, which made me reflect even more on what I knew*" [P8]. This indicates a potential domino effect where individual learning contributes to wider community awareness.

The significant increase in knowledge observed in participants after a week of using the *Sex-Educated* app underscores its effectiveness in enhancing sexual health education. This finding addresses RQ4 and demonstrates the app's success in improving users' understanding of sexual health.

6.1.3 Motivational Appeal of *Sex-Educated* App

ARCS motivation model is widely used to inform the design and evaluation of the motivational appeal of persuasive systems [32]. I used the ARCS motivation model to determine the overall motivational appeal of the *Sex-Educated* app across the four dimensions of motivation: (1) Attention, (2) Relevance, (3) Confidence, and (4) Satisfaction. Orji et al [51] also showed that promoting attention, relevance, confidence and satisfaction in a system can improve the system's persuasiveness too. The result from evaluating the motivational appeal of Sex-Educated has shown all four constructs were higher than the neutral value. which signifies that the app has been successful in creating motivation among its users, capturing their attention, by being relevant to its target audience, boosting confidence with an easy-to-use interface and creating overall satisfaction. In the interviews also, phrases like "*the game had caught my attention*" and "the *content was engaging*", indicated that the participants were motivated to use the app. This answers the RQ5, by showing that Sex-Educated is effective in motivating the users towards the healthy sexual behaviour .

6.1.4 Usability and User Experience of *Sex-Educated*

Studies have shown that the usability of a system is linked to its usefulness and this influences how users evaluate the system [37]. In this study. I employed SUS [7] and UEQ [43] to evaluate usability and user experience. The SUS is a widely used questionnaire-based instrument employed in measuring the perceived

usability of a system which assesses the user's subjective perception of the system's ease of use, efficiency, learnability, and overall user satisfaction. It provides valuable insights into users' perceptions of usability, allowing researchers and designers to understand how usable their system is. The SUS score of the app was calculated to be 73.78 which is higher than the average SUS score of 68 [106]. The results from the UEQ also showed that the app provided a positive user experience. The qualitative results provide further insights into the usability and user experience of the app. The design was considered to be "simple', "easy to use", and "not so complicated" by the participants. Some participants also commented on how the design was easy and simple that it can also be used by people who are not very technologically adept. There were a few suggestions to add more elements in the leaderboard and knowledge corner, to make it more detailed and engaging. This raises the scope for the future version to be tailored to different kinds of users based making it more challenging to experienced users, and easy for new or inexperienced users. To answer the RQ6, it can be said that the overall, usability and user experience of *Sex-Educated* were positive.

6.1.5 Perceived Persuasiveness of *Sex-Educated*

To address the RQ7, the perceived persuasiveness of *Sex-Educated* was evaluated. The persuasiveness of an intervention can result in a change towards the desired behaviour. The higher the persuasiveness of the intervention, the more likely the intervention is to cause the desired behaviour change. In the phase 2 study, the persuasiveness of the individual features was evaluated which gave an insight into what features were more persuasive, and what could be done to improve the persuasiveness of the other features. The feedback was incorporated into the app design and in the phase 3 study the overall persuasiveness of the app was evaluated. From the results, it can be observed that the *Sex-Educated* was perceived to be highly persuasive among the participants. This also validates that the combination of persuasive strategies employed in the app was effective overall.

6.2 Encouraging Open Communication

Sex-Educated app has proven to be a significant facilitator of open communication about sexual health among its users, including interactions between friends and

intimate partners. This effect was particularly evident from user interviews conducted as part of the study. One participant noted, "*As both my partner and I are using the app, we discuss some things we learned*" This feedback underscores the app's role in fostering dialogue about sexual health, thereby contributing to the broader objective of enhancing communication on sensitive topics.

Effective communication is a crucial element in sexual health education and intervention. Addressing sexual health topics through interactive platforms can lead to improved discussion and openness among users [75,76]. By integrating educational content with interactive features, the *Sex-Educated* app not only imparts knowledge but also stimulates conversations among users. This interaction is instrumental in reducing the stigma associated with sexual health topics, encouraging users to engage in discussions that they might otherwise avoid.

The app's design encourages users to share information and insights with their peers, which facilitates a broader dissemination of knowledge. This peer-to-peer interaction can enhance collective understanding and promote a supportive network around sexual health. As users engage in discussions about the app's content, they reinforce their own learning while also contributing to the educational experience of others.

Moreover, the facilitation of communication through the app aligns with best practices for health interventions, which emphasize the importance of creating environments where individuals feel comfortable discussing sensitive issues. By promoting such dialogue, *Sex-Educated* addresses one of the key barriers to effective sexual health education in India: the reluctance to discuss sexual health openly. Sex-Educated app's ability to encourage communication among users not only enhances its educational impact but also supports the creation of a more informed and engaged user community. This communication fosters a culture of openness and mutual support, which is essential for effective sexual health education and behaviour change.

6.3 Increasing Awareness about Risky Sexual Behaviour

Sex-Educated offers detailed explanations of various risky sexual behaviours. By highlighting the potential consequences of these behaviours, the app helps users

recognize the risks involved and understand the importance of taking preventive measures. The app encourages users to be more mindful of their sexual choices by providing clear information about what constitutes risky behaviour. Participants mentioned in interviews, that they did not consider some sexual behaviours risky at all, before knowing about the potential health risks from the app.

> "*I never thought, a small exchange like that could be so dangerous*" [P18]

> "*Learning about the symptoms of the STIs made me more mindful of my choices*" [P9]

This increased awareness is corroborated by the quantitative results from the study, which demonstrate that participants gained a deeper understanding of their sexual health and were more conscientious about their sexual choices. Apart from risky behaviours, participants also mentioned how they became more aware of their sexual hygiene, which they took for granted. By offering guidance on maintaining good sexual hygiene, the app helps users adopt healthier practices and become more aware of their sexual health. Participants reported that their engagement with the app led them to seek additional information independently. One user noted, "*After using the app, I have also searched about a few queries I had regarding my sexual health*" [P14]. This comment underscores how the app has successfully encouraged users to pursue further research and education on their own, thereby amplifying the app's educational reach. By making the topic more accessible and engaging, Sex-Educated stimulates users' interest in learning more about sexual health issues and encourages them to seek out additional resources. Users' proactive approach to seeking further information indicates a positive shift towards greater awareness and understanding of sexual health, which is a critical component of promoting informed decision-making and fostering healthier sexual behaviours.

6.4 Appreciation for a Broad Range of Topics

The evaluation of the *Sex-Educated* app underscores its effectiveness as a comprehensive sexual health tool, addressing a wide range of topics that participants found both novel and valuable. During the user feedback phase, many participants revealed a limited understanding of sexual health, with familiarity restricted to only one or two sexually transmitted infections (STIs). They

expressed surprise and appreciation for the app's broad coverage, which extends beyond mere STI information and contraception. The app's inclusion of diverse topics—ranging from various STIs to their prevention, methods of contraction, and symptoms—was particularly praised. Participants frequently highlighted the benefit of learning about lesser-known STIs and understanding preventive measures, which they had not encountered before. As one participant remarked, "*I only knew about a couple of STIs before, but now I have a much broader understanding of sexual health issues*" [P2]

While previous interventions targeting specific diseases or particular behaviours have demonstrated success, they often address only a narrow segment of the population. As noted by one participant, "*I have seen an app on HIV before, but I did feel the need to use it*" [P20]. This underscores a significant limitation: interventions that concentrate exclusively on one condition may fail to engage users who seek broader, more comprehensive sexual health education. The *Sex-Educated* app addresses this gap by providing a wide array of information on various sexual health topics, including prevention methods, symptom identification, and relational aspects such as consent and communication. This broad-spectrum approach not only diversifies the content but also engages users who might otherwise be disinterested in specialized, disease-specific information. By encompassing a range of topics, the app caters to diverse interests and learning needs, making sexual health education more inclusive and accessible. Participants appreciated the varied content, as it allowed them to explore and learn about different aspects of sexual health that they might not have otherwise encountered. This comprehensive approach fosters a more engaged and informed user base, ultimately supporting better overall sexual health education.

Moreover, the app's emphasis on relational aspects of sexual health, such as consent and communication, received positive feedback. Users valued the app's holistic approach, which integrates practical advice on intimate relationships, including consent and effective communication. As another participant noted, "*The section on relationships and consent was eye-opening. It's something I hadn't seen in other resources and found it very helpful*" [P9]

Overall, the comprehensive nature of *Sex-Educated*, with information on various aspects of sexual health, significantly enhances user knowledge and supports more informed and responsible sexual behaviour.

6.5 Design Recommendations for Future Works

Based on the discussions above, a set of guidelines for designing interventions to promote sexual health awareness and encourage positive behaviour change can be offered.

6.5.1 Need for Information-based Games

A major part of the *Sex-Educated* app is its gamified features. The quiz game in *Sex-Educated* was identified as the most interesting, and informative by almost all the participants in the study. Some comments about the game were

> "*I prefer playing the quiz, rather than reading the information, just as it is*" [P9]
> "*Getting the correct answers, keeping up the scores, it was so fun, but I was happy I was actively learning something in the process.*"

The effectiveness of information-based games, as demonstrated by the quiz game in *Sex-Educated*, lies in their ability to maintain user focus on the educational content while still providing an enjoyable experience. This contrasts with other interventions that may prioritize gameplay over educational value, potentially diverting users' attention from the primary objective of knowledge acquisition. By embedding substantial information within the game, Sex-Educated ensures that users are continuously learning even as they engage in gameplay. This approach not only keeps the learning process engaging but also reinforces the educational objectives of the intervention. The need for information-based games is further underscored by the positive outcomes observed in this study. The integration of educational content within the quiz game resulted in significant knowledge gains among participants, demonstrating that interactive, game-based learning can effectively contribute to behavioural change. Knowledge change is a critical precursor to behaviour change, particularly in the context of sexual health, where informed decision-making is crucial. By enhancing users' understanding of sexual health topics through engaging and interactive methods, information-based games like *Sex-Educated* play a pivotal role in promoting healthier sexual behaviours.

The study's findings advocate for the design and implementation of more information-based games in sexual health apps. These games should strive to balance educational content with engaging gameplay to ensure that users remain

focused on learning objectives while enjoying the experience. Such an approach not only enhances user satisfaction but also maximizes the educational impact of the intervention, leading to more informed and healthier behavioural outcomes.

6.5.2. Keep the Interface "easy to use"

The study results indicate that users appreciate having an app that is easy to use and understand. Existing studies show that mobile apps are often overly complex [158], and many find the interactions with the interface challenging [61,155]. Usability holds great importance concerning behaviour change, as providing someone with an interface with complex navigation or a cluttered UI can cause a loss of confidence and interest in using the system and consequently could result in the abandonment of the system. This will hinder the purpose of the intervention. Many users explained in the interview how easy it was to start using the interface because it was "easy to use." Interviews from this study revealed that many users found the app easy to start using due to its user-friendly interface. Many participants commented on the simplicity of the app.

> "*The app was so easy to navigate. It did have many buttons and icons which sometimes feel very confusing while using a new app*" [P10]

> "*This app was very easy, even for someone who is not very comfortable with mobile games*" [P2]

Based on these findings, several recommendations can be made to enhance usability further:

Use of simple colours and icons: Employing a straightforward colour scheme and a clear icon set helps users quickly understand the function of each feature. This minimizes confusion and reduces the cognitive load required to navigate the app.

Incorporate white space: White space, or the area surrounding content and features, is essential for creating a clean, uncluttered interface. It provides breathing room, making the app visually appealing and easier to navigate. By minimizing the amount of text and functional items displayed at once, white space helps prevent users from feeling overwhelmed.

Declutter the main menu: Keeping the home screen as simple as possible is crucial. Only the most essential features should be highlighted, with additional

options available through intuitive navigation. This approach ensures that users can quickly find and access what they need without unnecessary complexity.

6.5.3 Design for Customizable Difficulty Level in the Game

In the study, feedback regarding the quiz difficulty was notably diverse, with some participants describing the quizzes as difficult while others perceived them as easy and completed them very quickly. This variability in-game experience highlights the challenge of designing a 'one-size-fits-all' system. To ensure uniformity for research purposes, the quizzes were designed with a standardized difficulty level. However, this approach does not account for the diverse range of user abilities and experiences, which can impact engagement and learning outcomes. To enhance the player experience and educational efficacy of the app, future versions could benefit from incorporating customizable difficulty settings. Allowing users to select their preferred difficulty level—such as 'easy', 'medium', or 'difficult'— would enable a more tailored learning experience.

Moreover, integrating adaptive difficulty levels that adjust based on real-time analysis of in-game player data could further refine the user experience. This adaptive mechanism would dynamically respond to the user's performance, providing a balanced challenge that is neither too easy to induce boredom nor too difficult to cause frustration. Such an approach would not only cater to individual learning paces but also sustain user engagement over time. By collecting and analyzing background data on player interactions and performance, the system could intelligently adjust the difficulty, ensuring an optimal balance that promotes continuous learning and retention. Incorporating these enhancements would address the mixed reactions observed in the study, making the quiz component more effective and enjoyable for a broader range of users. Ensuring that the quizzes remain challenging yet achievable is crucial. Balancing difficulty across levels so that each new stage feels like a natural progression from the last can keep users motivated without causing frustration.

6.5.4 "I want to play more"- Design for Longer Gameplay

The diverse range of participants and their varied motivations for engaging with the *Sex-Educated* app highlighted distinct user experiences, particularly in their

interaction with the quiz game. While the app's quiz content was robust enough to evaluate user behaviour and experiences effectively, it became apparent that some users completed all available levels with remarkable speed, indicating a high level of engagement and interest. For instance, one participant remarked, "*I love playing quizzes, and I enjoyed this quiz so much that I exhausted all the levels in 2 days*" [P20]. This suggests that the existing levels might not have provided enough challenge or variety to sustain prolonged engagement for all users. Additionally, feedback from other participants underscored the desire for more content. Some users expressed a preference for not revisiting completed levels, highlighting a need for continuous challenge and novelty. As one participant noted, "*Once I finish a level successfully, I do not like to go back and repeat it*" [P9]. This sentiment indicates that while the quiz was enjoyable, its replay value was limited without additional content. Another participant added, "*I wish there were more levels in the game. I wanted to play more*" [P4], emphasizing the demand for an expanded quiz structure to enhance user engagement and satisfaction.

To address these points and further enhance the quiz game's appeal, I recommend the addition of more challenging and longer games. However, it should be kept in mind, longer game designs can also cause loss of interest and negatively impact the user engagement. To tackle that, introducing branched new levels with increasing difficulty can help maintain user interest and challenge, thereby prolonging engagement. Escalating challenges and adding new content are essential for keeping users invested. Furthermore, incorporating diverse question types and themes related to sexual health can enrich the educational experience, making learning more comprehensive and engaging. The extension of the game with additional levels should focus on maintaining the engaging and interactive nature of the original content. One approach is to incorporate narrative elements that progress with each level, offering a storyline that unfolds as users advance. This can provide a sense of continuity and purpose, encouraging users to keep playing to discover what happens next. Additionally, integrating various types of interactive content such as multimedia elements, and scenario-based questions can diversify the user experience, making it more dynamic and less monotonous.

Overall, expanding the number of levels and diversifying the quiz content would likely increase user satisfaction, encourage continued use of the app, and reinforce the positive impact on users' sexual health knowledge and behaviours.

6.5.5 Balancing Privacy with Social Features

Many users express concerns about privacy when using health-related apps, especially in communities where sexual health is not an open topic of conversation. These concerns can range from fears about data breaches to worries about their personal information being shared without consent. In the domain of sexual health, these worries are exacerbated by the stigma often associated with sexual health issues. Users may fear judgment or discrimination if their use of such an app were to become known. Therefore, it is essential that sexual health apps prioritize privacy to alleviate these concerns.

Allowing users to interact with the app without revealing their real identities can significantly reduce the fear of stigma. For instance, enabling users to choose pseudonyms or different usernames can help them feel more comfortable and secure while using the app. This approach was validated in our study, where participants appreciated the ability to use the app without disclosing personal information. A participant said, "*I didn't use my first name as my game username. I wasn't giving any personal data and the app also did not ask any permission to access my data in my phone*" [P19]. This highlights the importance of anonymity in user satisfaction and engagement.

While privacy is paramount, it is also important to balance it with social features that can enhance user engagement. Features such as leaderboards can motivate users by introducing a competitive element. However, it is essential to implement these features in a way that maintains user anonymity. For example, displaying pseudonyms rather than real names on leaderboards can provide social and motivational benefits without compromising privacy. As one participant noted, "*I wanted to be on the leaderboard, but I did not want to show others my real name, so I used a different username*" [P16], indicating that anonymity does not detract from the app's engaging features. However, this feeling varied among participants. Some participants expressed,

> "I *do not mind if my real name shows on the game. It is a fun game, nothing to be ashamed about*" [P3]

> "*It was fun playing with people you know. When I saw my friend's name on the top rank, I wanted to get more score to compete with him.*" [P7]

Given these mixed reactions, it is essential to incorporate flexible privacy settings in sexual health apps. Allowing users to choose their level of anonymity based on their comfort can cater to a broader audience, ensuring that everyone feels secure while using the app. By providing options for both real name usage and pseudonymity, developers can create a more inclusive environment that respects individual preferences and encourages participation. This flexibility not only enhances user trust but also supports the app's goal of promoting sexual health awareness and education effectively.

6.6 Study Summary

This research focuses on designing a persuasive app to encourage education on sexual health and promote healthy sexual behaviour. The initial design of the system was based on Fogg's 8-step process of designing a persuasive intervention. The app was also developed in two phases, following a UCD approach, taking the user feedback from the first phase and finally developing the app. The app was evaluated with a sample population, with surveys before and after the in-app evaluation, and interviews. The results show significant improvement in attitude, intention and self-efficacy, which are the key indicators of behaviour change. As the app is knowledge-based the change in knowledge among the participants was also analysed, and the results show a significant improvement. The app was based on persuasive strategies, the persuasiveness of the app is a crucial factor. The findings from the study show the app is highly persuasive and motivating. It is very important to have a positive experience while using the app, otherwise, even if the intervention has various persuasive features and motivating content, the user will not tend to use the app. The results show that the app cultivated a positive user experience. The overall findings from this research, answer all the research questions that were formulated to answer the primary research question of "Can *Sex-Educated* promote healthy sexual behaviour and educate about sexual health?" Table 6.6 summarises the findings.

Tested variables	Outcomes
Efficacy of the app to promote behaviour change (attitude, intention, self-efficacy, and knowledge)	Positive change in attitude, intention, self-efficacy, and knowledge of the participants
Motivational appeal	Highly Effective overall as well as across four dimensions (attention, relevance, confidence, and satisfaction)
Usability and User-Experience	Positive usability and user-experience
Persuasiveness	Highly Persuasive

6.7 Limitations

Although this research uncovered many interesting results, there are several limitations.

- The first limitation of the research is the issue of self-reporting. Although, before the user study, the participants were instructed to answer the questions sincerely and to make their answers a representation of their individual states of mind, it is common knowledge that human perception is not always perfect, and bias would most likely be present. There is no way to ensure that participants were actually answering the attitude, efficacy and intention questions without bias. Nevertheless, self-reporting is still the valid and predominant approach for assessing beliefs and attitudes in the area of HCI.

- *Sex-Educated* was made only for Android devices. Although research shows that Android devices possess the most smartphone penetration in India [59], this does not mean that there are no users of other smartphone platforms like iPhone. This means that this intervention does not cater to these other smartphone populations.

- The present study could also have some other external validity issues because it was not checked if the observed behaviour change identified in this user study is a temporary change or a permanent stage. The time for the study was too short and the time point of data collection was too few. A more detailed study would possess more than two time points for collecting data about the players' behaviour, over a longer period of time.

- Another limitation is the demographic characteristics of our participants. As shown in Table 5.2, the demographic data of participants were not balanced. For Age, there was 21%, 72%, 7% and 0% respectively in the 4 different categories. Gender had 54%, 44% and 2% respectively in the 3 categories while Academic qualification had 2%, 45%, 41%, 12%, respectively in the 5 categories. These unbalanced demographic representations made it difficult to draw some insight from the demographic data. This imbalance has the potential to introduce bias and thereby limit the generalization of these findings.

6.8 Future Work

In this section, I outline some areas of future development of *Sex-Educated.*

- **Integration of Multimedia Elements:** The current iteration of Sex-Educated primarily relies on text-based content, which, while informative, can become monotonous for users. Future updates should incorporate a diverse range of multimedia elements, including videos, images, and interactive graphics. Video content can offer dynamic explanations of sexual health topics, providing visual and auditory reinforcement of key concepts. For instance, educational videos could demonstrate safe sex practices, explain complex health information, or feature testimonials from healthcare professionals. Images and infographics can visually break down intricate information, making it more accessible and engaging. The inclusion of these multimedia elements is expected to enhance user interaction, maintain user interest, and improve overall comprehension of the material.

- **Incorporation of Local Sexual Health Resource Information:** Another critical enhancement is the integration of information about local sexual health clinics across India. Currently, users of the app lack access to practical resources that could help them seek further assistance or services. By incorporating a feature that allows users to locate nearby sexual health clinics and services, the app could provide actionable support beyond educational content. This addition would help bridge the gap between learning and practical application, empowering users to access healthcare services when needed. A geolocation feature could enable users to find clinics based on their current location, and the inclusion of contact information and service descriptions could further aid in navigating these resources.

- **Expanding Sexual Health Topics to Include LGBTQ+ Needs:** Incorporating sexual health and sexuality topics specifically tailored for the LGBTQ+ community in the app will ensure inclusivity and comprehensive education. This addition would address the unique challenges and health concerns faced by LGBTQ+ individuals, such as understanding sexual orientation, gender identity, and the risks associated with different types of sexual activities. By providing accurate, non-judgmental information and resources, the app can support the diverse needs of all users, promoting a more inclusive approach to sexual health education. This expansion would also help in filling the significant gap in accessible sexual health information for LGBTQ+ individuals in India, fostering a greater understanding of sexual diversity and helping to reduce stigma.

- **Development of a Multi-Language Interface:** While the *Sex-Educated* app was designed with the Indian audience in mind, it is currently available only in English. Despite English being one of India's official languages, a significant portion of the population prefers or requires content in other Indian languages. To broaden the app's accessibility and inclusivity, future development should focus on creating a multi-language interface. This feature would involve translating the app's content into major Indian languages, such as Hindi, Bengali, Tamil, Telugu, and others. By offering language options, the app can cater to a more diverse user base, enhancing its usability and effectiveness across different linguistic demographics.

Chapter 7

Conclusion

This thesis represents a pivotal contribution to the realms of PT and Human-Computer Interaction for Development (HCI4D) within the larger HCI domain by creating a persuasive sexual health app specifically designed for the Indian population. It showcases how persuasive applications can be crafted to enhance understanding and promote awareness about sexual health, addressing a significant public health issue in a context where conversations about sexual health are frequently stigmatized in the community.

The research was conducted in three distinct phases to ensure thorough and reliable findings. The initial phase involved the conceptualization and designing of the app. The second phase involved iterative refinement of the app, incorporating feedback from potential users to ensure its relevance and effectiveness. The final phase of the study included the development and evaluation of the app, during which participants actively used the app for a week. The results from this evaluation phase were compelling, indicating that the app significantly influenced users' attitudes, intentions, and self-efficacy against risky sexual practices, resulting in a positive behavioural change. The app also improved the participants' knowledge of sexual health and provided information about healthy sexual behaviour. The educational aspect of the app was highly appreciated by the participants. Participants' feedback also highlighted the app's high motivational appeal and persuasiveness. The results revealed that users found the content engaging and the interface user-friendly, which facilitated a deeper understanding of sexual health topics. This positive reception was corroborated by the quantitative and the qualitative data.

Moreover, the study demonstrates the effectiveness of integrating PT with a UCD approach. By actively involving users in the design process, the app was tailored to meet the specific needs and preferences of its target audience, enhancing its relevance and impact. This approach ensured that the app was not only educational but also engaging and accessible, thereby maximizing its potential to effect meaningful behavioural change.

A key strength of this research is its focus on an often-overlooked demographic. While many existing sexual health apps are tailored for users in the USA, Southeast Asia, or African countries, this study addresses a critical gap by targeting the Indian context. By including relevant content such as sexual health issues that are common in India, promoting clear communication among partners, and topics such as consent, and boundaries, *Sex-Educated* is made to cater to its Indian audience, where cultural taboos and limited resources frequently impede effective sexual health education. By developing an app specifically for a developing country with low-resourced communities, this research underscores the importance of culturally and contextually appropriate design in health interventions.

The implications of this study are far-reaching. It provides a valuable framework for designers and developers aiming to create sexual health apps that are not only usable and useful but also culturally sensitive and acceptable to their target audiences. The insights gained from this research can inform the development of similar apps in other contexts, potentially improving health outcomes, fostering healthier relationships, and promoting better sexual lifestyles globally. This thesis highlights the potential of well-designed persuasive technologies to drive positive social change, particularly in underserved populations.

In conclusion, this thesis offers a significant advancement in leveraging persuasive interventions to promote sexual health awareness. It illustrates the power of persuasive mobile apps in enhancing knowledge and promoting healthier behaviours. The findings from this research provide valuable insights for future studies, paving the way for more effective and culturally relevant health interventions through technology.

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Appendix A: Ethics Approval for Both the Phases of User Study

Phase 2

Health Sciences Research Ethics Board
Letter of Approval

July 18, 2022

Pratyasha Bhattacharya
Computer Science\Computer Science

Dear Pratyasha,

REB #:   2022-5966
Project Title: Design and development of a mobile application to spread awareness about risky sexual behavior among young adults in India

Effective Date: July 15, 2022
Expiry Date: July 15, 2023

The Health Sciences Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans.* This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Phase 3

Health Sciences Research Ethics Board
Letter of Approval

February 12, 2024

Pratyasha Bhattacharya
Computer Science\Computer Science

Dear Pratyasha,

REB #:   2024-7050
Project Title: Evaluating a Persuasive Sex Education App for Indians
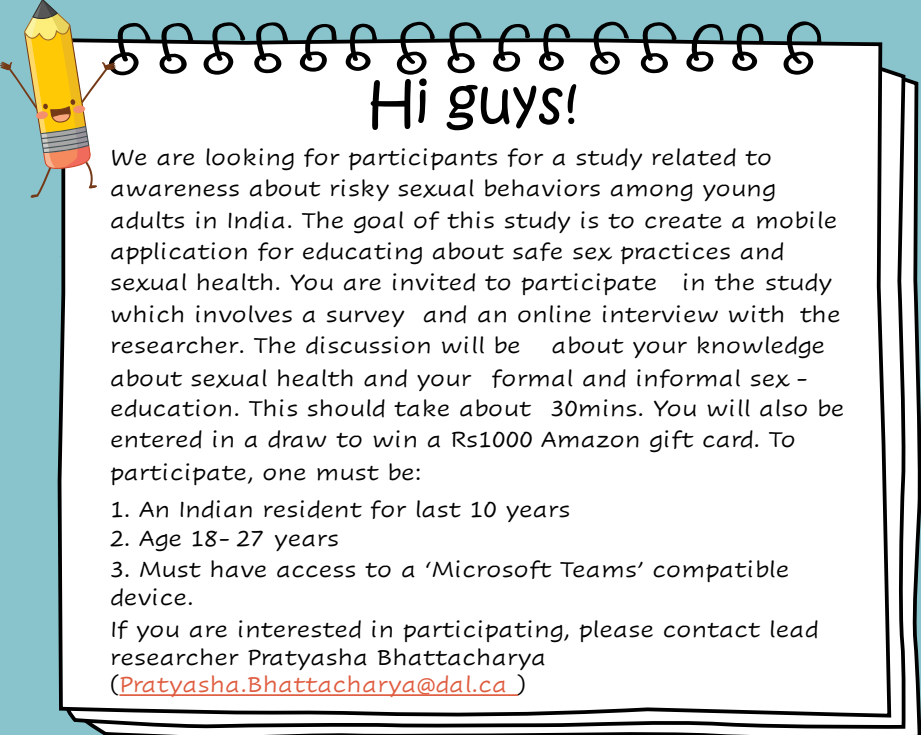
Review Type: Delegated Review
Effective Date: February 12, 2024
Expiry Date: February 12, 2025

The Health Sciences Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be ethically acceptable in accordance with the *Tri-Council Policy Statement Ethical Conduct for Research Involving Humans.* This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Appendix B: Recruitment Notice for Phase 2 study

Hi guys!

We are looking for participants for a study related to awareness about risky sexual behaviors among young adults in India. The goal of this study is to create a mobile application for educating about safe sex practices and sexual health. You are invited to participate in the study which involves a survey and an online interview with the researcher. The discussion will be about your knowledge about sexual health and your formal and informal sex - education. This should take about 30mins. You will also be entered in a draw to win a Rs1000 Amazon gift card. To participate, one must be:

1. An Indian resident for last 10 years
2. Age 18- 27 years
3. Must have access to a 'Microsoft Teams' compatible device.

If you are interested in participating, please contact lead researcher Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca)

Appendix C: Consent Form for Phase 2 Study

Project title: Design and development of a mobile application to create awareness about risky sexual

behaviour among young adults in India

Lead researcher: Pratyasha Bhattacharya, a graduate student at the Faculty of Computer Science, Dalhousie

University.

Contact person: Pratyasha Bhattacharya, Faculty of Computer Science

Pratyasha.Bhattacharya@dal.ca (+1-902-989 7379)

Supervisor: Dr. Rita Orji, Faculty of Computer Science, rita.orji@cs.dal.ca

Introduction

We would like to invite you to participate in a research study being conducted by Pratyasha Bhattacharya on an online platform called 'Microsoft Teams'. You may leave the study at any time. This is a study, and participation is entirely voluntary. The information provided below explains what is involved in the research, what you will be asked to do, and any benefits, risks, inconvenience or discomfort that you might experience. Participating in the study may not benefit you, but it is possible that we will learn something that will benefit others. You should ask Pratyasha, the lead researcher, any questions you have about this study. Please feel free to ask as many questions as you want. If you have any further questions, please contact the researcher,

Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca)/(+1-902-989-7379)..

Purpose and the Research Study

The study's goal is to create a mobile application aims at increasing awareness about risky sexual behaviors and promote knowledge about safe sex practices and sexual health. You will be asked to explore a mobile app prototype and give your opinion about the design, concept and features. You will also be asked to share your feedback, experience, and also share your likes and dislikes about the prototype along with your valuable suggestions about the design of the app. The interview session will last 15-20 minutes. With your permission, the interview will

be audio recorded. If you wish to discontinue at any point of the study, your data will be deleted and your account will not be used in the study.

Who Can Take Part in the Research Study:

To participate in this study, you must be an Indian resident who has resided in India for at least 10 years in the last 15 years, 18-28 years old.

Possible Benefits, Risks and Discomforts:

There is no potential risk associated with this study.

How your information will be protected:

The audio recordings of the interview will be securely stored in password-protected Onedrive, accessible only to the lead researcher (ie, Pratyasha Bhattacharya) and will be deleted after the results are published.

If You Decide to Stop Participating:

If you wish to stop participating in the optional interview, you can leave the session. Your contribution will be discarded if you wish to leave. You can also withdraw from the study at any time as long as the data is not analysed (within 2months from the beginning of the study).

How to Obtain Results

When the entire study will be completed, the results will be published which may hold anonymous comments from participants using participant ID as P1, P2. No individual results will be provided. You can check the below check box to receive a copy of the publication. I want to receive the details when the study is published

Questions

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca, +1-902-989 7379) [or Rita Orji (at rita.orji@dal.ca)] at any time with questions, comments, or concerns about the research study. If you have any ethical concerns about your participation in this research, you may also contact Research Ethics, Dalhousie University at 902-494-3423, or email: ethics@dal.ca. and reference REB Submission[Bhattacharya].

Consent

I have read the explanation of this study. I have been given the opportunity to contact and discuss any question related to the study and my questions have been answered to my satisfaction.

I agree to take part in this study. My participation is voluntary, and I understand that I am free to not complete the interview if I choose.

I understand that my responses during the optional interview will be audio-recorded. I agree that direct quotes from my responses may be used without identifying me:

☐ Yes
☐ No
☐ Name: _____
☐ Email id: _____
☐ Date: _____

I consent, and I agree to participate.

Appendix D: Phase 2 Demography and Background Questionnaire

What is your age ?

○ 18 - 21
○ 22 - 25
○ 26 - 29
○ 30 - 34
○ 35 and above

What do you identify yourself as ?

○ Male
○ Female
○ LGBTQIA+
○ Prefer not to say

What is the highest level of education you have completed ?

○ Less than High school
○ High School or equivalent
○ College diploma
○ Bachelor's degree
○ Master's degree
○ Doctoral degree

What is your marital status ?

○ Single
○ Married
○ Widowed
○ Divorced
○ Separated
○ Other, specify

_____

Are you currently living in India ?

○ Yes
○ No

[If you currently do NOT live in India, please skip this question]
How long have you been in India?

○ 0-5 years
○ 6-10 years
○ 11-20 years
○ More than 20 years

[If you currently live in India, please skip this question]
How long have you been in India?

○ 0-5 years
○ 6-10 years
○ 11-20 years
○ More than 20 years

How would you describe your area of residence ?

○ City
○ Town
○ Rural area

What is your current occupation ?

○ School student
○ Undergraduate student
○ Grad student/ Postdoc
○ Government employee
○ Private firm employee
○ Self-employed
○ Military
○ Unemployed
○ Others, please specify

Did you get a formal sex education in school/ educational institute ?

○ Yes

○ No

Did you have an informal sex education from your parents/guardians at home?

○ Yes

○ No

Were you comfortable to ask questions about sexual health to your parents/guardians ?

○ Yes

○ No

At what age did you acquire knowledge about sexual health and sex education ?

○ Below 9 years

○ 9-12 years

○ 13-17 years

○ 18 and above

Appendix E: Phase 2 Survey

Motivational Appeal Test

The app would capture and hold my attention.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly Agree

The app has some content that stimulates my curiosity.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The content of the app would be relevant to me.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The purpose of the app makes sense to me.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

I can relate with the content and goal of this app.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The content of the system would be useful to me.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The app is easy to use for me.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The purpose of the app does not make sense to me.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

I am comfortable using this app.

	1 2 3 4 5	
Strongly disagree	○ ○ ○ ○ ○	Strongly agree

The app design is aesthetic.

1 2 3 4 5

Strongly   ○ ○ ○ ○ ○   Strongly
disagree   agree

I would really enjoy using the app.

1 2 3 4 5

Strongly   ○ ○ ○ ○ ○   Strongly
disagree   agree

The app is very complex to use.

1 2 3 4 5

Strongly   ○ ○ ○ ○ ○   Strongly
disagree   agree

It would be a pleasure to work with a system like this.

1 2 3 4 5

Strongly   ○ ○ ○ ○ ○   Strongly
disagree   agree

The app would help me have better knowledge about sexual
health.

1 2 3 4 5

Strongly   ○ ○ ○ ○ ○   Strongly
disagree   agree

Perceived Persuasiveness Test

This feature shows you the levels of the quiz game. Each level represents a bud. Once you start a level by clicking on a bud, you will get 10 questions about sexual health. One needs to get at least 8 out of 10 questions correct to go to the next level. Once you complete a level, the bud will bloom into a flower. Your goal is to make all the flowers in the vine fully bloomed.

		1 2 3 4 5	
This feature would influence me to be more aware about healthy sexual behaviour.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree

		1 2 3 4 5	
This feature would convince me to be improve my sexual lifestyle.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree

		1 2 3 4 5	
This feature would be personally relevant for me.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree

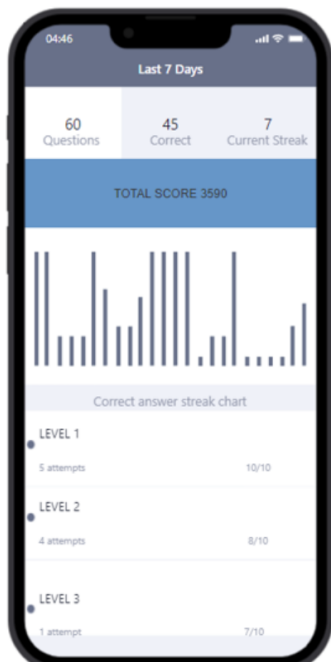|		1 2 3 4 5	
This feature would make me mindful of my sexual behaviour and practices.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree

This is the Level completion screen. Once you get at least 8 out of 10 questions correct in a level, you will see a screen congratulating you for completing a level. From this screen, you can move to the next level or play the same level again.

This feature would influence me to be more aware about healthy sexual behaviour.	Strongly disagree	1 ○ 2 ○ 3 ○ 4 ○ 5 ○	Strongly agree

This feature would convince me to be improve my sexual lifestyle.	Strongly disagree	1 ○ 2 ○ 3 ○ 4 ○ 5 ○	Strongly agree

This feature would be personally relevant for me.	Strongly disagree	1 ○ 2 ○ 3 ○ 4 ○ 5 ○	Strongly agree

This feature would make me mindful of my sexual behaviour and practices.	Strongly disagree	1 ○ 2 ○ 3 ○ 4 ○ 5 ○	Strongly agree

This is the My Scores feature. In this feature you can see the total number of questions you have attempted, number of your correct answers and the most current streak of correct answers. You can also see your scores from last 7 days in a graph. The scores in every level are also be shown in this screen.

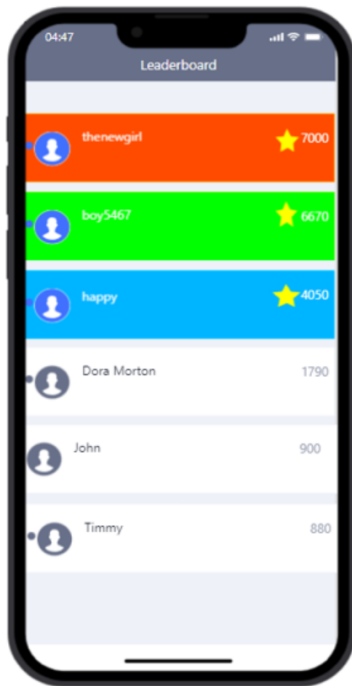| This feature would influence me to be more aware about healthy sexual behaviour.	Strongly disagree	1 2 3 4 5 ○ ○ ○ ○ ○	Strongly agree
This feature would convince me to be improve my sexual lifestyle.	Strongly disagree	1 2 3 4 5 ○ ○ ○ ○ ○	Strongly agree
Please select option 4.	Strongly disagree	1 2 3 4 5 ○ ○ ○ ○ ○	Strongly agree
This feature would be personally relevant for me.	Strongly disagree	1 2 3 4 5 ○ ○ ○ ○ ○	Strongly agree
This feature would make me mindful my sexual behaviour and practices.	Strongly disagree	1 2 3 4 5 ○ ○ ○ ○ ○	Strongly agree

This is the Leaderboard feature. This feature will show you your rank among other players in the app based on your score.. You can also see the top players with the highest scores in this feature..

This feature would influence me to be more aware about healthy sexual behaviour.	1 2 3 4 5	
	Strongly disagree ○ ○ ○ ○ ○	Strongly agree

This feature would convince me to be improve my sexual lifestyle.	1 2 3 4 5	
	Strongly disagree ○ ○ ○ ○ ○	Strongly agree

This feature would be personally relevant for me.	1 2 3 4 5	
	Strongly disagree ○ ○ ○ ○ ○	Strongly agree

This feature would make me mindful my sexual behaviour and practices.	1 2 3 4 5	
	Strongly disagree ○ ○ ○ ○ ○	Strongly agree

Appendix F: Interview Questions for Phase 2 Study

Sexual health education through a mobile application

1. Would you prefer to use an application that would provide information about sexual health and safe sex practices? Why?

2. Will you feel comfortable using this application?

3. Do you have any concerns or doubts about this kind of mobile application?

Feedback on the app prototype

4. How was your experience with the app prototype?

5. Which feature did you like the most? Why?

6. Is there any feature that you did not like? Why?

7. Do you have any suggestions/comments about the app?

Appendix G: Recruitment Notice for Phase 3 Study

Participants Needed

For evaluating a persuasive sex education app for Indians

You are invited to take part in a research study to evaluate a mobile app called *Sex-Educated*. You will be contributing to determining if *Sex-Educated* can increase your knowledge of sexual health. For the study you will be asked to use the Sex-Educated app for a week and then take an online survey and an interview (optional).
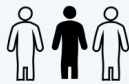
You can participate if :

You are an Indian citizen of age 18 and above

You have access to an android phone

If you meet the above criteria and are interested in participating, please click on this link: https://surveys.dal.ca/opinio/s?s=75934

All data will be treated confidentially and for research purposes only.

If you have any question about the study, feel free to contact the lead researcher Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca).

DALHOUSIE UNIVERSITY

Appendix H: Consent Form for Phase 3 Study

Project title: Evaluating a Persuasive Sex Education App for Indians

Lead researcher: Pratyasha Bhattacharya,

 Faculty of Computer Science, Dalhousie University

 Pratyasha.Bhattacharya@dal.ca (+1(902)989 7379)

Other researchers

Dr. Rita Orji, Faculty of Computer Science,

rita.orji@cs.dal.ca

Introduction

We would like to invite you to participate in a research study being conducted online by Pratyasha Bhattacharya. You may leave the study at any time during the study. Your participation is entirely voluntary in this study. The information provided below explains what is involved in the research, what you will be asked to do, and any benefits, risks, or inconvenience or discomfort that you might experience. Participating in the study may not benefit you directly, but it is possible that we will learn something that will be beneficial. You can ask Pratyasha, the lead researcher, any questions you have about this study. Please feel free to ask as many questions as you want. If you have any questions, please contact Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca)/(+1(902)989-7379).

Purpose and Outline of the Research Study

The study's goal is to evaluate a mobile app that aims to increase awareness about risky sexual behaviors and promote knowledge about sexual health. The study will include using the mobile app for 7 days (approximately 5-7 minutes/day), and then providing your feedback about the app through a survey. The survey may take upto 20 minutes. You can also choose to participate in an optional one-to-one interview, to share a more detailed insight about your experience using the app.

Who Can Take Part in the Research Study

- You must be an Indian citizen of age 18 and above.

- You must have access to an android/iOS mobile phone.

What You Will Be Asked to Do

You will be requested to install and use the Sex-Educated mobile app for 7 days (approximately 5-7 minutes per day).

After 7 days you will be asked to complete a survey. The survey will contain some demographics and some simple questions about your perception of the app. The survey may take up to 20 minutes.

You can choose to participate in a one-to-one interview after the survey, to provide more detailed feedback on the app. The interview will be scheduled on Microsoft Teams and can take 25 minutes.

Possible Benefits, Risks and Discomforts

Benefits: Participating in the study might not benefit you directly, but we both might learn things that will be beneficial.

Risks: There are no known risks to this study. This app will not cause any discomfort in your device's performance.

Incentives / Reimbursement

No incentive is provided.

How your information will be protected:

Privacy: Your participation in this research will be known only to the lead researcher.

Confidentiality: The information that you provide to us will be kept confidential. Only the lead researcher at Dalhousie University will have access to this information. Our research team will keep all research information confidential. All your identifying information (such as your name and contact information) will be securely stored separately from your research information. We will use a participant number (not your name) in our written and computer records so that the research information we have about you contains no names. During the study, all electronic records will be kept secure in an encrypted file on the researcher's password-protected computer.

We will describe and share our findings in thesis, presentations, and journal articles. We will only report aggregate results and not individual results. This means that you will not be identified in any way in our reports.

Data retention: Once the study is over, your data will be deidentified, and will be destroyed after 6 months of the study.

If You Decide to Stop Participating

You would be free to stop using the app at any time, but you should inform the lead researcher about that. If you successfully complete using the app for one week and then while filling the survey you want to stop, you may go ahead and not submit it but if you submit it and then do not want to go for the one-to-one interview then your survey contribution cannot be discarded by the lead researcher.

You would be free to leave the one-to-one interview at any time and the lead researcher would be able to disregard/delete your contribution. After participating in the interview, you can decide for up to 7 days if you want us to remove your interview response. After that time, it will become impossible for us to remove it because it will already be analysed and anonymized.

How to Obtain Results

Describe what study results will be made available and how.

When the entire study will be completed, the results will be published which may hold anonymous comments from participants using participant ID as P1, P2. No individual results will be provided. You can check the below check box to receive the details of the published work via email.

☐ I want to receive the details when the study is published.

Questions

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact Pratyasha Bhattacharya (Pratyasha.Bhattacharya@dal.ca, +1-902-989 7379) or Rita Orji (rita.orji@dal.ca) at any time with questions, comments, or concerns about the research study. If you have any ethical concerns about your participation in this research, you may also contact Research Ethics, Dalhousie University at 902-494-3423, or email: ethics@dal.ca. and reference REB Submission [Bhattacharya].

Signature Page

Project Title: Evaluating a Persuasive Sex Education App for Indians

Lead Researcher: Pratyasha Bhattacharya,

   Faculty of Computer Science, Dalhousie University

   Pratyasha.Bhattacharya@dal.ca (+1-9020989 7379)

If you want to participate in the study, please read and fill the section below:

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I understand that I have been asked to take part in a study. I agree to take part in this study. My participation is voluntary, and I understand that I am free to withdraw from the study at any time, during using the app, and the survey.

_____   _____   _____

Name   Signature   Date

Please enter your email ID for contact: _____

If you choose to opt in for participating in the optional one-to-one interview after the survey, please read the next section:

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I understand that I have been asked to take part in an interview that will occur on Microsoft Teams. I agree to take part in this study. I realize that my participation is voluntary and that I am free to withdraw from the study at any time, until 7 days after my interview is completed.

_____   _____   _____

Name   Signature   Date

Options (you can still participate in the research if you select no):

I agree that my interview may be audio-recorded   ☐Yes ☐No

I agree that direct quotes from my interview may be used without identifying me
 ☐Yes ☐No

_____   _____   _____

Name   Signature
            Date

Submit

Appendix I: Demographics Questionnaire for Phase 3 Study

1. Enter the your email you provided on participation :

   [   ]

2. **Are you an Indian ?**

   ○ Yes

   ○ No

3. **What is your age ?**

   ○ Under 18

   ○ 18 - 24

   ○ 25 - 30

   ○ 31 - 36

   ○ 37 - 42

   ○ 43 - 49

   ○ 50-59

   ○ 60+

4. **What do you identify yourself as ?**

   ○ Male

   ○ Female

   ○ LGBTQIA+

   ○ Prefer not to say

5. **What is the highest level of education you have completed ?**

   ○ Less than High school

   ○ High School or equivalent

   ○ Bachelor's degree

   ○ Master's degree

   ○ Doctoral degree

6. **What is your relationship status ?**

   ○ Single

   ○ In a relationship

   ○ Married

   ○ Separated

   ○ Divorced

7. **How would you describe your area of residence ?**

○ City

○ Town

○ Rural area

8. **What is your current occupation ?**

☐ School student

☐ Undergraduate student

☐ Grad student/ Postdoc

☐ Medical health professional

☐ Government employee

☐ Private firm employee

☐ Self-employed

☐ Unemployed

Appendix J: Pre-test Survey

14. I intend to ensure that my partner consents before any sexual activity.

        1 2 3 Neutral 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

15. I intend to use a condom or barrier method protection whenever I have sex with someone not my exclusive partner.

        1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

16. I intend to use an non-emergency contraception (condom, IUD, birth-control pill) if I am not planning to have a child

        1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

17. I intend to be open to communicate with my partner before and during sexual activity.

        1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

18. I intend to do an STI test periodically if I have unprotected sex or have more than one partner.

        1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

[Next]

Tell us how you feel about the following statements :

9. Having safe sex is

        1 2 3 4 5 6 7

Uninportant ◯ ◯ ◯ ◯ ◯ ◯ ◯ Important

10. Having safe sex is

        1 2 3 4 5 6 7

Harmful ◯ ◯ ◯ ◯ ◯ ◯ ◯ Beneficial

11. Having safe sex is

        1 2 3 4 5 6 7

Unpleasant ◯ ◯ ◯ ◯ ◯ ◯ ◯ Pleasant

12. Having safe sex is

        1 2 3 4 5 6 7

Dangerous ◯ ◯ ◯ ◯ ◯ ◯ ◯ Adventurous

13. Having safe sex is

        1 2 3 4 5 6 7

Unenjoyable ◯ ◯ ◯ ◯ ◯ ◯ ◯ Enjoyable

[Next]

19. **I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

20. **I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent at that time even if it was decided earlier.**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

21. **If I want, I could reject a sex offer from someone I am sexually attracted to.**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

22. **I am confident that I will always use a condom when having sex.**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

23. **I am confident that I can always use a protection even if my partner refuses to**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

24. **I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent.**

               1 2 3 4 5 6 7

Extremely unlikely ◯ ◯ ◯ ◯ ◯ ◯ ◯ Extremely likely

Thank you!
Please continue to use the app Sex-Educated for the next few days.

Finish

Appendix K: Post-test Survey

Behaviour change questionnaire

		1 2 3 4 5	
How likely are you to have vaginal sex without a condom?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
How likely are you to have anal sex without a condom?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
How likely are you to have sex under the influence of alcohol?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
How likely are you to have oral sex without a condom/dental dam?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
How likely are you to have sex under the influence of drugs or substances?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
How likely are you to have sex without a condom with someone you have just met?	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely
Avoiding risky sexual behaviour is	Uninportant	○ ○ ○ ○ ○	Important
Having safe sex is	Harmful	○ ○ ○ ○ ○	Beneficial
Having safe sex is	Unpleasant	○ ○ ○ ○ ○	Pleasant
Avoiding risky sexual behaviour is	Dangerous	○ ○ ○ ○ ○	Adventurous
Having safe sex is	Unenjoyable	○ ○ ○ ○ ○	Enjoyable

		1 2 3 Neutral 5	
I intend to ensure that my partner consents before any sexual activity.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I intend to use a condom or barrier method protection whenever I have sex with someone not my exclusive partner.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I intend to use an non-emergency contraception (condom, IUD, birth-control pill) if I am not planning to have a child	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I intend to be open to communicate with my partner before and during sexual activity.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I intend to do an STI test periodically if I have unprotected sex or have more than one partner.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent at that time even if it was decided earlier.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I am confident that I will always use a condom when having sex.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
If I want, I could reject a sex offer from someone I am sexually attracted to.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I am confident that I can always use a protection even if my partner refuses to	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

		1 2 3 4 5	
I am confident that I will not proceed with any sexual activity if my partner did not specifically show consent.	Extremely unlikely	○ ○ ○ ○ ○	Extremely likely

ARCS Scale

		1 2 3 4 5	
This app influenced me to be more aware about healthy sexual behaviour.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
This app convinced me to be more aware of my sexual behaviour.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
This app is personally relevant for me.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
This app made me mindful of my sexual behaviour and practices.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
I would like to use this app frequently.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
I found this app unnecessarily complex.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
The app was easy to use.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
I think I would need support from a technical person t be able to use this app.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
I thought the various functions of the app were well-integrated.	Strongly disagree	○ ○ ○ ○ ○	Strongly agree
I thought there was too much inconsistency in the app.	Strongly disagree	○ ○ ○ ○ ○	Strongly Agree

I imagine most people will learn to use this app very quickly.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I found the app awkward to use.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I felt confident using the app.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I needed to learn a lot of things before I could use this app.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

SUS

It would like to use this app frequently.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I found this app unnecessarily complex.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

This app is easy to use.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I think I would need support from a technical person to use this app.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I found the various features of the app well-integrated.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I thought there was too much inconsistency in the app.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I imagine most of the people can learn to use this app quickly.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I found this app to be very awkward to use.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I felt confident in using the app.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

I needed to learn a lot of things before I could use this app.

Strongly disagree   1   2   3   4   5 ○ ○ ○ ○ ○   Strongly agree

UEQ

	1	2	3	4	5	
obstructive	○	○	○	○	○	supportive

*

	1	2	3	4	5	
complicated	○	○	○	○	○	easy

*

	1	2	3	4	5	
inefficient	○	○	○	○	○	efficient

*

	1	2	3	4	5	
confusing	○	○	○	○	○	clear

*

	1	2	3	4	5	
boring	○	○	○	○	○	exciting

*

	1	2	3	4	5	
not interesting	○	○	○	○	○	interesting

PPS

The app would capture and hold my attention.

1 2 3 4 5

Strongly disagree ○ ○ ○ ○ ○ Strongly Agree

The app has some content that stimulates my curiosity.

1 2 3 4 5

Strongly disagree ○ ○ ○ ○ ○ Strongly agree

The content of the app would be relevant to me.

1 2 3 4 5

Strongly disagree ○ ○ ○ ○ ○ Strongly agree

I can relate to the content and the goal of this app.

1 2 3 4 5

Strongly disagree ○ ○ ○ ○ ○ Strongly agree

The purpose of the app makes sense to me.

1 2 3 4 5

Strongly disagree ○ ○ ○ ○ ○ Strongly agree

Appendix L: Interview Questions for Phase 3 Study

1. What did you think about this app?

2. Describe your experience with the app.

3. Was there anything you liked?

4. Was there anything you didn't like?

5. Did you learn anything new while using the app?

6. Do you think you can trust the app? Why or why not?

7. How much time did you spend on this app?

8. Did you think the app was useful? Any example?

9. What's most appealing about this app? Why?

10. What's the hardest part about using this app? Why?

11. Was there anything missing from this app that you expected? Why?

12. What could be done to improve this app?

13. Did you discuss about the app with anyone?

14. Finally, is there anything else you would like to tell me about your experience with the app I have not asked you?

Appendix M: Permission to Use

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