CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2021

An analysis of how well serious games cover the PMBOK

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Abstract

Playing the role of project manager requires a certain level of knowledge and experience from previous projects, thus enabling better decision making. The use of serious games increasingly allows newer project managers to gain the necessary experience and knowledge in a controlled environment. Since several serious games have been developed, the need then arose to conduct a study to measure the level of coverage these simulators provide to the PMBOK. Fifteen games were included in this study and it is remarkable the effort that has been made to improve these tools, as it was found that of the 12 games, 7   covers at least 3 of the 5 process groups found in the PMBOK. It was also found that more than 80% of the serious games cover time management and that less than 20% of the games do not cover the procurement area. Our study recommends that comparative studies be done between simulators in ways to evaluate the improvements that newer simulators bring. Studies to evaluate the teaching learning method of the simulators should also be conducted so that the efficiency of this teaching learning method can be evaluated.

Keywords: Project management; Serious game; Educational games;

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10.1016/j.procs.2021.12.104

1. Introduction

Since 90s decade, companies have turned to project management to help them plan and manage more complex tasks and achieve new goals within tighter deadlines [1].

Project management (PM) consists in the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. It has always been practiced informally but began to emerge as a distinct profession in the mid-20th century. To support project management, many best practice guides have been proposed and used for more than 20 years. Among the proposed guides or methodologies are: PMBOK, PRINCE2, AIPM, IPMA, ISO, APM and many others [2][3]. However, due to its worldwide popularity, relevance, and acceptance of its proposed practices to market segments [3], we used PMBOK as the object of study in this research.

In 2017, the PMI released the most recent best practice guide, the Project Management Body of Knowledge or just called PMBOK [4].

Like can be seen, PMBOK comprise ten knowledge areas that comprise managing integration, scope, time, cost, quality, human resource, communication, risk, procurement, and stakeholders, and five process groups, namely initiation, planning, controlling & monitoring, executing and closing. These extensive set of knowledge areas and process groups are a challenge for training and development of project managers [5][6]. Project management as a specific discipline of management have been growing rapidly and is part of the rapid development of management as a general science of managing companies and other systems and enterprises [7][1].

Although, there are many project managements courses available, it is clear that the content offered by training providers does not reflect what is required in today's complex project environment [1]. The project management discipline is based on theory and practice. The abstract, conceptual understanding of project management methods, tools and practices it is not enough for project managers. Project managers must also be able to apply this knowledge in complex work environments [5].

Despite the variety of existing information and there are several best practice recommendations, project Management has a strong dependence on past experience and knowledge, which makes traditional approaches often inadequate to deal with the current complexity of projects. When analysing decisions, project managers usually try to recall similar situations in other projects, take advantage of their understanding of the current environment and mentally evaluate the possible future based on the available options [8].

However, incorporating professional practice into the learning process can be a challenge. Consequently, young professionals often lack practical training in real-life situations and usually gain experience by working on real projects, where the consequences of a bad plan or decision can lead to project failure or loss of interest for the company. [9].

This necessity has led teachers to adopt new pedagogical methods and techniques to promote highly practical learning and to increase students' motivation and participation in the learning/teaching process. The development and use of gamification strategies are one of the new methods used to increase user engagement, motivation and effectiveness in learning-teaching process and to create a more engaging learning environment [10][11].

Games and simulations allow students to experiment, learn from mistakes, and experience real situations in a free-risk environment. Games that are not designed just for entertainment are called serious games [10]. One possible solution to these challenges presented previously is to use serious games [6].

Nowadays, serious games are known as a promising new method of teaching and learning in various fields, which has recently emerged in industrial, project management, healthcare, defence, education, policy, training and ecology [6][10][12][13][14][15].

There have been in literature numerous proposals of project management games, that indicates a growing interest in researching serious games in project management domain. Due the interest, a study was conducted to review the actual serious game literature, and how these games might improve knowledge retention and skills in neonatal healthcare professionals. Twelve serious games were included and was concluded that serious games have the potential to improve healthcare professionals' knowledge and skills [14].

In our paper, the main goal is to present serious game for project management and describe the coverage that they offer to PMBOK by playing the games and reviewing the documentation.

The structure of the paper is as follows. Section 2 presents the systematic literature review. Section 3, the methodology for the study is introduced. Section 4 shows the results and discussions. In Section 5, presents conclusions and future

work based on the findings obtained.

2. LITERATURE REVIEW

2.1. Serious games

When we are talking about serious games, we can find in literature words like, games and simulators that are presented with different meanings. Where que games can be defined as any play contest among adversaries operating under constraints for an objective to have fun [13]. Simulation shortens the observation time between actions and consequences, which supports the learning process by reducing the time needed to analyze a given element or process in the real world [5]. Games are for pure entertainment while simulations are for skill building [13], [16] some differences between can be seen on table bellow:

Table 1 Differences between entertainment games and serious games

	Serious games	Entertainment games
Task vs. rich experience	Problem solving in focus	Rich experiences preferred
Focus	Important elements of learning	To have fun
Simulations	Assumptions necessary for workable simulations	Simplified simulation processes
Communication	Should reflect natural (i.e., non-perfect) communication	Communication is often perfect

Serious games are developed with these two concepts games and simulations. In general, serious games consists in an activity whose main purpose is learning serious context through playing [12]. Where learning and teaching along games are the main objectives rather than pure entertainment [9].

The following points should be considered on the serious game design [17]:

– The educational objective should be considered a key element of serious games. Targeted contents and knowledge of new concepts should be well clarified as the objectives of the game design.

– The activities and exercises should increase students' motivation and interest in the subject.

– There should be a positive correlation between the success of the game and the content or knowledge required. First, it should be easier to find the right content and knowledge. Sometimes games may fail due to a lack of content or specific knowledge. However, in the next phase, students can immediately correct these mistakes using their newly acquired knowledge.

– It is impossible to judge the correctness of each decision during the game. At best, the rules of the game encourage students to seek advantages and make their own decisions.

– The outcome must be measurable to assess whether a serious game has achieved all its objectives.

2.2. Serious games applied in teaching context

As in academy [7][11], on-the-job training seems to be a very important factor in achieving success and maintaining the skills needed in the job market [15].

A learning model describes the main interactions between teachers, learners, learning materials and other learning resources. Most current learning models focus on content and teachers: teachers are responsible for what students learn, when and how learning occurs. Differently, some research shows that adults prefer to learn from experience and that they learn best what they can apply to a given problem [5] [8].

A serious game is a game designed to teach or educate the user. In this context, it can be a useful way to gain experience and motivate learners. In addition, serious games allow real-world scenarios to be incorporated into the learning process in a free-risk environment [16]. According to a report by IMARC [18], the global serious gaming market reached a value of US$ 5.8 Billion in 2020. The report also states that serious games will grow significantly over the next five years and represent one of the fastest growing trends in education worldwide.

The main purpose of serious games is to learn and educate through play, guarantee of high-quality teaching [9]. It was highlighted that serious games should facilitate knowledge transfer and create good relationships between teachers and students [14]. The goal is for future professionals to gain work experience during their studies, not just afterwards, and the learning is very hands-on in nature [16].

Games should allow students to acquire knowledge through their own actions and should allow them to cooperate and debate the acquisition of new knowledge while learning with other peers [17].

2.3. Serious games applied in project management context

Unlike other industries, such as medicine or aviation, young project managers have serious gaps in practical skills early in their careers, as a future professionals they need to develop their skills by working on real-world projects where poor planning or decisions can lead to failure or major losses [16]. Nelson (2007), share some project management interesting failures histories that cost millions on organizations like Nike, McDonalds and Bank of America [19].

As mentioned previously, PMI in the PMBOK describe ten main knowledge area such as five process group that establish the theoretical content needed to develop a project [4]. And on other hand, stresses the importance of developing soft skills, which can significantly reduce the number of failed projects [20].

It looks like the current training of project managers does not seem to adequately prepare them for complex real-world situations and resolve the challenge cited above. The existing project management training can be simply insufficient to prepare project managers for project management, due the absence of practice perspective [7] [21].

The use of modern methodologies to train students with a wide range of knowledge and skills has increased the educational value of games. In recent years, the use of serious games has become increasingly popular as they have proven useful in a variety of areas, such as healthcare, social skills, and the military [9]. Then, serious games can be a possible key to the challenges above cited.

Serious games are designed to teach people individual theme playing, to extend concepts, to enhance their development, to help them practice or learn skills, or to change their thinking [13]. University project management programs have begun to adopt serious games in their courses [22].

Unlike common methodologies, serious games allow students to experience the consequences of applying or not applying project management principles, solve complex project management problems, and try different ways of solving them [6][23].

3. Methodology

The main purpose of the study was to investigate the application of serious games in project management and analyze the coverage that serious game provides to PMBOK processes. The stated research question was: what level of coverage do PMBOK processes, classified by knowledge area and process group, have in serious games?

In order to achieve the principal purpose of this study, a research methodology using quantitative and qualitative methods was followed [24]. The qualitative research component comprised experimentation and analysis of content concerning the different games. The quantitative analysis consisted in collecting and enumerating the processes of the PMBOK knowledge areas and groups supported by each game, to assess the degree of coverage provided.

3.1. Identification and selection of serious games

The identification and selection of the games to be used was subject to several stages. From September 2020 until May 2021, intensive research was systematically performed using multiple sources (research papers, international serious gaming awards, contact with experts, gaming forums) in order to identify the project management serious games available. This investigation led to the identification of over thirty (30) serious games related to project management. However, a selection was required to select the serious games that were suitable for the scope of the research. The following criteria were followed to undertake this selection: the serious game should be based on PMI's PMBOK project management tools or techniques; the game should have at least a demo mode to assure experimentation and finally they should have documentation.

Since the serious games market is very proliferated and defragmented, as games were found and selected , they were subjected to content analysis and experimentation while in parallel further research was carried out to ensure that as many applications as possible could be found.

As a result, throughout this period, were selected 12 games (see Table 2).

Table 2 Project management serious games

Game	Year	Company
SimulTrain	2017	Sauter Training & Simulation
PM-Game	2013	ALBASIM
ADA: Serious game for internal communication, training and onboarding	n.a.	Gamelearn
Triskelion: Serious game on time management and personal productivity	n.a.	Gamelearn
JA My Way	2018	PMI Educational Foundation (PMIEF)
The Crowd Training Games	n.a.	TheCrowdTrain
SimProject	2001	SPL
Cesim Project	n.a.	Cesim
Unlock: Project Management	2012	Totem Learning
The PMgame	2010	Robc
PTB	2016	SandboxModel
Project Management Simulation: Scope, Resources, Schedule V2	2013	Harvard

4. DISCUSSIONS AND RESULTS

The results of this study show that there is sufficient evidence that serious game have been used in context of project management and is acceptable as a methodology to help in the teaching/learning process. In order to analyze the level of coverage that serious games provide to the PMBOK, 12 different games were selected based on some predetermined criteria and considering the concepts of serious games. By reading the documentation and trying out the games, it was possible to survey the games in more detail.

In general, the games are not difficult to play, despite the fact that each game has a different simulation scenario, which leads to each of the games having a different duration as well. SimulTrain, for example, can be played in several 90 minutes, ADA is a somewhat time-consuming game because it requires more attention to detail, and it can take several hours to change phase, PMgame is a game that simulating an environment where it is necessary to plan the time and costs of a project, however it is a fast game.

Our results also indicate that 5 of the games namely: Project Management Simulation: Scope, Resources, Schedule V2, ADA: Serious game for internal communication, training and on boarding, Triskelion: Serious game on time management and personal productivity, The Crowd Training Games and JA My Way are single player focused while the remaining 7: SimulTrain, PM-Game, SimProject, Cesim Project, Unlock: Project Management, The PMgame and PTB namely, can suit either single or multi player. All games are web based, with the exception of PTB. It is also relevant to note that most of the games are not available for free.
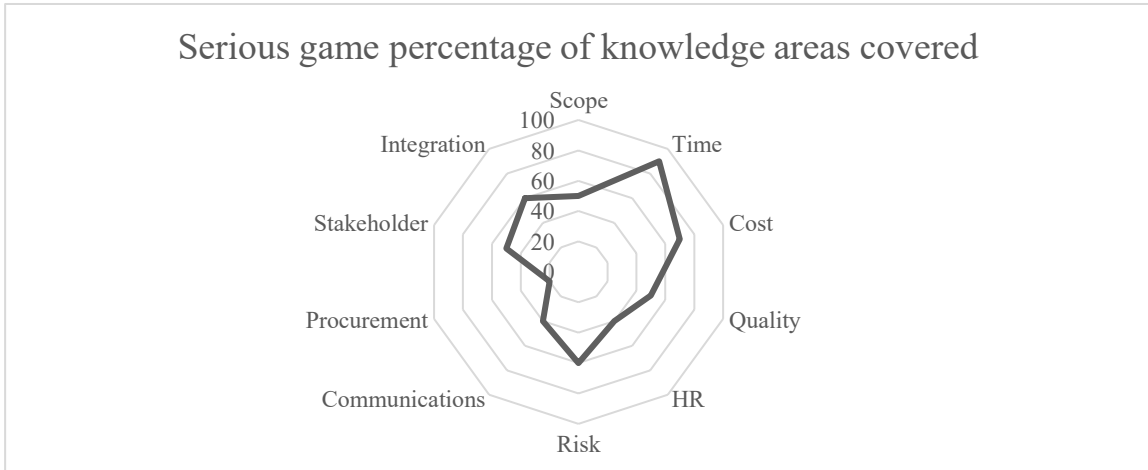
Figure 1 Serious game percentage of knowledge areas covered

As mentioned above, this analysis is based on the PMBOK that compose the following knowledge area: integration, scope, time, cost, quality, human resource, communication, risk, procurement, and stakeholders.

As we can see in the figure 1, some areas are more covered than the others. More than 50% of the games cover knowledge areas like integration, time, cost and risk. Other areas like scope, quality, human resource, communication, procurement and stakeholder are covered for less than 60% of the games. The procurement management, singularly, received less attention, covered just for one game. This leads us to believe that the search has received less attention than other areas of knowledge. On the other hand, time management has received a lot of attention, since almost 100% of the games deal with this subject. One more interesting discovery is that, at least one knowledge area is covered for one game.

Table 3 Serious game percentage of process covered

Game	Initiating	Planning	Execution	Monitoring & Control	Closing
SimulTrain		X	X	X	
PM-Game	X	X	X	X	X
ADA: Serious game for internal communication, training, and onboarding			X		
Triskelion: Serious game on time management and personal productivity		X			
JA My Way	X	X	X		
The Crowd Training Games	X	X	X	X	X
SimProject	X	X	X	X	X
Cesim Project	X			X	
Unlock: Project Management	X		X		X
The PMgame		X	X		
PTB		X	X	X	
Project Management Simulation: Scope, Resources, Schedule V2		X	X	X	X

Based on the results (Table 3), we can observe that ADA and Triskelion are focused simply on one process, becoming the games that cover fewer processes. Cesim Project, The PMgame, and Project Management Simulation: Scope, Resources, Schedule V2 each focus on two distinct processes as well, which brings us to the third group,

composed of SimulTrain, JA My Way, Unlock: Project Management, and PTB, which cover three groups of processes each. On the other hand, there are 4 games that cover all 5 process groups, namely: PM-Game, SimProject, The Crowd Training Games and Rita's Process Chart Game.

With this, in terms of knowledge area and process coverage, we can say that the process group most covered by the games is the execution process and it, followed by planning, on the other hand the least explored processes in the games are Monitoring & Controlling and Closing.

With this, in terms of knowledge area and process coverage, we can say that the process group most covered by the games is the execution process, followed by planning. Considering the relevance of these two processes, it can be said that it is acceptable the tendency that researchers have to focus on these processes. According to PMI [4], these two phases directly influence the project conclusion, once that, they are responsible to define, redefine the objectives to be met and the definition of the course of action to be followed, as well as the achievement of the planned processes in order to meet the project specifications. On the other hand, the least explored processes in games are Monitoring & Control and Closing. Which are also of very important, since it is through monitoring and control that it is possible to review and identify necessary changes to the plan [4]. The closing phase also plays an important role, because it is through this phase that all phases of the project are closed and formal closure is given.

In this study, preliminary evidence that serious games cover some PMBOK's knowledge area and process group are showed. And also, can provide a positive contribution to the students' experience and perceived learning based on the literature. But we suggest researchers to include these phases in their project management games in order to cover all PMBOK process Groups. Adding some failure scenarios could help students decision-making capabilities.

5. Conclusion

At the beginning of the study, two main issues were identified regarding current project management training. The first was to describe serious game as a methodology to teach project management. The second challenge was to cover a wide range of project management knowledge are and processes.

In order to answer the first challenge, a systematic literature review was made to gain a better understanding of serious games with a project management focus. Project management requires students must take in consideration a wide range of information, analyze the project instruction, and make decisions throughout the project life cycle. Concerning to the relevance of hands-on teaching in project management, the usage of serious games is certainly an attractive method and technique to cover the real-life scenarios in the teaching and learning process and translate theoretical lessons into a practical environment.

The second challenge consists in measure the level of coverage that serious games provide to PMBOK knowledge areas and process groups, we conducted a study involving 12 different serious games. In summary, our study indicates that there is a growing interest in developing serious games focused on project management. However, despite this interest, the games that have been developed do not cover at all the knowledge areas and process groups proposed by the PMBOK.

Unlike the other studies, that usually focus on systematic literature review of serious game, present methodologies to design serious game, or just study software project management serious game, in this study, preliminary evidence that the actual serious games cover just some specific PMBOK's knowledge area and process group.

6. Future work

Most of these articles discussed the potential of serious games in project management, described serious game for software engineering, or analyze the games based on the existing articles, but these papers do not propose a case of study with a specific game where students can play and based on the student's feedback identify the principal gaps and the real effectiveness of project management serious game. According to the literature there is not studies focused to analyze project management games to improve the soft skills of the students. Our study recommends a comparative study between simulators, to evaluate the improvements that newer simulators bring.

Acknowledgements

We thank ISCTE -IUL, for the research funding supported by the FCT UIDB/04466/2020 project.

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