Development of a Mobile Game to Influence Behaviour Determinants of HIV Service Uptake Among Key Populations in the Philippines: User-centred Design Process

Charlotte Hemingway, Emmanuel S Baja, Godafreda V Dalmacion, Paul Mark B. Medina, Ernest Genesis Guevara, Tyrone Reden Sy, Russell Dacombe, Claire Dormann, Miriam Taegtmeyer

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Abstract

Background: Opportunities in digital distribution place mobile games as a promising platform in games for health. However, designing a game that can compete in the saturated mobile games market and deliver persuasive health messages can feel like an insurmountable challenge. While user-centred design is widely advocated in the field; factors, such as; the user's subject domain expertise, budget constraints and poor data collection methods can restrict the benefits of user involvement.

Objective: To develop a playable and acceptable mobile game, targeted at adolescent and young adult key populations in the Philippines.

Methods: Focus group discussions (FGDs) with Filipino gamers, most of whom identified as men who have sex with men (MSM), were used to; identify preferred game features, technical requirements and to assess game playability and acceptability. Discussions were transcribed and analysed thematically. Conceptual frameworks in health intervention acceptability and game design guided the interpretation and use of the data.
In-game events were captured through the Unity Analytics service (v.2017.1) to monitor uptake and game use, and identify and fix issues impacting game performance, over a 12-month period.

Results: Early user involvement revealed a strong desire for online multiplayer gameplay, yet most reported that access to these types of games was restricted due to technical and economic constraints. Role-playing games (RPG) with combat elements was identified as the most appealing gameplay style. Findings guided us to a game that could be played offline, which blended RPG elements; including narrative, character customisation and turn based combat with match-3 puzzles.
While the resulting game exceeded expectations and was reported to be playable and acceptable, gameplay was at times perceived as repetitive with limited appeal among certain gamer types. Knowledge transfer was predominantly achieved through interpretation of the game's narrative, highlighting this as an important design element in the game's potential influence on behaviour determinants.
Uptake of the game was positive; between 01/12/2017 - 01/12/2018, 3,325 unique device installs were reported globally. In-game events provided evidence of game adoption by young adult MSM in the Philippines. Game uptake and use was substantially higher in regions where direct engagement with target users took place and increased after resolution of an access issue on Android devices.

Conclusions: The inclusion of informants that possessed relevant subject domain expertise provided design solutions that addressed contextual constraints. Multiple data collection methods, to inform the game design and evaluate acceptability, enabled us to triangulate findings so as to mediate the inherent biases of the different techniques.
While success on the app stores is not an exact science, factors such as user-involvement, playability and the marketing strategy play an important role. Facilitating meaningful interactions between health professionals, the entertainment games industry and end users will support the games for health industry as it matures.

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Abstract

Background: Opportunities in digital distribution place mobile games as a promising platform in games for health. However, designing a game that can compete in the saturated mobile games market, and deliver persuasive health messages, can feel like an insurmountable challenge. While user-centred design is widely advocated in the field, factors such as the user's subject domain expertise, budget constraints and poor data collection methods can restrict the benefits of user involvement.

Objective: To develop a playable and acceptable game for health, targeted at young key populations in the Philippines.

Methods: A literature search was conducted to identify a range of user-centred design methods to be used in tandem. The resulting design process involved a phased approach, with 40 primary and secondary users engaged during the initial ideation and prototype testing stages. Selected methods included participatory design workshops, playtests, playability heuristics and focus group discussions. Subject domain experts were allocated roles in the development team. Data were analysed using a framework approach. Conceptual frameworks in health intervention acceptability and game design guided the analysis.

In-game events were captured through the Unity Analytics service (v.2017.1) to monitor uptake and game use over a 12-month period.

Results: Early user involvement revealed a strong desire for online multiplayer gameplay, yet most reported that access to this type of game was restricted due to technical and economic constraints. A role-playing game (RPG) with combat elements was identified as the most appealing gameplay style. Findings guided us to a game that could be played offline and that blended RPG elements such as narrative, character customisation and turn based combat, with match-3 puzzles.

While the game received a positive response during playtests, gameplay was at times perceived as repetitive and predicted to only appeal to casual gamers. Knowledge transfer was predominantly achieved through interpretation of the game's narrative, highlighting this as an important design element.

Uptake of the game was positive; between 01/12/2017 - 01/12/2018, 3,325 unique device installs were reported globally. Game metrics provided evidence of game adoption by young key populations in the Philippines. Game uptake and use was substantially higher in regions where direct engagement with target users took place.

Conclusions: User-centred design activities supported the identification of important contextual requirements. Multiple data collection methods enabled us to triangulate findings to mediate the inherent biases of the different techniques.

Game acceptance is dependent on the ability of the development team to implement design solutions that address the needs and desires of the target user. If target users are expected to develop design solutions, they must have adequate expertise and a significant role within the development team. Facilitating meaningful partnerships between health professionals, the entertainment games industry and end users will support the games for health industry as it matures.

Background

The Philippines' HIV Epidemic

The Philippines has the fastest growing HIV epidemic in the Southeast Asia region. The dominant mode of transmission reported in the Philippines is sexual contact among males who have sex with males (MSM) and transgender women (TGW). As of 2017, UNAIDS reported the HIV prevalence rate at 0.1% for general adult population (15-49 years old), 0.3% among young men (10-24 years old), 4.9% among MSM and 1.7% among TGW [1]. Specific data for TGW are limited [2]. Although a cross-sectional study in Cebu City in 2015 showed an 11.8% HIV prevalence rate in this group [3]. Cases are forecast to triple in the next 10 years with the majority of new infections among young MSM (15-24 years old) [4]. Since the first reported case in 1984, the National HIV/AIDS and ART Registry of the Philippines has confirmed 59,135 cases as of September 2018, of which 28% were aged 15-24 years old and 51% aged 25-34 years old at the time of diagnosis. The proportion of HIV-positive cases in the 15-24 age group has almost tripled in the last ten years [5].

Young key populations worldwide pose a complex public health challenge; transmission rates are high, diagnosis is often delayed and linkage to care and treatment is poor among those found to be infected [2,3]. Barriers to HIV services vary across contexts. In the Philippines, intrapersonal and social barriers exist alongside health system and economic barriers. Recurring themes associated with barriers to HIV services in the literature include low perceived risk of HIV infection; fear of losing access or status in important social spheres as a repercussion of accessing HIV services; lack of awareness or negative perceptions of treatment; belief that clinics do not provide confidential or private services; and restricted access to testing services due to time constraints, economic constraints, and legal constraints for those under 18 years old [7–11].

Why Play Mobile Games?

As the HIV epidemic worsens, social changes are occurring for young people in the Philippines. Increased online connectivity, a growing economy and prevalent mobile device use has changed the way people spend their time and socialise. This change has generated new possibilities for the public health sector to deliver targeted health messages [12]. Utilising technology already popular among adolescents and young adults may provide access to individuals that do not otherwise engage with traditional forms of HIV education and advocacy [13]. Mobile games in particular offer a promising platform to address the knowledge gaps, perceptions, social pressure and self-stigma that deter young key populations from accessing health services [14]. A recent meta-analysis of 54 digital games for healthy lifestyle promotion found small but significant effects on behaviour, determinants and clinical outcomes, demonstrating the potential benefits [15].

Mobile games contain structural elements that effectively engage users [18], and it is through these elements that mobile games could influence behaviour determinants. Players can model health-related behaviour and witness positive and negative outcomes within a safe environment. Well-designed narratives, integrated with the gameplay, can foster identification with the characters, thereby increasing a player's sense of personal risk or self-efficacy in overcoming barriers to HIV services [19]. Positive portrayals of characters living with HIV may help form beliefs that players can also remain or become their desired self after a positive diagnosis. Influence may also be found from the complex interplay between digital gaming and social behaviour [20]. Even a single-player mobile game can trigger meaningful social interactions, from recommending a new game to offering advice on how to complete a challenge. For example, a player may recommend the game to a peer or family member who they believe could benefit from the health-related content. Narratives and characters within the game could also trigger meaningful conversations within social groups. Such

use of the game could generate social pressure around health-related behaviour.

A Need for User-Centred Design in Games for Health

Rittel and Webber (1973) defined the term 'wicked problem' as a design problem that cannot be solved in a step-wise problem-solving manner [21]. Game development is riddled with wicked problems. They are inherently interactive and any interactive component must be tested with users. Even a simple game has an interconnected system as its backbone; any change to one component of the game will have ramifications to all connected components. Furthermore, game development is bound by countless budget, technical, user and market constraints. As a solution to wicked problems, some game developers turned to user-centred design [22]. User-centred design is an iterative process; using a range of research techniques, feedback is obtained from users at different stages of product development to ensure their needs and preferences are considered in the design [23]. This design approach was established in the software industry to identify and rectify usability issues and expanded for use in game design to evaluate experiential aspects, supporting the development of games that are both functional and fun. User involvement in game design may have benefits with regards to the effectiveness of the game, although the evidence is mixed when reviewed in the context of games for healthy lifestyle promotion [24]. The core principle behind this theory is that, for a game to be effective, it must be acceptable and appropriate. This can only be achieved through consultation with target users, especially if the developers do not share the same characteristics as them. User involvement is also predicted to improve user adoption and enable developers to critically reflect on the value and consequences of a game when vulnerable groups are involved [25]. Thus, user-centred design methods must encompass interpretation and emotional response to health-related content in the game as well as evaluating usability.

As the purpose of our game expanded beyond entertainment, we developed a theory of behaviour change (Figure 1) to guide the design process. Context-specific learning objectives were generated through a review of the literature and formative research with target users and HIV service providers in the regions of Davao and Manila. Data were collected through focus group discussions with HIV services providers, in-depth interviews with MSM and TGW and an online survey on enablers and barriers to HIV services. Findings from the formative research are not included in detail in this paper. The framework references modifying factors relevant to the Philippines' HIV testing context such as health system, legal and economic constraints. Given that the target audience for the game will be young MSM and TGW, we do not expect the game to impact modifying factors but note that these are important considerations in evaluation of the game's perceived effectiveness.

In this article we describe the user-centred design process for a mobile game titled "Battle in the Blood" and explore the effect of user-centred design techniques on the game's acceptability as a health intervention and uptake among target users.

Methods

Battle in the Blood was developed from 2016 to 2018 through a collaborative effort with experts from the UK and Philippines. Final design choices were made by the game's co-producers: a British behavioural scientist specialising in game design for health system benefit (CH); the director of an independent game development company with over 10 years industry experience based in Scotland; and a Filipino clinical epidemiologist (EB). The process was divided into 3 phases and aligned with development milestones for the game (Figure 2). Internal playtests were frequently conducted by members of the project team and their immediate networks. Change requests and bugs were recorded and shared with the development team using Google Docs.

A literature review was conducted to identify a range of user-centred design methods to be used in a combined approach. Methods were selected based on their fit to the question the development team wanted to answer and available resources. The resulting design process involved a phased approach,

with primary and secondary users engaged during the initial ideation and prototype testing stages. Resources were prioritised to capture important contextual requirements and evaluate educational and experiential aspects of the game. Selected methods included participatory design workshops [26], extended playtests [22], playability heuristics [27], focus group discussions and game analytics. As the methods for each phase were distinct, recruitment, data collection and analysis has been described for each. Data were collected in the cities of Manila and Davao. The study was part of a much larger project which included assessment of a rapid diagnostic algorithm for HIV that was being piloted in these cities.

Phase One: Game Design

To determine important contextual requirements and user preferences, design workshops with Filipino gamers were conducted during the initial specification and ideation stage. Subject experts in clinical practices for HIV and the Philippines HIV epidemic were allocated informant roles in the game development team.

Recruitment

Filipino individuals aged over 18 who regularly played digital games or were involved in game development or e-sports, regardless of sexual identity, were invited to participatory design workshops via social networking sites including Facebook and Steam forums. It was theorised that the game would need to appeal and be accessible to a range of gamer types, and that gamer type would not be dictated by sexual identity. 18 participants were divided into two groups (11 and 7). Participants were aged between 21 and 30 and were a mixed group of MSM and non-MSM.

Data collection

Group sessions were facilitated by UK and Filipino researchers (CH, EB, EG, JD), in which (i) participants responded to questions by creating a human scatter graph indicating their level of agreement to different statements by their physical proximity to the statement placed on the floor, creating an instant visual of the group's perception and experience of mobile games and games for health; (ii) group discussions were held on design and technical enablers and barriers to digital gaming; and (iii) participants were divided into teams (max. 6 participants in a team), to develop pitches for games to promote HIV services, which they then presented and discussed. HIV clinic counsellors were present at both workshops to answer any questions the participants had regarding HIV and provided information on HIV service provision in the Philippines. The session was audio recorded and transcribed and photos were taken to record the human scatter graphs and visuals from the game pitches.

Analysis

Transcripts and session outputs were analysed using a framework approach [28] to identify a set of recommended game features. A 4-day workshop was conducted with the full development team to translate the list of recommended game features into a game design document. Game features were also connected to the context-specific learning objectives outlined in Figure 1.

Phase Two: Prototype Testing

Playtesting sessions and focus group discussions (FGD) were conducted to assess the acceptability and playability of the beta game build.

Recruitment

Participants were over 18 years old and self-identified as MSM. Our aim was to ensure the narratives and art style were appealing, relatable and inoffensive to the target users. Participants were recruited

using social networking sites including Facebook, Grindr, Growler and Planet Romeo, known as popular networking sites for the MSM and TGW community. Peer counsellors from HIV testing services were also recruited as they were predicted to be an important user group for the game.

Five FGDs and playtesting sessions involving a total of 22 participants were conducted between 20/08/2017 and 18/11/2017; four in Manila (17 participants all MSM) and one in Davao (5 participants all peer counsellors and MSM). Game changes and bug fixes were implemented between each testing session.

Data Collection

Sessions were facilitated by UK and Filipino researchers (CH, EB, EG, JD). User testing was divided into three activities: (i) participants' screens and faces were video recorded as they played the game for 30-45 minutes; (ii) all animations in the game were played on a big screen and a short discussion was held by participants for each one; and (iii) a group discussion on the perceived acceptability of the game.

Analysis

Analysis of data from the game testing sessions was divided into two parts. The first utilised playability heuristics to identify and fix design flaws. Playability heuristics are a set of qualities by which a game's engagement and usability can be assessed. They are typically used by game developers and professional game testers. We adapted an existing list of playability heuristics for mobile games [27] to use as a coding framework to analyse the video recordings and transcripts (Figure 3). Screen recordings were primarily used to identify technical and usability issues, while transcripts were more conducive to recognising different experiential aspects. For example, expressions of confusion by the player when they lost a level, especially when followed by repeated failed attempts, could be marked as a violation of gameplay heuristic GP1, "the game provides clear goals" (Figure 3). This is an example of what is termed a playability violation. Playability reports were developed independently by two researchers (CH, EG). The reports described each playability violation and gave recommendations for game improvements. The reports were compared and discussed by the game development team before agreeing on a final list of game changes. Where feasible, changes were implemented before the next game testing session. Software bugs and technical issues were also recorded, and fixes implemented.

The second part of the data analysis utilised the transcription of the group discussions to assess the acceptability of the game as a health intervention. Data analysis was informed by a general inductive approach, aligning emerging themes identified in the transcripts with pre-determined constructs of health intervention acceptability; affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness and self-efficacy [29].

Quality assurance: Phases One & Two

All qualitative data collected was translated into English for analysis (EG) and the translation checked for accuracy by members of the research team. Analysis was led by a UK researcher (CH) with regular consultation and input from the full project team to improve quality and depth. All design choices resulting from the data were reviewed by the development team before implementation.

Phase Three: Game Analytics

Recruitment

Game use data was obtained from users who installed the game and gave permission for the application to access device storage. Geolocation data was obtained from users who granted access

to their devices' location data and played the game with Global Position System (GPS) switched on. Information about why data was being gathered and reassurances that all data would be kept anonymous were presented on the app store page, and in the game when access was requested.

The game was made available on the Apple App Store and Google Play and on the 27/11/2017, and was officially launched during World AIDS Day celebrations in the Davao Region on the 01/12/2017. Marketing events for the game included local television appearances by project staff, printed and online news articles, exhibitions at health and game related conferences in the National Capital Region and Davao Region, social media adverts on Facebook and Twitter and posters displayed in 4 HIV testing and counselling clinics (3 in Manila, 1 in Davao). The game analytics span a 12-month period from 01/12/2017 to 01/12/2018.

Data Collection

Data were automatically gathered from devices with the game installed through the Unity Analytics service v2017.1. For data to be sent from the device, the user must have opened the game at least once while the device was connected to the internet. Events are stored locally on the device when the game is played offline and sent the next time the game is opened and the device is connected. All data points were stored in the Unity Data Store. The game metrics (Table 1) were exported and converted into a readable format for use in statistical analysis software.

Table 1. Game metrics

Segment	Metrics
Active player metrics	Daily active users Monthly active users New users (unique device installs)
Session metrics	Sessions per day Sessions per user Total daily playing time Total playing time per active user
Retention metrics	Day 1, 7 and 30 retention
Platform segment	Total Android and iOS users
Custom segments	Level events – reports each time a level is completed or failed, and the players end score Link event – reports the click through rate of all in-game links to external information Question events – reports the response to all in-game questions, including a set of demographic questions Geolocation per session – reports the devices current location at the start of a session to 2 decimal places Application version

Analysis

Descriptive statistical analysis was conducted in Microsoft Excel v1812. Spatial analysis was conducted in QGIS v3.2.3.

Ethical assurance: all Phases

Legal advice was sought to ensure management of game analytics complied with the 2018 EU General Data Protection Regulation.

Ethical approval for the project was obtained from ethics committees at the University of the Philippines College of Medicine and Liverpool School of Tropical Medicine (Research Protocol 16-017).

Results

Phase One: Game Design

Direction on game elements to support health-related behaviour change first emerged through the human scatter graph activity. Figure 4 demonstrates that the two groups had varied perceptions on the effectiveness of games for health-related behaviour change. Participants were questioned as to why they had chosen their place on the graph. Perceived limitations of the game's effectiveness were centred around beliefs that changes in knowledge would not be sufficient to change behaviour, and that the use of technical language would makie the game's content inaccessible, as illustrated by this quote:

> *"I'm still not convinced with the knowledge part because, as with some health*
> *conditions, even with some health benefits and stuff, there will be some things that*
> *a player will not understand, especially if it's scientific jargon…but I do believe*
> *that behavior can change especially if it's immersive and it is an experience that*
> *will change your perspective on very different matters." -Group 2: Respondent B*

Facilitators to behaviour change centred around the use of immersive experiences that could change perspectives and generate social interactions between users, as illustrated by this quote:

> *"Because whenever I'm playing games, they would often ask me 'Hi [name]!*
> *What's that game? Is that available in iOS? Is it available in the Android Play*
> *Store?' Right after I told them about it, they would go check out the game and*
> *download it. So, it's not just me but also them that learns from the game." - Group*
> *1: Respondent J*

During group discussion, the game's narrative was identified as an important feature. If done well, it fostered identification with game characters and motivated players to overcome challenges in the gameplay to witness the story unfold. The narrative was identified as the logical place to communicate why it was important to know your HIV status. Participants felt that the game should not provide technical information on HIV or HIV services but should focus on telling an emotionally driven story and provide player choice over the narrative direction.

When the groups were divided into teams (2 teams in each group) to pitch their HIV advocacy games, 3 out of the 4 teams presented a similar concept of a hero sent on a quest to fight or evade the HIV virus, where story and RPG elements intertwined and where reality and fantasy existed in the same space.

Multiplayer gameplay was reported to be a strong motivator for repeated gameplay and was perceived to play a role in the effectiveness of the game, as illustrated by this quote:

> *"…they say that no man is an island. So, I think it would affect the behaviour of*
> *the person if there is a community that pushes you. Someone playing alone will say*
> *'I'm just alone, nobody will care if I do this or do that.' But if you know somebody*

else is pushing you, it will affect your behaviour, it drives you as a person." –
Group 1: respondent I

However, participants also reported that access to these types of games was restricted due to the requirement of a stable internet connection:

"I have external and internal factors why I leave the game. The external factor is
whenever the game requires internet connection because the internet, the wireless
data in the Philippines is not that good." Group 1: Respondent E

This presented a dilemma for the game design. On one hand, multiplayer gameplay was a very desirable game style among the participants as they could participate in discussions about HIV, behaviour and personal values and co-construct their own narratives about a desired future. This was further evidenced by the market success of multiplayer mobile games in the Philippines. On the other hand, we did not have the resources to develop and maintain and online multiplayer platform and known issues around internet connectivity would restrict access to the game.

Combining feasibility with desire

Findings from the Phase One game design workshops directed the game's overarching narrative and the integration of gameplay and storytelling. Players take on the role of the protagonist, entering the blood stream in an anti-retroviral (ARV) pill capsule and battling anthropomorphic viruses, bacteria and cancer cells using a weaponised mech-suit. The gameplay combines match-3 puzzles with turn-based combat; players connect icons on a puzzle board that represent condoms, ARVs, healthy living, healthcare and time. Connecting the icons builds up the player's defence and attack status during the rounds of combat. The match-3 game style was selected due to the availability of pre-built game assets and source code which substantially reduced the development time and enabled the team to allocate time to the custom animations.

The gameplay is segmented with a series of 8 animated stories about people living with HIV that the player helps by progressing through the game. The difficulty of the levels and the types of enemy units are connected with the story line. For example, if the character in the storyline is diagnosed with gonorrhoea, an enemy unit representing gonococcus appears during the gameplay. In the game's final mission, the player is introduced to a character with acquired immunodeficiency syndrome (AIDS) in critical condition; it is revealed that he has never been tested for HIV, treatment fails and the character dies. Throughout the game, the player is awarded with fragments which combine to form an anting-anting, a traditional Filipino amulet believed to have magical powers. This amulet allows the player to travel back in time and change how the story ends for this character by encouraging him to undergo a HIV test.

The game can be played and completed offline. Online features include a global leader board ranking players by their total score and hyperlinks to websites containing information on HIV and HIV services in the Philippines. The file size of the game was also restricted to 53.4MB on Android and 70MB on iOS to reduce the risk of failed download attempts from the app stores. This in turn had ramifications for animations and sounds in the game, both of which can substantially increase the file size. To maintain a small file size, the number of sound effects and music tracks in the game was limited and animated stories were presented in a dynamic 2D comic book style, where static images moved across the screen to give the scenes depth and movement.

Integration of context-specific learning objectives

Table 3 details the design choices made in relation to the context-specific learning objectives outlined in Figure 1.

Table 3. Theory of behaviour change design choices

Context-specific learning objective	Game design element

To believe that you can live a fulfilling life after a positive diagnosis	The animated stories depict people living with HIV pursuing their ambitions, being socially active or spending time with their family. For example, a transgender character enters a beauty pageant and, as she takes her medication in the dressing room, the text reads 'I fought to be my true gender, I can win this fight too.' This particular storyline was selected due to the cultural relevance pageantry has in the Philippines and the great esteem in which Filipinos hold contestants.
To know that HIV treatment makes your immune system stronger and more able to fight off illness, reduces the risk of transmitting the virus to someone else, reduces the effect of the illness on quality of life and, if started early, leads to a significant reduction in the risk of death	ARV tablets feature in every animated story except the one where the character dies. Treatment is also shown to improve the physical appearance of characters in the later missions. Players can earn an extra life during gameplay by answering a multiple-choice question. Some questions address knowledge on treatment effects and feedback containing the right answer is given. Hyperlinks to websites containing information on HIV treatment are included throughout the game and the click-through rate is measured.
To know that HIV testing and treatment services are available for free in the Philippines and results are given on the same day	In the animated stories, the words 'Free HIV tests' appear in the background of all of the clinic waiting room scenes. The rapid testing procedure is depicted in the first 3 animations. Multiple-choice questions address the availability of free testing and the time taken to results in the Philippines. Hyperlinks to websites containing information on HIV services in the Philippines are included throughout the game and the click-through rate is measured.
To recognise common co-infections and signs of HIV infection, and to know that symptoms may not appear until long after infection	Enemy units in the game include representations of gonorrhoea, tuberculosis, hepatitis B, herpes and cancer. Common signs of HIV infection are depicted in the animated stories and some characters show no symptoms.
To know that there is a risk of HIV transmission among heterosexuals	The first animated story depicts a heterosexual couple. In several other animated stories, the character's sexuality is ambiguous.
To know the location of HIV services	A hyperlink to a website containing the contact information and location of all testing sites in the Philippines is featured throughout the game.

Figure 5 uses screenshots from the game to illustrate some of the design choices made. A table summarising the Phase One design process (multimedia appendix 1) and the game design document v0.15 (multimedia appendix 2) is included as supplementary material.

Phase Two: Prototype Testing

Table 4 summarises the final agreed list of playability violations, and the game changes made as a result.

Table 4. Playability violations and game changes

Playability Heuristic	Evidence of Violation	Game Change
GP5 There are no repetitive or boring tasks	Participants felt bored and disengaged with the animation when the first half of the storyline was repeated. Video footage demonstrated that players did not realise they could skip the recap by tapping anywhere on the screen.	On the second playthrough, a title screen appears with the text 'Previously on Battle in the Blood… Skip?'
GU1 Audio-visual	Players reported the icons as unintuitive	The design of the icons was adjusted

representations support the game	because the colour of the icons did not correspond with the combat status bars that they effected. Video footage showed players taking decisions based solely on the length of the chain, not the colour of the icons, and becoming frustrated when they repeatedly lost a level.	to correspond visually with the attack and defence bars.
GU11 The game contains help	Participants did not feel the onboarding was comprehensive enough and new mechanics in the game were not explained.	When a new mechanic is triggered, a dialogue box appears which explains the new mechanic using a small amount of text and images. This information can also be accessed via the game's menu and via the level pause screen.
GP6 The players can express themselves	Participants stated that they did not like the mech suit as they had spent time customising the avatar but rarely saw it in the game as most of it was covered.	Avatar appears animated in the level complete or fail screen.
GP2 The player is rewarded, and the rewards are meaningful/ GP5 There are no repetitive or boring tasks	Participants stated that they wanted to be able to earn in-game currency through completing the levels, which could be spent on upgrading or customising their character. They also felt this would make the gameplay feel less repetitive.	Implementing an in-game currency system and custom character upgrades would have required additional resources and delayed the planned launch of the game. The change request was logged but not implemented for the pilot.

Learning achieved predominantly through interpretation of the animated narratives

Participants repeatedly drew inferences between the presence of ARVs and the positive outcome in the short-animated stories, recognising the unique benefits of treatment for each character, as illustrated by this quote:

> *"Ever since the guy was given the ARVs, his fear of him having STDs or socializing with people is now gone, and he was able to not be afraid to connect with other people." –GameTester_MSM*

As well as inferred benefits of HIV treatment, participants also identified messages around the consequences of delayed access to HIV services. One participant reported the game had changed his personal understanding of when to undergo a HIV test, as this conversation shows:

> *"For me it's better to test at the earliest, so you can know if you're positive and prevent it earlier." - PhaseTwo_GameTester_MSM*

> *"So, before you played the game, you just know that you need to get tested when?" - Interviewer*

> *"Only if you're already having symptoms." - PhaseTwo_GameTester_MSM*

Participants interpreted the stories based on their current knowledge and personal values. In one case this led to the message of the story being repeatedly challenged:

> *"…he was told that he has Gonorrhoea and he was then given pills to cure it and the HIV treatment. With that, he told himself that this could save his life and then could continue living his life normally. And then he was seen to be at the bar again. But it was somehow an off for me because it gave me the impression that just because there's treatment, you can go on with your promiscuous activity all your life." - PhaseTwo_GameTester_MSM*

Some counterarguments were expressed due to pre-existing knowledge, namely a lack of awareness that ARVs can reduce the viral load to the point where the individual is no longer infectious, and social norms in which sexual promiscuity is perceived as an undesirable trait. Most participants concluded that the character in this particular animation was sexually promiscuous because the story centred around a nightclub and he was diagnosed with HIV and gonorrhoea. In this case, the narrative appeared to challenge stigmatising perceptions around sexual promiscuity and its association with HIV.

While participants felt the health-related messages were reinforced in the turn-based combat levels, most of the learning outcomes were achieved through interpretation of the animated narratives and the discussions they triggered. A potential concern is that the animations were perceived to be disconnected from, and less engaging than, the gameplay. During the prototype testing session, all in-game animations were played in sequence through a projector and participants intently watched and discussed each animation. Interpretation of the narrative may be significantly different by a user casually playing the game alone with no direct incentive to focus on and analyse the content.

Identification with game characters

Animated narratives where the players shared a set of commonalities with the character diagnosed with HIV elicited a stronger emotional reaction than those where characters did not share similar demographics or behaviours. The story of a young MSM, who resorts to solicitation to afford to play games at an internet café, was reported to be the most impactful storyline by almost all game testers. This was likely due to the recruitment strategy, as most game testers were part of the young MSM community and had a strong interest in gaming:

> *"Well it seems relatable for me because I'm a gamer. And I have a friend who does that thing sometimes. And thankfully he hasn't got any HIV. It's relatable to me because well, I know those who did, I experienced one but thankfully I haven't got HIV." - GameTester_MSM*

The game follows the stories of 8 different characters diagnosed with HIV. Each character is unique in their sexuality, gender, appearance and behaviour. Therefore, a user is likely to empathise with or relate to some but not all characters in the game. As game characters are presented in a pre-determined sequence, some users may never witness a character that they share commonalities with, reducing the potential impact of the in-game narrative for certain users based on their progress in the game. The representation of different sexualities and genders was well-received by participants as they acknowledged that it could help to address misconceptions that HIV only effects MSM, indicating that the design flaw was the delivery of the narratives rather than the inclusion of multiple character types.

Gameplay perceived as enjoyable but potentially limited in appeal

Despite a positive response from participants in which gameplay was described as 'enjoyable, addictive and challenging', there were indications that the game would have a limited appeal. In the

first instance, participants had very low expectations for the game and expressed surprise at playing a game comparable to commercial games on the app stores. In one FGD, participants identified two categories of gamers, casual and hardcore, and discussed which category the game would appeal to and why. A casual gamer was perceived to be someone who occasionally engaged with digital games as a form of distraction, whereas a hardcore gamer's life would revolve around digital games. Most agreed that the game would have little to no appeal for hardcore gamers. For casual gamers, the consensus was that the game would be appealing but required an effective marketing and deployment strategy to overcome competition from similar games. Offline gameplay was perceived to be a strong motivator, regardless of gamer type, as it would enable players to alleviate boredom when they were unable to access features on their devices that required an internet connection. Marketing Battle in the Blood as a game about HIV was perceived to have two effects on the appeal; in most cases it would arouse curiosity or tap into a desire to learn, while in some cases it could be off-putting. Participants felt that the game's marketing should also be targeted towards parents and should offer information on the age-appropriateness of the content.

Phase Three: Game Analytics

Game analytics reported 3,325 unique device installs globally during a 12-month period. The game received an average of 10 installs per day. Installs peaked during active and incentivised marketing events; the maximum number of installs in one day was 367 at the time of the World AIDS Day launch event in Davao.

Unity Analytics provided a more accurate report of game uptake and reach than the app store services due to the common practice of using third party apps, such as SHAREit, to access the game via Bluetooth and avoid data costs. Installs via this method would not have been captured by analytics services provided by the Apple App Store or Google Play at the time of the study.

Regional Game Uptake

Geolocation data was collected for at least 1 play session from 50.8% (1688/3325) of users . Of the users from whom geolocation data was collected, 85.4% were located in the Philippines (Figure 6). Game use was concentrated in urbanised areas. Uptake of the game was highest in the National Capital Region and Davao Region. 54% (1796/3325) of users reported their age, gender and gender of sexual partners; of these users, 28% (504/1796) reported as sexually active MSM. Within the sexually-active MSM category, 47.8% reported their age between 25-34 years old, 26% between 20-24 years old and 7% between 10-19 years old.

Two factors are believed to have contributed to the substantially higher uptake among target users in the regions of Davao and Manila. First, several promotional exhibitions for the game were held by project staff in these regions. The exhibitions often included prize giveaways for those who downloaded the game, indicating a dependency on these types of active and incentivised marketing events. Self-reported data indicateed that marketing events targeting adolescent users were potentially lacking. Secondly, user-centred design activities were conducted in these regions with influencers in both the gaming and HIV community, and it is likely they also played a role in promoting the game.

Low rates of game completion

As of 01/12/2018, 15% (498/3325) of users were reported to have completed level 45 and 4% (133/3325) were reported to have completed level 90, the last level in the game. Factors believed to have contributed to the reported low rates of game completion are the gameplay being perceived as repetitive and having limited appeal and missing data due to the provision of offline gameplay.

Additional factors impacting uptake and progression will be explored further through interviews with end users and follow-up interviews with participants involved in the design process.

Identification of access issue on Android devices

Game analytics and app store reviews were monitored throughout the 12-month period. Monitoring activities supported the identification of an access issue on Android devices, related to app permissions managed by the Google Play store. A fix was launched on 05/11/2018. Between 05/10/2018 and 04/11/2018 the average number of daily active users was 16, and this increased to 40 in the month following the fix.

Discussion

User-centred design methods supported the identification of contextual requirements for the game [24]. Qualitative methods provided a deep understanding of important factors that both motivated and enabled gameplay, which are likely to have contributed to the reported uptake and use of the game. The human scatter graph method and game pitches enabled participants to reflect on their views and the views of others which, in turn, ignited valuable discussion on the qualities the game required to both be appealing and deliver persuasive health messages. While findings from Phase One influenced the creative direction of the game, each design choice made by the development team was prefixed with a discussion on what was feasible within the pre-determined budget and development timeframe. For example, during Phase One, an action RPG in which the player could control their character's strength and traits was found to be highly desirable, but adequate resources were not available to implement a stable and balanced underlying mathematical model for this feature. In this case, the design workshops supported the identification of a wicked problem, the solution of which was informed by the experience and best judgement of the game's co-producers [21]. The reported low rates of game completion indicated that optimal design solutions were not achieved by the game's producers.

User-centred design and community adoption

Results from the game analytics indicated that user-involvement in the game development process had a positive impact on uptake among target users. However, the extent of that impact cannot be determined from the available data. For example, while unique device installs were substantially higher in regions where user-centred design activities took place, the proportion of installs credited to such activities cannot be determined, especially with the presence of targeted and incentivised promotional events in those regions. Further studies are recommended to explore the correlation between user-involvement and community adoption of games for health. The way in which target users involved in the design are credited may also be an important factor to consider.

Narratives in games for health

Storytelling has long been established as an effective means of attitude and behaviour change [19] and this was reflected in findings during the user-centred design process. This also highlights the importance of having an experienced narrative designer as part of the development team to work in partnership with subject domain and behavioural experts. Assessment of the game's acceptability found that mobile game design that accommodates typical user behaviour is not always conducive to effective storytelling. To be suitable for use in a public space, the animated stories had to be highly captivating to retain focus while also allowing the player to disengage without missing vital information. While Battle in the Blood made some headway in delivering a narrative that was accessible and accommodated typical user behaviour, a lack of interaction, an obscure link to the gameplay, delivery through linear episodes and limited character identification may have rendered the animated stories ineffective in generating new knowledge and perceptions when the game is played outside a facilitated gameplay session. These design flaws could be addressed through the inclusion of additional branching narratives driven by player choice; forming a stronger link between

the gameplay and cause and effect sequences in the narrative; inclusion of stories based on true events; allowing players to select narratives they are interested in; and facilitating group gameplay sessions where players are encouraged to discuss their interpretation of the narratives as part of the game's distribution strategy.

Multiple data collection methods to mediate biases

Telemetry and geolocation data are widely used in the mobile games industry to improve app revenue. There are countless articles ranking key performance indicators by their value to app developers. In response to demand, a range of services are now available that process large volumes of data into actionable information with very low setup costs. In the case of the Unity Analytics service (v.2017.1), standard metrics can be obtained by toggling a switch in the Unity game engine. While generating income may not be a primary goal, it could be argued that analytical services that capture data during gameplay are currently underutilised in games for health development and evaluation [30]. In contrast to FGDs, telemetry and geolocation data collected through the game are not biased by the presence of a researcher, however, emotive responses to gameplay cannot be captured this way. Thus, it is important not to focus solely on one data collection technique but rather to triangulate results from a range of different data sources in order to mitigate bias while providing a more complete picture of game performance.

This study explored the effect of user involvement on health intervention acceptability and community adoption and described in detail the methods used. Further evaluation of the game has been conducted to explore the game's effect on knowledge, attitudes and HIV service use among target users, the results of which will be published in a separate paper.

Limitations

As with all qualitative research, findings cannot be applied to the wider population with certainty. Perceptions from under-18s and subjects outside Manila and Davao were not captured. While the project team failed to recruit TGW during Phases One and Two of the game development process, they were included during the formative research stage which informed the conceptual framework for the game (Figure 1). Feedback on how the transgender character in the game was portrayed was provided by TGW known to the research team in the Philippines in an informal capacity.

The authors note that the recruitment strategy and use of FGDs is likely to have resulted in a bias towards participants less encumbered by stigma towards their sexuality or HIV status. Given that recruitment adverts stated that participants would be inputting into the design of an HIV advocacy game, this may have also created a bias towards individuals with a vested interest in health advocacy and/or game design.

Timing for Phase Two protype testing was not ideal, which is believed to have impacted the changes implemented in the game design.

Certain terms used by participants did not have a direct English translation which, at times, led to ambiguity in the data during the translation process.

Conclusion

By involving users from the outset, the development team were guided towards narratives that were shown to be relatable and understandable and to gameplay that provided enjoyment. The resulting product is a game that is accessible, simple and entertaining due to universally recognised game mechanics, small file size and offline gameplay. At a minimum, games for health should involve target users in early stages of the design process as a relatively cost-effective method of cataloguing important contextual requirements and user preferences. If target users are to be tasked with developing design solutions, then interaction with the development team must go beyond FGDs. For

the target user to be a valued member of the game development team, they must have adequate expertise in design, a shared goal and be properly credited and compensated for their contributions [24]. Increased reporting of design approaches and stronger collaboration between health professionals, the entertainment games industry and end users will support the games for health industry as it matures. Restructuring projects to involve users prior to determining the development budget will enable design choices to be driven more by user requirements and less by what is feasible.

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Conflicts of interest

As the game is free to use and distribute the authors and EM Studios do not stand to gain anything from the publication of this manuscript.

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