

# Survey on ICT for HIV/AIDS Preventive Education: Are the teenagers forgotten in developing countries?

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## ABSTRACT

HIV/AIDS epidemic is still a major societal problem in developing countries, especially in Africa. ICT (Information and Communication Technologies) is seen as one of the most important solutions in order to provide HIV/AIDS preventive education for all members of the society. In this study, we performed a literature review in order to identify the uses of ICT for HIV/AIDS preventive education in developing countries with a specific focus on teenagers. We also searched information about the existing methodologies for the design and development of technology supported HIV/AIDS preventive education. We reviewed altogether 20 articles reporting uses of ICT for HIV/AIDS preventive education. We made four observations in our analysis: (1) mobile technologies have been widely used for HIV/AIDS preventive education to address both adults and teenagers; (2) static websites (e.g. web1.0) and CD-ROMS are still the prevailing solution for HIV/AIDS preventive education both in adult population and in schools; (3) one advanced computing technology solution – an expert system for HIV/AIDS preventive education- was identified; (4) one set of guidelines was identified for designing technology enhanced support for HIV/AIDS preventive education. We noticed in our survey that contemporary ICT technologies, such as web2.0 tools and computer games, have not been extensively applied in HIV/AIDS preventive education in the context of developing countries. We conclude that there is a need to carry out more extensive research and development work in order to harness the potential of contemporary ICT solutions for targeting teenagers in developing countries.

**Keywords**— HIV/AIDS preventive education, technology supported learning environments, e-learning

## 1. INTRODUCTION

The fight against the spread of HIV/AIDS has become an important endeavor especially in many African countries. The sixth United Nations millennium development goal is to defeat HIV/AIDS, malaria, and other diseases by 2015. The number of people living with HIV/AIDS continued to grow in 2008 reaching an estimated amount of 33.4 million people [1]. The total number of people living with the virus in 2008 was more than 20% higher than in 2000, and the prevalence was roughly threefold higher than in 1990s. The rates of HIV infection among adults are very high in different African countries with Botswana 24.16%, Namibia 19.9%, South Africa 18.8% and Mozambique 16.1% of infection rates [2, 3]. In contrast, the prevalence of HIV infection among adults is 0.6% in the United States, 0.3% in Canada and 0.3% in Western and Central Europe [2].

The HIV/AIDS pandemic has brought devastation especially in sub-Saharan Africa by causing [4, 5]:

- 1) *Destruction of social capital.* The disease undermines the knowledge base of society and weakens the production sectors.
- 2) *Weakening of institutions and services.* HIV/AIDS causes frequent sickness to the employees and eventually leads to deaths of the citizens in governance, civil services, judiciary, armed forces, education, health, and other crucial sectors in society.
- 3) *Increasing level of poverty and social problems.* Weakened institutions and destroyed social capital causes reductions in savings, profits and production. The disease has increased urban migration, stigma, discrimination, and gender inequality.
- 4) *Increased number of orphans.* Millions of children have lost one or both parents to the HIV/AIDS epidemic. There is a high risk of losing generations where children have no proper education leading to poor socialization.
- 5) *HIV/AIDS mainly affects poor countries in Sub-Saharan Africa.* These countries lack the means to control the disease and research capacity to find solutions for fighting the disease.

Various actions have been taken to tackle HIV/AIDS. For instance, Ugandan government has developed a number of approaches to fight spread of AIDS epidemic in years 1992-2001. In that period of one decade, Uganda registered success story in decline rate of HIV infections. The effect of HIV prevalence intervention in Uganda between 1992 and 2001 appeared to have had a similar impact as a potential vaccine of 80% efficacy [6]. Most recently UNAIDS has outlined a framework for the HIV/AIDS control from 2009 to 2011. One of the focus areas in the framework is the need to empower young people to protect themselves from the disease [1]. ICT (Information and Communication Technologies) solutions have a great potential to scale up the HIV/AIDS preventive education. However, extensive research has not been carried out to investigate how ICT-solutions have

been targeting teenagers, especially in the developing country context [7]. In our previous work, we have identified that existing technology enhanced solutions for HIV/AIDS preventive education provide limited educational possibilities to teenagers with most solutions presenting static online content, cartoon-based stories and using email as a means of communication [8]. The current study contributes to the research work in the field by identifying knowledge gaps on the use of contemporary ICT solutions, such as web2.0 and games, for HIV/AIDS education in developing country context. The paper has a following structure. First, we will discuss about the role of ICT in HIV/AIDS preventive education. Second, we will introduce the research methodology of our study. Third, we will discuss about the results of the literature review. Finally, we will discuss about the findings of the study.

## 2. THE ROLE OF ICT IN HIV/AIDS PREVENTIVE EDUCATION

ICT has a dual nature of capacities: first it provides a basic infrastructure and secondly it enables us to develop innovative products and services [9]. ICT interventions have been used in a variety of fields for preventive education such as smoking [10, 11 and 12] and major depressive disorders [13, 14]. Especially Internet and cell phones have been identified as feasible technologies to deliver HIV/AIDS prevention programs in order to target groups with high risk, such as early adolescent females [15, 16 and 17]. HIV/AIDS education for youth is a challenge because many feel uncomfortable when talking with adults about these topics [18]. Privacy and flexibility are advantages of technology supported HIV/AIDS preventive education directed at youth [19, 20]. Benefits of ICT-mediated HIV/AIDS prevention approaches include [21]: low cost of service delivery and greater intervention fidelity and enhanced flexibility in dissemination means. It is important to consider the need to find novel and effective ICT solutions for enhancing protective attitudes among the specific target groups for HIV/AIDS preventive education [22]. There is need for research that investigates the ways in which treatment information is being met by HIV/AIDS community members and how technology fits into this process [23].

In Western countries, one can identify several examples of ICT-based HIV/AIDS preventive education solutions. For instance, in U.S.A various technology supported HIV/AIDS preventive solutions have been implemented to target HIV positive adults [24], men who have sex with fellow men [25, 26], HIV positive adolescents and at-risk young adults [27]. The programs aimed at reducing risky behavior, and increasing STD/HIV knowledge, HIV/AIDS awareness and condom use [20]. For instance, online educational resources were implemented in order to distribute information about HIV/AIDS-related conferences, workshops and preventive issues [28]. Also various SMS solutions have been implemented in U.S.A to increase HIV/AIDS preventive knowledge and to inform the users about the available

services [7]. According to various experiences, text messages proved to be a feasible tool for HIV/AIDS preventive education. The implemented solutions informed the youth of the dangers of HIV/AIDS epidemic and hence created awareness of the epidemic [29, 27]. In addition the following environments, among various others, have been developed for HIV/AIDS preventive education in U.S.A and Europe.

1. *Keeping It Safe* environment was designed to increase HIV/AIDS knowledge, protective attitudes, and risk reduction self-efficacy among early adolescent girls [22]. The platform taught girls basic medical information about HIV/AIDS, its mode of transmission, and behaviors that reduce HIV risk. Learning was reinforced through an interactive game in which girls identified facts and myths about HIV/AIDS and received feedback for their responses. Girls also viewed videotaped footage of a young woman who contracted HIV/AIDS as a teenager through unprotected intercourse. In the environment, a speaker shared her story and discussed common misperceptions about HIV/AIDS, beliefs and attitudes that might place girls at risk for the disease, and preventive behaviors to reduce the risk.
2. *SAHARA* is an interactive website that is gender and culturally sensitive to African-American Women in between 18 to 29 years of age. This intervention focuses on ethnic and gender pride, HIV/AIDS risk-reduction information, sexual negotiation skills, proper condom use, and development of partner norms supportive of consistent condom use [30].
3. *JAIP* (Jerusalem AIDS project) project was originally launched in 1986 to provide regular HIV/AIDS education to thousands of young Israelis, both in and outside of schools [31]. JAIP is a volunteer-based nongovernmental organization, which works on implementing HIV/AIDS education activities in primary and secondary schools and among members of police and armed forces. JAIP aims to prevent HIV/AIDS infection, increase awareness of HIV/AIDS, encourages changes in attitudes and behavior, and increase acceptance of people living with HIV/AIDS. Via the active participation of its volunteers, JAIP facilitates communication about HIV/AIDS through a triangular model that involves students, parents (and the community at large), and school staff. The JAIP project established a telephone hotline for the young people to call trained AIDS counselors and discuss issues concerned with HIV/AIDS. The project has also produced online learning materials for HIV/AIDS preventive education [32].
4. *e-AIDS* is an European project run by University of Rome, Taurus, Euro-net, Save the Children, Tempo and Agora. The project aims at strengthening the education and training on HIV/AIDS prevention education through an e-learning environment. The users of the environment are adult population namely teachers, medical staff, volunteers, social workers and

trainers of adult education institutions. The integrated web site forms the e-learning environment with three structured levels: (1) informational level consisting of informative space for visitors, (2) the learning space including learning content and material for online courses and (3) communication level for sharing experiences, and keeping up-to-date with issues related to HIV/AIDS. The environment is open to adults from all over Europe, who want to improve their knowledge and acquire new information about HIV/AIDS. The learning content is delivered static web content, video materials and games supported by an online evaluation test for tracking learner's progress [33]

People from Sub-Saharan Africa have not received the same benefits from ICT as people in industrialized nations. There is significant untapped potential to use technology in order to improve the quality of HIV/AIDS educational programs in developing countries [34]. A cross-sectional survey related to the potential of Internet in HIV/AIDS preventive education among adolescents of 12 to 18 years old was carried out [35]. The results showed that 35% of the students had used the computer or Internet to find information about HIV/AIDS, and 20% had looked for sexual health information. Finally, 66% of students who participated to the study reported that they would search for information about HIV/AIDS prevention from the Internet if the access was free. The researchers concluded that the adolescents had a high desire to use Internet for searching information about sexual health and HIV/AIDS. The authors acknowledged Internet as a promising strategy to deliver low-cost HIV/AIDS risk reduction interventions in resource-limited settings, such as developing countries.

### 3. RESEARCH METHODOLOGY

In this section, we present the research objectives, questions and the research design of our study. We choose a literature review as our research instrument, because it can provide valuable information related to knowledge gaps in previous research. The method can also be used to illustrate how the subject has been studied earlier and it can be used to establish a knowledge base on the given subject [36, 37]. In this study, we use the literature review to identify previous research and development work related to the use of ICT for HIV/AIDS preventive education targeting teenagers with a specific focus on the developing country context.

#### 3.1 Research objectives

Our research objectives are

- To explore what kind of technology enhanced HIV/AIDS preventive education has been implemented in developing country context.
- To identify how contemporary ICT solutions in HIV/AIDS preventive education have been

targeting teenagers, especially in a developing country context; and

- To gain methodological insights related to the design and development of technology supported HIV/AIDS preventive education.

#### 3.2 Research questions

The research objectives are operationalised via a set of research questions presented in Table 1. We have divided the main research questions into three main categories: A, B and C.

**Table 1: Research questions and their purpose**

Category	Questions	Purpose
A	How have contemporary ICT solutions, such as mobile technologies, games, Web2.0 and advanced computing solutions been used for HIV/AIDS preventive education to address teenagers?	To identify possible knowledge gaps in the research and development field related to the use of ICT for HIV/AIDS preventive education targeting teenagers in developing countries.
B	What are the main ICT solutions for HIV/AIDS preventive education for schools?	To identify the current trends on the technologies used by the schools in developing countries.
C	What kind of methodologies exists for developing ICT-based interventions for HIV/AIDS preventive education?	To find out whether there is a need for additional research to address the methodological issues related to the design and development of technology supported HIV/AIDS preventive education.

#### 3.3 Data collection and analysis

The literature survey was carried out by searching publications reporting research and development work in ICT-based HIV/AIDS preventive education. The specific focus of the survey was on the use of technology supported HIV/AIDS education in developing countries. We also included non-scientific publications in our survey,

since some of the identified ICT solutions for HIV/AIDS preventive education have not been reported in scientific forums. However, the information provided from non-scientific forums can be highly relevant from a practical point of view. A net search of the articles was performed from June 2010 to March 2011. Also we searched IEEE and ACM databases. We used the following search terms: mobile technologies for HIV/AIDS prevention education, ICT-based HIV/AIDS prevention intervention, Web-based HIV/AIDS preventive education, Digital learning environment for HIV/AIDS prevention. After we found articles that seemed to be relevant, we read the titles and abstracts in order to decide whether or not to include it into the survey. We used the following criteria for selecting articles for the review:

- 1) The article reported the use of ICT in HIV/AIDS preventive education
- 2) The article was published in a scientific journal, proceedings of international conferences or it was available via a web portal that is dedicated to HIV/AIDS preventive education.

- 3) The article was chosen if it did not overlap with an already found article. In a situation where we found two or more articles presenting the same work we chose the most recent or the most comprehensive article.
- 4) The article was published after year 2000
- 5) The article reports final research outcome not work-in-progress.

We identified total of 29 articles that were relevant for our study. Table 2 shows authors, year of publication, year of study, location, subjects, method and design type of the articles that were extracted for this research. We recognized that this is not a comprehensive survey. However, the purpose of the study is not to be completely comprehensive, but rather a specially directed probe into the use of ICT in HIV/AIDS preventive education. Table 2 summarizes the articles included in the review according to authors, year of publication, year of study, location, subjects, method, design type and the source of the article.

**Table 2: Summary of the articles included in the survey**

Author(s)	Year of Publication	Year of study	Location	Subjects	Method	Design type
Ortiz et al.	2010	2009	Angola	Adults (soldiers)	Focus Group discussions	Participatory
Chao et al.	2010	2008	KwaZulu S. Africa	Adults - Educators	CD-ROM intervention, questionnaires	Experimental design
Hwabamungu and Williams	2010	N/A	Pretoria, S. Africa	AIDS Patients	Case study	Qualitative design
Davis et al.	2010	2008-2009	Uganda	Youth and Adults	Case study	Experimental
Freedom HIV/AIDS	2010	2005	Uganda, Kenya, Malawi, Mozambique	Adults and youth	Mobile games	Experimental design
Woodrow	2009	2009	Several countries, including Africa	Adults	Literature research, interactive video, focus group discussion	Meta-analysis of research, Explorative design
Hoefman & Apunyu	2010	2009-2010	Lira, Uganda	Adolescents and adults	Survey, text messaging, HIV testing	Exploratory design
Adegoju	2010	2008	Nigeria	Youth and adults	Radio drama for education	Qualitative design
Duveskog et al.	2009	2008	Iringa Tanzania	Adolescents	Interviews, carton-based stories	Participatory design
Masizana-Katonga et al.	2009	2006	Botswana	Adolescents and Adults	Interviews, Literature, Focus groups	Participatory design for expert system

<http://www.cisjournal.org>

Fazekas and Moffet	2009	2007	Uganda	Adolescents	Focus groups	Experimental design
Learning About Living	2010	2007	Nigeria	Adolescents	Web Experiment	Experimental design
Svoronos et al.	2008	2006	Rwanda	Children and adults	Literature review, Interviews	Experimental design
Walsh	2008	2007	Thailand	MSM and MSW	Experiment with animations	Exploratory
Bull et al.	2007	2006	Colorado, Denver	Youth (15-25 years)	Focus group discussion, tape-recording	Qualitative design
Ybarra et al	2006	2005	Mbara Uganda	Adolescents	Survey, questionnaire	Cross-sectional design
Chikonzo	2005	2005	Zimbabwe	Youth and adults	Literature review	N/A
Duveskog et al.	2003	2001-2002	Tanzania	Adolescents	Focus group discussions	Experimental design
Bloome	2003	2001-2002	Uganda, Ghana, Botswana	Adolescents and teachers	Prototyping	Participatory design
Kelly	2001	2000	Kenya	Adult and youth	Mobile text experiment	Experimental design
<b>Articles excluded from the deeper analysis</b>						
Kidd et al.	1994	1993	Australia	Students	Interviews, rapid-prototyping	Experimental design
Petri, C. J	2000	1996	Alabama University	Students	Prototyping	Experimental design
Forcolin	2009	2009	Uganda, Botswana, Lesotho, S. Africa	Children and Adults	Case study	Quantitative and Qualitative design

**Table 3: Summaries of the source and databases where the articles were retrieved for the analysis**

Source/Database	Number of articles	(3) Article
Publication in a scientific journal series	3	Chao et al. (2010); Svoronos et al. (2008); Adegaju (2010)
SpringerLink, <a href="http://www.springerlink.com">http://www.springerlink.com</a>	1	Bull et al. (2007).
ACM Digital library, <a href="http://portal.acm.org/dl.cfm">http://portal.acm.org/dl.cfm</a>	4	Woodrow (2009); Duveskog et al. (2009); Davis et al. (2010); Hwabamungu and Williams (2010)
Web portals dedicated to HIV/AIDS preventive education/ medical centers.	5	Bloome (2003); Kelly (2001); Fazekas and Moffet (2009); One World UK (2009); Freedom HIV/AIDS (2010); and Learning About Living (2010); The world starts with me (2009);

<http://www.cisjournal.org>

Publication in a scientific conference forum	5	Hoefman & Apunyu (2010); Duveskog et al. (2003); Masizana-Katongo et al. (2009); Ortiz et al. (2010); Walsh (2008); and Chikonzo (2005)
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#### 4. RESULTS

After collecting and pre-analyzing the articles, we next performed a deeper analysis on the extracted information.

Consequently, we organized the articles according to the set of observations as depicted in Table 4. The observations emerged from the data we extracted the articles. After the observations were identified, they were mapped to the research questions of the study.

**Table 4: Observations on ICT-based HIV/AIDS preventive education solutions**

Observation	Description	Related research question
Observation 1	Mobile technologies have been used widely for HIV/AIDS preventive education among the adult community. Mobile phones have also been used for communicating information on HIV testing places and counseling services. We also found mobile technology solutions that were targeted towards teenagers.	A
Observation 2	Traditional ICT solutions are the prevailing solution to provide HIV/AIDS basic knowledge and information to adult population and to target schools. We did not find, for example, research conducted of using Web 2.0 tools with teenagers. On the other hand, Web1.0 (e.g. static content without interactions) solutions are the prevailing solution to provide HIV/AIDS basic knowledge and information to adult population. Additionally, computer games have not been used for formal teaching of HIV prevention in schools. We were able to find recent research where, for example, radio drama has been used for HIV/AIDS awareness campaign.	A, B
Observation 3	One system using advanced computation was found for HIV/AIDS preventive education – an expert system in HIV/AIDS.	A
Observation 4	One set of guidelines was identified for designing a learning environment for HIV/AIDS preventive education	C

In the following sections, we will discuss each of the four observations in more details.

##### **Observation 1: Mobile technologies have been widely used for HIV/AIDS preventive education and treatment among the adult community**

###### *South Africa: Mobile phones for monitoring AIDS patients*

The use of mobile phones was investigated for communicating HIV/AIDS information in South Africa [38]. The researchers examined the sustainability and scalability challenges of mobile phone-based applications/projects for HIV/AIDS care in developing. The research results show that adoption and sustainability from care givers' and patients' perspective is not merely dependent on the technology's capabilities to enhance service delivery, but on their willingness and capability to incur any technological adoption when there are continuous costs. The other factors that favors adoption is the user's pre-conceived notion of government or sponsor-supported service provision. The users were enthusiastic to

use m-Health services but few were prepared to incur minimum cost for the services.

###### *Uganda: Mobile phone quiz for HIV education and SMS for HIV awareness campaign and testing information*

An experiment was performed to establish the effectiveness of SMS-based HIV education system that uses quiz format to assess people's knowledge of the disease, including its causes and methods of prevention [39]. This study was carried out in North-western and South-eastern areas of Uganda. The researchers adopted an approach called "Text To Change (TTC)", which is a SMS-based approach for communicating HIV basic facts and prevention methods to the public. Text to change has a strong history of implementing behavior change communication interventions. Questions were sent to the participants' mobile phones and they replied back to the service. The participants with highest accuracy and participation rates were entered into drawings for free "airtime" (pre-paid mobile phone units) and other prizes. The researchers concluded that structured SMS messages

can be used effectively for HIV/AIDS education in an application where errors are tolerable.

In another study in Uganda, SMS was established as a feasible tool that connects users, allows exchange of vital information and expert opinions in near real-time. The researchers affirmed that SMS provides a trusted resource for asking time-sensitive questions, while providing an anonymous forum for gaining insights on potentially sensitive subjects [40]. To investigate the usefulness of SMS for communicating HIV/AIDS testing information and awareness campaign, the researchers surveyed 7,000 people in Lira district of Uganda for SMS-based Health education. There was a high acceptance of SMS use for the HIV/AIDS awareness campaign. The SMS was very highly valued by the participants; almost all stated that they gained knowledge and learned new aspects about the disease.

#### *Nigeria: mobile-based e-learning program for HIV prevention intervention to the youth*

A mobile-based e-learning platform was created to provide Nigerian teenagers with relevant skills to protect themselves against HIV/AIDS and gender-based violence. The multi-stakeholder project was initiative of OneWorld UK, in partnership with Butterfly Works Netherlands and ten Nigerian partners. The e-learning platform uses video, SMS and News as approaches to enable communication among youth on HIV/AIDS prevention and to foster behavioral change. The lessons in the environment were designed using cartoons to engage the young people through exercises and quizzes. Mobile phones were used to enable communication among the youth. Over 10,000 questions and answers were delivered via the e-learning platform during the first month of its operation [41].

#### *Indian Mobile Games to fight HIV/AIDS in Africa*

In 2006, Freedom HIV/AIDS introduced the STAR programme to fight against HIV/AIDS in six African countries namely: Uganda, Tanzania, Kenya Malawi, Mozambique and Namibia. The STAR programme aimed at designing and developing new mobile games to increase HIV/AIDS awareness in Africa. The games were designed for a variety of devices from basic Java Phones to Smart phones and Pocket PCs. Examples of mobile games developed in the project include Penalty Shoot Out and AIDS Fighter Pilot. In the Penalty Shoot Out game the player gets messages related to the HIV/AIDS depending on whether he/she is saving a penalty or scoring a goal. When saving a penalty, the player gets a message related to HIV/AIDS awareness and prevention, while scoring a goal the player receive information about transmission, myths and misconceptions about HIV/AIDS [42]. The AIDS Fighter Pilot is an adventure game where the player will be playing characters that have dedicated their lives to fight HIV/AIDS.

#### *South Africa: Project Masiluleke*

Project Masiluleke is a recent breakthrough cross-sector collaboration that uses mobile technology as a high-impact, low-cost tool for fighting HIV/AIDS epidemic and tuberculosis in South Africa. South Africa has more HIV/AIDS positive citizens than any country in the world. In some provinces more than 40% of the population is infected. Majority of HIV-infected patients in South Africa seek care only after they have developed HIV/AIDS symptoms which are too late for survival. Masiluleke means “give wise counsel” and “lend a helping hand” in Zulu. Mobile technologies were used in the project because of the high penetration rates of mobile phones in South Africa and their capacity to foster social change [43]. The project brought together a world class coalition of organizations and domain experts (including MTN, Nokia, Siemens Networks) to test and scale up novel mobile technology solutions for HIV/AIDS education. The project aimed to raise widespread public awareness about accessing help, encouraging people to go for HIV testing and also encouraging the infected people to go for treatment. In October 2008, the project Masiluleke launched a mobile HIV/AIDS-awareness campaign using simple text messaging. Within a period of one year, the volume of the communication tripled inspiring more than 150,000 people to reach out for help via the campaign [43].

#### **Observation 2: Traditional ICT solutions are the prevailing solution to provide HIV/AIDS basic knowledge and information to adult population and to target schools.**

The following examples show the traditional ICT solutions which are predominantly for technology enhanced HIV/AIDS preventive education solution in developing countries. The prevailing solution is to use websites based on the Web1.0 principle: (1) the information is published on the web in a static manner; (2) hyperlinking the web-pages and bookmarking are the most useful features. Sites are not usually interactive and the users are not able to contribute to the content of the sites, as in Web2.0. Also we found that radio broadcasts have been used in various occasions.

#### *TRACnet in Rwanda*

Rwanda’s “The Treatment and Research AIDS Center” (TRAC) got recognition for providing real-time access of information on HIV/AIDS and Anti-Retroviral drugs (ARVs) nationwide through the use of ICT. A web-based system TRACnet was developed in order to provide HIV/AIDS anti-retroviral treatment monthly indicators and weekly reporting on drug shortages and stock outs, and case-based reports on CD4 cell counting tests. TRACnet accepts both phone and Internet-based data entry. This demonstrates the importance of phone-based reporting capabilities [44].

### *Animation for safe sex practices in Thailand*

In Thailand, animations were created for increasing understandings of safe sex practices and for addressing low perceptions of personal risk among some of the most vulnerable groups to HIV/AIDS infection [45].

### *Angola and Nigeria: Radio drama interventions for HIV/AIDS prevention*

A multiple HIV prevention interventions were developed for the Angolan Military in order to compare degree of engagement and sustainability across several modalities of presentation: paper-based intervention, game-based intervention and ICT-based intervention [46]. The ICT-based intervention used by them was a radio drama. A radio program developed incorporated narratives from real soldiers to address many of the challenges faced by the soldiers in preventing infection with HIV. The use of radio drama for communicating HIV basic knowledge and preventive education to the rural communities was investigated in south-western Nigeria [47]. The messages for HIV prevention the radio listeners learnt through drama was highly appreciated by them. People do not change behavior when they are told how to act. Instead, they are most likely to listen when they are presented with accurate information that depicts a situation they can relate to and touches their heart [47].

### *World Links and the AIDSWEB Project*

AIDSWEB was an online collaborative project on HIV/AIDS prevention and care. In early 2000, fifteen schools in Ghana, South Africa, Uganda and Zimbabwe used the ICT resources and training available at the World link's Internet learning and community centers, which were established in each of the countries [48]. In 2001, twenty-five schools with 200 teachers and students participated in the project; in 2002, over thirty schools with about 300 teachers and students enrolled in the project to exchange questions, answers and discussions via the project's moderated e-mail listserver. The five educational components formed the core activities of the project: cultural exchange, basic facts about HIV/AIDS, the danger of HIV/AIDS, the challenge of HIV/AIDS prevention, and social action plan. Furthermore, teachers and students explored myths and misunderstandings of the disease and conducted research on how they could prevent HIV/AIDS within their communities. In the social action plan component, students and teachers developed an HIV/AIDS action plan in order to impact their community. Some of the social action plans included working with Parent-Teacher Associations, establishing income generating projects for the youth, and collecting testimonies from people living with HIV/AIDS. For instance, in Uganda students went out in their communities and interviewed mostly elderly people to find out their views about HIV/AIDS. The people were also asked to exchange information regarding various preventive measures [48]. Another priority of the project

was to get more and better HIV/AIDS educational materials into schools. World Link worked on two fronts to provide appropriate information to project participants. A CD-ROM with supporting HIV/AIDS websites was produced and disseminated for schools with slow or no Internet connections. The content of the CD-ROM was created from existing online materials. The AIDSWEB project was short intervention and the activities did not continue after the initial phase.

### *Uganda: Internet for teenage health education*

A total of 500 teenagers participated in a cross-sectional survey of Internet use among adolescents in Mbarara, Uganda. The results show that over one-third (35%) had used Internet to find information about HIV/AIDS, and 20% had looked for sexual health information. Therefore, the desire to use and the actual use of Internet is high among the teenage children in Mbarara, Uganda. The researchers concluded that the Internet may be a promising strategy to deliver low-cost HIV/AIDS risk reduction interventions in resource limited settings with expanding Internet access [35].

### *Uganda: E-mail-based on-line counseling in Schools*

In Uganda, an online counseling programme for kids was launched in May 2001 [49]. The service was first established in three school-based telecenter sites; this was followed by training of teachers and online student-peer counselors to reach the local areas around the telecenters. The purpose of the centers was to help young people to understand how reproductive health problems relate to HIV/AIDS infection. Through the initiative, the teachers and students acquired counseling skills; developed basic ICT skills required for online counseling, and designed actions plans for the project. The online counseling service was initiated jointly by SchoolNet Uganda, ICT for education program of World Bank Institute and Straight Talk Foundation.

### *Zimbabwe: Email services for information dissemination*

Different forms of ICT have been used in Zimbabwe to disseminate information on several health issues including HIV/AIDS. ICT-based health services in Zimbabwe are mainly provided by SateLife's health network. This network provides low-cost e-mail and health information services to the health community. HIV basic information and preventive issues are thus disseminated using e-mail services [50].

### *Uganda: The World Starts With Me*

The World Starts with Me is a web-based initiative used by secondary schools in Indonesia, Thailand, Kenya and Uganda. The programme presents HIV/AIDS prevention education and reproductive health education. The content was developed for self-study [51].

*Tanzania: HIV/AIDS education blended with learning to programme and Sura ya UKIMWI*

HIV awareness creation was done through Java programming course at Kidugula secondary school in Tanzania [52]. The students acquired knowledge about HIV/AIDS after writing programs that produced useful information regarding HIV/AIDS dangers. At the end of the course the students not only benefited from programming skills but also from HIV/AIDS knowledge acquisition. In another experiment at the same school, *Sura ya UKIMWI* (The face of AIDS) was designed by a team of secondary school children, HIV/AIDS counseling experts, and experts in ICT. The participatory design approach enabled the children to compose their own stories related to their life experiences. The objectives of the *Sura ya UKIMWI* project are: to make youth consider their behavior; suggest a life style that eliminates risky behaviors, prevent new infections to take place; reduce the stigma attached to the disease; and bring hope to those infected. The *Sura ya UKI* platform was designed using graphics, Swahili and English translation, flash drawings, and voices and sounds [53].

*South Africa: CD-ROM intervention for HIV and life skills education*

An experimental research was conducted to establish different methods for teaching AIDS educators. The researchers selected sixty educators from eight schools in KwaZulu-Natal province, South Africa, the trainees received HIV training by use of an interactive CD-ROM intervention. The next group of sixty educators was selected from other schools and they underwent two-day life skills training programme provided by the department of education. The researchers evaluated these two interventions and established that Life skills training programme to be superior in enhancing basic knowledge about HIV, and the CD-ROM was superior in teaching about HIV transmission risks [54].

### **Observation 3: Advanced learning technologies: a HIV/AIDS expert system**

Integrated Healthcare Information System through Mobile Telephony (IHISM) was initiated in 2005 at Department of Computer Science at University of Botswana under Microsoft Research funding [3]. The project explored the use of mobile phones as an access technology to a variety of HIV/AIDS related information required by the general public. The IHISM project developed a general HIV and AIDS information portal which is queried by the users using mobile phone technology. The information service allows the general public to request for information on topics related to HIV/AIDS such as descriptions, infection, testing, counseling and support, opportunistic diseases and pediatrics care, etc. The portal represents this information in the form of frequently asked questions (FAQ) service in

which the user inputs query on any of the subjects. The system is meant to act as an online "expert" in HIV/AIDS information and it derives some information through inference as opposed to simple data retrieval [3].

### **Observation 4 Guidelines for designing learning environments for HIV/AIDS preventive education**

A set of guidelines to support the design of learning environments was developed for HIV/AIDS preventive education [20]. The researchers used participatory research approach to develop a theoretically sound HIV/AIDS preventive education site for delivering key messages about the use of condoms. A focus group data collection approach was used to collect ideas and suggestions from patients of sexual transmitted disease clinics and parenthood clinics. The following guidelines were suggested in order to support the design and development of technology supported HIV/AIDS preventive education

- Interactivity: the solution should be interactive with multiple features such as chats, instant messages, and quizzes. The colors for use should be bright; less text should be used with pictures and audio.
- Role model: a role model should be used when delivering a message with similar age group.
- Focus on risk awareness: the environment should offer credible statistics and consequences for not using condoms
- Versatile perspectives: participants suggested a balance between offering information on what good things would happen if condoms were used and offering information on what you would avoid if you used condoms.
- Real stories: Participants preferred to read real stories about the use of condoms, rather than factual knowledge
- Basic advices: Beside stories, the participants suggested the need for detailed information on how to use a condom and how to talk to your partner about the issues related to HIV/AIDS and other sexually transmitted diseases.

Although the above suggestions refer to the specific topic of condom use in HIV/AIDS education, they can also be applied to design technology supported solutions for other areas.

## **5. DISCUSSION AND CONCLUSION**

In this study, we reviewed literature related to the use of ICT for HIV/AIDS preventive education in developing countries. We made the following four observations:

- 1) Mobile technologies have been used for HIV/AIDS preventive education among the adult

community. Mobile phones have been used, for instance, to communicate about HIV/AIDS testing places and counseling services.

- 2) Traditional ICT solutions are the prevailing solution to provide HIV/AIDS basic knowledge and information to adult population and to target schools. We did not find, for example, research conducted of using Web 2.0 tools with teenagers. On the other hand, Web1.0 (e.g. static content without interactions) solutions are the prevailing solution to provide HIV/AIDS basic knowledge and information to adult population. Additionally, computer games have not been used for formal teaching of HIV prevention in schools. We were able to find recent research where, for example, radio drama has been used for HIV/AIDS awareness campaign
- 3) One expert system for HIV/AIDS preventive education was identified.
- 4) One set of guidelines to support the design and development of technology supported HIV/AIDS preventive education was identified.

In our survey, we noticed that many of the identified technology supported solutions for HIV/AIDS preventive education in developing countries were designed to address the needs and requirements of adult population. We also noticed couple of cases where mobiles were effectively used to support communication among teenagers. We further observed several ICT-based HIV/AIDS projects which were initiated in various schools around Africa. These initiatives were often donor lead and they were only active within the time frame of the project. An example of such projects is the AIDSWEB project. We identify the following. The limitations of our study are: (1) the search terms might not be comprehensive enough so that relevant articles were left out from the survey; (2) the main author of the article did not have an access to all electronic databases, for example, ISI Web of Knowledge, which also might limit the amount of articles included in the survey; (3) since our observations emerged from the data, there are some bias in the findings and other researchers might have found different observations from the same data; (4) we were not able to find similar articles in order to relate our findings to them.

Most of the identified HIV/AIDS preventive education initiatives operated using unidirectional communication where the recipients of the information did not communicate back to the sender. We can also conclude that ICT has been used mainly to address the HIV/AIDS problems that are present with the adult population with little focus on teenagers. The future depends on the teenagers, giving them little focus in ICT-based HIV/AIDS preventive education intervention is like addressing challenges of today and not focusing on the same challenges that will occur tomorrow. There is a need to involve teenagers to discuss problems of HIV/AIDS infection and prevention approaches using, for instance, the community features of web2.0 tools. ICT is a viable

tool for communicating important points that may be difficult to communicate in face-to-face interactions. This is true when it comes to the teenagers' communication to the adults on issues related to sex education. Web provides anonymity and has been effectively used for discussing important points and at the same time protecting the identities of the parties involved in the discussions. Also in the developing countries Internet technologies can be used to allow communication among teenagers via peer education and counseling leading to behavioral change.

We argue that existing approaches in developing countries could be enriched by including the following components to HIV/AIDS preventive educational environments: (1) set up an online environment where students can contribute their own ideas in preventive actions against HIV/AIDS spread in society using mobile technologies, (2) an online counseling service could be set up where HIV/AIDS counselors can attend to students who are infected or affected (orphans) by HIV/AIDS epidemic, (3) web 2.0 tools and computer games designed based on the contextual factors have potential for creating motivating and inspiring technology supported solutions for HIV/AIDS preventive education. In the literature survey we found one set of recommendations for designing technology supported HIV/AIDS preventive education. Hence, more work is required to come up with a comprehensive software design methodologies for HIV/AIDS preventive education. Our next step is to contribute to the development of the field by developing more specific guidelines and suggestions for the design and development of ICT-based interventions in HIV/AIDS preventive education. Since the youth have interest to use Internet for health education including HIV/AIDS basic knowledge and prevention (Ybarra and Suman, 2006), a digital learning environment has potential of engaging school children to learn about HIV/AIDS epidemic by use of a variety of learning objects such as games, online lessons and discussion forum in a common environment. The above potential has not been fully explored in the context of secondary school teenagers in developing countries. The developing countries are not fully utilizing digital services for a number of reasons that include: lack of electricity, lack of computer hardware equipment, slow Internet due to small bandwidth, lack of funds for investments in ICT, poor attitude towards technological innovations, and lack of skills for modern application development. However, our argument is that despite of these challenges, appropriately designed technology supported HIV/AIDS preventive education solution are able to contribute to the fight against the disease.

From the literature, we discovered that learning objects for HIV/AIDS education were implemented in isolations. The future research needs to address development and evaluation of technology enhanced HIV/AIDS prevention education targeting educational needs and contextual peculiarities of teenage children in secondary schools. Computer games and virtual classroom are potential learning objects for HIV/AIDS education targeting teenagers. The future research also needs to examine the contribution of technology enhanced

HIV/AIDS prevention to sexual behavioral change among teenage youth as a way of avoiding HIV/AIDS infection.

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