Fall 11-10-2016

# Sex Ed to Go- An Analysis of Comprehensive Sexual Education Mobile Phone Applications

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SEXUAL EDUCATION MOBILE PHONE APPLICATIONS**


**by**


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JULY 2014**


THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of

**Master of Arts
Communication**

The University of New Mexico
Albuquerque, New Mexico


**December 2016**

**ACKNOWLEDGMENTS**

I heartily acknowledge my advisor and committee chair, Dr. Judith McIntosh White, for her guidance and encouraging words throughout the last year. Her recommendations and suggestions made this work possible.

I also want to thank my committee members, Dr. Tamar Ginossar and Dr. Julia Hess, for all their efforts in bringing this thesis together. I appreciated their professional opinions and advice that helped me grow as a researcher and encouraged me to continue with my academic career.

A big thank you also to Andrew West and Syed Fawad Ali Shah for their time and effort during the coding process- your help was greatly appreciated!

And finally, I want to thank my husband for his endless support and love. Your encouragement brought me to where I am today.

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## ABSTRACT

The United States has one of the highest teen pregnancy rates among developed countries and the numbers of STIs have increased during the last few years. Mobile phone applications constitute a promising platform to disseminate sexual health information and to reduce adverse health outcomes, particularly among teens. In order to be effective, apps have to follow a comprehensive approach to sexuality education, include concepts of behavior change theories, and adhere to health literacy principles.

This study used a mixed-methods approach consisting of a quantitative content analysis and qualitative thematic analysis to assess the quality of sexual education apps available to users on the iOS and Android app market.

The results show that there is a dearth of health literate, evidence- and theory-based sexual education apps available to teenagers in the United States. The focus

remained on the negative consequences of sex and their prevention, while other topics such as identity or personal safety were hardly addressed. Interactive features were used in only 40% of apps. Furthermore, content was female-oriented and reinforced negative stereotypes and perceived norms that may have a negative impact on the sexual health of teens.

These findings suggest that the potential of apps has not yet been fully realized in the context of sexual health promotion. This thesis provides suggestions and guidelines for individuals interested in developing theory-and evidence-based sexual education apps.

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## Chapter 1: Introduction

> Those who have prophesied dreadful consequences as a result of the greater
> sexual freedom which the young assert — unwanted babies, venereal disease and
> so on — are usually the very same people who seek the fulfillment of their
> prophecies by opposing the free availability to the young of contraception and the
> removal of the stigma and mystification that surround venereal disease. (Ward,
> 1973, p. 74)

The education of youths about sex, sexuality, and sexual health has undergone decades of
controversies and debates. During most of the twentieth century, sexuality was very much
associated with immorality, impurity, and even filth and was treated in a highly private
manner. Sex was something that happened between husband and wife, within the four
walls of their bedroom. Today, half-naked women cover magazines and advertisement
boards, teenage popstars sing about their latest sexual encounter, and books such as
*Wetlands* describe in detail the sexual fantasies of a teenage girl.

Ironically, the omnipresence of sexual messages and associations in our society
does not change the fact that sex and sexuality remain highly controversial topics. In
contrast, what Colin Ward articulated in 1973 is still in place today: a major divide in
opinions on how sexuality should be approached and, more importantly, how teenagers
should be educated about it. That it is an important part of health education is generally
agreed upon. Rising numbers of sexually transmitted diseases and HIV infections during
the 1960s led to growing support for sexual education in schools. However, the format
and content of sex education classes remain contested.

At the core of the debate are opposing views and perceptions of what sexuality constitutes. For many, sexuality refers to the sexual act itself as a means of reproduction between wife and husband. Parents are often at loss when they find their young children engaging in sexual behaviors or when they are asked questions. They are embarrassed and uneasy with talking about sexuality, which instills the idea in their children that sexuality is something unnatural, dirty, or wrong. Instead of providing children with accurate and comprehensive information about sexuality, they try to scare them into abstinence by focusing on the negative outcomes of sexual intercourse, such as diseases and unintended pregnancies.

The idea of sex as a natural act between two people that can create something beautiful or positive has been largely absent from the discourse around sexuality. For Mary Calderone, co-founder of the Sexuality Information and Education Council of the U.S., sexuality is an essential component of the human being that defines a child from the moment it is conceived. In an interview with *Voice of America* in 1984, she explained:

> Most people, of course, think that sex is something you *do.* It is not. It's something you *are.* Your sexuality is yourself, as the total person you are. That relates to being male or female, with everything that happened *before* you were born, and your inheritance, your genes, and what has happened to you *since* you were born. All of that turns you, at any given moment, into the sexual person you are. (p.42)

Calderone was one of the first advocates for a holistic and positive approach to sexuality education. In her view, sexuality education should not primarily focus on reproduction, but teach children in an open and respectful manner that sexuality is a natural part of an

individual's identity and that there is much more to it than "just sex." Her views have gained increasing support during the last few years. Instead of teaching sexual education from an abstinence-only approach, schools have started to implement comprehensive curricula that encourage teenagers to have a healthy and satisfying sex life, instead of a repressed one. However, the debate surrounding the format of sexual education is still characterized by tensions between these two poles, leading to policies at local levels that vary widely from community to community. It is thus time to consider ways to bridge these differences by making use of media that teens are enthusiastic about: mobile phone apps. Younger generations grew up with a variety of technology that are increasingly complementing conventional education sources. These platforms can be effectively used to disseminate information and to promote healthy sexual behaviors.

With the following study, I seek to advance Calderone's perspective on sexuality and sexual education and transfer it into the context of information and communication technology. More specifically, I examine how sexual health is and can be promoted through one of the newest and most popular technology features: mobile phone applications. Having worked with children and teenagers for several years has left no doubt in my mind that the smartphone has become an indispensable part of many children's lives. Making use of these communication channels may increase awareness of sexual health issues in positive ways, promote healthy sexual behaviors, and decrease the number of adverse health outcomes. The next paragraphs will provide a more detailed account of the issues related to sexual health of teenagers in the United States and set the rationale for the study.

**Statement of Problem**

For many teenagers and young adults, adolescence constitutes a time of major challenges and changes. The World Health Organization defines adolescence as the period after childhood and before adulthood, between the ages 10 to 19, during which the human body grows and develops at a very fast pace (WHO, n.d.). Children and teenagers in this age group not only experience profound physical and intellectual changes, but also emotional, social, and moral transformations. Skills are acquired, identities formed, and behaviors established that have an immense influence on decision-making processes later in life. Adolescence thus represents a time that is essential in the formation of individuals that have the knowledge, skills, and values necessary to make healthy decisions throughout their lives.

Despite its potential for positive development, the period before adulthood also poses several health risks. Many youths experience pressure to drink alcohol, use drugs, or engage in sexual activities from an early age, which can lead to severe health problems (WHO, n.d.). According to the CDC (2014), there are six priority-risk behaviors that contribute substantially to morbidity and mortality rates of youths, including alcohol, drug, and tobacco use; unhealthy diets; insufficient exercise; unintended pregnancies; sexually transmitted diseases, as well as behavior that leads to injuries and violence. Among these, sexual risk behavior is of particular concern for 10 to 19-year olds, leading to over 300,000 births and over 500,000 cases of sexually transmitted diseases, as well as over 2,000 HIV infections annually.

Much has been done in recent years to reduce the number of adverse health outcomes related to risky sexual behavior. A wide variety of pregnancy and HIV/STI

prevention programs has been developed and implemented, differing greatly in their foci and formats. In order to get a better understanding of their effectiveness, researchers and health educators have been evaluating curricula and programs thoroughly, leading to an evidence-based corpus of effective and non-effective curricula components. Having specific criteria that have shown to reduce teen pregnancies and STIs and HIV infections was an essential step toward positive change on a broader level. As a result, effective programs were adapted for different communities, and existing curricula were re-evaluated and revised according to the new standards. Since the 1990s, when sexual education curricula were implemented in schools, teen pregnancy rates have declined steadily. Even though there are other factors that influenced their decrease, prevention programs have certainly contributed to this development.

Despite many positive developments, risky sexual behavior remains a high priority health issue that needs to be addressed. Teen pregnancy rates in the United States are still one of the highest among developed countries, and the numbers of HIV infections and STIs remain substantial. More and more health care providers, organizations, and educators have thus started to seek other ways to reach their young audiences.

Over the last years, new communication technologies have altered the ways in which teenagers and young adults solicit health information. The internet has become an invaluable source of information, facilitated by the spread of laptops, tablets, and smartphones. Among these new technologies, the smartphone represents a unique information and communication technology. Text messages, calls, social media networks, and the internet are now all accessible through one single device. What makes the

smartphone so distinctive, however, is not only its constant connectedness to the internet, but rather its ability to download mobile applications, or *apps*. A survey by Madden, Lenhart, Cortesi, and Gasser (2013) shows that 58% of teens between 12 and 17 have downloaded apps to their mobile phones or tablets. Furthermore, teenagers and young adults make use of these apps to seek, exchange, and provide information. This behavior becomes the more significant in the field of health prevention and information dissemination. Several studies found that teenagers and young adults are enthusiastic about using health-related mobile apps. A survey among approximately 900 college students showed that 75% of the students have downloaded health and medical apps to their smartphones (Richman, Webb, Brinkley, & Martin, 2014). Wartella, Rideout, Zupancic, Beaudoin-Ryan, and Lauricella (2015) found that 36% of teenagers aged 13 to 18 who have downloaded health apps have changed health behavior because of an app.

In the field of sexual and reproductive health, mobile apps represent a promising platform that can be used to inform teens about pregnancies, STIs, HIV, and healthy sexual behaviors. More and more health care providers and health educators are making use of the smartphone as a communication hub to disseminate sexual health information and to provide preventive services. Furthermore, an increasing number of schools and universities have developed sexual education apps to complement face-to-face curricula and to offer additional information. They use these new technologies to reach teens and young adults through their preferred communication channels and to make information more attractive and approachable. However, the application of information and communication technology in health contexts is a comparably young field of study, and not much research has been done on the use of mobile applications in regard to sexual

and reproductive health. The following study thus seeks to contribute to the research on mobile applications and sexual education in several ways.

**Rationale of the Study**

To date, there is a dearth of evidence-based and evaluative research on the effectiveness of the use of information and communication technology, particularly the smartphone, in sexual health contexts. Moreover, there seems to be a discrepancy between our understanding of effective sexual education programs that are taught face-to-face and those that are technologically mediated. Through years of evaluation research, we know what works in sexual education curricula to reduce sexual risk behavior, but has this knowledge been applied to the context of information and communication technology?

Furthermore, extensive literature on information-seeking behavior of youths suggests that adolescents take advantage of the anonymity and accessibility of the internet to solicit health information. Within the last few years, researchers and health professionals have thus started to evaluate and develop websites to meet the needs of this age group, but scholars still lag behind in considering the values of newer media functionalities, particularly mobile phone applications. Additionally, studies have identified several components and characteristics of online platforms that are preferred by teenagers and young adults (Wartella et al., 2015; Richman, Webb, Brinkley, & Martin, 2014). However, many of them do not incorporate feedback and suggestions from young users and thus forfeit the chance to effectively reach their target audience. Research has also shown that informing sexual health interventions by theories related to human behavior and learning may increase program effectiveness, including online interventions

(Webb, Joseph, Yardley, & Michie, 2010; Huang, Chien, Cheng, & Guo, 2012). Assessing the presence and the scope of health behavior change and learning theories in mobile phone applications could provide insight into their theoretical grounding and may help identify potential points of improvement.

Lastly, the majority of health apps are designed by IT and Tech professionals that do not have a background in medicine or healthcare (Research2Guidance, 2015). However, it is essential that apps made available to users contain reliable and credible information and adhere to health literacy principles. Adapting content to the literacy levels of young people, as well as considering the constraints of a mobile phone screen in the mediation of knowledge, is important in the development of health apps. A growing corpus of research related to mHealth literacy and app design provides suggestions and guidelines on the format and presentation of health information in the context of mobile applications, but is such knowledge applied in practice?

**Research Questions and Study Objectives**

Given the popularity of mobile phone applications among youths, these new media represent a promising platform to promote sexual health behavior and to reduce adverse health outcomes. The app market provides a variety of available apps, but discrepancies in content as well as in degrees of seriousness and reliability raise the question of the quality of sexual education mobile applications (Lupton, 2015; Mangone, Lebrun, & Muessig, 2016). Since there are an increasing number of teenagers and young adults who turn to mobile devices to seek sexual health information, it becomes essential to examine and to evaluate sexual health applications that are offered on the app market.

This study seeks to contribute to the corpus of mHealth research that relates to the use of mobile phone applications in sexual and reproductive health by exploring the following research questions (RQ):

RQ1: What types of mobile phone applications are available to users in the iOS and Android app stores that relate in any way to sexuality, sexual health, and sexual education?

RQ2: What types of sexual health informational and educational mobile phone applications are available to iOS and Android phone users?

RQ3: To what degree do existing comprehensive sexual education mobile phone applications contain components of school-based sexual education curricula that have shown to be effective?

RQ4: To what extent are mobile phone application for sexual health promotion based on health behavior and learning theories and frameworks?

RQ5: To what degree do existing sexual education mobile phone applications adhere to health literacy principles in terms of content, organization and navigability, as well as interactivity?

RQ6: How is content presented in comprehensive sexual education apps?

Answering these questions will lead to a more thorough understanding of the status quo of sexual health apps regarding their quantity and quality.

In order to explore the research questions in depth, I conducted a systematic review of literature on the state of sexual and reproductive health of youths in the United States and on measures that have been taken to reduce sexual risk behavior. More specifically, I looked at statistics with regard to teen pregnancies, HIV, and STIs and

gave an overview of the history of sexual education curricula and programs in the United States. The review of sexual education curricula allowed me to identify specific components shown to be effective in preventing sexual risk behavior. Furthermore, I reviewed literature on health-information-seeking behavior of teenagers and young adults and reviewed the ways in which new technologies and media are used in the realm of sexual health promotion. Lastly, I focused on mobile phone applications and their potential to complement face-to-face sexual education. The literature review contributed to my understanding of what constitutes effective sexual education, how youths look for sexual health information, and how mobile applications could be used to facilitate sexual information dissemination to reach adolescents.

Secondly, I examined and evaluated sexual education mobile applications that were available via the iOS and Android app stores. In particular, I focused on three major evaluation areas: the content, the use of health behavior and learning theories, as well as the health literacy levels of existing apps. These areas were assessed using a mixed-methods approach consisting of a quantitative content analysis as well as a qualitative thematic analysis.

Third, I discussed the findings of the quantitative and the qualitative analyses. The discussion summarized and interpreted the findings of the data collection and analysis and addressed their theoretical and practical implications.

**Chapter 2: Literature Review**

**The State of Sexual and Reproductive Health in the United States**

      **Sexual-risk behavior among youths in the United States.** For many teenagers and young adults in the United States, engaging in risky sexual behavior constitutes a major threat to their physical and mental health. Sexual risk taking can be associated with other diverse risk behaviors, such as drug and alcohol abuse, and includes unsafe sex, early sexual onset, and sex with several partners (WHO, 2005; Kalmuss, Davidson, Cohall, Laraque, & Cassell, 2003). In their yearly survey on risk behavior of high school students, the CDC (2014) found that nearly half of the students had ever had sexual intercourse, while 34% said they were currently sexually active. Of the latter, 41% did not use a condom during the last time they had sex, and 14% did not use any form of pregnancy prevention. Nineteen percent of students stated that they or their partner have used birth control pills during their last sexual encounter, while only 8.8% of adolescents reported having used both a condom and another form of birth control, such as the birth control pill or ring. Furthermore, only 22% of students that have had sex have ever been tested for HIV.

      The results of the survey also revealed major disparities with relation to race and ethnicities. Black and Hispanic high school students were more likely to have had sex than their white peers, with 60% and 49% respectively, as compared to whites with 44%. The percentage of white students having had sexual intercourse before the age of 13 (3.3%) was significantly lower than the percentages of Blacks (14%) and Hispanics (6.4%). The prevalence of not having used any type of birth control to prevent

pregnancies was higher among black students (15.9%) and Hispanic (19.7%) students, than white students (11.1%).

Besides early onset of sexual activity and the non-use of contraceptives, there are several other behaviors that pose risks to the physical and mental health of adolescents. One out of five high school students that reported being currently sexually active said they had drunk alcohol or used drugs before their last sexual encounter. Furthermore, 10% of students that dated someone during the 12 months preceding the study reported experiencing some kind of dating violence, including being hit, slammed against an object, or injured with a weapon. Another 10% of students said that they were kissed, touched, or forced to sexual intercourse against their will one or more times during the year before the survey.

These behaviors related to sexual and reproductive health are not only alarming due to their interconnectedness with other risky behaviors, but more importantly because of their adverse physical and mental health outcomes. Having sexual intercourse without using condoms and another form of birth control puts teenagers and young adults at risk for sexually transmitted infections (STIs), HIV infections, and unintended pregnancies. These physical outcomes may, in turn, also affect the mental health of adolescents.

**Physical and mental health outcomes of sexual-risk taking.** Within the last decade, several factors have contributed to a general increase in contraceptive use among youths and a steady decline in teen pregnancy rates. A report by Boonstra (2014) attributed the declines to contextual factors, such as changes in the structural and economic nature of the nation, as well as the shifting of social norms. Moreover, more informational and educational resources were provided for teens that decreased risky

sexual behavior. Despite these positive changes, the numbers of STIs, HIV infections, and teen pregnancies are still alarmingly high (Henry Kaiser Family Foundation, 2014). According to the CDC (n.d.-a), nearly 10,000 young people between 13 and 24 years were diagnosed with HIV in the United States in 2013, with young gay and bisexual men, particularly African-American and Hispanic gay men, being most severely affected (CDC, n.d.-b). Moreover, nearly half of the 20 million sexually transmitted infections that are reported each year are diagnosed among teenagers and young adults between 15 and 24 years. There has not been a decline in new HIV infections within the last years, and the number of STIs has, in fact, considerably increased (CDC, 2015).

The consequences of HIV infections and STIs can vary widely in their severity. According to the CDC (2015), chlamydia, gonorrhea, and syphilis are the three most common types of STIs. Untreated, they can lead to severe health issues, such as infertility, and may also facilitate the transmission of HIV infections. Besides the apparent negative physical health outcomes, the treatment of STIs represents a major economic burden on individuals and the society as a whole, reaching $16 billion per year. Even though not as prevalent as STIs, HIV infections can lead to far more extreme health outcomes and are often accompanied by major economic and social issues. According to an estimate by the CDC (n.d.-b), 50% of youths aged 13 to 24 with HIV were unaware of their infection in 2010 and thus stayed untreated. The low rates of testing pose a major health threat to young people that carry the virus and place their sexual partners at risk. HIV infections can lead to death, and infected individuals often have to endure discrimination and stigmata (Taraphdar et al., 2011).

Risky sexual behavior not only increases the numbers of HIV infections and STIs, it can also lead to unintended pregnancies. The United States has one of the highest teen pregnancy rates among developed countries (United Nations Statistics Division, 2015). According to the CDC (n.d.-a), over 273,000 babies were born to girls aged 15-19 years in 2013. Teen pregnancies are concerning for various reasons. Hoffman and Maynard (2008) found that teen mothers, as compared to women that have children later in their lives, are less likely to finish high school, more likely to rely on public assistance, and are more likely to have children that have lower educational achievement and poorer health during their adolescence. These socioeconomic circumstances can also result in mental health problems and other adverse health outcomes. Pregnant adolescents have an increased risk of developing depression (Hodgkinson, Colantuoni, Roberts, Berg-Cross, & Belcher, 2010) and are more likely to experience dating violence that may lead to posttraumatic-stress disorders (Kennedy & Bennett, 2006; Mitchell et al., 2010). Further research suggests that teen pregnancies are related to higher rates of substance-abuse in adolescent mothers (Shahul & Gfroerer, 2003).

As can be gathered from the high numbers of STIs, HIV, and teen pregnancies, sexual risk behavior remains a major health threat to teenagers and young adults in the United States. Since the early twentieth century, organizations and individuals interested in promoting sexual health have thus developed and implemented a variety of programs and curricula to prevent adverse health outcomes. However, the programs differed greatly in their formats and foci due to opposing views on sex, sexuality, and sexual health. The next section will give an overview of the history of sexual education in the United States

that will lead to a better understanding of the controversies regarding the teaching of sexual health that exist still today.

**The History and Development of Sexual Education in the United States**

The history of sexual education in the United States can be traced back to the beginning of the early twentieth century. According to Elia and Eliason (2010), school-based sexual education began in 1913, the year in which the American Social Hygiene Association was founded. The goal of the founders was to reduce sexually transmitted diseases and prostitution through the means of "character building." They put forth the idea of getting schools involved in the promotion of moral purity, sexual hygiene, and sexual abstinence until marriage. This conceptual understanding of sexual education lasted until the 1960s, when attitudes toward sexuality started to change. Several factors contributed to a more positive perspective on human sexuality, such as the introduction of the birth control pill and the Hippie movement (Elia, 2009). The 1960s also experienced a growth of organizations that promoted this positive approach to sexual health. Dr. Mary Calderone, who was the director of the Planned Parenthood Federation at that time, co-founded the Sexuality and Information Council of the United States to provide people with access to accurate medical information on sexual health (Planned Parenthood, 2012). At the same time, there was a backlash from conservative organizations that opposed the idea of a liberal approach to sexuality and called for restrictions of school-based sexual education. Their efforts were quite successful and resulted in several state laws prohibiting sexual education in schools.

In the 1980s, rising numbers of teen pregnancies and HIV infections reopened the debate on sexual education in the classroom. While a growing number of individuals

called for a broader approach to sexual education that would also include issues such as safe sex, conservatives promoted a "Just say no" campaign. Their efforts resulted in the Adolescent Family Life Plan passed by the Congress in 1982, which funded programs that promoted an abstinence-only approach to sexual education. The 1990s were marked by a conservative stronghold and culminated in Title V of the welfare reform legislation that granted $50 million annually for abstinence-only sexual education programs. As Elia (2009) points out, this federal legislation had a major impact on the course and the format of sexual education in the United States. From the 1980s onward, discussions about the approach to sexual education in schools revolved around the two divergent concepts, abstinence-only versus comprehensive sexual education.

Since the beginning of the twentieth century, abstinence-only programs have dominated the discourse on sexual education of teenagers and young adults in the United States. However, 2010 marked a turning point in terms of federal funding for abstinence-only programs. The Obama administration eliminated two major funding streams and allowed Title V, the third source of federal funding, to expire in 2009. However, Title V was incorporated into the health care reform package in 2010 and thus granted another $250 million to abstinence-only programs for the following four years (Sexuality Information and Education Council of the United States, SIECUS, n.d.-a). At the same time, the government launched a major funding initiative that supported comprehensive sexual education curricula, namely the Personal Responsibility Education Program (PREP). The adoption of this initiative provided individual states with an alternative to abstinence-only funding, which resulted in a steady increase of applications for PREP. In fiscal year 2011, 48 states applied for PREP funding, while 34 states applied for Title V

funding. However, in 2011, six states applied for Title V funding that had not applied in 2010.

Sexual education in the United States remains a controversial topic that is situated between the extremes of abstinence-only programs and comprehensive approaches to sexual health. Proponents of abstinence-only programs argue that abstinence is the only effective way to prevent unintended pregnancies and the transmission of STIs and HIV and that teaching youths about contraceptives would just increase the likelihood of sexual intercourse outside of marriage (Kirby, 2008). Proponents of comprehensive education, on the other hand, argue that their programs emphasize abstinence as the most effective way to reduce adverse health outcomes and pregnancies, but at the same time acknowledge the fact that many teenagers are sexually active and thus need to have access to information on contraceptive use (Kirby, 2008). They furthermore claim that a comprehensive approach to sexual health is more effective in reducing sexual risk behavior than abstinence-only programs. Within the last few years, researchers have conducted several studies to evaluate the effect of sexual education curricula in schools. Since teen pregnancy rates and the numbers of STIs and HIV infections remain high in the United States, health educators and professionals have called for a more thorough and systematic assessment of existing programs that seek to reduce sexual risk behavior. The following section will review literature on the evidence of the effectiveness of both approaches.

**Abstinence-only programs.** As described in the previous section, abstinence-only programs have a long history in the United States. Authorized with the Social Security Act of 1996, the Title V, Section 510 Abstinence Education Program has as its

mission to promote sexual abstinence until marriage. More specifically, abstinence-only programs have to adhere to the following eight principles of abstinence education: (1) have as its exclusive purpose teaching the social, psychological, and health gains to be realized by abstaining from sexual activity; (2) teach abstinence from sexual activity outside marriage as the expected standard for all school-age children; (3) teach that abstinence from sexual activity is the only certain way to avoid out-of-wedlock pregnancy, sexually transmitted diseases, and other associated health problems; (4) teach that a mutually faithful, monogamous relationship in the context of marriage is the expected standard of sexual activity; (5) teach that sexual activity outside the context of marriage is likely to have harmful psychological and physical effects; (6) teach that bearing children out of wedlock is likely to have harmful consequences for the child, the child's parents, and society; (7) teach young people how to reject sexual advances and how alcohol and drug use increase vulnerability to sexual advances; and (8) teach the importance of attaining self-sufficiency before engaging in sexual activity (Social Security Act, Title V).

Programs that are funded through Title V must follow these guidelines and cannot use these funds to teach any topics or to address issues that are not in line with the promotion of abstinence as the exclusive goal of sexual education. According to the Sexuality and Information Council of the United States (SIECUS, 2013), this also includes any information on the use of contraceptives to prevent teen pregnancies, STIs, and HIV infections.

The effectiveness of abstinence-only programs has long been challenged, and several studies have in fact shown that approaching sexual education solely from an

abstinence-until-marriage perspective does not reduce sexual risk behavior and related adverse health outcomes. Trenholm et al. (2007) evaluated four abstinence-only programs that were funded under Title V, Section 510 and found that they had no impact on the rates of sexual abstinence. None of the programs helped delay onset of sexual intercourse or reduced the number of sex partners. Furthermore, teens that took part in such programs were less likely to perceive condoms as an effective prevention method for STIs, as compared to youths in the control group. These findings were consistent with Underhill's (2007) systematic review of 13 abstinence-only programs. Her results showed that abstinence-only programs do not decrease sexual risk among youths and are ineffective in preventing HIV infections. One of the largest assessment studies (Kirby, 2007), evaluated eight abstinence-only programs as part of the National Campaign to Prevent Teen and Unplanned Pregnancy. The majority of them did not delay sexual activity onset, did not reduce the number of partners, and did not have any impact on sexual behavior of teens. Only two studies showed some positive effects in reducing sexual initiation and decreasing the frequency of sex. However, Kirby points out that these studies lacked a rigorous evaluation design.

Besides the overall ineffectiveness of abstinence-only programs in reducing sexual risk behavior, several studies found that they may even have a negative impact on teen's sexual health. A content analysis of the most popular abstinence-only curricula used by the largest federal abstinence-only initiative called SPRANS (Special Programs of Regional and National Significance Community-Based Abstinence Education), found that over 80% of the curricula contain "false, misleading, or distorted information about reproductive health" (United States House of Representatives, 2004, p. i). For instance,

the effectiveness of condoms and other contraceptives to prevent STIs and pregnancies was often presented as a non-scientific assertion not been supported by data. The Sexuality and Information Council of the United States (n.d.-b) further criticized that curricula often use fear and shame appeals to promote their abstinence-until-marriage education.

Despite the overwhelming evidence that abstinence-only programs do not decrease risky sexual behavior and are thus ineffective in preventing unintended pregnancies and the transmission of STIs and HIV, a majority of states still apply for Title V funding. According to the Guttmacher Institute (2016), only 18 states and the District of Columbia require the inclusion of contraceptive information into their curricula. Nonetheless, more and more health care professionals and organizations call for an increase in comprehensive education curricula and the promotion of contraceptives.

**Comprehensive sexual education curricula.** As a counter-movement to the conservative approaches to sexual health and abstinence-only programs, proponents of comprehensive curricula sought to provide young people with accurate medical information about their sexual health and to promote a more positive view of sexuality. In 1991, the National Guidelines Task Force, in collaboration with SIECUS, presented a framework to facilitate the development of comprehensive sexual education curricula or the evaluation of existing curricula. In their guidelines, they describe the characteristics and objectives of comprehensive sexual education as follows: (1) provide accurate information about human sexuality, including growth and development, human reproduction, anatomy, physiology, masturbation, family life, pregnancy, childbirth,

parenthood, sexual response, sexual orientation, gender identity, contraception, abortion, sexual abuse, HIV/AIDS, and other sexually transmitted diseases; (2) provide an opportunity for young people to question, explore, and assess their own and their community's attitudes about society, gender, and sexuality; (3) help young people develop relationship and interpersonal skills, including communication, decision-making, assertiveness, and peer refusal skills, as well as the ability to create reciprocal and satisfying relationships; and (4) help young people exercise responsibility regarding sexual relationships, including addressing abstinence, pressures to become prematurely involved in sexual relationships, and the importance of practicing safer sex and other positive sexual health measures (NGTF, 2004, p. 19).

Several studies have shown that programs that incorporated these principles into their design have had a positive impact on teen sexual behavior. In 2007, Douglas Kirby, one of the leading sexual health researchers in the United States, presented the results of his systematic review of 115 prevention programs conducted for the National Campaign to Prevent Teen and Unplanned Pregnancy (Kirby, 2007). Out of the 115 evaluated programs, 48 were comprehensive curricula. The findings showed that over 40% of them delayed sexual onset, reduced the number of sex partners, and increased the use of contraceptives (Kirby, 2007). In contrast to comprehensive programs, abstinence-only curricula did not show any change in sexual risk behavior. Other studies presented the same results: instead of increasing sexual activity among teenagers, as claimed by abstinence-only proponents, comprehensive curricula were successful in reducing the number of sex partners, increasing condom and contraceptive use, and delaying sexual onset (Robin et al., 2004; Walcott, Meyers, & Landau, 2008; Jemmott et al., 2010).

The growing numbers of evaluation research on comprehensive sexual education curricula has led to a corpus of programs that have shown to be effective in reducing sexual risk behavior among teenagers and young adults. Even though these programs follow the same approach to sexuality and sexual health, their formats and designs still vary widely. Several leading health organizations, including the CDC, the SIECUS, and the National Campaign to Prevent Teen and Unplanned Pregnancy, have thus started initiatives to identify specific standards and components of curriculum-based comprehensive sexual education that have shown to be effective in reducing adverse sexual health outcomes. These standards and core components can be used as guidelines to develop and implement sexual education curricula that have a positive impact on teenagers' sexual behavior. The next section provides an overview of the most effective components of sexual education curricula.

**Components of Effective Curriculum-based Programs**

As of today, there exist several program lists and toolkits that allow educators to evaluate existing curricula or that facilitate the development of new programs. The next paragraphs will provide an overview of the most important and influential toolkits.

**Douglas Kirby - The National Campaign to Prevent Teen Pregnancy.** In 2001, Kirby published his findings on the effectiveness of sexual and reproductive health programs as part of the National Campaign to Prevent Teen Pregnancy. He found that curriculum-based programs shown to be effective in decreasing the number of STIs and HIV, as well as the number of teen pregnancies, include the following components and characteristics (among others):

(1) They are based on theoretical approaches that have been demonstrated to influence other health-related behavior and identify specific important sexual antecedents to be targeted;

(2) They provide basic, accurate information about the risks of teen sexual activity and about ways to avoid intercourse or use methods of protection against pregnancy and STIs;

(3) They provide examples of and practice with communication, negotiation, and refusal skills;

(4) They employ teaching methods designed to involve participants and have them personalize the information;

(5) They incorporate behavioral goals, teaching methods, and materials that are appropriate to the age, sexual experience, and culture of the students;

(6) They deliver and consistently reinforce a clear message about abstaining from sexual activity and/or using condoms or other forms of contraception.

According to Kirby, the last component mentioned in this list is of particular importance in distinguishing between effective and non-effective programs. He concludes that there is extensive evidence showing that abstinence-only programs do not delay sexual activity and are not effective in reducing STIs and teen pregnancy rates. However, abstinence and information on contraception are not two mutually exclusive concepts. As Kirby points out, the most effective programs present abstinence as the safest option for teens, while also acknowledging the fact that many teenagers are sexually active and providing information on how to use contraceptives to prevent diseases and unintended pregnancies.

In his later work for the National Campaign to Reduce Teen Pregnancy, Kirby,

together with Lepore (2007), identified over 500 risk and protective factors for sexual

health that have an effect on sexual risk behavior. They differentiated between factors

that relate to the environment and factors that depend on individual conditions.

Environmental influences stem from the community, the family, peers, as well as

romantic partners, while factors on the individual level include biological factors, social

relationships with others, as well as personal values, skills, and knowledge. Kirby's and

Lepore's (2007) findings contributed to our understanding of the correlations of different

conditions and factors to sexual risk-taking and stressed the importance of a more

comprehensive approach to sexual health.

**National Health Education Standards- HECAT and FoSe.** Kirby's findings

laid the groundwork for further work on guidelines for curricula in terms of designs and

formats. In 2012, both the CDC, as well as the Future of Sex Education Initiative (FoSE),

published evaluation tools that can be used by health educators to refine existing

programs or to develop new ones. Both documents are based on the National Health

Education Standards (NHES) that were first created in 1995 and that provided a

framework for the teaching of health education throughout all school grades. Updated in

2007, the standards serve as concrete expectations of knowledge and skills that school

children should attain by grades 2, 5, 8, and 12. The National Health Education Standards

contain the following eight expectations (CDC, 2012):

> **Standard 1:** Students will comprehend concepts related to health promotion and
> disease prevention to enhance health.
> **Standard 2:** Students will analyze the influence of family, peers, culture, media,
> technology, and other factors on health behaviors.

**Standard 3:** Students will demonstrate the ability to access valid information, products, and services to enhance health.

**Standard 4:** Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.

**Standard 5:** Students will demonstrate the ability to use decision-making skills to enhance health.

**Standard 6:** Students will demonstrate the ability to use goal-setting skills to enhance health.

**Standard 7:** Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.

**Standard 8:** Students will demonstrate the ability to advocate for personal, family, and community health.

These standards apply to any health-related topic taught in schools and thus do not provide concrete instructions on content coverage within specific health areas, including sexual health education. Nevertheless, the definitions of the standards reflect the comprehensive character of health education curricula, because they focus not only on the transmission of knowledge, but rather aim at enhancing students' abilities, values, and skills to internalize and implement healthy behavior.

The CDC used these standards as a framework and applied it to the context of different health topics, such as healthy eating, alcohol and drugs, and sexual health. This Health Education Curriculum Analysis Tool (HECAT) can be used by health educators seeking to promote different health behaviors in school settings (CDC, 2012). Divided into grade groups Pre-K-2, 3-5, 6-8, and 9-12, each of the eight standards provides a checklist with detailed and specific expectations of what students should know and be able to do at a certain grade level and related to a specific health topic.

Similarly to the CDC, the Future of Sex Education (FoSE, 2012) created National Sexuality Education Standards that contain the core content and skills for school children from K-12. The FoSE was created in 2007 as a collaboration between Advocates for Youth, Answer, and SIECUS and sought to "create a national dialogue about the future of sex education and to promote the institutionalization of comprehensive sexuality education in public schools" (FoSE, n.d., para. 1). Based on the HECAT, the National Health Education Standards, as well as guidelines proposed by the National Guidelines Task Force, the Future of Sex Education has developed National Sexuality Education Standards that specify minimum or core content of sexual education curricula. The eight National Standards of Health Education are divided among seven topic areas that were identified by FoSE as the minimum content every sexual education curriculum should address. The seven topics include (1) anatomy and physiology; (2) puberty and adolescent development, (3) identity, (4) pregnancy and reproduction, (5) sexually transmitted diseases and HIV, (6) healthy relationships, and (7) personal safety. These topics are similar to those suggested by the National Guidelines Task Force (2004), which included human development, relationships, personal skills, sexual behavior, sexual health, and society and culture.

**Sex-positive approaches.** Despite the comprehensiveness of these standards and tools, the focus of most curricula is still very much on the prevention of negative consequences of sexual activities. However, studies have shown that a positive attitude toward sexuality and sex can, in fact, improve sexual health. Promoting sexual pleasure, sexual satisfaction, sexual self-efficacy, and sexual self-esteem can enhance an individual's sexual, mental, and physical health in various ways. Higgins, Hoffman,

Graham, and Sanders (2008) found an association between the use of different

contraceptives and sexual pleasure. Men who used condoms showed the lowest

satisfaction, while women who used both a condom and a hormonal contraceptive had the

highest sexual satisfaction scores. The authors suggest that women who use dual

contraception feel more satisfied, because they know that they protect themselves against

pregnancy and STIs. The finding that men feel less satisfied when using a condom is a

commonly observed phenomenon that leads to a general decrease in condom use (Oncale

& King, 2001). Philpott, Knerr, and Boydell (2006) have studied how sexual pleasure

could be used to reverse this trend and to promote the use of condoms. In their *Pleasure*

*Project*, they related sexual health content to eroticism and pleasure and found that

teaching people erotic ways to put on condoms, for instance, led to an increase in safer

sex practices.

Incorporating ways to experience sexual satisfaction and pleasure by promoting

safe sex at the same time could enhance a person's overall sexual health. Approaching a

teen's sexual behavior from a very negative perspective that is associated only with risk

and danger may not be the most effective way to reduce sexual risk-taking. The

International Planned Parenthood Federation (IPPF, 2010) has added sexual pleasure to

their list of effective sexual education components and are thus one of the first health

organizations that recognizes the importance of approaching sexuality in a positive and

respectful way. In their IPPF Framework for Comprehensive Sexuality Education, they

name gender; sexual and reproductive health and HIV; sexual rights and sexual

citizenship; pleasure; violence; diversity; and relationships as the seven essential

components of comprehensive sexual education curricula. Sexual pleasure should be

treated as an essential component of sexual education and should not be left out of the discourse around sexuality.

**Theory-based sexual education components.** All approaches to sexuality education as mentioned above stress the importance of addressing sexual health from a comprehensive or even holistic perspective. They all agree that solely providing factual knowledge may not be enough to prevent risky sexual behavior. Instead, they call for an education that helps teenagers develop skills and abilities to judge their own actions, empowers them to make their own decisions, and provides them with the necessary tools to live a healthy sexual life. However, not much explanation has been given as to the theoretical rationale of why these principles and characteristics should be included in sexual health education.

There exists a number of theories and approaches that have been framing the development of sexual health prevention programs. Among the most widely used theories are the social learning theory (Bandura, 1977) and the social cognitive theory (Bandura, 1986). In both theories, learning processes are viewed as the results of the interaction between personal factors, environmental factors, and actual behavior. Bandura (1977) claims that one way of learning is through response consequences, where individual actions produce either positive or negative outcomes and thus either reinforce or decrease a certain behavior; the second way of learning is through modeling, that is, observational learning. The latter is particularly essential in sexual health education because teenagers can benefit in several ways from observing others: first, they can profit from other people's experiences by observing their behavioral outcomes; second, modeling behavior in a more concrete sense can help teens acquire specific skills. In his social cognitive

theory, Bandura (1986) expanded his earlier work and focused on the cognitive processes between motivation, affect, and action. The construct of self-efficacy plays a major role in this context and describes an individual's "judgment of personal capability" (Bandura, 2012, p. 357), that is how capable a person thinks he or she is- or actually is- in performing a specific task. As a second major concept in his theory, outcome expectancies refer to the physical, social, and self-evaluative outcomes that may result from performing a certain action. According to the social cognitive theory, an individual's motivation to act is thus influenced by the belief in his or her ability to undertake a specific action and consideration of possible outcomes.

Bandura's theories acknowledge the complexity of learning processes and stress the importance of considering both personal as well as environmental factors when it comes to behavior change. Furthermore, equipping individuals with the skills and abilities to perform a certain behavior and making them feel confident enough to put it into action, contributes substantially to positive behavior change. His theories were widely recognized and used as a framework for many sexual health behavior change programs and curricula. The National Sexuality Education Standards proposed by FoSE (2012), for instance, were developed based on both theories. Informed by the social learning theory, several concepts were included into the development of the curriculum toolkit such as personalizing content, showing students their susceptibility to certain risks, providing them with the confidence to manage risks (self-efficacy), discussing the influence of norms, as well as developing specific skills to apply the knowledge to their own lives. From the social cognitive theory, a focus on the emotional and affective learning processes of individuals was added and more attention was paid to an

individual's motivation to learn or to change behavior. Similarly, Kirby and Lepore (2007) identified over 500 risk and protective factors that relate to individual and environmental influences on sexual health behavior of youths. They furthermore stressed the importance of personalizing content and teaching methods to individuals as well as allowing youths to practice specific skills. Further studies showed that using the social cognitive theory as a framework had a positive effect on condom use and, in turn, reduced the numbers of STIs (Snead et al., 2014; Lopez, Tolley, Grimes, & Chen-Mok, 2011)

Besides Bandura's theories, several other learning and behavioral theories have influenced the development of effective sexual health programs and curricula. According to the theory of reasoned action (Fishbein & Ajzen, 1975), which was later extended to the theory of planned behavior (Ajzen & Madden, 1986), an individual's actions are immediately anteceded by a behavioral intention to act in a certain way. A person's intention is furthermore guided by the assumed consequences of that behavior, beliefs about norms that relate to that behavior, as well as the degree of control an individual believes to have to act without hindrances. Thus, attitudes toward a behavior as well as subjective norms and control are essential components of behavior. However, the theory of reasoned action assumes that humans have volitional control over their social behavior; the theory of planned behavior, in turn, also takes into account that there are instances when a person does not have control to act in a certain way.

Similarly to Bandura (1977, 1986), Ajzen and Madden (1986) include environmental and external factors into their analysis of behavior. Their theory provides a framework for the identification of attitudes, norms, and perceived control that lead to

intention, and eventually to actions. It also raises awareness of factors that might prevent or impede an individual's ability to act in a certain way. The theories of reasoned action and planned behavior have both been adapted to the development of various prevention programs, such as drug abuse (Huang, Chien, Cheng, & Guo, 2012), dating violence (Foshee et al., 2005), and condom use (Albarracin, Johnson, Fishbein, Muellerleile, 2001).

Further theories that have informed sexual health programs are the health belief model (Janz & Becker, 1984), the transtheoretical model (Prochaska, Redding, Harlow, Rossi, & Velicer, 1994), and the information-motivation-behavioral skills model (Fisher & Fisher, 1992). Each of these theories adds its own perspective to learning processes and behavior; however, there are substantial overlaps in their approaches and in their understanding of elements and factors that contribute to behavior change and learning. Motivation, self-efficacy, goal setting, internal and external factors, as well as control are a few of the elements that have been studied in the context of a majority of these theories.

Understanding what drives human behavior is an essential step toward positive change. As Kirby (2001) found in his evaluation of sexual education curricula, the most effective programs were based on behavioral or learning theories. Theories can facilitate the development process of effective sexual health programs in several ways: they can help identify specific constructs to be targeted, such as attitudes, norms, or beliefs of individuals toward a specific behavior; they can inform the implementation of strategies to promote behavior change, and they can assist in tailoring the mode of delivery toward the target audience (Webb, Joseph, Yardley, Michie, 2012). As could be seen from the description of evaluation tools in the previous sections, many of the constructs discussed

in behavioral and learning theories have been applied to the context of sexual health and prevention. Both the CDC (2012) and the FoSE (2012) call on educators to include theory-based components into their programs, which is reflected in the teaching of skills and abilities, the content, as well as the teaching methods and strategies. These theories are not only important in terms of understanding how individuals come to exert a certain behavior, but more importantly provide a rationale for how it can be changed.

**Discussion.** As the review of toolkits showed, the development of most curricula and programs has been informed by theories of learning and human behavior as well as research evidence. They thus overlap in their description of the most important components and characteristics of effective sexual education curricula. First, they provide individuals with the knowledge they need to make informed health decisions by addressing sexuality from a broad perspective and by showing how society, the media, and relationships in general influence and effect sexuality and sexual health. Second, they encourage educators to include the practice of communication skills, such as negotiation and refusal skills, into their curriculum. Thus, teenagers are equipped with the necessary tools to exert healthy behavior. Lastly, they recognize motivation as a predictor of behavior change by tailoring and personalizing sexual health information to the needs of their target audience.

These findings show that providing accurate, judgement-free, and comprehensive information to teenagers through face-to-face education can reduce sexual risk-taking among teens and promote healthy attitudes and behaviors toward sexuality. Unfortunately, schools often lack the resources and the time to conduct comprehensive curricula, so students do not receive the necessary education to make healthy choices.

Within the last few years, health educators and professionals have used new media and technologies to disseminate information and to reach a broader audience.

This shift from face-to-face education to a technology-based or –mediated education, however, poses several challenges. Since the main goal of sexual education is to promote sexual health by utilizing teaching methods and material adapted to the culture, age, and sexual experience of the target group, the content and format of these platforms have to be carefully designed. This includes the integration of sexual education components shown to be effective into the context of information and communication technology, as well as the adaptation of content to the abilities and skills of the specific age groups. In order to get a better understanding of how new technologies and media can be used to promote sexual health among teenagers, it is important to first examine how technologies have changed the field of health and how they are used by the younger generations to find health information.

**Information and Communication Technology in Health Care- eHealth and mHealth**

The value of information and communication technology (ICT) in health care, promotion, and intervention has long been recognized. Within the last two decades, different types of media, including radio, telephone, computers, television, and the internet, have been introduced into the field of health care and health promotion (Edouard & Edouard, 2012). Two major fields have emerged from this shift toward a technology-mediated approach to health: eHealth and mHealth.

The field of eHealth encompasses a variety of different aspects, and researchers have not yet reached a consensus on a uniform definition. Depending on the context and the discipline, eHealth has been related to commerce, business, medical informatics,

health care, or communications (Della Mea, 2001; Boogerd, Arts, Engelen, & Van de

Belt, 2015; Pagliari et al., 2005; Oh, Rizo, Enkin, & Jadad, 2005). According to

Eysenbach (2001), the term was first used in the field of marketing in the late 1990s and

was later adopted by academics. It originally referred to everything related to computers

and medicine, but was soon expanded to include other technologies as well. Eysenbach

was one of the first academics to offer a definition of *eHealth:*

> e-health is an emerging field in the intersection of medical informatics, public
>
> health and business, referring to health services and information delivered or
>
> enhanced through the Internet and related technologies. In a broader sense, the
>
> term characterizes not only a technical development, but also a state-of-mind, a
>
> way of thinking, an attitude, and a commitment for networked, global thinking, to
>
> improve health care locally, regionally, and worldwide by using information and
>
> communication technology. (para. 3).

Eysenbach's definition touches on the value and the advantages of eHealth as an

enhancement and promotion of health related issues. Electronic health records, patient

monitoring, telemedicine, and medical education programs are only a few of the areas in

which technology has led to major improvements in the healthcare sector (Silber, 2003).

Information and communication technologies not only revolutionized health care and

medical provision, they have also transformed the field of health promotion and

prevention. The use of technology enables health professionals to tailor messages to

individuals, to standardize material, and to make health promotion more engaging and

interactive (Bull, 2012). In the field of sexual health, for instance, scholars have

developed interactive online platforms to promote healthy sexual behavior, including new

media channels, such as social networking sites and online games. In recent years, these interventions were more thoroughly evaluated, and to date there exists evidence for their effectiveness in reducing sexual risk behavior (Levine, 2011).

Mobile Health (mHealth) is often considered as a component, or even an advancement, of eHealth (WHO, 2011; Akter, Ambra, & Ray, 2011). Contrary to eHealth, mobile Health focuses on mobile devices and technology used in health related fields. The World Health Organization (2011) defined mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices" (p. 6). MHealth evolved from the field of eHealth and shares certain characteristics with it, but at the same time provides additional advantages and features. The use of mobile technologies allows for more flexibility, adaptability, and accessibility in the management and delivery of health care and has been successfully introduced to various health environments and contexts. One feature that has increasingly gained attention is the mobile phone application, or *app*. Apps can be seen as advanced functions of the internet and contain the same interface and content principles as websites; however, they can be accessed from the smartphone at any time and are often seen as more interactive and engaging by youths.

Being a comparably young field of study, literature on the use of mobile applications in sexual health contexts is rather sparse. Some scholars have implemented mHealth interventions by using text-services or mobile applications, but the evaluation of health outcomes of these interventions remains a challenging process. Furthermore,

research on the design and format of mobile phone applications and their effectiveness is in its infancy.

Nevertheless, the similarity of mobile phone applications to websites allows us to transfer knowledge that we have gained through the evaluation of online interventions to the context of the mobile phone. The shift from face-to-face to online communication in the late 1990s has led to a corpus of research on technology use and online information-seeking behavior of adolescents. Since mobile phones are an advanced function of the internet, it is essential to examine how the knowledge we have gained through online interventions can be applied to the mobile phone. The following sections thus aim to answer the following questions: How did the internet change health information seeking behavior of youths? What functions and features of the internet do teenagers prefer? How can we use this knowledge in the context of mobile applications?

**Internet use among youths.** For many teenagers and young adults, new technologies such as the internet, the TV, and mobile devices have become indispensable parts of their lives. The younger generations, who are also often referred to as *digital natives* or *millennials,* grew up with this new technology, viewing it not only as a useful tool, but rather as an integral part of their identities and lives (Levine, 2011; Gardner & Davis, 2013). A survey by the Kaiser Family Foundation (Rideout, Foehr, & Roberts, 2010) found that tweens and teens between eight and eighteen years spend an average of 7.5 hours with media per day, into which they manage to cram 10.75 hours of media content by multitasking with different media channels. In a survey by Lenhart, Rainie, and Lewis (2001), a 17-year old explained: "I multi-task every single second I am online. At this very moment, I am watching TV, checking my email every two minutes, reading a

newsgroup about who shot JFK, burning some music to a CD and writing this message"
(p. 10). The internet has become a primary platform for entertainment, social interactions,
and information seeking and offers a variety of features and services.

      According to Lenhart (2015), 92% of teens aged 13 to 17 go online daily, while
24% are online almost constantly. Some of the most commonly used features of the
internet are social networking sites, such as Facebook, Twitter, or Instagram. Eighty-nine
percent of teenagers maintain a social network profile and use these platforms to connect
and interact with people through messages and chats, as well as to share their own
content (Lenhart, 2015; Levine, 2011). Besides the use of social media to post content,
there are specific video-sharing webpages, where users can watch, upload, rate, and
discuss videos. Eight to eighteen-year-olds spend 16% of their online-time on video
websites, such as Youtube and MySpaceTV (Rideout et al., 2010). A third popular
function of the internet is user-generated-content (UGC). According to Lenhart, Madden,
Macgill, and Smith (2007), nearly two-thirds of online-teens actively create their own
content on the web. Thirty-nine percent of teens reported having shared their own
creative artwork, pictures, videos, or stories, while 28% said they had created their own
blogs or webpages (27%). There is also an increasing number of mobile apps or websites
that specifically target youths wanting to share their own content or remix existing online
content (Lenhart et al., 2007). For instance, Wikis allow people to collectively work on
the creation of content for certain topics, whereas online pinboards, such as Pinterest, can
be used to "pin" online content to a user's own creative collage of pins. Lastly, widgets,
e-cards, podcasts, and vodcasts are popular features used to spread messages and to
inform others about important topics.

Considering the increasing number of functionalities of the internet and their popularity among youths, the question arises whether teens make use of these features not only to entertain themselves or to connect with friends and families, but also for health purposes. The next section thus examines how teenagers and young adults use the internet to solicit health information.

**Health information seeking behavior of youths online.** It is important to note that despite the popularity of the internet to solicit health information, many teens still turn to conventional sources when they need health advice. A survey by Whitfield, Jomeen, Hayter, and Gardiner (2013) showed that 13-16 year-olds view their friends and parents as the most useful sources of health information, with 47% and 42% respectively. These findings suggest that the influence of parents and peers still plays a major role in the health-decision-making process of teens.

Nevertheless, the internet is the source that is most often named after family and friends. Whitfield et al. (2013) reported that 40% of students use the internet to find health-related information, following friends (47%), TV (42%), and parents (41%). A survey by Wartella, Rideout, Zupancic, Beaudoin-Ryan, and Lauricella (2015) found that the internet by far surpasses any other media. Eighty-four percent of teenagers between 13 and 18 years reported having gotten health information online, compared to books (70%), TV news (69%), TV shows (59%), and the radio (44%). Students were furthermore asked what type of source they use to obtain health information online. Google was mentioned most often (49%), followed by medical websites (31%), and Youtube (20%). Younger teens (13- to 15-year olds) were more likely to use Youtube for health-related information than older teens (28% compared to 21%) and were also more

likely to visit a website that was specifically for teens. Social networking sites, such as Facebook or Twitter, are also a source of health information for 33% of teens. Among youths who reported having searched for health-related topics online, there are substantial divides in terms of gender and race. For instance, 40% of black youths reported getting "a lot" of information from online sources, compared to 31% of Hispanics, and 18% of whites. Girls (37%) are more likely to get health information from social networking sites than boys (29%). Other studies found that bisexual, gay, lesbian, or queer youths are more likely to search for health information online than their heterosexual peers (Mitchell, Ybarra, Korchmaros, & Kosciw, 2014). These statistics suggest that minority youths rely more heavily on informal sources such as the internet to inform themselves about health-related issues.

**Interventions using new media and technologies.** Within the last few years, there was a dramatic rise in prevention programs making use of new technology channels in an effort to decrease sexually transmitted diseases and to promote sexual and reproductive health. Health educators have recognized the need to move away from traditional classroom lessons and to take advantage of the various forms of media becoming more and more popular with teens and young adults. According to Kelly (2010), these new approaches are effective in reaching specific target audiences, particularly teens and young adults, and overcoming limitations regarding access to face-to-face personalized education and health education resources. The new technology provides an innovative learning experience for teens, where information does not have to be absorbed linearly and one-sidedly, but in an interactive and engaging way (Levine,

2011). A number of programs have effectively incorporated media channels preferred by teenagers into their efforts to promote sexual health.

In 2011, MTV, in collaboration with the CDC, the Kaiser Family Foundation, and Planned Parenthood, launched a nation-wide campaign to encourage young people to get tested for STIs, including HIV. They featured celebrities from musicians to designers involved in their campaigns, while connecting fans and followers through Facebook and Twitter. On Facebook, the campaign had its on page called GYT (Get Yourself Tested); MTV posted videos and articles to promote their campaign and to interact with their audience. According to a report by the Henry Kaiser Family Foundation (2012), data collected from Planned Parenthood showed a 71% increase in STI testings in April 2010 as compared to the same month one year earlier.

Other examples include the use of video sharing sites, such as Youtube and MySpaceTV. The California Family Health Council created a Youtube channel to which they uploaded more than 35 videos on a variety of themes, including healthy sexual lifestyles (Levine, 2011). The Midwest Teen Sex Show releases one podcast episode per month, created by comedians in order to make sexual education less formal. Several studies have used videos in combination with other media. Nguyen et al. (2013) launched the *FaceSpace* Project, which included the use of a Facebook page and a Youtube channel through which they promoted healthy sexual behavior and provided information. Lou, Zhao, Gao, and Shah (2006) implemented a web-based intervention consisting of a variety of new media technologies, including educational videos and counseling through emails. Their results showed a significant increase in knowledge about STIs,

reproduction, and contraception as well as a change of attitudes regarding delaying sexual onset.

To make health information more interactive, many scholars also integrated audios, games, role plays, and quizzes into their interventions. Roberto, Zimmerman, Carlyle, and Abner (2007) implemented a seven-week computer-based intervention in high schools to prevent teen pregnancies, STIs, and HIV infections. Their intervention was composed of six different internet-based interactive activities, such as quizzes and audio recordings. Furthermore, they integrated a virtual game exposing users to a dating situation in which a partner wanted to have sex but the user did not. Depending on the choices the user made in the game, several outcomes were presented. The results were overall positive: students in the experimental school showed greater knowledge, self-efficacy in condom negotiation, and were less likely to initiate sex. Bull, Pratte, Whitesell, Rietmeijer, and McFarlane (2009) exposed participants in an internet-based HIV intervention to role model stories using audios and pictures. These stories were linked to content presented online. Even though the overall effects were moderate, the intervention led to an increase in the use of contraception. One of the most cutting-edge research includes the use of virtual environments to change sexual risk behavior among men who have sex with men. Read et al. (2006) conducted an intervention in which men who have sex with men were placed into an interactive virtual environment. They were confronted with different sexual encounters and narratives and prompted to make decisions, guided by virtual counselors. The results showed that men who took part in the interactive video intervention reduced risky anal sex behavior and used more protection as compared to the control group only receiving peer-to-peer counseling.

In addition to interactive features and social media sites, messages through phones and emails constitute another major channel to promote sexual health. A report by the Kaiser Family Foundation (Rideout, Foehr, & Roberts, 2010) found that a teen sends an average of 57 texts per day, making it a popular medium to disseminate information. According to Levine (2011), SexINFO was the first US text messaging service that provided facts about sexual health and relationships to youths in 2006. Various other text messaging services followed, for instance, the ICYC text-chat program launched by Planned Parenthood. Teens can send any questions they have regarding sexual health through text messages and receive answers from educators and health professionals. Moreno et al. (2009) used emails sent by a professional through the internet platform MySpace to inform youths against displaying risk behavior on social networking sites. Their results show that some teenagers are receptive to online feedback and even change behavior based on suggestions through emails.

New media channels show great potential in reaching teenagers and reducing sexual risk behavior. As the previous sections have shown, teenagers are enthusiastic about the interactivity that technologies offer and use these channels to solicit health information. Television, computers, radios, and video games have been part of teenagers' lives for a long time; however, the twenty-first century has experienced a shift in the way media are approached and consumed. It is not necessary anymore to watch TV with the family in the living room, or go to a friend's house to play a video game together—that can now all be done via mobile devices that fit in one's pocket. The smartphone has facilitated and increased the consumption of media, leading to constant connectedness to a virtual world of information and data.

**The Smartphone as a Major Source for Sexual Health Information**

Mobile devices, such as the smartphone or tablet, provide flexibility, accessibility, and convenience in entertaining individuals, sharing and exchanging information, or surfing the web. In the United States, 73% of teenagers own a smartphone, with African-American teens being more likely to have access to one than any other cultural group. Compared to 71% of white Americans and 71% of Hispanic youths, 86% of African-American teens reported owning a smartphone (Lenhart, 2015).

The smartphone is unique in that it can be seen as a combination of several technologies, such as the television, the phone, and the computer and thus embodies a wide variety of media characteristics. Users can make calls, send text messages, or access the web through wireless connections at any time and place. Mobile internet use is one of the factors that has particularly contributed to a rise in media consumption and multitasking among youths (Lenhart, 2015). Adolescents are now able to show and watch videos, listen to podcasts, connect to friends on social media pages, or seek information on the go. In addition to the convenience of wireless internet connection, one feature has gained particular popularity among adolescents: mobile phone applications.

Smartphone apps are software products that can be downloaded to the phone itself and that offer a wide variety of activities, services, and features. Instead of going online to search for a certain website or to log into social media pages, the user can simply download the corresponding app and have immediate access to its features. The two biggest providers for mobile phone applications are Android and iOS (Lupton & Jutel, 2015). As of July 2015, the Android Playstore offered 1.6 million apps, while the Apple app store provided 1.5 million apps to users (Statista, 2016). According to a survey by

Madden et al. (2013), 58% of teens between 12 and 17 have downloaded applications to their mobile phones or tablets. Boys are more likely to download apps (79%) than girls (62%), and teens living in wealthier households are more likely to download apps than teens from lower income households. The topical range of apps available to users in both app stores is diverse: some of the main categories include business; entertainment; education; news; shopping; photography; communication; and health.

The growing popularity of the smartphone as a communication hub combining characteristics of several media has increasingly been recognized by marketing personnel and industries that seek to reach the younger audiences. The slogan "There's an app for that" can now be heard in nearly any context when individuals ask for further information or advice. This trend had also been acknowledged in the field of health promotion. Communication channels preferred by teenagers and young adults represent promising platforms to raise awareness, change health behavior, or simply disseminate information. The next section will review how adolescents use mobile apps to seek sexual health information.

**Mobile phone applications for the promotion of sexual health.** Health related mobile apps constitute a major part of the app market and are some of the most often downloaded apps in both the iOS and Android app stores (Kratzke & Cox, 2012). According to Jahns (2014), the number of mHealth apps has more than doubled in two and a half years to more than 100,000 apps in the Apple and Android stores.

Teenagers and young adults are enthusiastic about and interested in using health related mobile apps. According to Wartella et al. (2015), nearly one third of students owning a mobile device have downloaded a health-related mobile app. Thirty-six percent

of teens that used health apps reported having changed behavior because of them. The eight most popular health categories were fitness, period tracker, nutrition, medication, depression, smoking reduction, alcohol/drug abuse, and birth control. The survey furthermore asked students what topics they find to be very important for teens their age (13 to 18 years). They named STIs (57%), pregnancies (56%), birth control (53%), puberty (47%), and domestic violence or sexual assault (42%), among others, as being important topics.

The CDC has called on sexual health professionals to use mobile applications and related technologies to meet the information needs of adolescents. Within the last few years, mobile phones have been increasingly adopted in the field of sexual health. Some of the ways in which the smartphone has contributed to the promotion of healthy sexual behavior are through connecting youths to service providers and testing locations, answering sensitive health questions, or reminding girls to take their birth control pills (Kachur et al., 2013).

In a survey among approximately 900 college students, Richman, Webb, Brinkley, and Martin (2014) asked students about their interest in using an app to help them manage and improve their sexual health. Over two-thirds of students expressed their interest in downloading such an app, with women as well as LGTBQ youths being significantly more likely to show interest in using sexual health apps than other students. Furthermore, students were asked to rank the three most useful features that sexual health apps should contain. Women chose a period tracker (46%) as the most useful tool, followed by a birth control reminder (43%) and a STI and pregnancy symptom checker

(27%). The top three features for males were STI and pregnancy symptom checker (27%), alternatives to physical sex (24%), and safer sex games and trivia (24%).

The Android and iOS app stores both provide a variety of sexual health apps. In her review of apps related to sexual and reproductive health, Lupton (2015) found that apps varied widely with regard to their functionalities and content. A majority addressed sexuality in terms of sex positions and pornography, while others provided self-tracking services or medical advice. Mangone, Lebrun, and Muessig (2016) came to similar conclusions. The authors reviewed over 6,000 pregnancy prevention apps to find out how many related to family planning and pregnancy prevention were on the iOS and Android app stores and to analyze their content and design. They identified several categories consistent with Lupton's (2015) findings, but also came to several significant conclusions in terms of the quality of available apps. First, they claimed it was difficult to identify relevant apps due to limitations in the search options of the app stores. Second, evidence-based practices of preventing pregnancies were largely absent from apps, and information was often lacking depth and comprehensiveness. Third, only a small number of apps provided videos (11%), audios (6%), or direct communication channels, such as chats (28%) or forums (27%). Even though there was a large number of apps available on both app stores, only 218 met the search criteria of the study, and the number of evidence-based, comprehensive, and interactive apps was even smaller. These results show that despite the popularity of sexual health apps, it is difficult to find apps that provide accurate, detailed, and relevant information in an interactive and engaging way. The next section will give an overview of how sexual education mobile apps should be designed,

based on the findings of the previous sections as well as on literature that focuses on the format, interface, and usability of mHealth literate apps.

**The challenge of developing health literate mobile phone applications.** The review of literature on school-based sexual education curricula as well as on online interventions to promote sexual health provided a profound understanding of features and components that could increase healthy sexual behavior and decrease adverse health outcomes. Knowing what works in face-to-face and online education facilitates the shift toward sexual education through mobile phone applications.

Nevertheless, the mobile phone brings its own challenges: limited screen size and condensed content, as well as restricted usability and navigability, are only a few of the factors that might impede access to health information. It is thus essential to present content in ways easily approachable for users. Adapting health information to the skills and abilities of individuals has often been referred to as *health literacy*. The U.S. Department of Health and Human Services (2010) defined health literacy as "the degree to which an individual has the capacity to obtain, communicate, process, and understand health information and services in order to make appropriate health decisions" (p. iii). In the context of mHealth, this means that mobile applications have to be carefully developed in terms of content, organization, and interactivity principles (U.S. Department of Health and Human Services, 2015). In 2014, the roundtable of the Institute of Medicine (IOM) produced a guide for the design of health literate mobile phone applications which was based on six strategies outlined in *Health Literacy Online: A guide to writing and designing easy-to-use health web sites* (Office of Disease Prevention and Public Health Promotion, ODPHP, 2010). As a result of the roundtable, Broderick et

al. (2014) provided a checklist with strategies to improve the design and development of health-literate and user friendly apps, which can be divided into the three broad categories of content, organization and navigability, as well as interactivity. Several studies have used their framework as a coding scheme to assess health literacy levels of mHealth apps (Caburnay et al., 2015, Ginossar et al., 2016). Their findings later also informed the second edition of *Health Literacy Online* (ODPHP, 2015).

  ***Content.*** According to Broderick et al. (2014), content needs to be written in actionable language and displayed clearly. Actionable content includes putting the most important information first, describing only the basics of health behavior and the benefits of taking action, as well as providing specific action steps. Furthermore, plain language should be used which refers to the use of short sentences (15-20 words), common, everyday language, active voice, and the avoidance of complex or medical terms.

  These principles are consistent with findings of studies on the design of eHealth and mHealth interventions. In a mixed-methods study on the use of new media to promote sexual health, Selkie, Benson, and Moreno (2011) found that youths want sexual health information to be easily accessible, trustworthy, and clear. Many participants criticized sexual health information as often containing complex language and medical terms that are difficult to understand. One student suggested that it would be helpful if medical terms were highlighted and definitions popped up when hovering over a word. Other students complained that the font size was too small and the page length too long. Including feedback from target audiences and adhering to health literacy principles may increase the effectiveness of sexual health mobile apps.

***Organization and navigability.*** Design is particularly important in the context of mobile phones. Smartphones have a limited screen size and users might have difficulties navigating the different sites. Therefore, the available space has to be organized carefully. Content should be limited to small paragraphs with no more than three lines and bulleted lists. Using a familiar font size (12-point type), avoiding clutter and dark backgrounds, and labeling links clearly can maximize readability. Furthermore, creating linear information paths can help users find information in a logical sequence. Lastly, clearly identifiable buttons and other organizational elements such as *Back* and *Next* buttons, menus, and search engines facilitate navigation for users.

***Interactivity.*** Even if health information is understandable and easy to find, it may not be effective if it is not engaging. As the section on technology use by youths showed, teenagers are enthusiastic about media, which thus represent important platforms to reach younger audiences. Several scholars have conducted surveys and interviews with teenagers to examine what features they prefer on sexual health websites and apps. A majority of adolescents favor an interactive and "fun" way to obtain sexual health information. Instead of reading lengthy texts, teenagers prefer pictures, videos, podcasts, and games. However, it is important that these media reflect "real life" people and situations so that teens are able to relate to them (McCarthy et al., 2012). Franck and Noble (2007) found that teenagers were enthusiastic about games and animations, but they also suggested that entertainment and educational components need to be balanced in order to be beneficial to youths. Dramatic stories particularly appealed to teens. Students were interested in the idea of being actively involved in decision making processes that end in different results.

Besides games and related media, social interaction was seen as an essential part of an interactive platform. Even though teens want to be anonymous, they nevertheless want to communicate with other teens and exchange experiences, ask questions, or discuss topics. Discussion boards or links to social networking sites were mentioned as media through which dialogue could be encouraged (McCarthy et al., 2012). Other teens expressed that it was important for them to be able to connect with health professionals through text messaging services or private messages (Holstrom, 2015).

In accordance with the feedback from adolescents, Broderick et al. (2014) suggest to use multiple formats when presenting health information. They encourage the integration of interactive features, such as audios, videos, and quizzes, as well as links to social media sites. Lastly, tailoring messages to characteristics and personality types of individuals can help users find information personally relevant to them.

**Summary**

This literature review stressed the importance of basing health promotion efforts on research evidence and behavior change theories. Several scholars have identified components of school-based sexual education curricula that have shown to be effective in reducing sexual risk behavior and related adverse health outcomes. Combining these components with the popularity of new media and technologies may increase awareness of sexual health issues and provide additional access to information. Mobile phone applications show particular potential in attracting youths through their interactive and engaging features. Teenagers prefer to absorb health content in a variety of formats, such as videos, audios, and interactive games, and it is important to reduce linearity in the presentation of information and instead turn to more creative features. When developing

sexual education apps, it is not only essential to include components of effective sexual education curricula and behavior change theories, but also to adhere to health literacy principles in the design of the apps.

The following chapter will examine how many and what types of sexual education mobile phone applications are available on the Android and iOS app stores. Furthermore, existing comprehensive sexual education apps will be analyzed in terms of their content and their adherence to behavior and learning theories as well as health literacy principles.

**Chapter 3: Methods**

The primary purpose of this thesis was to evaluate existing comprehensive sexual education apps regarding their quality and their occurrence of effective sexual health components, behavioral and learning theories, and literacy levels. In order to accomplish these objectives, a mixed-methods approach was used with a focus on quantitative methods (Creswell & Plano Clark, 2011). The research questions were best answered by providing quantitative measures of the frequency of the different coding items while at the same time giving in-depth descriptions of how they occurred. Furthermore, a thematic analysis added to a more comprehensive perspective on the presentation and arrangement of content in the context of sexual health apps. This approach was also used by Marques et al. (2015) who analyzed sexual education websites in terms of their occurrence and use of effective framework-based components. The authors conducted a content analysis examining how often components of the framework provided by the International Planned Parenthood Federation (2010) appeared on sexual education websites. They furthermore identified and discussed themes that emerged during the content analysis.

In the context of this study, using a mixed-methods approach similar to Marques et al. (2015) allowed for a thorough and systematic analysis of sexual education apps, leading to a deeper understanding of both the quantity and quality of content components and literacy levels. While the quantitative analysis assessed the absence or presence of effective sexual education curricula components, theories, and literacy principles, the qualitative analysis examined *how* content was presented. The following sections provide a detailed description of the search and screening process of relevant apps and discuss the

quantitative and qualitative methods used to analyze comprehensive sexual education apps.

**Search and Screening Process**

The primary focus of this study was on the examination and analysis of comprehensive sexual education apps. Nevertheless, it was essential to first get an overview of the status quo of the app market in terms of apps related to sex and sexuality and to identify comprehensive sexual education apps; thus the first two research questions sought to answer what types of apps were available to users related to sexuality and what types of sexual health apps provided educational and informational resources. In order to answer these research questions and to identify the final sample of comprehensive apps, the first part of the analysis consisted of a rigorous screening and categorization process of available apps.

In February 2016, the Apple ITunes store as well as the Android Playstore were screened for relevant apps. Nine search phrases were used to identify these apps: *sex*; *sexuality*; *sexual health*; *sexual education*; *reproductive*; *contraceptive*; *safe sex*; *sex and relationships*; and *STI*. Several of these keywords were taken from Mangone, Lebrun, and Muessig (2016), who examined and analyzed pregnancy prevention apps in terms of design and content. Since pregnancy prevention constitutes an important part of sexual education, some of the keywords used by the authors could also be applied to the current study.

Each keyword was typed into the search bar of the ITunes store and the Android Playstore, resulting in a total of 2,693 suggested apps. Overall, the results for each keyword varied widely in their relevance and relation to sex, sexuality, or sexual

education. To allow for a more systematic and consistent screening, a data scraping tool

was used to extract the most important information for each available app. For the

software to work, the URLs for each app had to be copied into the data scraping tool.

Once the URLs were copied, the software was trained to extract the following content

from the webpage of each individual app: the app title, the app category, the developer,

the targeted age group, the ratings, and the description of each app. The training process

involved extracting the information of the first five app webpages manually until the

software recognized the extraction pattern and was able to automatically collect the

requested content. Subsequently, the results for each keyword were transferred to a

spreadsheet and screened for relevance. To be included in the final sample of

comprehensive sexual education apps, applications had to fulfill the following criteria:

(1) Apps provided sexual health information on a variety of topics without addressing
one specific aspect of it (such as STI only, pregnancy only);

(2) The purpose of the app was clearly to provide informational resources (i.e., not
primarily entertainment);

(3) The app provided extensive and comprehensive information (i.e., not only facts);

(4) Comprehensive sexual education apps targeted teenagers and young adults (i.e.,
not parents, health care providers, etc.);

The screening process identified 26 apps that fulfilled these criteria and were thus

included in the final sample of comprehensive sexual education apps. Once identified,

these apps were downloaded onto a smartphone that was compatible with the iOS or the

Android software, depending on the app. After the download, these apps were examined

quantitatively and qualitatively. However, some of the apps that had been included in the

final sample due to their eligibility had to be eliminated after their download. The reason

for this was that the apps were chosen based on the information and descriptions the

developers had provided on the app stores. However, the information online did not

always correspond with the actual content of the app or its characteristics. Thus, five apps

had to be excluded. Furthermore, two apps targeted parents and their small children and

four did not function at all. This led to a remainder of 15 comprehensive sexual education

apps that were analyzed (see Appendix A for a complete list).

**Quantitative Analysis of Sexual Education Apps**

The quantitative analysis consisted of a content analysis of the 15 comprehensive

sexual education apps that were included in the final sample. According to Berelson

(1952), a content analysis is "a research technique for the objective, systematic and

quantitative description of the manifest content of communication" (p. 18). For the

purpose of this thesis, a content analysis was used to quantify the occurrence of sexual

education components, behavior change techniques, as well as health literacy principles

in sexual education apps. The analysis followed broadly the typical process of a content

analysis as outlined by Neuendorf (2002), which included the following: theory and

rationale, conceptualizations, operationalizations, coding schemes, sampling, training and

pilot reliability, coding, and final reliability. However, due to the small sample size some

of these steps had to be adapted to the context of the current study.

**Conceptualization of coding items.** In the first step, all coding variables related

to sexual education components, health behavior change techniques, and health literacy

levels were conceptualized. The following sections provide a detailed description of each

of the categories and their coding items.

*Components of effective sexual education curricula.* As the literature review showed, there are several toolkits and evaluation checklists that enable educators to incorporate components of successful curricula into new or existing programs. These components refer to the content as well as the development and implementation of sexual education programs. Furthermore, a major focus was on building skills and values in teenagers enabling them to make decisions that contribute to a healthy life.

For the purpose of this study, the National Sexuality Education Standards as proposed by the Future of Sex Education (FoSE, 2012) were used to evaluate existing comprehensive sex education apps. The Sexuality Education Standards named seven topics as key areas of effective sexual education curricula and listed specific outcomes for each of them. These seven topics included (1) anatomy and physiology; (2) puberty and adolescent development; (3) identity; (4) pregnancy and reproduction; (5) sexually transmitted diseases and HIV; (6) healthy relationships; and (7) personal safety. In addition to these seven core areas, sexual pleasure was added to the coding scheme as proposed by the International Planned Parenthood Federation (2010). The conceptualizations for the eight categories were taken from each of the frameworks, which contained detailed descriptions and examples (see Appendix B).

Providing the necessary knowledge to make positive health decisions constitutes the first step toward positive health behavior change; however, it is essential to also equip teenagers with the skills and capabilities to successfully perform a specific health behavior. As the review of learning and behavioral theories showed, empowering youths through the teaching and practice of skills can increase their perceived self-efficacy and, in turn, may influence their intentions and actions (Bandura, 1977, 1986; Ajzen &

Madden, 1986). Both the HECAT (CDC, 2012) and the FoSE (2012) toolkits stressed the importance of a skill-based sexual education curriculum and proposed the inclusion of negotiation, decision-making, and interpersonal communication skills. Even though the context of technological-mediated education may pose more challenges to the teaching of specific skills, interactive features such as videos or simulation games may be useful to convey how to effectively communicate with partners or how to navigate different relationships.

To summarize, the analysis evaluated existing comprehensive sexual education apps on the absence (0) and presence (1) of items that were conceptualized as follows:

(1) Anatomy and physiology: Provides a foundation for understanding basic human functioning;

(2) Puberty and adolescent development: Addresses a pivotal milestone for every person that has an impact on physical, social, and emotional development;

(3) Identity: Addresses several fundamental aspects of people's understanding of who they are;

(4) Pregnancy and reproduction: Addresses information about how pregnancy happens;

(5) Sexually transmitted diseases and HIV: Provides information on how STIs and HIV are transmitted, their signs and symptoms, testing, treatment, and prevention;

(6) Healthy relationships: Offers guidance to students on how to successfully navigate changing relationships among family, peers, and partners;

(7) Personal safety: Safe environment for children and adolescents;

(8) Sexual pleasure: Sexuality is approached in a positive way;

(9) Communication and interpersonal skills: Builds personal and social competence.

***Theory-based components.*** Besides the inclusion of skills into the curricula,

several other constructs may increase positive sexual health behavior. As reviewed

earlier, there exists a variety of theories related to human behavior and learning that have

been applied to the development of sexual health programs. Even though these theories

have their own unique approach to behavior change, they often overlap in their

descriptions of the main constructs and concepts. Unfortunately, a "standardized

vocabulary that defines intervention components" (Abraham & Michie, 2008, p. 379)

does not exist and the same constructs and concepts are often called differently across

theories. It has thus become increasingly difficult to identify theoretically-based

constructs in interventions and, more importantly, to evaluate the effectiveness of specific

components across interventions (Abraham & Michie, 2008; Michie & Prestwich, 2010).

In order to allow for a more holistic, replicable, and systematic evaluation of theory-

based interventions, recent research has started to identify common and distinctive

techniques across interventions that are related to learning and behavioral theories. These

techniques have been coined behavior change techniques (BCT) and are defined as an

"observable, replicable, and irreducible component of an intervention designed to alter or

redirect causal processes that regulate behavior; that is, a technique is proposed to be an

'active ingredient' (e.g. feedback, self-monitoring, and reinforcement)" (Michie et al.,

2013, p. 82). Abraham and Michie (2008) developed the first taxonomy of 26 behavior

change techniques, which was later extended to 93 BCTs (Michie et al., 2013). Both

taxonomies have frequently been used as coding schemes for the identification of

behavior theories in online health interventions, such as cancer interventions (Vollmer

Dahlke et al., 2015), physical activity and healthy eating (Michie et al., 2011; Direito et al., 2014), as well as sexual health (Carswell, McCarthy, Murray, & Bailey, 2012).

For the purpose of this study, the coding of behavior change techniques in sexual education apps was based on Abraham's and Michie's (2008) taxonomy of 26 BCTs and supplemented by coding guides developed for cancer survivorship apps (Vollmer Dahlke et al., 2015) as well as sexual health websites (Carswell et al., 2012). The coding schemes developed by Vollmer Dahlke et al. (2015) as well as Carswell et al. (2012) were both based on Abraham's and Michie's (2008) taxonomy, but provided additional descriptions of examples for specific BCTs that facilitated the coding process for sexual education apps. Of the 26 BCTs as proposed by Abraham and Michie (2008), the following six were included into the coding scheme:

(1) Provides information about behavior-health link: General information about behavioral risk, for example, susceptibility to poor health outcomes or mortality risk in relation to the behavior;

(2) Provides information on consequences: Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behavior;

(3) Prompts intention formation: Encouraging the person to decide to act or set a general goal, for example, to make a behavioral resolution;

(4) Prompts barrier identification: Identify barriers to performing the behavior and plan ways to overcoming them;

(5) Models or demonstrates the behavior: An expert shows the person how to correctly perform a behavior;

(6) Self-efficacy: Aids user in recognizing skills or education developed (Vollmer

Dahlke et al., 2015).

*Health literacy principles.* As reviewed earlier, Broderick et al. (2014) provided a

guideline to analyze health literacy levels of mobile phone applications in relation to

content, organization and navigability, as well as interactivity. The following sections

provide an overview of the items that were included into the coding scheme.

*Content.* To see whether content is presented in an accessible and understandable

way, information on the mobile apps was coded for the following categories:

(1) Most important information comes first: Additional information should come

after basics (U.S. Department of Health and Human Services, HHS, 2015);

(2) Describes the health behavior—just the basics: What to do and how to do it

(HHS, 2015);

(3) Includes the benefits of taking action;

(4) Provides specific action steps: how to act on the information provided (Broderick

et al., 2014);

(5) Uses common, every day words: no jargon;

(6) Avoids undefined technical or medical terms;

(7) Uses active voice;

(8) Short sentences: 15-20 words.

*Organization and navigability.* The interface and the navigability of the mobile apps

were coded in the following categories:

(1) Uses bullets and short lists;

(2) Uses a familiar font: at least 12- point type;

(3) Uses white space and avoids clutter: each page should have at least 10-35% of white space (CDC, 2009);

(4) Labels links clearly: underlines links, makes them long enough to "grab" them; uses buttons (HHS, 2015);

(5) Avoids dark backgrounds;

(6) Creates linear information paths: clear and logical sequence;

(7) "Back" button works;

(8) Easy access to home and menu pages;

(9) Search function is available.

*Interactivity.* The last component of health literacy relates to the engagement of the user with the mobile platform. The following categories were included in the analysis:

(1) Includes interactive content: quizzes, games;

(2) Includes audio and video content;

(3) Images facilitate learning;

(4) Media contain "real life" people and situations (McCarthy et al., 2012);

(5) Provides tailored information: customizes content to personal interests or characteristics (HHS, 2015);

(6) Provides social media sharing options.

**Code schemes: Code sheet and code book.** To facilitate the coding process, both a code sheet and a code book were developed. The code sheet consisted of a spreadsheet which contained the name of the app, the developer, the category the app appeared in, and the ratings. Furthermore, the name of the coder as well as the date and time of the coding were added. Subsequently, all coding items were transferred to the spreadsheet.

Furthermore, a code book was developed which provided detailed descriptions and examples for most of the coding items as described above (see Appendix B). In total, the code sheet and the code book contained nine coding items for the topical categories, six behavior change techniques, and 23 items for health literacy.

**Coder training.** Two independent coders were trained by the first author in two training sessions to ensure mutual understanding of the conceptualizations of each coding item. Both coders were doctoral students at the time of coding. They downloaded the 15 comprehensive sexual education apps onto Android smartphones, since all of the apps were compatible with the Android software. The team was then trained for the code book in two two-hours training sessions and each coding item was discussed in detail.

**Unit of analysis.** In order to be as inclusive as possible in the coding process, the unit of analysis was the entire mobile phone application, i.e., each window that could be opened as well as functionalities and tabs. If an app provided a link to a website, only the first webpage of that website was coded. However, links were only coded for absence and presence of the items if they were directly related to the topic addressed in the paragraph preceding the link. For instance, if an app provided information on how to communicate with a partner about contraception use and included a link to more information or specific examples, coders also included that specific webpage into their analysis. On the other hand, if an app provided a tab with links to further resources without specifically mentioning their purpose or how they relate to a certain topic, they were excluded from the analysis.

**Pilot sample and inter-coder reliability.** In order to check for inter-coder reliability, a pilot sample of seven apps was coded for absence (0) and presence (1) of all

38 coding items by the two coders independently. The results showed values between .6

and 1.00 for Krippendorff's alpha which corresponds to a percentage agreement between

85.7% and 100%. After the pilot coding, disagreements between the two coders were

discussed and conceptualizations of coding items refined in the code book to ensure

mutual understanding of each item. Thereafter, the code book was not changed anymore

to maintain consistency. Subsequently, both coders continued to code the remaining eight

apps and the results for all 15 apps were again checked for inter-coder reliability. Values

for Krippendorff's alpha were between .73 (93.3% agreement) and 1.00 (100%

agreement) which satisfied the required minimum values for Krippendorff's alpha

(Krippendorff, 2004). The results for each variable can be found in Appendix C.

Disagreements between the coders were discussed until a consensus was reached.

**Qualitative Analysis of Comprehensive Sexual Education Apps**

In order to contribute to a deeper and more comprehensive understanding of the

quality of sexual education apps, qualitative analysis was used to complement the

quantitative findings. The focus of the qualitative assessment was primarily on the

presentation of content in the topical categories and the use of behavior change

techniques in apps. Furthermore, it allowed me to examine overarching themes that

emerged from the analysis of the apps.

As a method to analyze the content qualitatively, a thematic analysis was chosen.

Boyatzis (1998) described a thematic analysis as a "process to encode qualitative

information" (p. vi), while Braun and Clarke (2006) defined it as "a method for

identifying, analysing and reporting patterns (themes) within data" (p. 79). It represents

an inductive and emic approach to data in which the researcher actively analyzes texts

and recognizes patterns. The purpose of the qualitative analysis in this study was not the creation of a larger theory, but rather to be able to make assumptions about the nature and the format of content and its meaning within the broader context of sexual education. Even though the results of the thematic analysis were grounded in the data and no pre-determined categories were used in the analysis, it cannot be seen as grounded theory, since its main goal was not to produce a theory, but rather to gain a deeper understanding of the presentation of the content (Braun & Clarke, 2006).

The qualitative analysis of sexual education apps fulfilled two purposes: first, it was used to complement the quantitative findings for research questions 3 and 4, i.e., to analyze descriptively how the topical components of sexual education were presented as well as to examine how behavior change theories were used in the presentation of content. Second, the qualitative analysis of content enabled me to identify themes that occurred across categories and across all apps. This approach was similar to Marques et al.'s (2015) mixed-methods analysis of sexual education websites.

**Use of NVivo.** The thematic analysis of the 15 comprehensive sexual education apps followed several steps which were adapted from Braun and Clarke (2006). Since research questions 3 and 4 focused on the content of the eight sexual education topics as well as behavior change techniques, each of the coding categories were examined separately to identify emerging themes.

To facilitate the analysis, screenshots were taken and imported into the qualitative data analysis tool NVivo 11 (QSR International, 2015). In order to answer research questions 3 and 4, nodes were created for each coding item regarding the topical categories (anatomy and physiology; puberty and adolescent development, identity,

pregnancy and reproduction, sexually transmitted diseases and HIV, healthy relationship, personal safety, and sexual pleasure) as well as behavior change techniques *(*provides information about behavior-health link; provides information on consequences; prompts intention formation; prompts barrier identification; models or demonstrates the behavior; self-efficacy). In NVivo, nodes can be seen as a collection of references about a specific topic or area of interest. Once the screenshots were imported into the software and the nodes created, each screenshot was examined and coded for content related to any of the nodes. The creation of nodes thus allowed me to analyze the content for each topic and behavior change technique separately.

**Sample size and data selection.** The assessment of comprehensive sexual education apps proved to be problematic in terms of the selection of analyzable data. The number of screenshots varied widely between the apps, ranging between 50 to over 600 screenshots. To ensure consistency in the coding process, data was limited to no more than three screenshots scrolling down, and no more than ten buttons or tabs related to any of the topical categories. For example, if an app provided information on STIs and the user had to scroll down more than three times to take screenshots, the subsequent screens were not taken into consideration for the analysis. Similarly, if an app provided more than 10 tabs related to STIs, every tab thereafter was left out of the coding.

**Familiarization with the data.** Each of the nodes was examined separately. As Braun and Clarke (2006) pointed out, it is important to immerse oneself into the data and to read through the data set several times. Even though the data for this project consisted of scientific and factual content rather than interpretive data, reading the content of the

screenshots several times enabled me to get a more thorough understanding of *how* the different topics were presented.

**Generating initial codes.** After reading the content for each node separately several times, initial codes were identified that represented interesting features within each node. According to Braun and Clarke (2006), the researcher ideally moves from a descriptive to an interpretive level. In the context of sexual education apps, the initial codes consisted of a description of both specific topics that were addressed within each node as well as elements that seemed of interest to me.

**Searching for themes.** In the next step, the codes were re-read several times and collated into themes. Due to the nature of the content, which was rather scientific and factual, the development of themes occurred across all nodes rather than within each of the nodes. Thus, the analysis of each node remained on a descriptive level while broader themes emerged across all categories. The results of the thematic analysis were used to complement findings for research questions 3 and 4 as well as to answer research question 6.

**Chapter 4: Results**

**Research Question 1 Findings**

The first research question sought to examine what types of mobile phone applications were available on the iOS and the Android app market that related to sexuality, sexual health, or sexual education. The purpose of this question was to get a better understanding of the types of apps offered to individuals who seek sexual health information through apps.

As already stated in the method section, nine keywords were typed into the search bars of both the ITunes store and the Android Playstore. These keywords were carefully sought out to identify the upmost number of relevant apps. The number of results differed between the ITunes store and the Android Playstore. The Android store provided approximately 250 apps for each keyword, resulting in 2,232 apps in total. The ITunes store was very limited in its search availability, and only 461 apps were found for all nine search phrases. The use of a data scraping tool as described earlier facilitated the categorization process; it allowed me to extract the most important information from the webpage for each app, including the app title, the name of the developer, the category it appeared in, the ratings, as well as the description.

The majority of the 2,693 apps were not related in any way to the search phrases and did not contain content about sexuality, sexual education, or sexual health. For example, when using the search phrase *sexual education*, apps related to other educational fields, such as geography or healthy eating, were shown. To identify relevant apps and to make the screening process more consistent, several criteria were established:

(1) Apps address sexuality, sexual health, or sexual education in some way; they either focus on a specific component of sexual health, such as STI or pregnancy prevention; include services (clinic locators, etc.); provide sexual health information in general; or address sexuality through interactive features (games, quizzes, etc.);

(2) Apps are in English;

(3) Apps are free;

(4) Apps were not developed for a specific event, such as a conference (Mangone, Lebrun, & Muessig, 2016);

(5) App was not exclusively developed for individuals or communities outside the United States.

These criteria were chosen after careful consideration. The first criteria ensured that only apps related to sex or sexual health were included into the analysis. Furthermore, these apps had to address individuals in the US and present content in English, without being developed for a specific event. Lastly, only free apps were included, since similar studies have shown that users are reluctant to pay for educational or informational apps (Vollmehr Dahlke et al., 2015).

After the screening process, the number of apps was reduced drastically. From the ITunes store, 257 out of 461 apps fulfilled the screening criteria, while only one quarter of the 2,232 Android apps (n= 577) were eligible. In the next step, both lists were combined, leading to 834 apps in total. This list was again screened, since some of the apps appeared in both the Android and ITunes stores, and duplicates needed to be eliminated. Further, several apps were taken out that did not fulfill the search criteria, but

that were overlooked in the first screening. The final list consisted of 679 apps that were free to users, in English, did not refer to a specific event, targeted individuals in the United States, and addressed sexuality, sexual health, or sexual education.
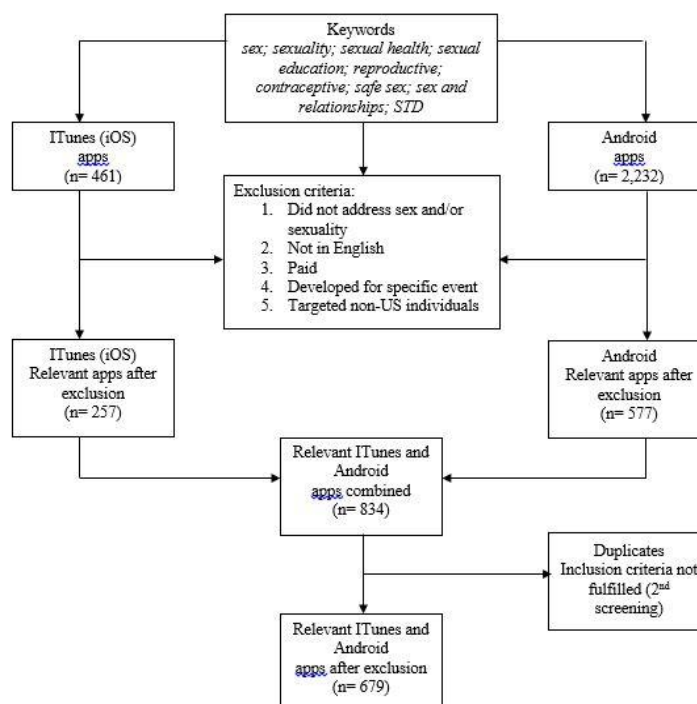


*Figure 1.* Screening process of eligible apps.

The final sample that was included to answer research question 1 thus consisted of 679 apps. In the next step, all 679 apps were reviewed and categorized in terms of their content by examining the descriptions that had been extracted with the data scraping software. Five categories emerged from the analysis of the app descriptions, which were defined as *dating, sex positions, games, tracking services, and education*.
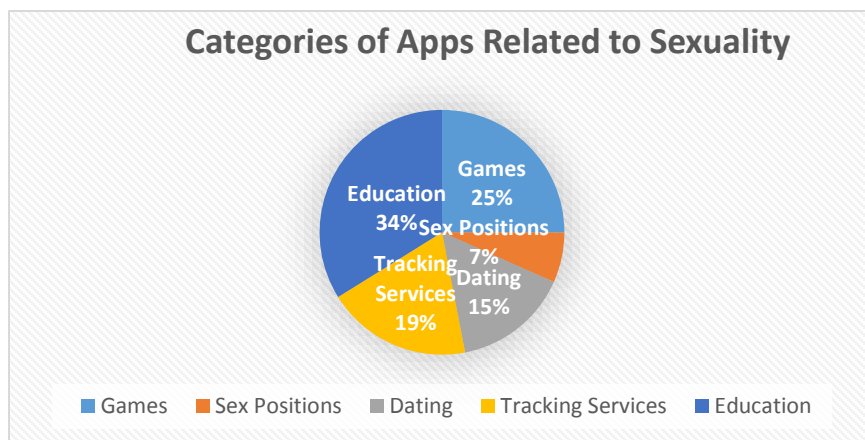
*Figure 2.* Categories of apps related to sexuality. This pie chart shows the different categories that emerged from the screening of apps related to sex and sexuality.

Fifteen percent of apps (n= 104) were categorized as dating apps, since their primary focus was to connect people to one another and to identify potential partners for a romantic or sexual relationship. A majority of dating apps targeted very specific groups or communities, including LGTBQ, ethnic minorities, or individuals that have HIV or other diseases. Another seven percent of apps (n=45) provided information on sex positions and aimed to increase sexual pleasure and satisfaction, without offering information about sexual intercourse and sexual health in general. One fifth of all apps (19%; n= 130) provided various tracking services. The most popular services included birth control pill reminders, menstrual and fertility tracking, as well as pregnancy calendars. Furthermore, 25% of apps addressed sexuality in the form of games, trivia, quizzes, or similar entertainment functionalities. Many of the games included horoscopes, sex position dices, pranks, or love and relationship tests. Apps that were assigned to this category were primarily focusing on providing entertainment to the users rather than educational information. The last category contained the majority of apps. Thirty-four percent of apps (n=230) addressed sexuality from an educational perspective, with the

main purpose of providing information on various topics related to sexuality, sexual health, or sexual education. Since the second research question asked how many and what types of educational or informational apps related to sexual health and sexual education were available in the app stores, the 230 apps were again examined and categorized depending on their content.

**Research Question 2 Findings**

Even though apps in the education category had the same objectives, they differed greatly in their content and format. Six categories emerged from the evaluation of app descriptions: *specific health topics, facts/tips, clinic/service referrals, counseling, games*, and *comprehensive sexual education*.
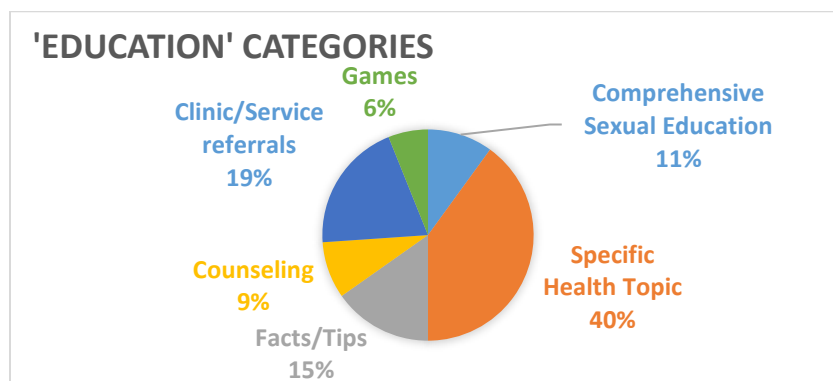


*Figure 3.* Education categories. This pie chart shows the different categories that emerged from the screening process of educational apps.

Forty percent of all apps (n=92) in the education category addressed a very specific sexual health topic or focused on a certain component of sexual education. Numerous apps provided information on contraception as well as STI prevention and treatment. Furthermore, infertility and sterility were topics that were repeatedly identified. Another sexual health area that seemed to increasingly gain attention on the app market was sexual violence and assault. Several apps provided information as well as

services for victims of sexual violence, including clinic referrals, counseling, or support groups.

Besides specific health topics, apps were also used by clinics, health care centers, and nonprofit organizations to promote sexual health and to offer their services (n=43; 19%). Most of the clinical apps provided only limited sexual health information and instead gave an overview of the services of the clinic and their procedures. Additionally, some clinics or centers used these apps to remind patients of appointments or to share diagnoses and test results. A smaller number of apps (9%; n= 20) provided counseling and advice services, where individuals could ask a health professional questions related to a variety of topics. The reliability of these apps varied greatly. While some apps seemed to offer genuine and trustworthy advice, others raised doubts of the professionalism and credibility of the information sources. Most of these apps provided counseling in terms of issues related to relationships or marriages.

Another category that emerged from the examination of app descriptions, were *facts* or *tips* (n=35; 15%). These apps provided sexual health information, but in the format of short facts or tips, without elaborating on the information presented. It needs to be stated at this point, though, that some of these apps had engaging interfaces and designs, which might attract users who want to absorb sexual health information in a more playful and accessible way. Similarly to the facts/tips category, there was a small number of apps (6%; n=14) that provided educational games and quizzes for users to disseminate sexual health information in a more entertaining way. The quizzes offered questions on a variety of sexual health topics, whereas games mainly focused on contraception and STI/HIV prevention. For instance, the game app Infection, which was

developed by the National AIDS Commission Secretariat (2016), made users navigate a character through a world full of viruses and infections and at the same time provided information on STIs and HIV. At the end of each level, users must pass a quiz with questions about the information that was provided during the game.

The last category that emerged from the screening of app descriptions were comprehensive sexual education apps. Apps assigned to this category were described by their developers as platforms that provided detailed and extensive information on a variety of sexual health topics. Furthermore, their main purpose was clearly to provide informational resources to teens, instead of entertainment. A total of 26 apps (11%) were identified as comprehensive sexual education apps. However, after downloading the 26 apps, 11 had to be eliminated from the final sample, because they did not function, addressed specific sexual health topics, or targeted adults.

**Research Question 3 Findings**

After the analysis of the types of apps related to sexuality and the identification of educational and informational apps, the last four research questions focused exclusively on comprehensive sexual education apps. These questions were answered using a mixed-methods approach.

Research question 3 asked to what degree comprehensive sexual education apps contained components of school-based sexual education curricula shown to be effective. First, all 15 comprehensive sexual education apps were coded for absence and presence of the nine topical categories as shown below. After the quantitative evaluation, the 15 apps were analyzed qualitatively, using a thematic analysis.

As an overall result, the coding showed that all 15 apps together addressed 66% of content that fell within the framework of the nine categories. This number shows that apps did not reach their full potential of covering the most effective components in mobile sexual education, leaving 34% of content within these categories unaddressed.

A closer look at the numbers shows that some topics were addressed more often in comprehensive sexual education apps than others (for full results for each individual app, please refer to Appendix D). The categories anatomy and physiology as well as sexually transmitted diseases and HIV appeared in 93% of all apps (n=14), followed by pregnancy and reproduction with 80% (n=12) and healthy relationships (73%; n=11). Sexual pleasure and communication skills were mentioned in over two thirds of apps with 67% and 60% respectively. Less than half of the 15 apps addressed puberty and adolescent development (47%) and personal safety (47%). Identity was discussed in only one third of all apps (33%; n=5).

Table 1.
*Frequency of topics addressed in comprehensive sexual education apps*

| Topical Categories | number (n) (N=15) | percentage (%) |
|---|---|---|
| Anatomy and Physiology | 14 | 93% |
| Puberty and Adolescent Development | 7 | 47% |
| Identity | 5 | 33% |
| Pregnancy and Reproduction | 12 | 80% |
| Sexually Transmitted Diseases and HIV | 14 | 93% |
| Healthy Relationships | 11 | 73% |
| Personal Safety | 7 | 47% |
| Sexual Pleasure | 10 | 67% |
| Communication and Interpersonal Skills | 9 | 60% |

The thematic analysis led to a deeper understanding of how the different topics were addressed and provided more specific descriptions of the content for each category.

As could be seen from the results of the quantitative analysis, the categories anatomy and physiology as well as sexually transmitted diseases and HIV appeared most often in sexual education apps. In terms of anatomy and physiology, content was most often related to organs and their functions, bodily changes during puberty, pregnancy, and menstruation. Screenshots addressing sexually transmitted diseases and HIV most often referred to how STIs spread, their symptoms, different types of STIs, how to get tested, treatment, as well as prevention. How to prevent getting STIs was mostly linked to the description of contraceptive methods; however being faithful and honest to a partner was also mentioned. Nearly every app that included information about contraceptive methods named abstinence as the only option which guarantees protection against STIs and unintended pregnancies. In addition, the majority of apps explained how each of the contraceptive methods works and how effective they are in preventing pregnancies and STIs.

The use of contraceptives was also discussed in relation to the category pregnancy and reproduction. Furthermore, the twelve apps that contained information about this topic talked about the physiology of getting pregnant. Interestingly, this information was often linked to the dismantling of several myths, such as one can only get pregnant at certain times of the month, in certain sex positions, or through masturbation. Another major topic related to pregnancy was teen pregnancy. Since all apps targeted teens, being pregnant was an issue that was often discussed in length. While one app used fear appeals to prevent teenagers from getting pregnant by including negative consequences for the baby as well as the parents, other apps created sympathy for the situation of pregnant teens and provided information about different options. Additionally, information about

laws and regulations about pregnancy in terms of consent, decision-making, and pregnancy options were discussed.

The topic of healthy relationships was addressed in 73% of all apps; however, the qualitative analysis showed that the majority of apps only mentioned characteristics of a healthy relationship in relation to other topics, such as sexual pleasure or personal safety. Only four of the 11 apps that contained information about healthy relationships had a separate tab or button which contained more elaborate content on the topic. However, these apps provided very detailed descriptions and explanations of what a healthy relationship should look like and what it should entail. Respect, trust, honesty, fairness, support, communication, and equality were characteristics that were most often mentioned. Moreover, specific examples were given for each of the characteristics, often in combination with questions the user could ask him or herself.

Closely connected to healthy relationships was the topic of sexual pleasure. Sexual pleasure had the third highest number of references among all nodes. How apps addressed sexual pleasure, however, differed greatly. While some apps only mentioned it once or twice, for instance in their question and answer section, other apps provided elaborate information. Topics that were most often discussed were masturbation, orgasms, types of sex, sex positions, and sex toys or games. Sex was seen as an important part of a healthy relationship and mostly portrayed as a normal and healthy component of a partnership. However, nearly every app stressed the importance of being responsible and to consider possible negative consequences, such as STIs or pregnancies. The app SexPositive (University of Oregon, 2014) combined safer sex messages with sexual pleasure by showing how condoms can make sex more fun or by describing how consent

can be sexy. Furthermore, they provided tips on how to increase sexual pleasure through the use of toys or games. The influence of media and society on individual's sex lives was mentioned in the app Sexual Health Guide (AIDS West, 2012). The app criticized that the media portrays orgasm as the desired climax of sexual activity, while intimacy may be more important and could also be achieved through other means, such as kissing or just being close to a partner.

The category puberty and adolescent development was addressed in less than half of all apps and only two apps discussed it in length. Despite the fact that puberty constitutes a normal part of human development, it was largely presented as a time period of confusion, anxiety, and embarrassment. Most apps talked about the emotional and physical changes during puberty which can in fact lead to confusion or anxiety; however, positive development was completely absent from information surrounding this topic. Nevertheless, the apps My Sex Doctor (My Sex Doctor, 2016) and ReproHealth (Women's Health and Action Research Centre, WHARC, 2015) provided extensive information on how to cope with bodily changes and described them as a normal process that everyone goes through. Being or feeling normal was repeatedly mentioned in the context of puberty, mostly in combination with social comparisons. For instance, in My Sex Doctor (My Sex Doctor, 2016) the beginning of puberty was described as follows: "Different people enter puberty at different ages. If some of your friends have already started showing some adult features but you still look like a child, it is completely normal." ("What if puberty doesn't begin?", 2016). This approach was also used in answering questions such as "Is my penis size normal?" or "Are my breasts normal?" Furthermore, sexual orientation and gender identity were discussed in relation to puberty.

Having feelings for someone of the same sex was described as normal during puberty which did not necessarily mean that a person is not heterosexual.

The topic of identity was mentioned in five apps. All five apps defined sexual orientation and gender identity as well as several other terms related to them. Only My Sex Doctor and Get Smart addressed issues such as gender based violence, homophobia, coming out, and emotional challenges. Identifying as LGTBQ was acknowledged as a difficult process which often leads to challenges in the society and negative consequences for the individual. Information was thus provided in a sensitive and sympathetic way including statements which expressed understanding for the challenges individuals have to go through. Get Smart, for instance, encouraged teens to make their own decisions and to not be pressured into labeling themselves. It was repeatedly mentioned that identifying as homosexual or as LGTBQ was nothing to be ashamed of and that it was an individual's choice to make a decision regarding coming out. Furthermore, detailed information was offered on how and where to seek help if needed.

Facing homophobia and violence was also discussed in the category of personal safety. Other topics related to that category included sexual abuse, dating violence, and rape as well as the influence of alcohol and drugs on a relationship. Personal safety in general was often contrasted to healthy relationships and it was described what an unhealthy relationship looks like. Characteristics included being disrespectful, pressurizing the partner, disregarding a partner's decisions, or cheating. More importantly, some of the apps provided specific examples of an unhealthy relationship and explained that it does not only entail physical violence. For instance, the app Get Smart (ImpactAspen, 2015) provided a list with detailed examples of what constitutes an

unhealthy relationship. Digital violence and online threats have also become an increasingly popular topic among sexual education apps. Get Smart and My Sex Doctor both talk about the danger of taking private pictures and having them uploaded on social media without consent. Online stalking and dating were also discussed.

Nearly all topical categories included communication and interpersonal skills. In general, communication was considered one of the most essential parts of a healthy relationship and it had the second highest number of references among all categories. Negotiation and decision-making skills were discussed in relation to sexual activities, such as having sex for the first time, setting boundaries, discussing the use of safer sex methods, or talking about STIs and testing. The majority of apps provided specific phrases or examples of sentences teenagers could use to start a conversation or to talk about certain topics. For instance, SexPositive (University of Oregon, 2014) included a list of questions teens could ask to get consent from their partners, such as: "Does that feel good?" or "Do you like that?" The app also provided several videos in which teens modeled or demonstrated conversations with their partner about sensitive or uncomfortable topics. The app It Matters (Big Yellow Star, 2016) offered a variety of responses to a partner who pressured someone to have sex. Besides specific phrases, apps also gave advice on how to communicate effectively, including using "I" statements, being direct and honest, asking questions, and being able to listen.

Other communication or interpersonal skills that were discussed in apps included how to break up with a partner, how to read someone's body language, how to kiss and flirt, how to come out as LGTBQ, and how to seek support. Most apps provided specific action steps that users could follow to boost their self-confidence and self-efficacy.

**Research Question 4 Findings**

The fourth research question examined to what extent apps were based on health behavior and learning theories. A majority of apps provided information on sexual health that showed a clear link between sexual behavior and its resulting health outcomes (n=13; 87%). Eighty-percent of apps addressed the consequences of sexual behavior and 73% (n=11) prompted intention formation. Less than half of apps modeled or demonstrated sexual health behavior (n=7; 47%) and only 27% (n=4) tried to increase the level of self-efficacy in their users. Lastly, only two apps (13%) addressed potential barriers to healthy sexual behavior.

Table 2.
*Frequency of behavior change theories used in comprehensive sexual education apps*

| Behavior Change Theories | number (n) (N=15) | percentage (%) |
|---|---|---|
| Provides information about behavior-health link | 13 | 87% |
| Provides information on consequences | 12 | 80% |
| Prompts intention formation | 11 | 73% |
| Prompts barrier identification | 2 | 13% |
| Models or demonstrates behavior | 7 | 47% |
| Self-efficacy | 4 | 27% |

As can be seen from the numbers, the majority of apps provided information about how behaviors are linked to health outcomes. In relation to sexual education, health outcomes most often referred to STIs, HIV, and unintended pregnancies. Despite 87% of apps showing how certain sexual health behaviors led to positive or negative outcomes, information was often build into other topics and could have been highlighted more clearly. For instance, most apps provided extensive information on STIs and mentioned the link between unprotected sex and STIs toward the end of a paragraph. Other apps stated clearly and concisely that not using a condom increases the risk of getting STIs or

becoming pregnant. The app Get Smart (ImpactAspen, 2015) said: "Bottom line: if you decide to have vaginal sex, condoms + birth control = the best way to prevent pregnancy and STDs" ("Do I need to use a condom if I'm on birth control?", 2016). Furthermore, nearly all apps named abstinence as the only effective way to avoid negative health outcomes while also providing information on the effectiveness of contraceptive methods. Besides STIs and pregnancies, other health-behavior links included negative consequences of drinking and smoking during pregnancies, the influences of alcohol and drugs on decision-making and behavior, as well as physical, emotional, and psychological effects of homophobia and bullying.

     As already described above, the consequences of sexual risk behavior were most often described as STIs and unintended pregnancies and referred to emotional, physical, and psychological outcomes. For example, the app HealthWise (Noble Microsystems, 2014) listed several negative consequences of teen pregnancies, such as economic hardships, dropping out of school, or facing shame in the society. Overall, there was hardly an app which provided positive outcomes of sexual activities or included success stories of other teens that managed to maintain healthy relationships or carry out a pregnancy. Similarly, most health-behavior links were phrased negatively instead of positively, i.e. instead of saying condom use can lead to positive outcomes, the majority of apps described the negative outcomes of not using condoms. Some of the consequences were also presented through fear appeals. The app The Real Deal (Youth and Family Education Resources, 2013) explained negative outcomes to mothers with a drug addiction by using generalizations and scare tactics: "Babies born addicted to drugs are very irritable, and may fit as they are withdrawing from the drugs. Most will need

special care in newborn intensive care nurseries only found in major hospitals. Separated from their mother for a long time if not forever!" ("Can I drink in pregnancy?", 2013). Despite a focus on negative consequences in terms of STIs and pregnancies, acquiring and using communication and interpersonal skills was often combined with positive outcomes. Apps mostly created a positive picture about how talking to a partner, friend, or parent may help making decisions or getting additional support.

Forming intention to change existing behavior or to adopt healthier sexual attitudes was addressed in 11 apps. Since the main purpose of sexual education apps is to improve STI and pregnancy prevention, most apps integrated statements that encouraged or prompted teenagers to use condoms and contraceptives, to get tested, and to live in healthy relationships. Apps used different methods to make teens want to change behavior, attitudes, or beliefs. Most apps used the imperative and addressed their target audience directly by using "you." Others provided a list with questions to give teens the opportunity to evaluate whether or not they wanted to engage in a certain behavior. For example, the app Get Smart offered several questions the user could ask him or herself to figure out whether or not he or she was ready to have sex. Most apps used possible consequences or scenarios to convince teens to become sexually healthy. As already stated above, these consequences were mostly negative in relation to STI and pregnancy prevention; however, communication was viewed as a major concept that would lead to positive outcomes. Additionally, several apps aimed to increase self-confidence by stressing an individual's self-determination and independence. They repeatedly mentioned that people could make their own decisions or change their minds without having to excuse or justify themselves.

Boosting self-determination and self-confidence constitutes a major part of self-efficacy. Only four apps included statements to increase teen's self-efficacy and to help them recognize skills or knowledge that they have developed. Apps mainly tried to strengthen the belief in one's capabilities indirectly by providing knowledge, skills, or increasing self-confidence levels. For example, My Sex Doctor stressed the importance of acquiring knowledge by saying: "To reduce the risk of getting into unhealthy relationships from which you struggle to escape, it is imperative that you learn as early as possible what a healthy relationship is about" ("Unhealthy relationships", 2016). The app subsequently provided a list of characteristics of unhealthy relationships. Similarly, apps aimed to increase self-efficacy by providing checklists and specific instructions or sentences teens could use to make decisions or to communicate their will more effectively. The app It Matters (Big Yellow Star, 2016) described in details what teens could expect from a visit to a healthcare center and provided a list with questions and topics teens could use to talk about their sexual health. Knowing what to expect may help teens become more confident in their abilities. Additionally, all four apps used encouraging statements to increase teen's beliefs in their self-determination and confidence. The app SAFE (Amphibia, 2014), for instance, stressed the importance of free will and decision making: "The decision to have sex and with whom to have sex with is yours and yours alone. No one else has the right to choose this for you. If you consent to sex, then you are agreeing, by your own free will, to participate in sexual activity with your partner, who should also give consent. Remember, you do not have to do anything you do not want to do." ("Consent", 2014). Having the right to say no at any time without having to explain oneself was repeatedly mentioned throughout all four apps. This

approach was often combined with the dismantling of norms. Showing what is normal versus what is not normal may help teens re-evaluate established norms and make them recognize if they are wrong in their normative beliefs. My Sex Doctor uncovered false beliefs about the normality of a relationship by refuting arguments and by showing what healthy behavior looked like.

Modeling or demonstrating behavior may also lead to increased self-efficacy. About half of all apps included information, videos, or instructions on how to perform a specific action. Most of the demonstrations were related to condom and contraceptive use, for instance, videos or pictures on how to use a condom. The app SexPositive provided videos in which teens modeled conversations about STI testing, having sex for the first time, or explaining their boundaries to their partner. As already mentioned before, many apps offered step-by-step instructions on how to talk to partners or family members about sensitive topics or how to seek help and support in difficult situations. Giving detailed instructions combined with pictures or videos may strengthen a person's self-confidence and increase their self-efficacy.

Lastly, identifying potential barriers to an individual's ability to perform a certain action may also promote healthy sexual behavior. Only two apps, The Real Deal and It Matters identified structural barriers that may hinder healthy sexual behavior. Both apps offered information on how to get access to health services, condoms, or contraceptives if a person did not have health insurance or money to obtain either one of them. Furthermore, It Matters discussed anonymity in terms of getting test results back as well as getting consent from parents to go to a healthcare center. For the purpose of coding, only structural barriers were included in the analysis, such as lack of money or insurance;

however, the qualitative analysis also showed that a majority of apps included emotional or psychological challenges as potential barriers to change behavior or to seek help. Eight apps named emotions or feelings as hindrances to healthy behavior. These included feeling confused, scared, embarrassed, pressured, or rushed. Emotions were often used in combination with persuasive strategies to change behavior or to strengthen the intention of changing behavior. Most apps used a format similar to this one: feeling of being scared or confused + (*,but…*) + counter-argument + positive consequences/future + tips or strategies how to overcome barrier. Creating sympathy and understanding for the challenges and difficulties teenagers face during puberty may increase their sense of self-confidence and, combined with specific action steps, increase their self-efficacy.

**Research Question 5 Findings**

Research question 5 asked to what degree existing comprehensive sexual education apps adhered to health literacy levels in terms of content, organization and navigability, as well as interactivity.

Regarding the health literacy levels of content presented in the apps, the results showed that over half of all apps adapted information to the literacy levels of their users. Ninety-three percent of apps used active voice (n=14) and 73% (n=11) put the most important information first and included the benefits of taking action. Furthermore, over two thirds of all apps used common words and short sentences (n=10; 67%), avoided medical or technical terms (n=9; 60%) and provided specific action steps (n=9; 60%). Half of all apps (n=8; 53%) described only the basics of health behavior.

Table 3.
*Frequency of health literacy levels in terms of content used in comprehensive sexual education apps*

| Health Literacy- Content | number (n) (N=15) | percentage (%) |
|---|---|---|
| Most important information comes first | 11 | 73% |
| Describes the health behavior- just the basics | 8 | 53% |
| Stays positive. Includes benefits of taking action. | 11 | 73% |
| Provides specific action steps | 9 | 60% |
| Uses common, every day words | 10 | 67% |
| Avoids undefined technical or medical terms | 9 | 60% |
| Uses active voice | 14 | 93% |
| Sentences are 15-20 words | 10 | 67% |

Similarly, the majority of apps adhered to health literacy principles in terms of organization and navigability. All apps used a familiar font size and avoided a cluttered interface (n=15; 100%), while 93% (n=14) provided clearly labeled links and easy access to the home menu. Eighty-seven percent of apps were organized linearly and used bullet points and short lists (n=13). On the other hand, only two thirds avoided dark backgrounds (n=9; 60%) and less than half of all apps had a functioning back button (n=7; 47%). Two apps included a search function into their app design (13%).

Table 4.
*Frequency of health literacy levels in terms of organization and navigability used in comprehensive sexual education apps*

| Health Literacy- Organization and Navigability | number (n) (N=15) | percentage (%) |
|---|---|---|
| Uses bullets and short lists | 13 | 87% |
| Uses a familiar font size in at least 12 point type | 15 | 100% |
| Uses at least 10-35% of white space and avoids clutter | 15 | 100% |
| Labels links clearly | 14 | 93% |
| Avoids dark backgrounds | 9 | 60% |
| Creates linear information paths | 13 | 87% |
| "Back" button works | 7 | 47% |
| Easy access to home and menu pages | 14 | 93% |
| Search function is available | 2 | 13% |

Compared to the number of health literacy principles included in apps regarding content as well as organization and navigability, the levels for interactivity were low. Fifty-three percent of apps allowed users to share content through social media (n=8), while only 40% (n=6) included interactive features such as quizzes and games. Audio and video content as well as images to facilitate learning appeared also in only 40% (n=6) of all apps. When media were provided, less than half of them contained "real life" people or situations (n=6; 40%). Lastly, only 33% (n=5) of apps provided tailored information to users, such as gender or age specific functions.

Table 5.

*Frequency of health literacy levels in terms of interactivity used in comprehensive sexual education apps*

| Health Literacy- Interactivity | number (n) (N=15) | percentage (%) |
|---|---|---|
| Includes interactive content | 6 | 40% |
| Audio and video content | 6 | 40% |
| Images facilitate learning | 6 | 40% |
| Media contain "real life" people and situations | 6 | 40% |
| Provides tailored information | 5 | 33% |
| Provides social media sharing options | 8 | 53% |

**Research Question 6 Findings**

Research question 6 examined themes that emerged from the qualitative analysis of the 15 comprehensive sexual education apps. In total, there were three major themes that occurred across categories, namely challenging the concept of normality, sex positivity versus negativity, and a female sexual health focus. Each theme will be discussed in the following sections.

**Challenging the concept of 'normality'.** What is normal? What is healthy? How does 'normal' and 'healthy' look like in different sexual health contexts? These questions were discussed across all topical categories and often used as part of behavior change

techniques. Two sub-themes were found related to the concept of normality. First, the way sexual health content was presented in apps led to a reproduction of stereotypes and norms about sex and sexuality that may reinforce unhealthy sexual behavior and attitudes. On the other hand, however, apps often contrasted false normative behavior to healthy behavior in order to encourage positive behavior change.

*Reinforcing stereotypes and perceived norms.*  Throughout the apps, stereotypes and norms underlay the discussion of a variety of topics, intensified by the use of social comparisons. A majority of apps used the concept of "I" versus "them" to explain differences between individuals, thus reproducing perceived norms and stereotypes that surround the discourse of sexuality.

Social comparisons were used particularly often in relation to a teen's body image and the size and form of diverse body parts, such as breasts or the penis. The overarching assumption was that there exists a 'normal' or 'ideal' image of what a male or female body should look like during adolescence and that teens who do not measure up to those expectations feel frustrated or uncomfortable. My Sex Doctor (My Sex Doctor, 2016), for instance, talked about flat chests during female puberty in the following way: "[I]f your doubts come from the fact that many of your girlfriends' breasts have started growing and yours haven't, don't worry. It's frustrating, but all you need is a bit more patience." ("What's happening to my body?", 2016). In this context, having bigger breasts seemed to be the desired ideal. This was also confirmed in the app ReproHealth (WHARC, 2016) which discussed the influence of exercise on the increase in breast size, which seemed to be a desired effect. Additionally to the size and form of body parts, how to manage acne

or pimples was another issue discussed in apps. Again, suggestions on how to get rid of acne reinforced a body image that describes clear and beautiful skin as the norm.

Similarly, norms were discussed in Question and Answer sections, which were often phrased like "What should I do when…?", "How should I act…?" or "Is it normal…?" The questions were followed by answers that revealed societal standards. The shaving of hair, for example, was described as a standard preferred by a majority of women. My Sex Doctor says: "While most women remove the hair in their armpits, the management of pubic hair is more variable. In early puberty, most girls leave their pubic hair alone (…). Other women go for the total removal of pubic hair." ("Is it true that many women shave their pubic hair?", 2016). Even though the app gave the user alternatives for how to deal with pubic hair, not shaving armpits was not even presented as an option. This may prevent people from questioning established norms.

Besides the establishment of social norms in terms of body image, sexual pleasure was another topic that contained stereotypes and reinforced sexual norms. In general, sexual pleasure and, more specifically, getting an orgasm was portrayed as the fulfillment and the climax of a healthy relationship. The definition of fulfillment evolved around the concept of sexual pleasure rather than on intimacy or friendship with a partner. Only the app Sexual Health Guide (AIDS West, 2012) acknowledged the media's influence on individual's perceptions of sexuality and what it constitutes: "There is more to a good sex life than penetrative sexual intercourse. Although the media sets penetrative sex and male ejaculation as the pinnacle of sexual activity, there are lots of other very enjoyable, mutually satisfying, intimate and sensuous things you can share together" ("Keeping passion in a relationship", 2012). Intimacy and closeness were seen as more important

than getting an orgasm, which was most commonly viewed as the main goal of sexual intercourse.

Using social comparisons when describing and explaining sexual health topics may unintentionally lead to the reinforcement of perceived norms that may, in turn, lead to negative sexual health consequences for teenagers. It is thus necessary to present content in a non-judgmental and unbiased way which also takes into consideration that norms are often influenced by the media and the society and are not necessarily healthy.

*Dismantling norms.* While some apps reinforced unhealthy social norms and stereotypes, the majority of apps used the concept of 'normality' to challenge unhealthy normative beliefs and attitudes in teens. Apps presented very specific examples of what constitutes normative behavior, for example in relation to healthy vs. unhealthy relationships, sexual pleasure, sexual orientation, or personal hygiene and body image in order to encourage healthy behavior.

Several apps discussed the characteristics of healthy relationships and corrected existing ideas of what seemed to be normal. My Sex Doctor explains: "Realizing that you are in an unhealthy relationship is not always easy. This is especially true at a young age, when you have limited dating experience and might think that what you are going through is normal and common to many relationships." ("Am I in an unhealthy relationship?", 2016). In the section following this introduction, the app provided very specific examples of what is healthy and what is unhealthy, such as being respectful versus lack of respect or making decisions together versus having someone say "Trust me; I know what's best." Unhealthy behavior was furthermore clarified as emotional, psychological, and digital instead of just physical abuse, which is often seen as the

stereotypical form of abuse. By describing in detail what counts as the norm in healthy relationships, teens are more likely to recognize unhealthy behavior and may feel more empowered to change unhealthy behavior.

Similarly, apps discouraged teens from comparing themselves to peers and from letting themselves being influenced by social comparisons. Having sex for the first time, for example, was often discussed by breaking perceived norms. Get Smart (ImpactAspen, 2015) stated clearly: "Even if it seems like everyone your age is having sex, it's probably not true. Only about half of high school students have ever had sex, and the average age when people start having sex is 17. But even once they have had sex, most teens don't have it very often" ("Am I ready?", 2015). Dismantling perceived norms and providing correct information to teens does not only help them make informed decisions, but may also increase their self-confidence in abstaining from early sexual activities.

Moreover, a few apps acknowledged the influence of the media and the society on the development and reinforcement of social norms and encouraged teens not to let them impact themselves. For example, identifying as LGTBQ was portrayed as something normal and healthy, even though it is not considered as normative sexual behavior by many people in the society. My Sex Doctor writes: "We live in a world where the majority of people are heterosexual (men are attracted to women, and women are attracted to men). Therefore, boys grow up expecting to become attracted to girls at some point, and vice versa." ("Why are some people confused about their sexuality?", 2016). The app Sexual Health Guide adds to that: "We are slowly moving away from labelling people as one orientation or another, to a society where everyone, whatever their sexual

orientation is accepted, as long as their actions do not impinge, frighten or harm another person." (AIDS West, "Sexual orientation", 2012).

The description of healthy sexual norms and the dismantling of false normative beliefs were often combined with messages to strengthen individual's self-determination and their perceived self-efficacy. The phrases "it is your body", "your decision", or "your right" appeared repeatedly across categories and across all apps. Social comparisons were often used to stress a person's individuality and uniqueness. A majority of apps wanted to show that despite what is perceived to be normative behavior, everyone has the right to choose for themselves and to live their sexuality as they please.

**Sex positivity versus negativity.** The second theme that emerged from the thematic analysis of comprehensive sexual education apps evolved around the perception of sex and sexuality as negative or positive. Overall, the content focused on the negative effects and consequences of sex, while love was completely absent from the discourse. Sex was often associated with risk and danger instead of love and intimacy. A word query in NVivo showed that *love* was mentioned 70 times, while *pregnancy* (387), *HIV* (216), or *STDs* (179) appeared far more often.

Clearly, the main focus of apps was on pregnancy and STI prevention, which led to an increased discussion of contraceptive methods and preventive measures. Sex was for the most part portrayed as something scary that teens should be afraid of due to the severe consequences. A majority of apps assumed that teens did not want to engage in sexual activity and thus provided detailed information on how to say 'no', offered checklists that would show teens whether they were ready for sexual intercourse, and discussed the negative health outcomes such as pregnancy and STIs. A common strategy

across apps was to use a sympathetic tone and to play on the feelings and emotions of teens to convince them not to have sex. Often, apps first acknowledged sex as something scary that makes teens feel insecure about themselves and their intention to have sexual intercourse. They then assured them that it was completely normal to have doubts and that sex was something which may lead to severe negative health outcomes. Most apps consequently provided information or phrases on how to say 'no'.

The focus on negative health consequences was congruent with findings by Marques et al. (2015) who conducted a content analysis of sexual education websites. The authors found that apps used fear appeals and a negative portrayal of sex to convince teens to abstain from sexual intercourse.

Even the discussion of healthy relationships and sexual pleasure was tailored toward the prevention of pregnancies and STIs. For example, being in a healthy relationship was often characterized by the ability to talk about having sex for the first time, using contraceptive methods, or telling the partner about sexual preferences. The concept of love and intimacy as the core of a relationship was completely left out of the discourse around sexuality. There were hardly any suggestions on how to maintain healthy relationships, such as spending time with one another or being intimate without having sex. Sexual intercourse was portrayed as the pinnacle of a relationship which diminished other concepts and values such as love, friendship, trust, or honesty.

**Female-focused sexual health.** The focus of the majority of apps was on a target audience consisting of female individuals. This became evident through the organization and the arrangement of content as well as the priority of female oriented topics.

Of the 15 apps, one app specifically targeted girls, while there was no app that was only for boys. The majority of apps that targeted both boys and girls presented topics for both sexes; however, the female-specific content was mostly presented first. For example, when apps provided information on contraceptives, female methods were mentioned first, followed by male methods. Similarly, female anatomy was discussed before male anatomy and sections on STIs provided information for women first.

Furthermore, some topics were presented prioritizing females, thus reinforcing the idea that sexual health is a rather female concern. Often, questions regarding different sexual health topics were phrased from a female perspective which puts the responsibility to act in the girl's hands. Some of the topics that were particularly female-oriented were pregnancy and contraceptive methods. Regarding pregnancy, apps often introduced information by asking a question, such as "Am I pregnant?", "When can I get pregnant?", or "If my partner pulls out, can I get pregnant?" (Big Yellow Star, 2016). Even though this information is also relevant to the male partner, phrasing the question from the girl's perspective emphasizes the responsibility of the female partner. Similarly, the app Get Smart (ImpactAspen, 2015) provided instructions on how to get contraceptive methods by asking "What's the best birth control?" and "How do I get birth control?" Responses address female users only by using the word "you" and by explaining what to get and how to get it. The assumption is that the girl should be responsible to prevent pregnancy, while the boy's responsibility is kept in the background. Other apps provided a separate section just for boys. The app The Real Deal (Youth and Family Education Resources, 2013), for example, had an additional tab that addressed pregnancy and parenting from a

boys perspective. However, information was given for the girl first, reinforcing a female-oriented presentation of content.

      In general, apps elaborated much more on female-specific information. Pregnancy, menstruation, and hygiene were discussed much more in detail and length for females than males. Furthermore, some topics seemed to be female-oriented, while other topics targeted male users. In the category healthy relationships, for example, getting pressure from a partner was described as an issue that was experienced more often from girls. My Sex Doctor said: "I'm not ready for sex, but I'm afraid of losing my boyfriend. What should I do?" ("The first time", 2016). The possibility that boys feel pressured to have sex by girls was not discussed.

**Chapter 5: Discussion**

This thesis examined the status quo of the scope and the quality of sexual education mobile phone applications. The motivation for this study derived from the need to promote sexual health among teenagers in order to decrease sexual risk behavior and, in turn, the numbers of teen pregnancies, STIs and HIV as well as adverse mental health outcomes. The scarcity of literature on the use of mobile phone applications to promote sexual health stressed the importance of evidence- and theory-based research on how the newest technological achievements are and could be used in the realm of sexual health to reach the audience that need it the most: teenagers and young adolescents.

This study contributed to a better understanding of the state of sexuality education in the United States, particularly in terms of the role of mobile phone applications in the dissemination of sexual health information. The literature review provided an extensive overview of the history of sexual education in the United States, effective and non-effective components of educational programs, and ways in which newest technologies have been and could be used to promote positive health behavior change. Based on this knowledge, over 2,600 apps on the iOS and the Android app stores were reviewed and 15 of them identified as comprehensive sexual education apps. Using a mixed-methods approach, these 15 apps were examined on their occurrence of effective sexual education components, their use of behavior change techniques, and their adherence to health literacy principles.

In the following, the principal findings of the analysis will be presented and their theoretical and practical implications in the context of current research and app development will be discussed.

**Principal Findings**

The overarching finding of this thesis was that despite a growing number of sexual health apps, there is dearth of health literate, evidence- and theory-based sexual education apps available to teenagers. The systematic screening and categorization process of sexual health apps identified over 600 apps related to sex and sexuality, but only 15 of them presented sexual health information according to the standards used in face-to-face education. These findings suggest that mobile phones have been recognized as a valuable platform to promote sexual health, but their content and design differ greatly from the structure of face-to-face education. Despite extensive research evidence on the content and format of effective sexual education, this knowledge has not yet been applied to the context of mobile phone applications, limiting their effectiveness.

The in-depth analysis of comprehensive sexual education apps furthermore led to the conclusion that app developers do not take advantage of the full range of evidence-based content components and behavior change theories to create effective apps that facilitate information dissemination and promote positive behavior change. These findings are consistent with prior research claiming that mHealth apps are missing opportunities to increase their effectiveness by applying research evidence and theories to the design of health apps (Mangone, Lebrun, & Muessig, 2016; Vollmehr Dahlke et al., 2015; Lupton, 2015).

Another major takeaway from the analysis of sexual education apps was that app developers do not take into account both the constraints as well as the potential of mobile phone applications. The design of mobile phone apps is still very much based on the design of websites or webpages and does not follow health literacy principles specifically

for mobile phone applications. However, it is essential to present health information in a clear, concise, and easily understandable way to ensure that teenagers can access and absorb information. More importantly, apps miss out on the opportunity to effectively reach their target audience by limiting interactive and engaging features to a minimum. Since games, quizzes, videos, and pictures represent functionalities most interesting to teens, not including them into sexual health apps diminishes the potential to promote healthy sexual behavior.

The qualitative analysis of comprehensive sexual education apps furthermore revealed that sexual education is still very much focused on the sexual act itself and its negative consequences, attenuating the value of the comprehensiveness of sexual education and raising the question of what constitutes the core of our understanding of sexual education. The thematic analysis identified underlying assumptions of the format and nature of sexuality that reinforce stereotypes and negative perceptions of sexuality in teenagers. These findings are consistent with Marques et al. (2015) who examined sexual education websites using the framework provided by the International Planned Parenthood Federation (2010). They found that the focus of sexual education websites was on basic reproductive health topics, with only minimal coverage of other topics, such as sexual rights or violence.

It is also noteworthy to mention that the analysis revealed methodological challenges in the context of mHealth research. Reviewing studies analyzing mobile phone applications led to the conclusion that a standardized methodology to conduct mHealth research is missing. Methods are used randomly and without providing a thorough rationale for their use. Moreover, there seem to be discrepancies in the definition and

conceptualization of quantitative or qualitative approaches, making it difficult to replicate or adapt methods to own research. Furthermore, there are challenges regarding the extraction of data from mobile phone apps, the identification of analyzable data, as well as the coding of items. Since mHealth is a growing field of study and its value has been shown in several studies and interventions, it is essential to discuss methodological challenges in order to find a more systematic, replicable, and effective way to conduct mHealth research. The theoretical and practical implications of these findings will be discussed in the following sections.

**Theoretical Implications of Findings**

The next sections examine the theoretical implications of the findings of the state of sexual education mobile phone applications from the broader perspective of sexual education in the United States and the context of mHealth research. Each of the principal findings will be discussed separately in the sections below.

**Differences in the quantity and quality of sexual health apps.** The results of research questions one and two examining the scope of apps related to sex and sexuality illustrated that a growing number of educators, professionals, and organizations has recognized the mobile phone as a valuable medium to disseminate health information and to offer services. As Eysenbach (2001) correctly observed, the use of information and communication technology in health care is not only a technological development, but rather a "way of thinking, an attitude, and a commitment for networked, global thinking" (para. 3). This could be seen in the wide range of health services offered through apps, showing the manifold opportunities of mHealth in the promotion of health and the improvement of health care services.

Apps provided informational, educational, or entertainment functions, and targeted either a broad audience or very specific communities and ethnicities. These findings suggest that people are increasingly taking advantage of the mobility, accessibility, and interactivity of the mobile phone. For example, many sexual health apps were developed by clinics or counselors to improve patient-provider communication and to provide additional information. Other apps combined entertainment with educational elements to increase awareness of health issues or offered counseling services to individuals with adverse health conditions. Also, even though apps targeting specific communities outside of the US were excluded from the sample for the purpose of this study, the screening process revealed that many apps were developed to improve certain health issues in developing countries, particularly in Africa. These findings support the growing importance and advantages of mobile phone applications in the advancement of local and global health. Furthermore, a variety of apps targeted specific minorities, such as LGTBQ, Hispanic, or Black communities. The literature review showed that Black, Hispanic, and LGTBQ youths are particularly interested in and enthusiastic about using mobile apps to solicit health information. The high numbers of apps addressing specific minority youths show that this need has been recognized.

Despite the variety of health apps on the app market, there exists an extreme discrepancy between the quantity and the quality of health apps. Consistent with the results of Mangone, Lebrun, and Muessig (2016) who examined over 6,000 pregnancy prevention apps, the analysis of this study showed that there is a dearth of evidence-and theory-based apps available to users. The transfer between effective face-to-face education and technology-mediated teaching and learning has not yet reached its full

potential. This can be inferred from the surprisingly low numbers of comprehensive

sexual education apps. Even though the effectiveness of comprehensive sexual education

has been increasingly recognized in face-to-face educational settings, its adaption to the

context of information and communication technology has not taken place. Out of the

over 2,600 apps that were screened, only about 230 addressed sexuality from an

educational perspective, and only 15 were finally identified as comprehensive sexual

education apps. This means that only 6% of educational apps were designed according to

the comprehensive framework that guides face-to-face sexual education. The importance

of comprehensive sexual education has not yet reached the development of mobile phone

applications and thus misses opportunities to reach teenagers through their preferred

channels.

Moreover, not only was there a limited number of relevant apps available, but it

was also time-consuming and difficult to find them. To date, there exists no quality

control for apps provided to users. This means that anyone can develop and upload an

app without providing any credentials to the quality and the accuracy of content, which

makes it very difficult for an individual to find relevant apps quickly (Mangone, Lebrun,

& Muessig, 2016). During the screening process, the descriptions of over 2,600 apps had

to be examined out of which only 600 were relevant for the purpose of this study. Some

of the results from the search engines were not even remotely related to sexual education

or the different keywords typed in. Furthermore, a user can only get to know about the

content of an app by reading through the description provided by the app developer. As

the analysis of apps showed, these descriptions were not always accurate or did not

comply with the actual content of the app. There is no feature in either app store that gives the opportunity to examine an app without having to actually download it.

The limitations in the search functions make it difficult for users to look for health information on the app market. As Selkie, Benson, and Moreno (2011) pointed out, teenagers want health information to be easily accessible and clear; however when teenagers search for sexual health information in the app stores, they first have to go through a considerable amount of irrelevant apps before they find one that might be useful to them. On top of that, they first have to download the app to get a better idea of its content. As the analysis showed, many of the apps do not function or contain other content as described, leaving the user disappointed and frustrated. This may prevent teenagers from getting access to the information they need.

**Absence of theory- and evidence-based sexual education apps.** The results of the in-depth analysis of comprehensive sexual education apps furthermore suggests that organizations and individuals understand the significance of integrating several aspects of comprehensive programs into apps, but they do not take advantage of the full range of effective components and behavior change theories available to them. Furthermore, the focus of sexual health was very much on topics surrounding STI and pregnancy prevention, while topics related to safety and identity were mentioned less frequently.

The coding of components shown to be effective in face-to-face education led to the conclusion that app developers do not reach their full potential in addressing content related to the nine categories suggested by the CDC (2012), the Future of Sex Education Initiative (2012), the International Planned Parenthood Federation (2010) and Kirby (2001; 2007). As the different toolkits and guidelines pointed out, effective sexual

education should contain information on anatomy and physiology; puberty and adolescent development; identity; pregnancy and reproduction; sexually transmitted diseases and HIV; healthy relationships; personal safety; and sexual pleasure. Furthermore, the focus should be placed on the development of skills and abilities to enable teenagers to perform healthy sexual behaviors.

The analysis of the comprehensive apps in terms of these categories found mixed results. Topics related to pregnancy and STI prevention were addressed frequently and extensively, which could be inferred from the high number of occurrences in these categories (80% and 93% respectively). Furthermore, information on STI and pregnancy prevention was presented according to the framework suggested by the FoSE (2012) and included information on abstinence, contraceptives, symptoms, and treatment options of STIs and pregnancies. More importantly, nearly every app stressed abstinence as the only effective method to prevent STIs and pregnancies, while at the same time providing information about different contraceptives. As Kirby (2001) pointed out, this constitutes the most effective approach to prevent adverse sexual health outcomes. Similarly, 67% of apps included sexual pleasure into the content of their apps. Several apps combined safer sex messages with pleasure, for example by describing how condoms can be used to enhance sexual satisfaction. Other apps included information on masturbation, sex positions, and sex toys. These findings differ from Marques et al.'s (2014) results which describe a constrained concept of pleasure, mostly framed toward male masturbation. The results of this thesis show that sexual pleasure was geared toward both male and female individuals and did not just include masturbation. Since research suggests that addressing

sexuality from a positive perspective can increase healthy sexual behavior, these findings are promising.

Furthermore, the development of skills and abilities was included in 60% of apps, suggesting that the need of teenagers to not only gain knowledge but to also obtain the necessary tools to perform certain actions, has been recognized. Not only was the importance of skill-based education emphasized by the CDC (2012), FoSE (2012), and Kirby (2001), but was also underlined in diverse learning and behavior change theories. Bandura's social cognitive theory (1977) focused on the construct of self-efficacy which highlighted the role of an individual's belief in his or her capabilities to act in a certain way. Similarly, the theories of reasoned action (Fishbein & Ajzen, 1975) and planned behavior (Ajzen & Madden, 1986) viewed a person's attitudes and perception of control as essential components influencing behavior change. Nearly two-thirds of apps provided specific action steps and guidelines on how to perform certain sexual health behaviors, such as asking for consent, talking to a partner about STIs and contraceptive use, or seeking help. Giving teenagers specific instructions on how to perform healthy sexual behavior may boost their self-confidence, which, in turn, may lead to increased self-efficacy and actual behavior change.

Other topics, however, were discussed less frequently, less in detail, and were often tailored toward STI and pregnancy prevention. Identity (33%) and personal safety (47%), for example, were only addressed sporadically. These findings were surprising for several reasons. First, LGTBQ youths are particularly in need of sexual health information, being one of the groups most severely affected by HIV (CDC, n.d.-a). Second, 10% of teens have experienced some kind of dating violence (CDC, 2014),

leading to adverse physical and mental health outcomes. However, issues related to identity and safety, such as sexual orientation, coming out, homophobia, or abuse were only mentioned in 33% of all apps. In order to ensure that teens receive information that contributes to their health, it is essential to include information regarding identity and personal safety.

The results of the analysis of curriculum components showed that the focus of sexual education is still very much on the sexual act itself and its negative consequences. This is in so far understandable as the main purpose of the apps is to prevent STIs and teen pregnancies; however, even content in other areas, such as puberty, healthy relationships, or sexual pleasure was mostly framed toward pregnancy and STI prevention. Despite the amount of evaluative research on programs and curricula showing that a more comprehensive view on sexuality decreases sexual risk behavior, apps do not take advantage of the full range of topics surrounding sexuality and thus attenuate the effectiveness of the comprehensiveness of sexual education.

Similarly, apps made use of learning and behavior change theories only to a certain extent. As the results of the quantitative and qualitative analyses showed, a majority of apps included a health-behavior link and potential consequences of sexual health behavior. According to the information-motivation-behavioral skills model (Fisher & Fisher, 1992), including a clear link between a certain behavior and its outcomes has a positive effect on decision-making processes and behavior change intentions. However, it could be observed that the focus was again very much on the negative consequences of sex and health-behavior links were most commonly phrased negatively instead of positively. According to the HHS (2015), users prefer a positive tone instead of being

confronted with negative effects of their behavior. Thus, instead of scaring teens into abstinence, it is more effective to encourage them to perform positive behavior by presenting the positive outcomes.

Similarly, 73% of apps prompted intention formation, but these statements could be phrased more clearly. Since intention directly precedes action (Fishbein & Ajzen, 1984; Ajzen & Madden, 1986), it is important to encourage an individual to decide to act in a certain way. Even though apps used imperatives or phrases to prompt an individual to change their intention toward positive behavior, the potential of interactive features, such as quizzes, games, or questions were not taken advantage of. This could also be observed in the context of images, audios, and videos. Less than half of all apps included these media to demonstrate or to model sexual health behavior. In sexual education in particular, it is essential to show teenagers how to perform certain behaviors in order to strengthen their self-efficacy and to enable them to demonstrate these behaviors themselves (Bandura, 1977). Since sex is a sensitive topic for many teens, the anonymity of the internet and apps make them valuable media to disseminate information and to teach skills through audios and videos, but many apps do not take advantage of it (Wartella et al., 2015; Richman et al., 2014). Furthermore, only two apps addressed potential barriers to healthy sexual behavior, such as peer pressure or lack of financial means. Kirby and Lepore's (2007) identification of sexual risk and protective factors stressed the influence of social determinants on sexual health behavior of teens. Considering how these factors might hinder youths to perform healthy sexual behavior can increase the effectiveness of mobile phone interventions. Lastly, one of the most crucial components influencing behavior change, self-efficacy, was only used in 27% of

apps. According to Bandura (1986), Ajzen & Madden (1986), Janz & Becker (1984), as well as other theorists, helping people recognize skills and knowledge developed and strengthening their perceived feeling of control can promote positive behavior change. It is thus essential to include statements showing how the development of specific skills and knowledge can be used to perform healthy sexual behavior.

**Considering constraints and potentials of mobile phones in the promotion of health.** Including components shown to be effective in education curricula and basing content on behavior and learning theories is important; however, they lose their value and effectiveness if users cannot access or understand information. As the review of literature on health literacy showed, apps have to be carefully designed in terms of content, navigability, and interactivity (Broderick et al., 2014; HHS, 2015). While the limited screen size and restricted navigability of mobile phones pose several challenges to the design of an app, the variety of interactive features and functionalities facilitate user engagement and render content more accessible and interesting.

The analysis of health literacy principles in sexual education apps found mixed results. While some literacy principles, particularly regarding content and navigability, appeared in the majority of apps, others were hardly used. For example, 73% of apps provided the most important information first and included the benefits of taking action, while 93% of apps used active voice in the presentation of content, which was suggested by Broderick et al. (2014) and the HHS (2015). However, only about half of all apps focused on the basics of health behavior and 40% of apps used technical or medical terms without providing definitions. As Selkie, Benson, and Moreno's (2011) study on online health information seeking showed, teens criticized the use of jargon and complex terms

on sexual education websites that made it difficult to understand information. They thus forfeit the chance to effectively reach their target audience. Similarly, the majority of apps considered health literacy principles for the organization of content, but did not make use of all of them to facilitate navigation. Every app used a familiar font size and avoided clutter, while content was presented linearly (87%) and with clear labels (93%). These principles make it easy for the user to find information quickly. On the other hand, only two apps offered a search function and the "back" button worked for only less than half apps. Making sure that there are no technical difficulties in the navigation of an app is essential in avoiding frustration with new technologies and ensures access to important information.

One of the most remarkable findings of the analysis of comprehensive sexual education apps was the lack of engaging and interactive features. Only 40% of apps included pictures, audios, and videos as well as other interactive features into their app design. The results were consistent with Mangone, Lebrun, and Muessig's (2016) analysis of interactivity levels of pregnancy prevention apps that identified an even lower number of videos (11%) and audios (6%). These findings are surprising considering the value of innovative and interactive features in the promotion of health through mobile phone applications. As the review of literature showed, smartphones have become an integral part of a majority of teens' lives and they are used daily to solicit information. However, teens do not want to read lengthy texts to obtain health information; they prefer absorbing content in more engaging ways. Sharing information, communicating with like-minded people, watching videos, listening to audios, or even creating own content are some of the features that teenagers are particularly enthusiastic about (Rideout et al.,

2010; Lenhart et al., 2007; Wartella et al., 2015). Several studies and projects have shown great success in disseminating sexual health information and promoting healthy sexual behavior by making use of these features (Levine, 2011; Lou et al., 2006; Nguyen et al., 2013); however, their potential has not been taken advantage of in the context of sexual education apps. It is thus essential to include more videos, audios, games, or quizzes into the development of apps to make them interesting to teens and to maximize their effectiveness.

Similarly, only one third of apps provided tailored information. As Kirby (2001) pointed out, it is essential to adapt sexual health content to the age, culture, and sexual experience level of individuals and to personalize information. Kirby's suggestions were consistent with the guidelines provided by Broderick et al. (2014) who claimed that personalizing information can help users find relevant content more quickly. Comprehensive sexual education apps that tailored information gave users the opportunity to choose their gender to obtain gender-specific information, mostly in terms of contraception use. No app differentiated between users with sexual experience and users without sexual experience or based information on age. Including more options for users to obtain personalized information can increase the quality of apps and lead to a better and more efficient information dissemination process.

The low levels of interactive and engaging features as well as the lack of health literacy principles regarding content and navigability suggest that more attention has to be paid to the design of apps. Apps do not tap their full potential in providing clear, concise, and engaging information and thus are not as effective in disseminating sexual health information as they could be.

**Attenuating the value of comprehensive sexual education.** Another finding of this thesis refers to the overall presentation of content and arrangement of topics. Despite recent attempts to promote a more positive view on sexuality by addressing topics such as healthy relationships or identity in the sexual education of teens, the focus remains very much on the sexual act itself and its negative consequences. This became particularly obvious through the thematic analysis of comprehensive sexual education apps.

Puberty and sexual activities were associated with embarrassment, challenges, and self-doubts while positive attributes such as intimacy or love were completely left out of the discourse. Topics that should also address the individual, peer, and social components of sexuality and relationships were tailored toward STI and pregnancy prevention, limiting the value and the effectiveness of the comprehensiveness of sexual education. These findings show that comprehensive sex education is still very much based on underlying assumptions and conceptualizations of sexuality taught in abstinence-only programs. As the literature review showed, abstinence-only programs follow eight principles, including teaching teens how to reject sexual advances, what the consequences of having a child out of wedlock are, and that monogamous relationships in the context of marriage are the expected standard (Social Security Act, Title V). Despite the claim of many apps to promote a more positive and inclusive view on sexuality, the thematic analysis showed that this is not the case for the majority of apps. Even though the tone of the language may have changed toward a more sympathetic and understanding wording, the underlying assumptions are the same: teens do not want to have sex or should not want to have sex, because it can lead to severe adverse health outcomes.

Similarly, the thematic analysis showed that apps reproduce stereotypes and norms that may have a negative impact on healthy sexual behavior. First, the focus of sexual education was mainly on the female, which could be inferred from the arrangement of topics. Much more information was provided for girls than boys and female-oriented topics were mentioned first. This may lead to the false conclusion that contraceptive use and pregnancy and STI prevention is a rather female concern. The responsibility is thus placed on girls and young women, instead of promoting shared responsibility. Second, several apps promoted unhealthy perceptions of ideal body images that are difficult to meet for many young girls and boys. Having big breasts, for instance, was often assumed to be a desired ideal, leading to the reinforcement of a norm that is unhealthy and does not represent the truth. According to the National Health Education Standards provided by the CDC (2012), it is essential in health education to make students understand the influence of peers, culture, media, and the society on certain health behaviors. Showing teenagers that the perfect body image is promoted mainly through the media and does not represent how a healthy body looks like, can boost a teen's self-confidence and improve critical thinking skills.

The dismantling of stereotypes and reproduction of norms is even more important when taking into account learning and behavior change theories. Both Bandura's theories (1977; 1986) and the theories of reasoned action (Fishbein & Ajzen, 1975) and planned behavior (Ajzen & Madden, 1986) emphasize the role of perceived norms on behavior. According to Ajzen and Madden (1986), an individual's intention directly precedes actual behavior; the intention is furthermore influenced by a person's perception of consequences and control, as well as beliefs about norms related to that behavior. In the

context of sexual education apps, this means that if teenagers believe that an ideal body consists of a big penis or big breasts, not having these ideal proportions may have adverse physical and psychological consequences. It is thus very important to descry underlying norms and assumptions in the presentation of content in order to prevent their unintentional reproduction. On a positive note, there were a few apps that intentionally challenged unhealthy normative beliefs. For instance, the app Get Smart (ImpactAspen, 2015) dismantled the perceived norm that every teenager has sex by providing statistics that show that only a minority actually has sexual intercourse in high school. Showing youths that having sex is not the norm may change their intention to have sex at an early age.

**Methodological challenges of mHealth research.** The analysis of mobile phone applications showed that there is a need for more research and dialogue on the use of methods to effectively analyze apps. Analyzing content in mobile phones is substantially different from the examination of websites and leads to major methodological challenges. More guidelines have to be provided regarding data extraction and methods used.

The review of mHealth studies for this thesis stressed the importance of developing a thorough and standardized method to evaluate mobile phone applications across health contexts. Even though researchers focus on different health topics and issues, the methods to analyze apps are very similar. However, there does not exist a common vocabulary describing the different approaches to mHealth research. Many researchers do not define the methodology used in their studies, making it difficult to identify whether a quantitative, qualitative, or mixed-methods approach was taken. Moreover, there seem to be discrepancies in the conceptualizations of the different

approaches. For example, some studies claimed to conduct a qualitative content or thematic analysis of apps, while their actual analysis stayed very much on the descriptive level instead of an interpretive level. Mostly, researchers using this approach examined the descriptions of apps and categorized them according to their content, which is a rather quantitative than qualitative approach.

Surprisingly, there was no example of a thematic analysis, following the steps as outlined in the method section of this paper (Braun & Clarke, 2006). An in-depth analysis of how content is presented can lead to valuable insights and adds to the quantitative findings of a study. As the example of this thesis showed, the thematic analysis identified underlying assumptions about the nature of sexual education that need to be addressed. Furthermore, focusing exclusively on the quantitative results may lead to false conclusions; as the analysis of research questions 3 and 4 showed, the quantitative results often differed from the findings of the descriptive, qualitative analysis. While items were coded for presence when only one instance was identified, the qualitative analysis found that information was often presented only once or in the context of a different topic, without being elaborated on. Using mixed methods thus constitutes an ideal way to examine apps both from a quantitative and qualitative perspective, leading to a deeper understanding of the presentation of a health issue.

The quantitative and qualitative analysis led to further challenges regarding the identification of the unit of analysis. Since apps differed in their organization and design, it was challenging to identify what content was to be analyzed and coded. This was particularly true for the thematic analysis. Since content had to be thoroughly examined and interpreted, it was important to extract the data to get a better overview of the

content. As already described above, there were no studies that conducted a thorough

qualitative analysis of apps that allowed for a replication of steps. For the purpose of this

study, the data analysis tool NVivo was used which facilitated the development of codes

and themes on the computer. However, the challenge was still how to get the data from

the apps on the smartphone onto the computer and into NVivo. The only solution was to

take screenshots of the app screens and transfer them into NVivo. This approach caused

several problems. Since apps differed greatly in their organization and depth of content,

the number of screenshots varied between 50 to over 600 and thus had to be limited. Due

to different organizational patterns used in apps, establishing exclusion criteria for data

was difficult. Apps either followed a vertical or horizontal organization, i.e. they either

had only a few tabs, but went into depth, or they had many tabs, but did not provide

extensive information for each of them. To make the analysis process more consistent,

data was limited to three screens scrolling down and ten tabs per topic. However, these

numbers were chosen randomly and may have led to the exclusion of valuable content.

The challenges of identifying analyzable content stressed the importance of a

standardized and more consistent method to analyze content in the context of mobile

phone applications.

  The last important finding related to methodology use was that more research has

to be done on the conceptualization and coding of behavior change theories as well as

health literacy principles. Several studies have shown that including elements of learning

and behavior change theories into online interventions can have a positive effect on

behavior change (Snead et al., 2014; Lopez et al., 2011; Kirby, 2001). However, it was

often difficult to conceptualize the different concepts and coding items, which led to

discrepancies in the coding process. Even though Abraham's and Michie's (2008) taxonomy of behavior change techniques (BCT) facilitated the coding process, there still needs to be more clarification on how the different BCTs are conceptualized in the context of mobile phone applications. For example, Bandura's construct of self-efficacy was difficult to code, because coders associated different concepts with it. Is providing knowledge already self-efficacy? Or does it have to be stated explicitly how certain information can be used to act in a certain way? The BCT prompting intention formation was also phrased rather loosely and it was not clear what its actual meaning was. Providing more specific examples may not only facilitate the coding process but also make it easier for app developers to include different components of behavior change theories or health literacy principles into the development of online or app content. This may increase the effectiveness of health apps in disseminating information and facilitating behavior change.

**Practical Implications of Findings**

The analysis of sexual education apps showed that the potential of mobile phone applications in the dissemination of sexual health information and services has been recognized. However, the content and the design of apps differ greatly from the structure of face-to-face education. Despite research on the effectiveness of comprehensive sexual education and its specific components, these findings have not yet been applied to the context of mobile phone applications to their full potential. Furthermore, app developers do not take advantage of the full range of behavior change theories and health literacy principles, particularly interactivity, when designing apps. They thus miss the opportunity to effectively promote sexual health in teens through their preferred channels. The

following sections provide suggestions on how these findings can help develop effective, health literate mobile apps that promote sexual education from a comprehensive perspective. Furthermore, suggestions will be given on how to improve the methodological challenges.

        **Developing effective comprehensive sexual education apps.** One of the most important findings of this study was that not all apps addressed and discussed the different topical categories as suggested by the CDC (2012), the Future of Sex Education Initiative (2012), the International Planned Parenthood Federation (2010) and Kirby (2001; 2007). Furthermore, they focused very much on the sexual act itself and its negative consequences and thus did not internalize the concept of comprehensive sexual education. In order to make apps more effective in the dissemination of health information, app developers need to make sure that they include content related to the topics of anatomy and physiology; puberty and adolescent development; identity; pregnancy and reproduction; sexually transmitted diseases and HIV; healthy relationships; personal safety; and sexual pleasure. Moreover, it is essential to elaborate on these topics and to avoid tailoring them exclusively toward STI and pregnancy prevention. Lastly, a more positive approach toward puberty and its challenges that diverges from the associations of embarrassment and insecurity may change teens' perception of sexuality as something negative. As the HHS (2015) claims, individuals are more likely to change behavior when it is presented in a positive way, without focusing too much on the negative consequences. It is also important to adapt content to the culture, age, and experience level of teens to provide the information that meets their individual needs. This means including more personalized content (HHS, 2015), for

example tabs that present knowledge for teens with sexual experience and tabs that target unexperienced youths. Since minority youths are in special need of sexual health information, including issues related to identity or ethnicity can also have a positive impact on their sexual health behavior.

To increase the effectiveness of apps, content should also be based on behavior change and learning theories. As already discussed in the section on theoretical implications, the link between health outcomes and behavior as well as the consequences of a certain behavior should be stated more clearly and phrased positively instead of negatively. Keeping health literacy principles in mind, this relationship should be presented concisely. The suggestion is to state boldly and directly how a certain behavior leads to positive consequences, preferably within one sentence. For example, instead of writing "If you do not use condoms, you are susceptible to STIs, HIV, and pregnancy", it is more effective to phrase it positively: "If you use condoms, you are less likely to get infected with STIs, HIV, or to become pregnant." According to the HHS (2015), users prefer a positive tone instead of being confronted with shame and fear appeals.

It can also help teens act in a sexually responsible way if they are shown how to overcome barriers keeping them from getting the information or services they need. As already discussed, apps need to focus more on potential barriers to healthy sexual behavior, such as peer pressure or financial shortcomings. Including these components into the presentation of content is not difficult, but may boost teens' self-efficacy. Similarly, prompting intention formation should be presented more concisely and clearly. For example, in their study on the occurrence of behavior change theories in cancer survivorship apps, Vollmer Dahlke et al. (2015) identified direct questions on whether the

user wants to change behavior or not, as prompting intention formation. The user had to

interactively give a response, which did not only lead to intention formation, but at the

same time provided personalized information. The only similar approach to prompt

intention formation in the context of sexual education apps was found in apps which

provided checklists or questions teenagers could ask themselves before performing a

certain behavior. This was particularly often used when apps discussed having sex for the

first time. Nevertheless, app developers could make use of quizzes or short questions,

following the example by Vollmer Dahlke (2015), to directly engage the user in the

decision making process.

Interactivity can also be used in the demonstration of specific sexual health

behaviors, which facilitates the development of skills and increases self-efficacy. The app

SexPositive (University of Oregon, 2014), for example, offered videos on a variety of

topics, such as how to talk to a partner about contraceptive use or how to put on a

condom. They created these videos themselves, using students as actors and actresses.

However, if app developers do not have the time and the financial means to conduct

videos themselves, they can easily make use of existing videos that are on Youtube or

other video-sharing sites and include links to them in their apps.

The last behavior change technique that could be included to improve sexual

health of teens is self-efficacy. As already stated earlier, the concept of self-efficacy is

complex and is understood differently by different people. In the context of this study, it

was conceptualized as helping users recognize skills or education developed, for example

through the strengthening of control beliefs or beliefs in their own abilities. Apps hardly

addressed self-efficacy. However, being such a crucial component of learning and

behavior change theories, it is essential to show how the acquisition of knowledge and the learning of practical skills increase an individual's ability to perform a certain action. Apps should incorporate explicit statements such as "Now that you have watched this video, you are able to show your partner how to use a condom next time you have sex." Other suggestions would be to include quizzes testing acquired knowledge; when users finish it successfully, they may feel more empowered to act in a sexually healthy way.

In order to create effective sexual education apps, it is also essential to adhere to health literacy principles as outlined by Broderick et al. (2014) and the HHS (2015). Keeping in mind the lack of specific guidelines on how to create health literate apps, the following paragraphs provide suggestions based on the findings of this study.

As already discussed, the most important health information has to come first and only the basics of health behavior, including their benefits, have to be stated. Ideally, this information should be mentioned within the first paragraph; additional information could be provided through links or new buttons. Furthermore, specific action steps should be included, for example through the use of bullet points to avoid lengthy texts. More importantly, sentences should be no longer than 15-20 words, written in active voice, and avoiding jargon or medical terms. Definitions could be used to facilitate information dissemination. Some apps included a glossary of medical terms or jargon; however, it might be more effective to define a term right when it is mentioned. That way, teens do not have to switch screens and go back to the information.

In terms of organization and navigability, it is essential to provide linear information paths and use back, home, and menu buttons, as well as providing a search function. The app SexPositive, for instance, was very creative and engaging in its design,

but the information path was not linear and it was thus difficult to find relevant information quickly. Clear buttons and labels facilitate the search for information and make it easier to re-track steps. Furthermore, using bullets and a familiar font size, such as Times New Roman 12p, and a light background makes it easier to grasp information quickly.

Lastly, app developers need to make use of the various features and functions apps provide, since these are what makes them so popular among teens. As the literature review showed, including games, trivia, or quizzes makes the dissemination of information more engaging. Furthermore, audios and videos can be used to replace text bulks; at the same time, they are great media to teach skills and abilities. Images can also facilitate learning. Less than half of all apps used pictures to provide examples of contraceptives or included them to show specific action steps, such as how to put on a condom. Including these images is not difficult or time-consuming, but makes information much more accessible to teens.

**Improving mHealth research and app development.** As discussed in the theoretical implications of this study, the analysis of sexual health apps suggests that research on mHealth is in its infancy and needs a more systematic and standardized approach for the analysis of apps. This has several practical implications.

First, in order to improve the challenges identifying relevant apps in the app stores, there should be a measure indicating the quality and the credibility of sources, especially when it comes to health apps. Since there is often no way to tell whether an app provides genuine and accurate health information, teenagers with limited literacy skills may not get access to information they need or even rely on false and misleading

information. To avoid this, a suggestion is to introduce a measure of quality control, for example tags, that show whether an app was developed by an individual with no medical background or a health organization, such as Planned Parenthood or the WHO. These tags could facilitate the search for reliable and accurate information and make content more quickly available.

Furthermore, researchers and professionals have to lead an open dialogue regarding their own methodological approaches and the rationale behind them. Many studies only superficially described their methods and did not provide a detailed description. It was thus difficult to replicate steps or to adapt them to own research. It has to be stated clearly whether a study uses a qualitative, quantitative, or mixed-methods approach. Moreover, distinctions between these approaches have to be made in the context of mobile apps. As the review of mHealth studies showed, there seems to be discrepancies in the understanding of what constitutes qualitative research. Even though many studies claimed to use a qualitative approach, it was very much based on the quantification of content.

Similarly, there needs to be more clarification on the conceptualization of health literacy principles and behavior change techniques. The taxonomy of behavior change techniques (Abraham & Michie, 2008) provides an effective way to identify and evaluate the use of concepts from different learning and behavior change theories across studies; however, their conceptualizations have to be described more in detail. In the same manner, the health literacy principles can help develop health literate websites, but their adaptation to the context of mobile phone applications is still challenging. Developing guides with specific examples of how these items could be used in the development of

apps can facilitate the coding process and lead to results that can be compared across different studies.

**Limitations**

The analysis of this thesis led to several important findings regarding the state of sexual health mobile phone applications and their theoretical and practical implications for mHealth research and app development. However, there were also several limitations to the study.

One limitation was the challenge to identify sexual education apps, which may have led to the exclusion of relevant apps from the analysis. The search phrases chosen may differ from those that teens would use to look for health information. Furthermore, only apps in English and free of cost were considered. It is thus possible that some apps were missed. Moreover, only comprehensive sexual education apps were included in the analysis. As the screening process showed, there is a number of apps addressing very specific sexual health topics, which may differ in the use of behavior change techniques and literacy principles. The results of this thesis were only focused on the comprehensiveness of sexual health apps; however, it might be that apps addressing specific sexual health topics are designed more effectively.

There were also several limitations regarding the methods used in this study. Due to the focus on comprehensive sexual health apps, the screening process led to a small sample size of only 15 apps. This decreased the generalizability of the quantitative results. However, the screening process was done thoroughly and consistently, suggesting that there were only 15 apps available on the app stores at that point of time that actually fulfilled the standards of comprehensive sexual education. Nevertheless, the small sample

size made it difficult to measure inter-coder reliability. Since a quantitative content analysis requires 10-20% of the sample size to be used as a pilot sample, using only one app was not enough to calculate Krippendorff's alpha. In order to get reliable and valid results, it was thus decided to code seven apps as a pilot sample. The results for Krippendorff's alpha were satisfying.

One of the most pertinent limitations of this study was choosing the unit of analysis for the qualitative analysis. As already discussed earlier, it was necessary to limit the number of screens to be analyzed, since apps differed in their organization and depth of content. However, the established criteria of three screens scrolling down and ten tabs within the same topic were set randomly. Content that fell beyond these criteria was not considered for the analysis. This may have decreased the reliability of the qualitative results.

The last limitation was the conceptualization of coding items for the quantitative content analysis. The dearth of literature on the coding of mobile phone apps made it difficult to code for health literacy principles and behavior change techniques in the context of mobile phones. Since there were not many examples of how each of the items was to be coded, there may be conceptual differences in how they were coded for the purpose of this study. However, the findings of this study may help guide further research and provide suggestions that can be used in future work.

**Direction for Further Research**

The analysis of this thesis was based on existing apps available on the iOS and Android app stores. The rationale behind the assessment of the quantity and quality of sexual education apps was to improve the sexual health of teens by making use of their

most preferred communication channels, namely the smartphone. The findings showed that the potential of mobile phone applications in the dissemination of sexual health information has not yet been completely recognized; despite a growing number of health apps, they do not take advantage of the full range of content components, behavior change techniques, and health literacy principles.

The findings of this study stressed the importance of conducting more research in terms of the design and content of sexual health apps. One area that has not been included in this study was entertainment education. Incorporating research findings on how health promotion can be facilitated through the combination of health messages and entertainment may have a significant impact on the value of mobile phone applications. Furthermore, research regarding persuasion may be useful in the context of mHealth and should be included in further studies on the effectiveness of mobile phone interventions. Lastly, it is essential to incorporate more feedback from teens regarding their use of sexual health apps. Focus groups and interviews constitute a great way to get feedback from teens and to develop apps that reach the target audience more effectively.

The next step following this thesis is to develop a comprehensive sexual education app according to the guidelines and findings of this study and to test its effectiveness. Since mobile health is a field that changes continuously and rapidly, there are hardly any studies on the effectiveness of apps to promote health. However, apps are becoming more and more popular for health information seeking and it is thus important to evaluate their effectiveness. A future research project could consist of a randomized control trial, in which high school students are either part of an intervention or the control group. The intervention would consist of the use of a sexual health mobile app consisting

of different modules adhering to the principles of comprehensive sexual education, as well as behavior change theories and literacy principles, while the control group takes part in the conventional sexual education class. Despite several challenges to this approach, the dearth of literature on mHealth interventions calls for more evaluative research on the effectiveness of apps.

**Conclusion**

This thesis addresses the need to promote the sexual health of teenagers and young adults in the United States. Even though the numbers of teen pregnancies have consistently declined since the 1990s, the United States still has one of the highest teen pregnancy rates among developed countries, and the numbers of STIs and HIV have increased. Besides the development of programs implemented in conventional educational settings, such as schools or health centers, the mobile phone has been increasingly recognized as a valuable platform to reach teens and young adults. Mobile phone apps are particularly useful in the context of sexual health promotion, since sexuality is a sensitive topic and the anonymity of the internet allows teens to get access to information quickly and on-the-go.

However, analysis of available sexual education apps found that their potential to provide sexual health information and services has not been reached. App content is framed toward pregnancy and STI prevention and lacks a comprehensive approach to sexuality, behavior change theories are only sporadically incorporated, and the presentation of information does not adhere to all health literacy principles. Thus, apps do not take advantage of the full range of effective design and content components available

to inform teens about sexual health and to provide them with the necessary skills to perform healthy sexual behavior.

Teens are enthusiastic about the variety of features and functions that turn the smartphone into an information and communication hub and it is thus essential to take advantage of them. Basing the development of apps on behavior change theories and health literacy principles will increase their effectiveness. It is even more important, though, to provide elaborate information on topics that make up the *comprehensiveness* of comprehensive sexual education. Despite recent attempts to approach sexual education from a more holistic and positive perspective, the analysis of comprehensive sexual education apps showed that the focus remains on the sexual act itself and its negative consequences. Even though apps include information on healthy relationships, identity, or personal safety, they are oriented toward pregnancy and STI prevention. Furthermore, the tone of sexual health information is still overall negative, focusing on negative health outcomes of sex, instead of including concepts such as love or intimacy. Comprehensive sexual education apps thus reproduce a conservative outlook of what constitutes sexuality and reduces it once more to its first three letters: sex.

If we want sexual education to be effective in reaching teens, we have to stop considering sexual education as a one-time lecture or discussion and start treating it the way Mary Calderone has described it: as *everything*. It cannot and should not be reduced to one single act between two people; it is the between itself which should be taken into consideration. Apps constitute an ideal platform to promote this view on sexuality; teens of all ages can access information instead of hearing it once in high school. They can access information on a variety of topics, providing them with the necessary knowledge

and skills to act in a sexually responsible way. With this thesis, I hope to have contributed to a better understanding of how comprehensive sexual education and its core components can be effectively transferred into the context of communication and information technology.

# Appendices

## Appendix A. Sample of Comprehensive Sexual Education Apps

| Name of App (Developer, year) | Age Group | Ratings | Description |
|---|---|---|---|
| The Real Deal (Youth and Family Education Resources, 2013) | Unrated | 3 | The Real Deal is just that! The real facts and truths about sex, relationships, pregnancy, birth and parenting presented in a way that is youth friendly, easy to understand and use. With a number of different topics, a frequently asked questions section and a "Get Help" button, all the answers are at your finger tips - for both guys and girls. This App can help make a difference. Share it, talk about it and help link ...more... Those who need good information to a great source of support! Youth & Family Education Resources (YFER) has created this free to download App alongside youth consultants, to help young people access Real answers to questions and issues that affect them, their friends/family directly and to show them where to look for help. This App will support teenagers to access quality information on relationships, pregnancy and parenting as well as access immediate and confidential follow up support and connection to their local health/community services via social networking sites and mobile applications. This valuable tool will assist young people in the community to make important decisions based on fact and access quality support in a timely, confidential manner […] |
| HealthWise (Noble Microsystems, 2014) | Unrated | 4.4 | HealthWise is an interactive and engaging mobile application and games that help raise awareness of preventive, causes, facts & figures about sexual and reproductive health and educate the young adults on preventive measures to take to reduce the risk of infection and death. Lack of sexual health information and services make young people vulnerable to sexually transmitted infections (STIs) and unintended pregnancy. However, Noble Microsystems is working to support MDGs to improve adolescent reproductive and sexual health through Mobile application. Features of |

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|---|---|---|---|
| | | | Health Wise: Period Calculator Pregnancy and its effects on young adults Self Breast Exam (BSE) Menstruation Cycle and Menstrual Hygiene Facts about menstruation stages cycle Sexually Transmitted Infections (STI) What are sexually transmitted Infections? How are STIs transmitted? Types of STIs, Prevention Strategies of STIs, Management of STIs, Complication of STIs in males and females CANCER OF THE BREAST AND REPRODUCTIVE ORGANS Most young adults are unaware of Cancer which is becoming a common health problems in the world health. HIV/AIDS Things to know: 1. Signs Symptoms of Aids 2. Major Signs and Symptoms 3. How HIV is not spread 4. How to prevent the spread of HIV 5. Effects of HIV and Aids 6. Importance of HIV Counselling and Testing (HTC) DEVELOP SELF VALUE SKILLS 1. Assertiveness Skill 2. Refusal Skill 3. Self Esteem Skill 4. Negotiation Skill QUESTION AND ANSWER (Game) Young adults learns fast during fun-fair. |
| iGirl (Pip90, 2013) | Unrated | 3.3 | A sexual Health app for ladies aged 18 to 30 years. |
| It Matters (Big Yellow Star, 2016) | Everyone | 5 | This app seeks to reduce the stigma around sexual and reproductive health concerns by allowing youth to tailor their online information seeking experience with assurance of its confidentiality, allowing them to follow-up and seek out in-person health services at their own comfort level. The primary audience for this app is youth ages 14-24 years old. The health services identified are available regardless of insurance status, and regardless of whether users have a regular place for health care. |
| SAFE (Amphibia, 2014) | Unrated | 4.2 | SAFE: Knowledge Source on All-Things Sex SAFE is short for Sexuality Awareness for Everyone and is an app designed to educate and facilitate both the young and the curious minds on sexual awareness. Studies have shown that many Malaysians are severely lacking the know-hows and are still unaware of the proper conducts on practice of safe sex. SAFE aims to |

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| | | | provide and equip Malaysians with important and comprehensive information on safe sex by making it easily accessible via a few taps away from the convenience of your phone. The app comes with in-depth details on: - Sexually Transmitted Infections (STIs) - Sexually Transmitted Diseases (STDs) - Tutorials and Information on Contraception - Campaigns and Insights on Sexual Awareness Here is the list of contents and features to be added in the future as we continue to update: - Information Update - Stability and Performance Enhancements - One-on-One Confidential Consultation - Emergency Hotline SAFE will also be bringing you newer and interesting contents, and interactive features with every update, so do stay tuned as we continue to grow! |
| SayWhat App (Webstudio, 2015) | Everyone | 2.8 | We recognise the ICT revolution and the convenience that it offers to young people in their quest to access sexual and reproductive health rights information. Learn and be heard. For more information on Sexual and Reproductive Health Rights (SRH) Visit Students and Youth Working on Reproductive Health Action Team (SAYWHAT) website, www.saywhat.org.zw |
| Shared Sexuality (Androidaplicaciones-divertidas, 2016) | Mature, 17+ | 3.8 | Human sexuality is a central aspect of being human along his life. Sex, identities and gender roles, eroticism, pleasure, intimacy, reproduction and the sexual orientation. Is lived and is expressed through thoughts, fantasies, desires, beliefs, attitudes, values, behaviors, practices, roles and relationships interpersonal. We could think that we know much about sex and sexuality, but know more data e information of the theme is important. Therefore so we created this app, so you can expand your knowledge in one of the topics that more interest has awakened through of the times. Might give response to questions like: - What is the most dangerous sexual posture? - What is sexual headache? - What is the sexual fantasia favorite of women? - Can you be addicted to sex? - You know interpret the signals of sex opposite? - |

| | | | Does sex thins? - Do you know that is a sexual parafilia? If you want to answer these and other questions about sex and are interested know about sexual curiosities of some of the more known historical characters not hesitate in DOWNLOAD THIS app |
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| SexPositive (University of Oregon, 2014) | Mature, 17+ | 3.8 | It's difficult to predict when you may need access to sexual health information. With SexPositive, the University of Oregon Health Center provides judgement-free, sex positive information about sexually transmitted infections (STIs), safer sex practices, partner communication tips and healthy sex advice. Whether you're considering having sex or you're curious about the possibilities, SexPositive delivers sex ed without the fear, secrecy, misinformation, judgment, and general negativity that often surrounds conversations about sexuality. How do we do that? We talk about what the University of Oregon Health Center knows best: what happens when a body part touches another body part or object. The interface is a fun, intuitive approach to sex education. Users are presented with two spinning wheels. The inner wheel represents the users body parts. The outer wheel represents various body parts and objects that the user may come into contact with. For each combination, information is provided about the risks of transmitting STIs, safer sex practices, healthy sex positive advice for beginners, and tips on effective partner communication. The communication/advice section of the app includes videos featuring students from the UO Sexual Wellness Advocacy Team and Health Center Peer Health Educators. Videos give sample scripts for students to use when requesting consent, negotiating boundaries, giving advice, requesting latex barriers, and more! In addition, we acknowledge that sexual communication starts by communicating with one's self. A judgement-free "Am I ready for sex?" self-assessment video features colleagues from the University Counseling and Testing Center. Also featured is a Yes/No/Maybe survey |

| | | | from scarleteen.com. The list includes a wide range of interpersonal activities that users can consider in a private, low-pressure environment before discussing them with their partners. A long list of sexy ways to ask for (and express) voluntary, non-coerced explicit consent is provided. In addition, the app links to "The Anatomy and Physiology of Orgasm," a popular annual lecture given by a Faculty member in the UO Department of Human Physiology. SexPositive is written and produced by sex-positive experts at the University of Oregon. The SexPositive app is free and none of your personal information is tracked or shared by the app. There are no ads or in-app purchases. |
|---|---|---|---|
| Sexual Health Guide (AIDS West, 2012) | Unrated | 4 | This app lets you explore the world of sexual health giving information and advice on how to be sexually healthy. A range of topics are covered which include Positive Sexual Heath, protection and contraception, information on STIs, FAQs, myths about sex, details of where to go for support and testing, useful videos and current news on sexual health. Features: Latest news on sexual health; Essential advice on being sexually healthy; How to have safer sex; Male and female sexual problems; Keeping passion in your relationship; Videos covering issues such as contraception, STIs etc.; Sexual orientation; Drugs, alcohol and effects on sexual performance; STIs, transmission, symptoms, diagnosis and treatment; Methods of contraception; Frequently Asked Questions; Myths about sex; Support, STI Clinics, maps, contact numbers and websites |
| Get S.M.A.R.T. (ImpactAspen, 2015) | Unrated | 3 | Get S.M.A.R.T. is an app that serves as a sex education resource for teens wanting to know more about this topic. It also serves as a resource for parents who want to learn more on how to have "the talk" with their teen. |
| Ask Without Shame (Social Innovation Academy, 2016) | Everyone | 4 | Making it possible for teens and young adults to get important sex education anonymously, put simply, to Ask Without Shame. |

| ReproHealth App (Women's Health and Action Research Centre, 2015) | Everyone | 4.5 | The Reprohealth App is a measure mapped out by the Women Health and Action Research Center (WHARC) to reach a wider audience of people across borders who lack knowledge of sexual and reproductive health. |
|---|---|---|---|
| My Sex Doctor (My Sex Doctor, 2016) | Teen | 3.7 | How much do you really know about Sex and Sexuality? Ever felt confused by your feelings toward someone? Excited for a new date but also afraid your partner will realize you're totally inexperienced? Need to know more about certain sexual acts and the risks associated with sex? Finally you can have all your questions answered! Join our revolution and take Sex Education in your own hands by downloading My Sex Doctor. My Sex Doctor offers tons of useful information about sex and sexuality. My Sex Doctor gives advice on puberty and body changes, on flirting and relationships, on the various sexual acts and on minimize the risks of sexually transmitted diseases and unwanted pregnancies. The app is super-easy to use, and not needing an Internet connection can be accessed anytime and any place in total privacy, in fact no one looking at you will ever realize that you are reading about sex. NHS Approved!!! - My Sex Doctor has been added to the "NHS Health Apps Library", a list of health apps reviewed and approved by NHS (UK National Health Service) own clinicians. |
| Sex Education (Ar Soft, 2015) | Everyone | 4.4 | Sex education ED Everything about sex Women's Health, Men's Health, Facts about sex Sexual disease, Pregnancy and Childbirth, False beliefs about sex Sex in different civilizations, Masturbation Impotency, Testosterone and all about sex |
| gPower (Georgia Campaign for Adolescent Power and Potential, 2015) | Everyone, 10+ | 4.3 | Teens in Georgia have the right to confidential sexual health services, without permission from anyone else. This app puts all the POWER in the palm of your hand. Use the app to search for clinics in Georgia that provide teen-friendly sexual health services and connect with GPS for turn by turn directions. Find out where to go (for services or condoms), what to get (which birth control method will work best for you), what to expect, and questions you should ask. Clinics |

| | | | provide: Condoms, Birth control, Emergency contraception, STD testing and treatment, HIV testing, Pregnancy testing, Counseling How did the clinic treat you? Rate your clinical experience and write an anonymous review. Read reviews by others. Set up reminders for your birth control or next visit. Watch fun videos developed by teens for teens. |
|---|---|---|---|

**Appendix B. Code Book**

This codebook contains instructions for the coding of comprehensive sexual education apps. It was used to facilitate the coding process by explaining the different coding categories and items.

I. General Data

    A.   App Title: Name of the app
    B.  Developer: Name of the app developer
    C.  Category: The category in which it was found in the ITunes or Android app store
    D.  Age Group: Age group that the app is targeting
    E.  Rating: The rating results of the app (on a scale from 1-5)
    F.  Coder Name: Name of the person who is coding
    G.  Date/Time: Fill in the exact time and the date of coding

II. Coding Categories (Researchers code for absence (0) and presence (1) for each item listed below)

    A.  Topics addressed: Does the app contain information on the following topics?

| Concept | Explanation | Examples |
|---|---|---|
| Anatomy and Physiology | provides a foundation for understanding basic human functioning | Description of body parts and explanation of their functions; human sexual response cycle |
| Puberty and Adolescent Development | addresses a pivotal milestone for every person that has an impact on physical, social, and emotional development | Explains the physical, social, and emotional changes; ways to manage changes associated with puberty |
| Identity | addresses several fundamental aspects of people's understanding of who they are | differences and similarities in how boys and girls may be expected to act; difference between biological sex, sexual orientation, and gender identity and expression; influence of peers, media, family, society, religion, and culture on the expression of gender, sexual orientation, and identity |
| Pregnancy and Reproduction | addresses information about how pregnancy happens | signs and symptoms of a pregnancy; contraceptive methods; laws related to reproductive and sexual health care services |
| Sexually transmitted diseases and HIV | provides information on how STDs and HIV are transmitted, their signs | Types of STDs; signs, symptoms; how to prevent STD; clinic referrals |

| | and symptoms, testing, treatment, as well as prevention | |
|---|---|---|
| Healthy Relationships | offers guidance to students on how to successfully navigate changing relationships among family, peers, and partners | characteristics of healthy romantic or sexual relationships; consent; how to maintain healthy relationships |
| Personal Safety: | safe environment for children and adolescents | sexual harassment, sexual abuse; unwanted sexual activities |
| Sexual pleasure | Sexuality is approached in a positive way, safer sex practices in combination with pleasure | how to use condoms in a stimulating way; masturbation; sex positions |
| Communication and Interpersonal Skills | demonstrate effective peer resistance, negotiation, and collaboration skills to avoid engaging in risky sexual behavior | demonstrates how to effectively support one's decision to abstain from sexual behavior; how to negotiate contraception use (including condom); navigate relationships |

B. Behavior Change Techniques

| Behavior Change Technique and Theory | Explanation | Examples |
|---|---|---|
| Provides information about behavior-health link (IMB) | General information about behavioral risk, for example, susceptibility to poor health outcomes or mortality risk in relation to the behavior | Likely to be infected with diseases if not using contraceptives; susceptibility to STIs ad HIV; must be clearly stated within one sentence |
| Provides information on consequences (TRA, TPB, SCogT, IMB) | Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behavior | Consequences of not using contraceptives; pregnancy, STIs |
| Prompt intention formation (TRA, TPB, SCogT, IMB) | Encouraging the person to decide to act or set a general goal, for example, | Includes suggestions for general behavior setting or formulating desired outcomes; language |

| | to make a behavioral resolution | indicates specific action or activity |
|---|---|---|
| Prompt barrier identification (SCogT) | identify barriers to performing the behavior and plan ways to overcoming them | Access to condoms; information; peer pressure |
| Model or demonstrate behavior (SCogT) | An expert shows the person how to correctly perform a behavior | How to ask for help; modeling of condom use; how to talk to your partner about a topic |
| Self-efficacy (SCogT) | Aid user in recognizing skills or education developed | Knowledge about how to talk to partner about topics; how to use contraceptives correctly; boost self-confidence; feeling of control; messages strengthen control beliefs |

C. Health Literacy

| Health Literacy Principle | Explanation | Example |
|---|---|---|
| Most important information comes first | Additional information later | |
| Describes health behavior: just the basics | Good to know vs. nice to know | |
| Includes benefits of taking action. | | |
| Provides specific action steps | how to act on the information provided | |
| Use common, every day language | No jargon, undefined terms | |
| Avoids undefined technical or medical terms | | |
| Uses active voice | | |
| Short sentences | 15-20 words | |
| Uses bullets and short lists | | |
| Uses a familiar font size | At least 12p | |
| Uses white space and avoids clutter | Each page should have at least 10-35% of white space (CDC, 2009) | |
| Labels links clearly | Underline link, make them long enough to "grab" them; use buttons (HHS, 2015) | |

| | | |
|---|---|---|
| Avoids dark backgrounds | | |
| Creates linear information paths | Logical sequence; easy to go back and forth | |
| "Back" button works | | |
| Easy access to home and menu pages | | |
| Search function is available | | |
| Includes interactive content | Quizzes, games | |
| Includes audio and video content | | |
| Images facilitate learning | | Pictures that show how something looks like/works |
| Media contain "real life" people and situations | Situations teenagers can relate to | Videos situated in familiar settings; people wear modern clothes |
| Provides tailored information | tailored to age/experience level of students | Information based on age; have already had sex or not |
| Provides social media sharing options | | Facebook, Twitter links |

**Appendix C. Krippendorff's Alpha Values and Percent Agreement for Each Variable**

| Variables | Krippendorff's alpha | Percent agreement (%) |
|---|---|---|
| Anatomy and Physiology | 1 | 100% |
| Puberty and Adolescent Development | 1 | 100% |
| Identity | 1 | 100% |
| Pregnancy and Reproduction | 1 | 100% |
| Sexually Transmitted Diseases and HIV | 1 | 100% |
| Healthy Relationships | 1 | 100% |
| Personal Safety | .74 | 86.7% |
| Sexual Pleasure | 1 | 100% |
| Communication and Interpersonal Skills | 1 | 100% |
| Provides information about behavior-health link | 1 | 100% |
| Provides information on consequences | 1 | 100% |
| Prompt intention formation | .85 | 93.3% |
| Prompt barrier identification | .77 | 93.3% |
| Model or demonstrate behavior | 1 | 100% |
| Self-efficacy | .85 | 73% |
| Most important information comes first | 1 | 100% |
| Describes the health behavior- just the basics | 1 | 100% |
| Stays positive. Includes benefits of taking action. | 1 | 100% |
| Provides specific action steps | 1 | 100% |

| | | |
|---|---|---|
| Uses common, every day words | 1 | 100% |
| Avoids undefined technical or medical terms | 1 | 100% |
| Uses active voice | 0 | 93.3% |
| Sentences are 15-20 words | 1 | 100% |
| Uses bullets and short lists | 1 | 100% |
| Uses a familiar font size in at least 12 point type | undefined | 100% |
| Uses at least 10-35% of white space and avoids clutter | undefined | 100% |
| Labels links clearly | 1 | 100% |
| Avoids dark backgrounds | 1 | 100% |
| Creates linear information paths | 1 | 100% |
| "Back" button works | 1 | 100% |
| Easy access to home and menu pages | 0 | 93.3% |
| Search function is available | 1 | 100% |
| Includes interactive content | 1 | 100% |
| Audio and video content | 1 | 100% |
| Images facilitate learning | .86 | 93.3% |
| Media contain "real life" people and situations | 1 | 100% |
| Provides tailored information | .73 | 86.7% |
| Provides social media sharing options | 1 | 100% |

**Appendix D. Coding Results for Comprehensive Sexual Education Apps**

| App Title | The Real Deal | Healthwise | iGirl | It Matters | Safe | SayWhatApp | Shared Sexuality |
|---|---|---|---|---|---|---|---|
| Developer | Youth and Family Education Resources | Noble Microsystems | Pip90 | Big Yellow Star | Amphibia | Webstudio | androidaplicaciones-divertidas |
| Category | Education | Health & Fitness | Health & Fitness | Health & Fitness | Health & Fitness | Health & Fitness | Entertainment |
| Age Group | Unrated | Unrated | Unrated | Everyone | Unrated | Everyone | Mature 17+ |
| Rating | 3 | 4.4 | 3.3 | 5 | 4.2 | 2.8 | 3.8 |
| <span style="color:red">Topics Addressed</span> | | | | | | | |
| Anatomy and Physiology | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Puberty and Adolescent Development | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Identity | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| Pregnancy and Reproduction | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| Sexually Transmitted Diseases and HIV | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Healthy Relationships | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| Personal Safety | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| Sexual Pleasure | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Communication and Interpersonal Skills | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| <span style="color:red">Behavior Change Theories</span> | | | | | | | |
| Provides information about behavior-health link | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Provides information on consequences | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Prompts intention formation | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Prompts barrier identification | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Models or demonstrates behavior | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Self-efficacy | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Health Literacy | | | | | | | |
| Most important information comes first | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Describes the health behavior- just the basics | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Includes benefits of taking action. | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| Provides specific action steps | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| Uses common, every day words | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| avoids undefined technical or medical terms | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Uses active voice | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Sentences are 15-20 words | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Uses bullets and short lists | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Uses a familiar font size in at least 12 point type | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Uses at least 10-35% of white space and avoids clutter | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Labels links clearly | 1 | 0 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Avoids dark backgrounds | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| Creates linear information paths | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| "Back" button works | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| Easy access to home and menu pages | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Search function is available | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Includes interactive content | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Audio and video content | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Images facilitate learning | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| Media contain "real life" people and situations | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Provides tailored information | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Provides social media sharing options | 0 | 0 | 0 | 0 | 1 | 1 | 1 |

| App Title | Sex Positive | Sexual Health Guide | Get SMART | Ask Without Shame | Repro Health | My Sex Doctor | Sex Education | gpower |
|---|---|---|---|---|---|---|---|---|
| Developer | University of Oregon | AIDS West | ImpactAspen | Social Innovation Academy | WHA RC | MYSD LTD | Ar Soft | Georgia Campaign |
| Category | Education | Education | Books & Reference | Health & Fitness | Health & Fitness | Lifestyle | Education | Health & Fitness |
| Age Group | Mature 17+ | Unrated | Unrated | Everyone | Everyone | Teen | Everyone | Everyone 10+ |
| Rating | 3.8 | 4 | 3 | 4 | 4.5 | 3.7 | 4.4 | 4.3 |
| <span style="color:red">Topics Addressed</span> | | | | | | | | |
| Anatomy and Physiology | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Puberty and Adolescent Development | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Identity | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Pregnancy and Reproduction | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Sexually Transmitted Diseases and HIV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Healthy Relationships | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Personal Safety | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Sexual Pleasure | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Communication and Interpersonal Skills | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| <span style="color:red">Behavior Change Theories</span> | | | | | | | | |
| Provides information about behavior-health link | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Provides information on consequences | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| Prompts intention formation | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| Prompts barrier identification | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Models or demonstrates behavior | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| Self-efficacy | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| <span style="color:red">Health Literacy</span> | | | | | | | | |
| Most important information comes first | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| Describes the health behavior- just the basics | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| Includes benefits of taking action. | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Provides specific action steps | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| Uses common, every day words | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| avoids undefined technical or medical terms | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Uses active voice | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sentences are 15-20 words | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| Uses bullets and short lists | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| Uses a familiar font size in at least 12 point type | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Uses at least 10-35% of white space and avoids clutter | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Labels links clearly | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Avoids dark backgrounds | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Creates linear information paths | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| "Back" button works | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| Easy access to home and menu pages | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Search function is available | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Includes interactive content | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| Audio and video content | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Images facilitate learning | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Media contain "real life" people and situations | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |

| Provides tailored information | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|
| Provides social media sharing options | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |

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