A SERIOUS GAME AGAINST DOPING: EVALUATION OF GAME USABILITY, EASE AND USERS' ENJOYMENT

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Abstract. *Doping is a threat to sport worldwide. Doping not only exists in professional sport, but also affects recreational athletes who increasingly use performance-enhancing drugs. As anti-doping authorities largely rely on detection, deterrence, and prevention to tackle doping use, the main tool for prevention is education. So far, educational interventions have largely used traditional teaching approaches such as face-to-face courses and online courses. The present study examines the usability of a serious game against doping (the GAME) as an alternative approach to traditional anti-doping education. In addition, this study will investigate its ease and users' enjoyment while playing the serious game. Participants in the evaluation were 21 undergraduate students who played the GAME and then were asked to respond to a questionnaire evaluating GAME's usability, ease and users' enjoyment. Concerning the usability and ease of GAME, the results demonstrated the high usability and ease of GAME. The findings related to the evaluation of users' enjoyment were also positive. Overall, players were largely satisfied with their gaming experience, rating the GAME as easy to understand and learn and very satisfying. The next step is to deploy the GAME in greater audiences and evaluate its effectiveness in changing beliefs and knowledge about doping.*

Keywords: *serious games, game-based learning, anti-doping, sports, evaluation.*

Introduction

Doping in sports

In order to increase their physical performance and obtain higher achievements in sports, athletes often use alternative methods to increase their training workload (Mazzeo, 2016). For years, athletes have tried to improve artificially their physical performance. Elite athletes are using several legal or illegal, healthy, or unhealthy methods in their effort to improve their performance (Mazzeo et al., 2016; Santamaria et al., 2013; Sjöqvist et al., 2008; Agulló-Calatayud et al., 2007). The reasons of these efforts vary and are changing over time (Lazuras et al., 2015; Nicholls et al., 2017). Furthermore, several actors are also involved in the process, such as friends and relatives of the athletes, and the athletes' entourage including medical staff, managers, chemists, biologists and pharmacists, as well as pharmaceutical industries, clandestine laboratories and criminal organizations (Marclay et al., 2013; Esseiva et al., 2007). Doping is nowadays considered as a public health issue that concerns the whole society (Lippi et al., 2008; Council of Europe, 1989) and also a threat to sport. Doping undermines the fundamental principles of sport about open and fair competition (Mottram, 2005). It is a behaviour that discourages the practice of sport in general and creates pressure on athletes who compete clean. It seriously affects the image of the sports industry and is a serious threat to the athletes' health (Council of Europe, 1989; Mazzeo et al., 2016).

Although doping has been associated with competitive sport, it also affects recreational athletes who increasingly use performance-enhancing drugs (Lazuras et al., 2017; Mazzeo, 2016). In particular, a study shows that doping use can be initiated among amateur athletes as young as 10 years old (Nicholls et al., 2017). Accordingly, another study shows that, on average, 1 out of 5 young amateur athletes and exercisers aged between 16-25 years have used doping substances at least once in their lifetime, with higher prevalence rates being reported in South-East European countries like Greece (27.6%) and Cyprus (28.9%), and lower prevalence rates in Germany (17%) and the UK (14.6%) (Lazuras et al., 2017). The increased prevalence of doping use in both competitive and recreational sports calls for an effective treatment, and scholars have recently advocated for an education-based approach against doping (Barkoukis, 2015).

Anti-doping education

The fight against doping largely focuses on three main pillars: detection, deterrence, and prevention. Testing for banned substances, gathering evidence, and imposing penalties for doping violations serve both detection and deterrence goals. With good testing systems, no athlete using prohibited means or methods should feel secure. The main tool of prevention is education (Cleret, 2011). However, this approach was found ineffective as doping prevalence remains as high as it was. To address this gap, education has been suggested as an alternative and potentially more influential approach to tackle doping use (Barkoukis, 2015). In response to this call, a number of educational interventions have been developed.

Such an example is the SafeYou Program (SafeYou, 2015) focused on recreational athletes. It consists of eight sessions that can be self-administered or educator-facilitated. Moreover, the educational material includes case studies from recreational athletes that are aimed to be used during the teaching process. Several of these case studies are illustrated via video in order to facilitate the educational process. In addition, the educational material includes a guide for facilitators indicating how to use problem-based learning. Furthermore, the educational material includes an interactive video providing a more gamified approach to teaching. Also, five videos with testimonials and information about doping are provided to help learners (and facilitators) deepen their understanding of the educational material. This material was further expanded with 12 Sessions grouped into eight stand-alone Themes to address the needs of competitive athletes. In addition, a mobile PAES information application was developed to assist learning, especially on the health side effects of doping use.

Another attempt involves the Coaches and Sport Integrity course, which is focused on the education of pre- and in-service coaches to sports integrity. The course includes 13 sessions for pre-service coaches and six for in-service coaches, and addresses corruption in sports, doping, match fixing, good governance, and whistleblowing. Another interesting educational approach is DELTS (Doping E-Learning Tools) that involves a series of six sessions on the side effects of doping. The course targets recreational sport athletes and is self-administered through an online platform. Another educational intervention developed for competitive athletes is My-choice that aims to influence specific psychological variables related to the decision to dope. More specifically, the program aims, through six sessions, to educate athletes on moral disengagement and self-regulatory efficacy.

All above-mentioned educational interventions targeted athletes. However, in line with Barkoukis et al. (2019) who have suggested that coaches are an influential agent in the decision-making process towards doping, the CoachMADE intervention (Ntoumanis et al., 2018) was developed to assist coaches to establish optimal motivational climates and prevent their adolescent athletes from current and future willingness to dope. The intervention consists of two seminars focused on developing a need-supportive motivational climate that facilitates coach-athlete interactions in general and on doping-related issues (e.g., checking for prohibited substances in athletes' medication).

However, recent evidence has demonstrated that athletes are not interested in attending anti-doping education (Loukovitis et al., 2020). Therefore, there is a need to advance anti-doping educational efforts for both competitive and recreational athletes. More specifically, there is a need to move forward and transform the way anti-doping education is designed, delivered, and evaluated. Towards this end, serious game learning can assist in reaching wider range of recipients, young and adolescent athletes, competitive and recreational athletes, elite and amateur athletes, and providing education on doping to the populations that may not be at risk for doping use. Therefore, there is a need to transform and advance anti-doping education by improving its design, delivery, and evaluation. In this respect, innovative and meaningful anti-doping educational interventions are required. Towards this end, serious game learning can assist in reaching wider range of recipients, young and adolescent athletes, competitive and recreational athletes, elite and amateur athletes, and providing education on doping to the populations that may not be at risk for doping use.

Serious games

Serious gaming is a priority area for information and technology researchers having recognised the potential of games, for example, teaching and training, social inclusion, health, digital transformation, and other societal purposes. The main advantages provided by serious games include appeal, since nowadays technologies are commonly used in daily life, being able to enhance more people's engagement (Andrade et al., 2014) because games are fun and can increase motivation and effectiveness, decreasing patients' dropout since they can experience new behaviours in a safe environment (Fleming et al., 2014).

The movement towards the use of serious games as training and learning is proliferated by the perceived ability of such games to create a memorable and engaging learning experience. Various commentators and players alike argue that serious games can develop and reinforce 21st century skills such as collaboration, problem solving and communication. While, in the past, players and trainers were reluctant to use serious games for improving skills and competencies, there is currently an increasing interest in exploring how serious games could be used to improve specific skills and competencies. The overarching assumption made is that serious games are built on sound learning principles encompassing teaching and training approaches that support the design of authentic and situated learning activities in an engaging and immersive way. Developing serious games based on activity-centred pedagogies that enable trainees to actively engage with questions and problems associated with sport activity and dual careers is an empowering approach with benefits for both subject learning and developing a wide range of important high-order intellectual attributes including the notion of

‘transferability’, that is being able to situate specific skills in different settings and contexts, a competence much needed (Barkoukis et al., 2020).

A serious game against doping

Currently, there is a need to advance anti-doping educational efforts and develop educational tools for both competitive and recreational athletes. Nowadays, several anti-doping educational interventions aiming to tackle doping use in competitive and recreational sports have been developed. However, there is a need to transform and advance the design, delivery mode and evaluation of anti-doping education. Serious gaming can contribute to anti-doping education by providing a serious game that will reach wider audiences of athletes as compared to the existing anti-doping education interventions. Furthermore, such a serious game will include an innovative educational approach that is more suitable for teaching adolescents and young athletes. Thus, the aim of this study is firstly to present the development and objectives of a serious game (i.e., the GAME) against doping, and secondly, to evaluate GAME’s usability, ease and users’ enjoyment.

Methodology

Participants

This study included 21 participants. All participants were Information and Technology students at the Aristotle University of Thessaloniki. Their mean age was 23.4 years ($SD = \pm 4.1$ years). Thirteen participants were males and eight were females. In order to be included in this research, all participants read the information sheet with information about the study, declared that they understood their tasks during the study, they understood that their participation was voluntary, that they could leave the research at any time they wanted without giving explanations and provided consent to take part in the study.

Development of the GAME

In order to deliver an innovative and impactful anti-doping educational intervention, the proposed serious game utilises: (a) existing research on doping use from the social and behavioural sciences; (b) innovative learning pedagogies; and (c) modern serious gaming design and technology. A state-of-the-art about e-learning platforms and the existing game engines research was conducted, and the result was the selection of the most suitable platform that fitted the project’s needs. The game engine that most suited the needs of the project was Unity (“Unity for all”, 2020). A concept design of these games was created to demonstrate the main structural idea behind them (Figure 1). Players have to be involved in realistic scenarios that aim to improve their personal skills, such as communication, and allow them to self-regulate.

Figure 1. The structure of pedagogical scenarios, GAME design and final version of GAME

The development of the frame required the cooperation between psychologists and anti-doping education experts on the one hand, and e-learning experts and game developers, on the other hand. To facilitate cooperation, the development team exploited flowcharts and mock-up tools that created a common basis of what each member of the team should do. For example, psychologists and anti-doping education experts were asked to present pedagogical scenarios using specific flowcharts, whereas e-learning experts and game developers made suggestions on game flow, user feedback, awards, badges, and game scoring system. The team collectively decided on the content and flow of the serious game.

Instruments

A questionnaire of 68 items was used. Responses were anchored on a seven-point Likert scale. In this Likert scale, 1 was used for totally disagree and 7 for totally agree responses, whereas number 4 was used for neutral responses. Two items included questions concerning knowledge about doping in sports. Twenty-five items included questions concerning usability and ease of the serious game based on the methodology described by Harrison et al. (2013). The last 41 items referred to learners' enjoyment of the GAME play based on a modified version of EGameFlow (Fu et al., 2009). The original version of EGameFlow consists of 52 items measuring eight dimensions: social interaction, goal clarity, immersion, feedback, challenge, concentration, control, and knowledge improvement. In the modified version of EGameFlow, we included the same number of dimensions using the 41 items that accurately described the content of the dimensions that were more relevant to the GAME.

Procedure

The evaluation of the GAME took place within the premises of the Faculty of Informatics and Technology at the Aristotle University of Thessaloniki. All participants visited a properly designed room with the required number of computers. After a briefing, which included information about the aims and objectives of the GAME, all participants had the time to play all stages of the game and provide feedback and their scores. Participants played the GAME for four hours. After finishing playing the game, they completed the study questionnaires.

Data analysis

All analyses were performed using SPSS version 26.0 (Statistical Package for the Social Sciences for Windows, Chicago, IL). After data collection, descriptive statistics have been used in order to evaluate the variables describing GAME's usability, ease and users' enjoyment. Means, standard deviations, analyses of frequencies and modes were used.

Results

As regards the two questions concerning the knowledge about doping in sports, users did not give any negative or neutral answers (from 0 - Totally disagree to 4 - Neutral). More specifically, most users say that they slightly agree (5), agree (6) or they totally agree (7) in both questions (Table 1).

Table 1. *Knowledge about doping in sports*

	Totally disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Totally agree	Total
It helps me better understand the issue of doping in sports.	0	0	0	0	28.6	42.9	28.6	100
It helps me better understand the health risks associated with doping.	0	0	0	0	28.6	28.6	42.9	100

Concerning the usability and ease of GAME, almost all answers ranged between 5 (slightly agree) and 7 (totally agree), showing its high usability and ease. The only answer showing to be neutral (4) was to question 18, "I quickly became a skilled user". As presented in Table 2, multiple modes exist in this question, and the smallest value is shown.

Table 2. *Usability and ease of GAME*

Question no.		N	Answers mode
Q1	It is useful	21	6
Q2	It gives me better control over my daily work	21	5
Q3	It makes it much easier to do what I want to do	21	5
Q4	It works as I would expect a doping training game to work	21	6
Q5	It is easy to use	21	5*
Q6	It is simple to use	21	7
Q7	It is user friendly	21	5
Q8	Requires the least possible steps to complete the tasks I want to do with it	21	6
Q9	It is flexible	21	5
Q10	Its use does not require much effort	21	5*
Q11	I can use it without reading written instructions	21	6
Q12	I did not notice any inconsistencies in its use	21	5*
Q13	I think both casual and regular users will like it	21	6
Q14	I can handle mishandling easily and quickly	21	5*
Q15	I can use it at any time	21	5
Q16	I learned to use it quickly	21	7

Q17	I can easily remember its operation	21	5
Q18	I quickly became a skilled user	21	4*
Q19	I am satisfied with its use	21	5
Q20	I would recommend it to a friend of mine	21	6*
Q21	Its use is fun	21	6
Q22	It works exactly as I want it to work	21	6
Q23	It is wonderful	21	5
Q24	I feel I need it	21	6
Q25	Its use is pleasant	21	7

*Multiple modes exist. The smallest value is shown.

Finally, regarding learners' enjoyment, based on answers modes, users did not give any negative answer (from 0 - Totally disagree to 3 - Neutral). In almost all questions, answers mode ranged between 5 (slightly agree) and 7 (totally agree), showing the high enjoyment of the GAME play. In 5 out of the 41 questions, the answer mode was neutral, more specifically, in questions Q9, Q11, Q26, Q28 and Q29. In questions Q9, Q11 and Q28, as described in Table 3, multiple modes exist and the smallest value is shown.

Table 3. *Results concerning learners' enjoyment*

No.	Dimension		N	Answers mode
Q1	Concentration	Most of the gaming activities are related to the learning task	21	5
Q2		No distraction from the task is highlighted	21	6
Q3		Generally speaking, I can remain concentrated in the game	21	6
Q4		I am not distracted from tasks that the player should concentrate on	21	6
Q5		I am not burdened with tasks that seem unrelated	21	5
Q6		Workload in the game is adequate	21	5
Q7	Goal Clarity	Overall game goals were presented in the beginning of the game	21	7
Q8		Overall game goals were presented clearly	21	6
Q9		Intermediate goals were presented in the beginning of each scene	21	4*
Q10	Feedback	Intermediate goals were presented clearly	21	5
Q11		I receive feedback on my progress in the game	21	4*
Q12		I receive immediate feedback on my actions	21	6
Q13		I am notified of new tasks immediately	21	5
Q14		I am notified of new events immediately	21	5*
Q15	Challenge	I receive information on my success (or failure) of intermediate goals immediately	21	6
Q16		The game provides "hints" in text that help me overcome the challenges	21	5
Q17		The game provides "online support" that helps me overcome the challenges	21	5*
Q18		The game provides video or audio auxiliaries that help me overcome the challenges	21	5
Q19		The difficulty of challenges increased as my skills improved	21	5*
Q20	Autonomy	The game provides new challenges with an appropriate pacing	21	6
Q21		The game provides different levels of challenges that tailor to different players	21	5
Q22		I feel a sense of control over interactions between roles or objects	21	6
Q23		I know next step in the game	21	5
Q24		I feel a sense of control over the game	21	5
Q25	Immersion	I forget about time passing while playing the game	21	6
Q26		I become unaware of my surroundings while playing the game	21	4
Q27		I temporarily forget worries about everyday life while playing the game	21	6

Q28		I experience an altered sense of time	21	4*
Q29		I can become involved in the game	21	4
Q30		I feel emotionally involved in the game	21	5
Q31		I feel viscerally involved in the game	21	5
Q32	Social Interaction	I feel cooperative toward other classmates	21	5
Q33		The cooperation in the game is helpful to the learning	21	6
Q34		The game supports social interaction between players (chat, etc)	21	6
Q35		The game supports communities within the game	21	6
Q36		The game supports communities outside the game	21	5*
Q37	Knowledge Improvement	The game increases my knowledge	21	5*
Q38		I catch the basic ideas of the knowledge taught	21	5*
Q39		I try to apply the knowledge in the game	21	5
Q40		The game motivates the player to integrate the knowledge taught	21	5
Q41		I want to know more about the knowledge taught	21	5*

*Multiple modes exist. The smallest value is shown.

Discussion

The aim of this study was firstly to present the development of a serious game (the GAME) against doping, and secondly, to evaluate its usability, ease and users' enjoyment. As regards the questions concerning the knowledge about doping in sports, all users stated that GAME made them better comprehend this issue. Also, they mentioned that GAME made them better realize the health risks associated with doping. These findings indicated that the pedagogical scenarios, as designed by sport psychologists and anti-doping education experts, included all up-to-date information about the problem of doping in sports and the health risks associated with doping.

Concerning the usability and ease of GAME, the present results showed that GAME was simple to use, its use was pleasant, and players learned to use it quickly. Furthermore, players agreed that GAME was useful, it worked as they would expect a doping training game to work, and they could use it without reading written instructions. Additionally, players agreed that GAME required the least possible steps to complete the tasks they wanted to do with it, it worked exactly as they wanted it to work, reported that both casual and regular users would like it and feel the need to play the game, its use was fun and they would recommend it to a friend. Lastly, players slightly agreed that GAME gave them better control over their daily work making it much easier to do what they wanted to do, it was easy to use, user friendly, flexible, and its use did not require much effort. Players' answers showed that GAME was slightly wonderful, they did not notice any inconsistencies in its use, could handle mishandling easily and quickly, could use it at any time and were satisfied with its use.

The findings of the 41 questions concerning learners' enjoyment grouped in height dimensions (Knowledge Improvement, Social Interaction, Immersion, Autonomy, Challenge, Feedback, Goal Clarity and Concentration) were quite satisfactory. GAME was globally evaluated based on the aforementioned dimensions by averaging the responses of students to individual questions corresponding to each dimension. As indicated by the results of the analysis, the players' opinion was positive. The only dimensions that had neutral to positive results were the questions "I experience an altered sense of time", "I become unaware of my surroundings while playing the game" and "I can become involved in the game" referring to

immersion, “Intermediate goals were presented in the beginning of each scene” referring to goal clarity and “I receive feedback on my progress in the game” referring to feedback. The most positive results were found for the Goal Clarity dimension, more specifically in the question “Overall game goals were presented in the beginning of the game”, with all participants answering that they totally agreed. It seems that players have adapted really quickly to the game environment and most of the gaming activities are related to the learning task.

Conclusion

Helping athletes acquire knowledge about doping and especially its severe health side effects is a first step to prevent doping. GAME is the first serious game aiming to improve the knowledge on doping in sports and the health-related issues of doping use. GAME players marked it as an informative, useful, user friendly, and enjoyable game to play. The next step is to deploy the game in greater audiences and evaluate its effectiveness in changing beliefs and knowledge about doping.

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