

A Systematic Review on Improving Health Literacy in Rural Africa Using Mobile Serious Games

Ismaila OUEDRAOGO^{a,1}, Michel J SOME^b, Roland BENEDIKTER^c and Gayo DIALLO^a

^a *BPH Centre Inserm 1219 – University of Bordeaux, Bordeaux, France*

^b *School of Computer Science, Nazi Boni University Bobo Dioulasso, Burkina Faso*

^c *EURAC Research Center for Advanced Studies Bolzano, Italy*

Abstract. Driven by an increase in the availability of cheap low-cost mobile phones and a jump in the number of telecom subscribers, the African gaming world is booming. Most importantly, it has opened an opportunity for rural communities to have an almost identical mobile phone experience than people living in urban areas. It has also opened an opportunity to leverage this high penetration of mobile devices to design mobile-based applications such as mobile serious games. The latter assists individuals living in these communities to modify, change or shape their behaviors and attitudes desirably. This paper reviews mobile serious games in healthcare education, especially those intended to improve health literacy in rural Africa. The challenges and issues encountered in the design and use of persuasive mobile games as a tool can promote behavior change among people living in the rural African communities.

Keywords. Health literacy, serious games, mobile health, Africa.

1. Introduction

With the ubiquitous nature of mobile phones and handheld devices, combined with the increasing adoption of games by people of all ages and ethnic groups [1], delivering mobile serious games has become a common practice[2]. Because of the motivational pull, these games offer, they are increasingly becoming the preferred medium to deliver persuasive contents that will motivate behavior change. Serious games can motivate behavior to change subtly while the user is having fun. Due to the recent spread of cheap Android phones across the African tech market, African populations have experienced a significant increase in the number of smartphone users and owners. Sub-Saharan Africa (SSA) has been experiencing very significant progress recently, and forecasts show that the number of smartphone connections in SSA will almost double to 678 million by the end of 2025[3]. This is also applicable to rural African audiences, despite their low financial and technical experience. These phones allow them to have an almost identical mobile phone experience to people living in urban areas. This development opens a window of opportunity to leverage this high penetration of mobile devices to design applications such as persuasive game interventions to assist individuals living in these communities to modify, change or shape their behaviors and attitudes desirably. One of the reasons for the specific focus on people in the rural areas is because the urban areas

in many African countries tend to be more influenced by Western culture. Hence, their behavioral patterns are more likely to be influenced by Western culture, unlike rural areas that have little or no exposure to Western culture. Above all, they are marginalized by tech intervention designers even though they suffer from many lifestyle-related health and environmental issues that can be prevented through adequate behavioral change.

This current review aimed to identify the existing mobile serious games for health in rural Africa and to highlight some challenges faced when come to implementing such technologies.

2. Methods

This study is performed according to the PRISMA protocol[4]. A wide range of studies, including articles and other publications published between 2011 and 2020 in English were included. No lower limit for the delivery date was applied. To perform our systematic review, PubMed, Scopus, Google Researcher and manual data sets were searched and looked up by using the accompanying request terms. We performed the study on 20 March 2022 using Boolean Operators ('AND', 'OR') with selected keywords to search in the 'titles, abstracts, keywords' of every published article related to health literacy and mobile technology. The following combinations were used to perform the search in the Scopus, PubMed, and NLM (National Library of Medicine): (Mobile health *) AND ((serious game*)) AND (education and Awareness) AND (Africa). After performing the keywords search, we chose to select only English language publications. Due to the rapid growth of mobile technology, we limited our literature review to studies published between 2011 and 2020. No author restriction was imposed. We exported data related to the 'title', 'abstract', 'keywords', 'author', 'publication dates', 'country of origin' to a comma-separated format. Then, we screened the full text of all publications according to the following criteria:

- studies focused on mobile technology and health literacy; otherwise, they were excluded;
- studies targeting public health issues in Africa;
- studies related to health literacy and mobile technology in rural areas were included.

Four researchers with diverse expertise in Information Communication Technology for development, health literacy and social science carefully analyzed the publications according to the criteria mentioned above and the resulting selected data were converted to a CSV file format. We excluded studies that did not meet the above criteria.

3. Results

The following **table 1** shows the results of the literature review regarding the use of mobile games for the improvement of literacy in rural areas of Africa.

Following the look-up using the identified keywords, 208 publications were found through our review. We found 30 papers in the Scopus database 10 papers in PubMed and 168 through the NLM (National Library of Medicine). Once the duplicates were removed, there were 60 papers left for screening. We screened the titles and abstracts of

all the 60 articles and we found that 12 studies were not related to the use of the serious game in rural Africa. So, we excluded 12 papers and 48 left for full-text screening. After screening the full text of the 48 papers, we included 8 studies for our review. Table 1 summarizes the included papers for our review.

Table 1. Set of included studies in the review

Game name	Description of the game	Characteristics of the technology
STD Pong	STD Pong is designed to promote risky sexual behaviour change among African youths [5].	Language of the game: English. The game is designed to be played on the Android platform and was developed using Unity Engine, Adobe Animate and Photoshop.
SwaziYolo	SwaziYolo (a smartphonegame) is an interactive, educational story game that puts the player in the role of a young adult looking for love in Swaziland, making important choices about relationships and sexual health. [5]	Language of the game: English. The game is a 49MB Android-based operating system.
My Jorley	Serious gaming for healthy sexual behaviour in Ghana and beyond [6].	Language of the game: English. The game is designed to be played on Android devices.
Ebola Strike Force	Ebola Strike Force represents a new paradigm in mobile gaming, empowering users not only to experience thrilling gameplay but also to learn about the Ebola virus in an interactive and immersive fashion [7].	Language of the game: English. The game is designed to be played on Android devices.
Hello Nurse	Ghana's Leti Arts game Hello Nurse, developed with the country's ministry of health and JHPIEGO, is an interactive story designed to help trainee medical staff (midwives and nurses) diagnose and treat malaria[8].	Language of the game: English. The game is designed to be played on Android devices.
Mosquito Smasher	Mosquito Smasher Game is a FUN game where one needs to smash mosquitoes as much as you can. Every successful tap of a mosquito counts for one point [9].	Language of the game: English. The game is designed to be played on Android devices.
Mosquito Hood	Mosquito Hood is a fast-paced 2D casual game that wants to help save Africa from the Malaria caused by mosquitoes by spreading real nets on the continent. Players play in sprite levels, scoring points for proceeding to other levels, and for achieving the game's goal [10].	Language of the game: English. The game is designed to be played on Android devices.
Tumaini	A narrative-based smartphone game designed to help prevent HIV among young Africans[11].	Language of the game: English. Internet is needed. The game takes various forms, including quizzes, jigsaws, and role-playing scenarios with feedback.

4. Discussion and Conclusions

Our study made it possible to identify eight studies falling within the framework of the use of mobile games for the improvement of literacy in rural areas of Africa. Most of the games were intended to provide information on childcare, general health and other specific sectors such as maternal and child health, reproduction and nutrition. Our findings suggest that language diversity, internet issues, energy consumption and electricity, memory space and CPU power, low literacy, game concepts, religion and culture are major challenges that persuasive game designers need to tackle to design serious games that will be effective for people living in the rural African communities. Therefore, these studies could assist persuasive game designers (persuasive game developers and researchers) in understanding the challenges faced by users in the rural African communities that they need to be mindful of when designing persuasive games targeting people in that region. We recommend designers to consider the integration of the local languages in the implementation of serious mobile health apps to facilitate their access for illiterate users. It is worth noting this study was conducted using only 3 databases. In further studies, we envision to include more databases and design a framework to facilitate the implementation of more inclusive technologies in rural areas of Africa.

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