Abstract

**Background:** Alcohol abuse is the primary cause of (public) health problems in most parts of the world. However, it is undeniable that alcohol consumption is a practice widely accepted socially in many places, even being protected by law as a cultural and historical heritage. The issue of alcohol abuse is complex and urgent and, consequently, it is necessary to create innovative approaches to treatment, such as the proposal explored in this research.

**Objective:** This research explores the development and evaluation of a serious game for mobile devices (Android) to present a novel approach to address the issue of alcohol abuse.

**Methods:** Development of a serious game to instill the consequences of alcohol abuse into the player through experimentation in the game. The consequences of alcohol use are represented by increasing the game speed, giving an illusion of fun, but also leading, proportionally to its abuse, to a premature death. The evaluation employs an assessment based on the Alcohol Use Disorders Identification Test (AUDIT) and the Game Experience Questionnaire (GEQ). The evaluation participants belong to the university student’s house.

**Results:** The general game development process is presented, including its mechanics and gameplay. The game developed in Unity3D has the style of action and adventure games, in which the player controls an indigenous avatar that can deflect or attack opponents coming his way. The game evaluation comprised an assessment based on 23 participants, aged 20 to 29. According to the AUDIT assessment, 18 reported having a low or nonexistent degree of alcohol dependence, and 5 declared an average dependence. Regarding their habit of playing games on smartphones, 9 participants declared they have this habit (H) and among the 14 that do not have this habit (NH), 3 participants declared not having a smartphone at all. The GEQ core assessment shows a higher positive affect among the participants with a habit of playing games, getting 2.80 (H), in a scale to 4.0, vs 1.61 (NH), and a higher tension as an opposite relationship of 0.81 (NH) vs 0.37(H). The overall GEQ evaluation shows the game presents more positive than negative effects to all users, besides showing the other desirable characteristics for serious games.

**Conclusions:** The authors present a new way of dealing with the issue of alcohol abuse through a game designed for mobile devices. It promotes an overall positive user experience, having a greater impact on users accustomed to games. The proposed game-based approach has its niche, though it is still a minority in the evaluated population. Further research would explore new game features, like new styles, to become more attractive to a wider audience, in addition to performing an in-depth study of the game playing effect.

**Keywords:** alcohol abuse; serious game development; game experience evaluation.
Introduction

Alcohol abuse is the primary cause of (public) health problems in Brazil. According to the World Health Organization (WHO), in 2012, about 3.3 million deaths, or 5.9% of all deaths recorded on the planet were attributable to alcohol consumption [1]. The abusive consumption of alcoholic beverages is the component cause of more than 200 types of diseases and injuries. Alcoholism represents harm to private health, public health, and the economy as a whole. The estimated annual cost of alcoholism is £20 billion in the United Kingdom and more than $200 billion in the United States. Brazil loses around 7% of its Gross Domestic Product per year due excessive consumption of alcoholic beverages. The cost estimated in 2014 reached R$372 billion [2].

However, it is undeniable that alcohol consumption is part of many cultures, being a practice widely accepted socially in most parts of the world. In Brazil, the spirit cachaca¹ is even protected by law for its distinguished characteristics (Brazilian Presidential decree n.6871/2009) and is considered a kind of national cultural and historical heritage. The issue of alcohol abuse is complex and urgent and, consequently, it is necessary to create innovative approaches to treatment, such as the proposal explored in this research.

The main premise of this research is to explore the possibilities offered by new technologies to address this very relevant issue. Numerous successful cases have been found in the literature employing serious games in dealing with relevant health care issues (e.g. [3]). Considering the growing use of smartphones, the creation of a serious game for mobile devices takes advantage of this important channel of communication to innovate treatment of such issues.

Our proposal is to employ new technologies to raise awareness about the consequences of alcohol abuse, promoting empowerment of the individual, traditional cultures and social responsibility. The authors believe that a suitable means for this is a playful educational tool, that is, a serious game. In this sense, the user is allowed to experience the option of drinking and modifying the gameplay, eventually increasing the fun, but showing the consequences, such as the premature termination of the game (player death).

Methods

The game development is based on the premise that games are strongly linked to reality. According to [4], a game has some core elements, such as rules, participants, information, gains and losses. It is also possible to assimilate factors such as competition, opposition and maximization or minimization of some factor over another. Thus, it is feasible to relate a game to other human activities, since all have

¹ This is a distilled spirit made from fermented sugarcane, the most popular distilled alcoholic beverage in Brazil.
rules (of society or particular environment), participants, successes and failures (of
tasks or procedures involved).

An indigenous hero is considered for the setting of the game. It is worth noting that
alcohol abuse also extends in Brazil to the indigenous sphere of society. Langdon et
al. [5] point out that due to the process of inclusion of the indigenous people in the
broader society, they have begun to substitute and/or add the distilled beverage in
their everyday life. The consequences of this change are also addressed by [6] and
[7], demonstrating that alcohol abuse is the main cause of addiction diagnoses,
accidents and cases of violence against other members of the community, including
the use of various weapons and fatal victims. The indigenous theme also brings out
the problem in these societies to a wider audience, since the work of prevention and
treatment in this area is also not an easy task and lacks attention in a broader sense.

As Tim Ingold [8] points out, the learning process is about the education of
attention. Thus, as a child, learning is consolidated through games and toys. Through
them, explains [9], "children exploit and accumulate the world, improving their skills
and abilities" because they are extremely motivating activities. However, later in
elementary school, there is a clear separation between learning and fun, making
learning somewhat unmotivating and unpleasant. This happens because motivation
dictates the learning flow – when motivation ends, learning and the act of playing
also end [10].

Electronic games have been proposed to make learning motivational since they have
the ability to communicate concepts and facts of many subjects effectively as well as
allowing people to recreate themselves in new worlds and achieve recreation and
depth learning at the same time. That is, they are capable of creating a dramatic
representation of the studied situation [4, 10, 11].

Such games were called educational games. However, they do not always achieve
their goal, since many prioritize the educational or entertainment components
separately. A methodology is used specifically for the development of Serious Games,
which are games that use the artistic medium of the game to deliver a lesson or
teach about some subject, so that both components are balanced [9].

According to [11], a serious game should contain some elements related to design
and development itself, including: 1) Simple (intuitive) – usable by people who have
little or no experience with digital games; 2) It has an adequate simulation – both in
terms of realism and difficulty; and 3) Progress analysis – it allows the player to
formulate strategies, in case he/she learns what the game wants to pass in order to
achieve greater progress in the game.

In order to achieve these desirable characteristics, the development was divided into
three stages: 1) planning; 2) prototyping; and 3) application consolidation. The
whole process was documented in the Game Development Document, which
contains all the necessary information for the game development, such as an
execution flowchart, the definition of gameplay, references and inspirations, among others. This article presents a consolidated version of the Game Development Document, highlighting the main concepts employed in the game regarding mechanics, gameplay and implementation.

The game evaluation was carried out with students from the Student Residence of the Federal University of São João del-Rei. This residence is the student housing provided by the University for low-income students under the university’s official assistance program. All participants were volunteers and had to sign a Participant Consent Form, which described the general purpose of the study and stated the research procedures, according to international and Brazilian ethical research laws and principles. The results are opinions declared by the participants and disclosed anonymously. The proposed evaluation consisted of three stages: two questionnaires (pre and post-intervention) and a 20-minute intervention phase of user interaction with the game. No further explanation about the game was provided, leaving the exploration process up to the participants. When participants asked about a specific game element, the feedback was an incentive for them to explore and test the interface to figure out the answer.

The pre-intervention interview was performed to characterize the participant, collecting information such as age, sex and their level of alcohol dependence. To identify the level of alcohol dependence of the users, the AUDIT, the Alcohol Use Disorders Identification Test, was employed. The World Health Organization recommends the use of AUDIT [12] as a simple, brief method of screening for excessive drinking. Its questionnaire contains ten multiple-choice questions with five choices each. The assessment works as a sum of points acquired by each alternative – from 0 to 4 – and the final result, that is, the sum of all the alternatives, determines the level of alcohol dependence of the interviewee. The risk degree of dependency, potential consequences and intervention recommendation for the interviewee are classified according to four levels. The correspondence between the score levels and their risk level meaning is shown in Table 1.

Table 1: Risk level scores regarding alcohol consumption behavior according to the AUDIT assessment.

<table>
<thead>
<tr>
<th>Score</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 7</td>
<td>Inexistent: Low-level drinking or abstinence</td>
</tr>
<tr>
<td>8 to 15</td>
<td>Low: Alcohol use in excess of low-risk guidelines</td>
</tr>
<tr>
<td>16 to 19</td>
<td>Medium: Harmful and hazardous drinking</td>
</tr>
<tr>
<td>Over 20</td>
<td>High: Alcohol dependence</td>
</tr>
</tbody>
</table>
The Game Experience Questionnaire (GEQ) [13] was used for the post-intervention evaluation. It consists of a questionnaire composed of three modules: the core, the post-game and the social modules. The questionnaire has simple and direct questions about the player's thoughts and feelings, such as: "I felt happy," "I felt angry," among others. The Core module has questions regarding feelings and beliefs that the interviewee had while playing. In the post-game module, the questions are focused on when the player stopped playing. In this way, the participant demarcates on a scale from 0 to 4 the level of agreement with the corresponding sentence, where 0 means no agreement and 4 means a lot of agreement.

Only the core and post-game modules were used since the proposed game does not have social interactions. The participants answered them after the intervention stage. In each module, a group of questions defined a component to be analyzed, and the final calculation of it was given by the simple average of the questions. The total average of the components was given by the simple average of all the individual components of the interviewees - with results ranging from 0 to 4. In this case, 0 means that there is no presence of that component, and 4 means there is a lot of it.

Finally, the post-intervention evaluation consisted of three questions to evaluate the design of the application concerning the visual and sound resources, the available information about the game (such as tutorials and information about the project) and also about the controls. A scale from 0 to 4 was also performed at concordance levels, where 0 meant weak and 4 meant optimal.

**Development**

The game design document details the proposed modeling, definition of the rules, basic interface, and other details. Not all details have been defined at first, especially due to the authors' lack of experience in producing the graphics and sound features for the application. Thus, two versions were developed, the first being a prototype made in the MIT AppInventor platform and, the second, a consolidated application on the Unity Graphic Engine (i.e. Unity3D).

The game was deployed on the Android operating system due to its popularity. The development of an application through native language is the development of an Android application exclusively using the Android SDK or Android NDK. Developing this way allows for efficient development since the developer has direct access to all the tools of the device. Access to all tools allows you to design the application in the best possible way for the operating system, maximizing the user experience. However, this environment requires mastery of the platform's native language, as well as its tools. All physical modeling involved in the application must be developed. In order to ease game development, many platforms can be found in the Android ecosystem in order to assist developers in creating new games. A study was carried out on game development platforms available for the Android system. The most promising ones were MIT AppInventor and Unity Graphic Engine.
The MIT AppInventor platform (http://appinventor.mit.edu/) is an Android application development platform supported by Google and maintained by the Massachusetts Institute of Technology (USA). It has a drag and drop system where users select, drag and fit blocks that determine a line or method of execution in an interaction area. It is an open source license environment that is easy to learn, with the freedom to run the program for any legal purpose.

At first, the authors chose the MIT AppInventor platform for prototyping due to the small learning curve and the need to set implementation details. It was a straightforward implementation of what was designed. However, due to performance issues when the game had to perform fast updates of the graphic elements on the screen (i.e. the game starts experiencing unexpected screen update errors) a more robust platform was needed. Therefore, the game’s final version was fully implemented using the Unity Graphic Engine. It took a while to learn this new platform, but the process of prototyping in AppInventor to achieve a better implementation later in Unity showed to be effective in order to enable fast prototyping, especially considering programmers without much experience in game development, and produce a better game in quality on a more robust platform.

The proposed game follows the style of action and adventure games, in which the player controls an indigenous avatar who can deflect or attack opponents coming his way. It has three screens: the initial menu; an information display about game rules and the project; and the screen that contains the game. The initial menu screen, described in Figure 1(Left), allows you to move to any other screen within the application, as well as exit the application. The information screen, shown in Figure 1(Right), allows the user to return to the initial screen (using the return button in the upper left corner). Information regarding the game screen (and the game itself) is described in the following subsections. It is important to note that all graphics and sounds are available on the Internet under Creative Commons license.
Figure 1: Two screens of the proposed game: (Left) First screen; (Right) About the game screen (in Portuguese).

The interaction with the user considers a touch screen, where areas are defined for interaction and arrangement of the elements of the game. Figure 2 (Right) presents a schematic of these areas in comparison to the game screen (Figure 2 (Left): 1) move character to the left; 2) move character to the right; 3) shoot the arrow; 4) restart the game; 5) enable or disable the display of the indicative signs of the action buttons; 6) enable or disable the sound in the game; 7) display the player’s current score; 8) return to the home screen; and 9) indicate current alcohol consumption level).
The player, as already mentioned, controls an indigenous avatar who can deflect or shoot arrows at the opponents that appear in his way. Opponents appear on the upper edge of the device screen, and when they reach the lower end, they disappear. Some defined opponents are the snake, the jaguar and the drink. Once the Indian comes in direct contact with the snake or the jaguar the game ends. If the arrow hits an opponent, the player gets a score that is added and displayed on the screen.

When the player consumes the drink, it increases the points and speed of the game, which in a way also increases the fun. The idea is that drinking causes the player to slow down compared to the world, i.e., the other elements get faster.

The opponents use a system for continuous displacement, explained in Figure 3 to avoid the overlap and improper collision of opponents on the screen. The lanes have counters associated with them to notify their availability (or not). At the launch of an opponent, the counter of the chosen and adjacent lane is incremented. Counters are decreased when an opponent passes a safety range (represented by the blue line in Figure 3).
Evaluation
Data were collected from a total of 23 participants, of whom 12 were male and 11 were female. Figure 4 depicts a graph consolidating several characteristics of the participants. The participants' ages ranged from 20 to 29 years, although two participants preferred not to declare their age. Regarding the degree of dependency identified by the AUDIT questionnaire 17., five claimed not having any alcoholic dependence, 13 reported having a low or nonexistent degree of dependence, and five declared an average dependence. No participant declared a high degree of dependency.

Figure 4: Participants characterization regarding age, AUDIT alcohol addiction risk level, game playing habit, and sex.
Of the 23 participants, only three did not have a smartphone. Among those who owned a smartphone, 11 did not use it for games. The 9 participants who stated they have a habit of playing games are shown first in the graph, as highlighted in Figure 4.

**Game Experience Questionnaire (GEQ)**

The Game Experience Questionnaire (GEQ) [13] was used to gain an understanding of the user experience with the game. Two GEQ modules were used: core and post-game.

First, the elements of the questionnaire should be understood. According to [14], the components -- Competence, Stress, Negative affect and Positive affect -- are self-explanatory. Negative and Positive affect refer to the user experience. For example, a user may feel good or unmotivated about the game. Challenge aims to present data regarding the amount of effort, difficulty and pressure felt by the user during the game. Tension is related to the player’s frustration while playing the game. Flow aims to identify how interested the user was during the game. Immersion shows how immersed the user was with the story and elements of the game. Finally, Competence is related to the player’s ability and how well he or she performed during the game. All core elements of the GEQ are presented in Table 2.

<table>
<thead>
<tr>
<th>Core GEQ Components</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immersion</strong></td>
<td>I was interested in the game's story.</td>
</tr>
<tr>
<td></td>
<td>It was aesthetically pleasing.</td>
</tr>
<tr>
<td></td>
<td>I felt imaginative.</td>
</tr>
<tr>
<td></td>
<td>I felt that I could explore things.</td>
</tr>
<tr>
<td></td>
<td>I found it impressive.</td>
</tr>
<tr>
<td></td>
<td>It felt like a rich experience.</td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>I was fully occupied with the game.</td>
</tr>
<tr>
<td></td>
<td>I forgot everything around me.</td>
</tr>
<tr>
<td></td>
<td>I lost track of time.</td>
</tr>
<tr>
<td></td>
<td>I was deeply concentrated in the game.</td>
</tr>
<tr>
<td></td>
<td>I lost connection with the outside world.</td>
</tr>
<tr>
<td><strong>Competence</strong></td>
<td>I felt skillful.</td>
</tr>
<tr>
<td></td>
<td>I felt competent.</td>
</tr>
<tr>
<td></td>
<td>I was good at it.</td>
</tr>
<tr>
<td></td>
<td>I felt successful.</td>
</tr>
<tr>
<td></td>
<td>I enjoyed it.</td>
</tr>
<tr>
<td><strong>Positive affect</strong></td>
<td>I felt content.</td>
</tr>
<tr>
<td></td>
<td>I thought it was fun.</td>
</tr>
<tr>
<td></td>
<td>I felt happy.</td>
</tr>
</tbody>
</table>
I felt good.
I enjoyed it.

**Negative affect**
It gave me a bad mood.
I thought about other things.
I found it tiresome.
I felt bored.

**Tension**
I felt annoyed.
I felt irritable.
I felt frustrated.

**Challenge**
I thought it was hard.
I felt pressured.
I felt challenged.
I felt time pressure.
I had to put a lot of effort into it.

The GEQ post-game questionnaire was used to identify how the player felt after playing. This questionnaire is composed of four variables: Positive Affect, Negative Affect, Tiredness, and Return to Reality. Positive Affect is related to the satisfaction, victory and power of the user after playing. In contrast, the Negative Affect addresses the user’s bad experiences after playing. Tiredness is related to user exhaustion during the game. Finally, the Returning to Reality component addresses user disorientation after a gaming period. Table 3 presents the post-game elements and related questions.

Table 3: Post--game GEQ Components and Response Options.

<table>
<thead>
<tr>
<th>Post-game GEQ components</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive affect</strong></td>
<td>I felt revived.</td>
</tr>
<tr>
<td></td>
<td>It felt like a victory.</td>
</tr>
<tr>
<td></td>
<td>I felt energized.</td>
</tr>
<tr>
<td></td>
<td>I felt satisfied.</td>
</tr>
<tr>
<td></td>
<td>I felt powerful.</td>
</tr>
<tr>
<td></td>
<td>I felt proud.</td>
</tr>
<tr>
<td><strong>Negative affect</strong></td>
<td>I felt bad.</td>
</tr>
<tr>
<td></td>
<td>I felt guilty.</td>
</tr>
<tr>
<td></td>
<td>I found it a waste of time.</td>
</tr>
<tr>
<td></td>
<td>I felt that I could have done more useful things.</td>
</tr>
<tr>
<td></td>
<td>I felt regret.</td>
</tr>
<tr>
<td></td>
<td>I felt ashamed.</td>
</tr>
<tr>
<td><strong>Tiredness</strong></td>
<td>I felt exhausted.</td>
</tr>
<tr>
<td></td>
<td>I felt weary.</td>
</tr>
<tr>
<td><strong>Returning to Reality</strong></td>
<td>I found it hard to get back to reality.</td>
</tr>
<tr>
<td></td>
<td>I felt disoriented.</td>
</tr>
</tbody>
</table>
I had a sense that I had returned from a journey.

**Analysis**

Analyses of the results from the core and post-game GEQ questionnaire (Tables 2 and 3, respectively) are presented as follows. The mean score was calculated for each component in both questionnaires. The average score was calculated for three different classes of users: No habit of playing (NH), Has the habit of playing (H) and Total (T). Table 4 presents the results of the core questionnaire for the three distinct classes. Figure 5 illustrates the graphical representation of the scores for the core GEQ questionnaire for all three classes.

As shown in the Table 4, the highest score found among users who declared themselves to be non-gamers was the Positive Affect (NH = 1.61) component, followed by Flow and Competence components (NH = 1.54). However, although the Positive Affect component obtained a higher score, it has a somewhat similar to the Negative Affect component (NH = 1.25). Tension component was the one with the lowest score (NH = 0.81). The score of the components Competence (NH = 1.54), Immersion (NH = 1.44) and Challenge (NH = 1.33) were higher than the general mean (Mean = 1.25).

The highest score was the Positive Affect component (H = 2.8), followed by Competence (H = 2.18), Immersion (H = 1.96), Flow (H = 1.89), Challenge (H = 1.16), Negative Affect (H = 0.69) and, finally, Tension (H = 0.37). It should be noted that in this evaluated class, the Positive Affect scored considerably higher than the Negative Affect. The scores obtained in the components Tension, Negative Affect and Challenge were below the arithmetic mean (M = 1.57).

A combination of the two classes (NH and H) was also performed. The Positive Affect component had the highest score (T = 2.08), followed by the components Competence (T = 1.79), Flow (T = 1.68), Immersion (T = 1.64), Challenge (T = 1.26), Negative Affect (T = 1.03), and finally, Tension (T = 0.64). In the combination of the two classes, it can be noted that the Positive Affect had a relatively higher score than the Negative Affect. Only the components Challenge, Negative Affect and Tension reached scores below the mean (M = 1.44).

**Table 4: Core GEQ Average Scores for the 3 Classes.**

<table>
<thead>
<tr>
<th>Core GEQ</th>
<th>Mean Score (NH)</th>
<th>Mean Score (H)</th>
<th>Mean Score (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative affect</td>
<td>1.25</td>
<td>0.69</td>
<td>1.03</td>
</tr>
<tr>
<td>Positive affect</td>
<td>1.61</td>
<td>2.80</td>
<td>2.08</td>
</tr>
<tr>
<td>Challenge</td>
<td>1.33</td>
<td>1.16</td>
<td>1.26</td>
</tr>
<tr>
<td>Tension</td>
<td>0.81</td>
<td>0.37</td>
<td>0.64</td>
</tr>
<tr>
<td>Flow</td>
<td>1.54</td>
<td>1.89</td>
<td>1.68</td>
</tr>
</tbody>
</table>
Regarding the results obtained through the GEQ post-game questionnaire for the class No habit of playing (NH), the Positive Affect component reached the highest score (NH = 0.75). Negative Affect was lower than the Positive Affect (NH = 0.5). The lowest value found was related to the Return to Reality component (NH = 0.43). The Tiredness component obtained a relatively high value in comparison to the other components (NH = 0.68). The results referring to the GEQ post-game questionnaire for the three distinct classes are presented in Table 5. Figure 6 depicts the scores of the post-game questionnaire.

For the Has the habit of playing (H) class, the component with the highest score was the Positive Affect (H = 1.17), followed by the components Return to Reality (H = 0.48), Negative Affect (H=0.2) and, lastly, Tiredness (H = 0). Positive Affect reached a score considerably higher than Negative Affect. The components below the arithmetic mean (M = 0.46) were Negative Affect and Tiredness.

The following scores were obtained to the two combined classes (NH and H): Positive Affect (T = 0.95), Return to Reality (T = 0.47), Tiredness (T = 0.43) and Negative Affect (T = 0.40). Only the Positive Affect component had a score above the arithmetic mean (M = 0.56). However, this score was responsible for an increase in the mean.

<table>
<thead>
<tr>
<th></th>
<th>1.44</th>
<th>1.96</th>
<th>1.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competence</td>
<td>1.54</td>
<td>2.18</td>
<td>1.79</td>
</tr>
</tbody>
</table>

Figure 5: Assessment of the positives affect, negative affect and tension of the core questionnaire.
Table 5: Post-game GEQ Average Scores for the 3 Classes.

<table>
<thead>
<tr>
<th>Core GEQ</th>
<th>Mean Score (NH)</th>
<th>Mean Score (H)</th>
<th>Mean Score (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive affect</td>
<td>0.75</td>
<td>1.17</td>
<td>0.95</td>
</tr>
<tr>
<td>Negative affect</td>
<td>0.50</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Returning to Reality</td>
<td>0.68</td>
<td>0.68</td>
<td>0.43</td>
</tr>
<tr>
<td>Tiredness</td>
<td>0.43</td>
<td>0.48</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Figure 6: Assessment of the positive affect, negative affect and tension in the post-game questionnaire.

The users also evaluated the proposed game interface in three aspects: i) defined controls for the game; ii) quality of the graphics and sound; and iii) game information about the project and how to play. The simple arithmetic mean of these aspects was calculated and presented in Table 6. Figure 7 illustrates the visual mode scores.

Table 6: Average evaluation of the usability aspects.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game Control</td>
<td>2.86</td>
</tr>
<tr>
<td>Graphics and audio resources</td>
<td>3.09</td>
</tr>
<tr>
<td>Available information</td>
<td>2.05</td>
</tr>
</tbody>
</table>
An important feature of this experiment was the division of participants into those who have the habit of playing and those who do not. It should be taken into account that the analyses performed by "players" tend to produce less variation since these participants have a basis for comparison with previous experiences.

During the results analysis, it was verified that the participants more accustomed to playing games did not feel challenged by the JIB. That can be explained by the difficulty of the game, since the game does not have an increasing level of difficulty, and can be saturated very quickly, using few iterations. Another factor that potentially influenced the perceived level of challenge in the game was self-declared competence.

The score of the immersion component was significant, even though the game was simple. Participants used to play games reported a good experience on this component. The Returning to Reality component scored 0 among participants who have the habit of playing (H). The authors believe that the habit of playing more complex games had a great influence on this component, since these people's sense of reality may be less influenced by the JIB and they could easily discern their virtual experience from the real one (Returning to Reality). In such cases, serious games with low complexity can possibly generate more significant results in people who do not have the habit of playing (NH).

Two participants were identified as outliers (11 and 22). Both of them had much higher stress levels (Tension) than the other participants. This component possibly had an influence on the Negative and Positive Affect components. Participant 22 had the highest Negative Affect score among all the participants. Participant 11, on the
other hand, obtained a score for Positive Affect within the average, which was not expected, given his/her level of tension.

**Related Work**

Although there is a vast body of literature available regarding serious games applied to health care, this is a recent topic and therefore, there are only a few pieces in the literature related to serious games that deal with alcohol abuse.

Gaibler *et al.* ([15]) presented a study that addresses the effect of alcohol on safe driving activity, especially in the young age group. The application, a serious game, consists of a racing game in the third person, where the intention is to reach the final goal safely, avoiding alcoholic beverages during the process. Our proposal shares the principle of alcohol consumption affecting the gameplay. In this game, the players are challenged by lowering their game vision according to the level of intoxication. In our proposal, varying the game speed offers a more dramatic consequence to the user experience, leading to a premature end of the game. Nonetheless, this article is limited to a discussion of some preliminary and promising results.

Rodriguez *et al.* ([16]) conducted a systematic review related to serious educational games aimed at the consumption of alcohol and other drugs by adolescents. The search for papers was carried out in research portals. According to the authors, eight papers related to the consumption of alcohol, cannabis, tobacco, methamphetamine, ecstasy and other drugs were found. Six other papers addressed the use of other drugs. However, only one of the papers showed a decrease in the frequency of drug use. The authors highlight the need of further investigation and development of serious educational games, such as the one presented in this article.

Boendermaker *et al.* ([17]) applied gamification techniques similar to a cognitive bias modification of attention (CBM-A) training task to draw attention away from images of alcoholic beverages. The applied training task is called visual probe task [18, 19], which consists of the use of pairs of images, where one presents an important stimulus to the alcoholic beverage and another one a neutral stimulus (something non-alcoholic). The activity consisted of four sessions, with at least a one-day difference between sessions, for two weeks. The study was aimed at undergraduate students (96 students, mean age 21.2 years). Through the use of questionnaires, the authors identified the problems of excessive alcohol consumption of the candidates. The authors concluded that the innovation proposed in their study was insufficient to the task of motivating young people in training when compared to conventional CBM-A training. They believe that one of the motivations for such an outcome is related to the expectation that a game should be fun, a feature that was not the focus of their study. In this study, the focus is on building a game that is fun and fosters educational drive, but no analysis regarding user motivation to play the game or gameplay consequences has been performed.
Concluding Remarks
The paper presented the development of a serious game for mobile devices aimed at addressing the issue of alcohol abuse. The main purpose is to call the player’s attention to the consequences of alcohol abuse through experimentation in the game. The authors do not have the illusion that people would cease drinking immediately but do intend to contribute to the awareness of this social problem.

In order to evaluate the proposed approach, an assessment based on AUDIT and GEQ was carried out with residents of a student’s house. The proposed evaluation consisted of three stages: two questionnaires (pre- and post-intervention) and one intervention stage, which consisted of 20 minutes of exposure to the game. The users were divided into groups based on their habit of gaming in the data analysis.

The quantitative analysis presents a high degree of Positive Affect concerning the participants who declared themselves to have the habit of playing, although they did not have a high level of challenge, due to the low difficulty and small learning curve. Overall (among all participants), the Positive Affect score was twice that of the Negative Affect. In this way, the authors believe that the JIB obtained a proper evaluation in the two different groups of participants, considering the limitations of this first version of the game.

In the future, the authors expect to continue to develop the JIB, to increase the level of difficulty and application of the game. New experiments should also be conducted using different groups of users, like indigenous people in urban contexts, and exploring the variations between gender, age, and family background related to the issue of alcohol abuse. Further research should also explore new game features, like new styles, to make it more attractive to a wider audience, in addition to performing an in-depth study of the effects of playing the game.

Conflicts of Interest
None declared.

Abbreviations
AUDIT: Alcohol Use Disorders Identification Test
GEQ: Game Experience Questionnaire
WHO: World Health Organization

References
2. Amorim D, 2015, Brasil perde 7,3% do PIB por ano com consumo excessivo de bebidas alcoólicas.


15. Rodriguez DM, Teesson M, Newton NC. A systematic

