

# **GAMIFICATION IN E-MENTAL HEALTH: DEVELOPMENT OF A DIGITAL INTERVENTION ADDRESSING SEVERE MENTAL ILLNESS AND METABOLIC SYNDROME**

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## **ABSTRACT**

MetaMood is a gamified Android application, developed from an existing paper-based health intervention program, designed to increase the motivation and engagement of participants. The development process followed a clinician-based design which was necessary to avoid exposing participants to an untested and unverified clinical tool. This paper describes design considerations and outcomes which could be useful for similar gamification attempts. It also presents the implementation and evaluation of a clinician review process, a vital step required before a full clinical trial. The success of MetaMood, evaluated through the results of the clinician review, suggests that a similar design, development, and evaluation process should be followed by future mobile e-health interventions before they are released through a public App Store.

## **KEYWORDS**

Gamification, e-mental health, digital intervention, mental illness, metabolic syndrome.

## **1. INTRODUCTION**

People who experience severe mental illness, for example chronic schizophrenia, or bipolar disorder, are frequently treated with atypical antipsychotic medications (Usher, Foster, & Bullock, 2008). One of the side effects of this type of medication is excessive weight gain, which can lead to obesity (Hoffmann, Case, Stauffer, Jacobson, & Conley, 2010; Malhi et al., 2015; Wu et al., 2008). Other co-morbid conditions develop in part related to obesity, including hypertension (high blood pressure) and diabetes (Usher et al., 2008). The combination of these three health problems (obesity, hypertension and diabetes) are collectively known as Metabolic Syndrome (Mental Health and Drug and Alcohol Office, 2009). Finding innovative and cost effective ways to motivate and engage people with severe mental illness to develop healthy lifestyle behaviors as a means to mitigating their physical and mental health problems is particularly challenging for consumers and health care professionals (Kwasniewska, Kaleta, Dzionkowska-Zaborszczyk, & Drygas, 2009). Some success with interventions using digital technologies has been noted (Christensen & Petrie, 2013; Jorm, Morgan, & Malhi, 2013; Titov, Dear, & Rapee, 2013). Depression is a neurological feature of severe mental illness, and with it, amotivation is a frequent occurrence. This, combined with an alteration in metabolic needs and hormone changes triggering appetite deregulation, often underpins a lifestyle where physical activity levels are low, and weight gain accumulates, which in turn perpetuates symptoms of depression (Blows, 2011).

Meanwhile, it is well known that the uptake of digital technologies has been increasing for some time with most people now owning an active internet account and smart device such as a smart phone, tablet or personal computer, with many users seeking health information in this environment (Australia Bureau of Statistics, 2013; Fox & Duggan, 2012). E-health, using a range of digital technologies, is increasingly seen as an efficacious mechanism for the delivery of meaningful health interventions, with funding bodies keen to

support development of e-health strategies to meet the expanding needs for health service delivery to populations (Department of Health and Aging, 2012).

This paper introduces a project that seeks to match the clinical profile of a disorder experienced by a vulnerable population, and apply a gamification approach to an Android-app-based intervention designed to motivate supportive healthy behaviors as an adjunct to usual therapeutic approaches to address metabolic syndrome among people with severe mental illness. The project is based on an eight-week program aimed specifically at rural patients who may have difficulty accessing clinicians. The program attempts to educate participants about their illness and promote and encourage a healthier lifestyle, whilst combatting the onset of associated illnesses such as depression (Wilson & Warren, 2011).

Gamification is an area receiving interest from several different fields (Chen, 2014; Comstock, 2012; Loria, 2014). The premise of gamification is to utilise game elements in non-game environments. While the word 'game' can refer to traditional games such as sports or card, dice and word games, in this context it is more typically related to video games. The elements and mechanics utilised include, but are not limited to, quests, achievements, tutorials and social aspects. In many cases this has led to increased levels of engagement, motivation and success rates (Luminea, 2013).

This paper describes issues related to the gamification of an intervention program to assist people with severe chronic mental illness in combination with metabolic syndrome. The result is a mobile app named MetaMood. MetaMood has been developed by applying gamification techniques and processes to the existing paper-based program, with an aim of increasing engagement and intake of the relevant information by participants.

Unlike some other health-related apps, which have been released through relevant App Stores before any clinical evaluation, MetaMood has undergone a clinical review. Increasingly, within the medical technological sector it is important to demonstrate quality and safety of an evidenced-based intervention prior to the administration of the intervention through access points such as app stores. Implementation of Internet based medical intervention requires that a rigorous ethical process has been demonstrated to show that the product has undergone sufficient review, such that health care professionals, intervention users, and the general public can trust that all reasonable steps have been taken to promote human benefit and conversely to limit or mitigate any potential harms or risks associated with usage. In this we decided to share the app with field professionals using the Google Play beta process, ensuring the public cannot access a completely untested clinical tool, ensuring that public safety was not risked. Data was collected from the professionals by means of a survey to enable the analysis of the gamification attempt to determine how successful it has been, and to understand if the product was acceptable, feasible and adhered to the concepts of recovery for the clinical problem it was designed to treat. This was seen as a vital first step before the app can undergo clinical trials to determine its effectiveness and suitability to be released to the general public through the Google Play Store.

## **2. RELATED WORK**

A game is an activity that one engages in for amusement, played according to rules. Gamification is the use of game elements and mechanics in non-game contexts, with specific goals of increasing user engagement and amusement to achieve a particular aim. It has been used in numerous contexts, such as education (e.g. (Iosup & Epema, 2014; Kingsley & Grabner-Hagen, 2015)), commerce (e.g. (Hamari, 2013)), and work (e.g. (Anderson, Huttenlocher, Kleinberg, & Leskovec, 2013)), however we will concentrate on applications related to healthcare, where there have been numerous projects with varying levels of success.

One example is a study in a hospital in the United Kingdom, where an electronic leader-board was attached to a cardiopulmonary resuscitation (CPR) training and feedback device. The device was made available 24 hours a day and calculated scores based on factors such as: rate, depth and hand position. At the end of the trial, the control group did not show any increase in score while the test group had a significant median score increase. It was concluded that the self-motivated gamification led to a statistically significant change in scores and infant CPR ability (MacKinnon et al., 2015).

Gamified online and mobile apps have also been developed to help improve mental health. SuperBetter is an application that was initially developed with the goal of helping people afflicted with depression, anxiety and post-traumatic stress disorder (Chen, 2014). It utilises quests and makes small suggestions to the player.

After completion, the player receives points and access to the next quest. A study around SuperBetter involved participants signing up and being randomly assigned to either a control group or an intervention group who played the game for a month. The 0-60 depression scale from the Center for Epidemiologic Studies was used, where a score above 16 suggests a case of depression (Montgomery & Asberg, 1979), and while the control group had a decrease in score of 4.3 points, the test group had a decrease of 11.3 points (Chen, 2014).

Social engagement has also been shown to be effective in gamification for health purposes. Type 2 diabetes accounts for almost 95 percent of all diagnosed cases of diabetes in adults and has prompted a health gaming company, Ayogo, to turn to gamification techniques to create a game to assist these people. The core aspect of their game is socialising with other players through an online community. The game allows the creation of an avatar and the player completes mini-games such as “choose your own adventure” story lines, where they can gain gold coins. The game attempts to help players help themselves (Comstock, 2012).

MetaMood combines both mental and physical health and, as such, results from the Blue Marble Game Co are of interest. The company focuses on therapeutic games where data can be generated after every movement, providing immediate quantitative feedback to the physical therapist. While the games have extremely positive feedback (Loria, 2014), it is important to note that the success varied with the nature of the patient. Some participants were extremely reluctant to participate while older participants were dubious that the game was “real therapy”. This study also revealed that the graphics were an integral part of the gamification process though, while they can help motivate and engage players, care must be taken not to overdo the graphics as they have the potential to distract the player and reduce the positive aspects (Loria, 2014).

The program that MetaMood is based upon was developed for people in rural environments, who may feel isolated, so a social feature like in the apps from Ayogo is important. By allowing users to interact with others in similar circumstances, it is hoped they will feel less alone and more likely to complete the program. Results from Blue Marble Game Co show that it is also important that the app is easy to use and not overdone, while obviously being related to the treatment program being undertaken, so not to distract the player or make them feel the app is not beneficial.

### 3. DESIGN AND GAMIFICATION

The design and development of this gamification attempt was iterative and clinician-based, with a field professional involved at every step of the process. After analysing the anticipated future users’ needs and considering the nature of the gamification attempt, which included making decisions regarding the art style and gamification techniques (Iosup & Epema, 2014; Loria, 2014), it was necessary to analyse and gamify the original model. The paper-based program that MetaMood is based on was split over eight weeks, with each week focusing on a different aspect of a healthy lifestyle and/or medical education. The analysis of the existing paper-based program resulted in each aspect or element of the original program having to be separated and categorised as either a lesson (something to be taught to the player), task (something the player must do) or question (something the player must answer), which was then converted to tutorials, quests or actions, respectively, as described in Table 1.

Other gamification techniques used in the process include:

- Incorporating a storyline: A storyline serves the purpose of giving the player some perspective of how far along they are in the game and hopefully also encourages them to continue to play so they can complete the story line. The story line chosen for this application was to make the player travel through eight villages, one for each week in the paper-based program.
- Including a “helpful character”: An owl character was implemented to greet new players and guide them on their journey through the story and the villages. This character offers hints, tips and tricks throughout the game while also being available at any time for the player to “talk” to and gain knowledge about various items of interest.
- Achievements and coins: After completing a quest, the user is rewarded with an achievement and a set amount of coins. This in-game reward is a core component of many previously successful gamification attempts (Chen, 2014; Comstock, 2012; Loria, 2014; MacKinnon et al., 2015) and the coins can be spent at the in-game “Arcade Corner” which acts as another reward mechanism, promoting engagement and motivation.

- **Social Feature:** Incorporating a social feature, implemented as a pseudonymous chat room where the player can specify their own screen name, assures the player that they are not alone and in turn they are further encouraged to continue in their “journey” while engaging with other players. A profanity filter was implemented over the chat room to help prevent players from feeling threatened, and use of particular keywords (such as “suicide”) result in an automatic intervention informing the player of various resources available to help in these cases.

Table 1. Traditional to game element conversion

Traditional Techniques				
		Lesson	Task	Question
<b>Gamified Technique</b>	Tutorial	Consider using a relatable character to deliver the lesson in appropriate language.	Very closely related to the lesson category, this encourages the player to learn how to complete the task by guiding them through one of a similar nature.	“Try to”: This category is asking the player to learn something new, that isn’t necessarily vital to the progression of the game.
	Quest	An example would be “Learn how to”. This can link to a question category as an examination of the skills learnt.	“Go to”: These quests can be encouraged further with rewards such as tokens or achievements.	“You must answer something to progress”: This category can easily be linked to tasks or lessons.
	Action	The most prominent of these would be guided gameplay of a particular level or section of a level.	“Do”, “Find”: This category forces the participant or player into action.	“Can you complete?”: This category can sometimes come across as something like a dare, and must be used with caution.



Figure 1. Screenshots of the final interface

Figure 1 shows some screenshots of the final interface. Players begin only able to access one village, but can further their progression by visiting characters in the buildings of the village. These characters prompt the user to complete the required tutorials, quests, and actions, gaining the player achievements and coins when they are successful. Coins can be spent in the “Arcade Corner” to play side-games not directly related to the program. The owl character is always available to offer helpful suggestions or encouragement to the player, and the player can access the chat room to interact with other players. After successfully navigating the villages and learning the tools and skills necessary, the player confronts a boss character, who is the personification of all the negative habits and lifestyle choices associated with metabolic syndrome. Use of the app is anonymous, however collected data is securely uploaded to a server when the player is connected to WiFi to allow the effectiveness of the app to be analysed.

It is necessary to make a distinction between MetaMood and other mobile applications with a similar focus in the medical intervention field. MetaMood is a digital intervention that uses a blended care approach in conjunction with clinical face-to-face consultations. It particularly targets people with severe chronic mental illness in combination with metabolic syndrome. If use of MetaMood was not anonymous then, due to the nature of the mental illnesses associated with metabolic syndrome, target users might not trust the app and use it improperly. Thus, the sign-up process used by SuperBetter, which required an email address, cannot be used for MetaMood, where the ideal distribution vector would be through native app stores with no need to sign in. However, this is problematic, since the app has not yet been subject to a clinical trial, so should not be made publicly available. Because of this, a clinician review stage has been completed for MetaMood first.

Clinicians were asked to provide feedback about the acceptability of the app as part of a clinical intervention for treating metabolic syndrome in a blended care format where the patient is supported to use the app during and outside of regular clinic sessions. A validated app assessment tool was used to collect data provided by the expert review of clinician informants in a modified online survey (Stoyanov et al., 2015). Clinicians were asked to first download the app and then become familiar with the components and features of the app, and then to complete an online survey to provide their feedback about the feasibility and acceptability of the app. This clinician review was considered an important step because it minimises the likelihood of the app causing any issues when a clinical trial is performed, and will strengthen reliability during the future patient test phase in the trial period.

#### 4. CLINICIAN REVIEW

While user-centered design dictates an iterative process of prototypes and mockups being presented to stakeholders and users, the development of MetaMood, as a clinician-based design process, was quite different. The development and prototypes were kept within the project team until such a time that the team felt that it was ready to be tested and reviewed by other field professionals and clinicians. This is a necessary first step in the rigorous process of designing a clinical digital intervention. The application must undergo testing and trials prior to administering to people with specific conditions to ensure that the intervention is safe and efficacious. For this reason, it was important to ensure that an ethical process was used in the prototype development phase so that a treatment was not prematurely available to people in an untested and unvalidated form. This clinician review, approved by our human research ethics committee, consisted of clinicians being invited to download and install a beta version of the application on their Android smart phone device. The beta process was handled by the functions available through the Google Play Developer Console and the Google Play Store, ensuring that the app was not available to the general public. After using the application for a period of time, the clinicians were asked to complete a short survey based on the standard Mobile App Rating Scale (MARS) tool (Stoyanov et al., 2015) for mobile application reviews and ratings. The surveys were administered through the online service Survey Monkey.

Twelve clinical professionals were contacted for the clinician review, though only five downloaded the application, and only four submitted the survey. While this is a small number, the reviewers are all experts in their field, so this is an adequate number to obtain an overall impression of these professionals, and to ensure that no obvious problems were overlooked in the development of the app. One of the main issues that caused this low participation rate was that many of the health professionals contacted had iPhones, and thus could not test an Android application. MetaMood was specifically developed for Android phones because it was

suggested by the team's clinician that people with metabolic syndrome and associated mental illnesses were more likely to be using this platform. The low completion rate was exacerbated by the fact that clinicians needed to express interest in evaluating the app before they could be added to the beta process (which required manually adding their email address) to be allowed access to the app, meaning they had to actively seek to evaluate the app twice.

The most important result is that all respondents answered "yes" to the question asking whether the app should proceed to clinical trial, with no requirement for further revision. Further, when asked whether they would recommend the app to people who might benefit from it, 50% responded "Definitely. I would recommend this app to everyone relevant", 25% responded "There are many people I would recommend this app to", and 25% responded "Maybe. There are several people I would recommend this app to", with all respondents indicating they could see themselves recommending the app to 10-50 clients in the next 12 months.

Respondents were also asked more specifically about the content and presentation in the app. When asked "Is the app content (visual information, language, design) appropriate for your target audience?", 75% of respondents said the app was well targeted, with either negligible or no issues, with the remaining 25% labelling the content as "acceptable, but not targeted". Respondents also believed the app was fun/entertaining to use, both by using strategies to increase engagement (50% "moderately fun and entertaining", 50% "Highly entertaining and fun") and by presenting content in an interesting way (50% "moderately interesting", 50% "very interesting"). All participants also indicated that it was "easy to learn how to use the app or has clear instructions", with one respondent indicating that they were "able to use the app immediately; intuitive; simple".

## 5. DISCUSSION

While there is a large amount of literature regarding the use of gamification aimed at addressing a wide range of health conditions such as diabetes, depression, and physical rehabilitation, there remains a significant lack of research specifically about the use of gamification strategies to reduce the impacts of metabolic syndrome, including how it can be applied and how effective it would be. The exploration of this niche area is significant because it combines the self-care health education about the management of a specific health condition with a traditional real-world clinic, typically referred to as blended care (Wilson, 2017). The combination of virtual- and real-world care utilising a blended care format makes this app a unique digital intervention.

A clinician-based design means that the project team is an interdisciplinary collaboration of professionals and academics with a single focused goal, and is particularly noteworthy because it has allowed new perspectives and possibilities for the development process. It has also allowed for the inclusion of previously unconsidered aspects into the MetaMood application. For example, the "Arcade Corner" would not have been integrated without the input of the clinician, who pointed out the potential clinical benefits of this addition, especially with games that had previously been successful in this area (Tong & Chignell, 2013). The external perspective allowed for a new question, not only about technical viability but also whether the "Arcade Corner" would fit with the already chosen gamification techniques. Perhaps the most important aspect of the interdisciplinary team is that it has prompted the examination of unusual design considerations, such as scenarios, situations or names that can potentially trigger adverse consequences for the players. For example, a village in the game was originally named "Broadchurch", but it was recommended that religious overtones be avoided because they could possibly trigger delusions in participants. These issues obviously must be considered in the development phase, with measures put in place to avoid any of the adverse consequences, which can only occur if all relevant parties are involved.

The results of the clinician review show that the app is entertaining and interesting, and well-targeted for the intended audience. This is a direct result of the iterative cross-disciplinary development process that took place. These results, alongside the responses indicating that the app was easy to learn and use, imply that MetaMood is engaging and motivating. When combined with the clinical professionals' opinion that the app should move to a clinical trial, and that they would recommend the app to several their clients, the design and development processes used to create MetaMood can be considered a success. Thus, this process could be useful for other similar online interventions. In particular, the use of a clinician review before making an untested clinical tool available through a publicly-accessible App Store is highly recommended.

## 6. CONCLUSION

This paper has described the design and development of MetaMood, a gamified Android application designed to increase motivation and participation for participants in a mental health program that traditionally requires weekly visits to a health professional. The considerations and lessons learned through the development of this application could prove useful for similar development attempts in the future. Further, the use of a clinician review, which allows health professionals beta access and the ability to provide feedback to ensure the safety and efficacy of the app, is highly recommended for any future mobile e-health interventions.

From this research, future work can be conducted to explore the value that is added by gamification and whether gamification improves effectiveness in scenarios similar to this one. The results of the clinician review indicate that the MetaMood application can now be finalised and taken to a full clinical trial, which will help determine whether programs designed to be face-to-face are still effective when presented via an alternative interface and whether anytime social interaction through an always-connected app is beneficial in this process. It will also give insight into how people who live with a syndrome affecting so many different aspects of their lives interact with games and game-like interfaces.

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