Teaching Communication Management in Software Projects Through Serious Educational Games

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Abstract

Companies that have been successful in implementing software project management, have focused efforts on people-oriented topics, for example, communication and teamwork. In order to effectively disseminate the attributes that the organization expects from a newly formed professional and what the university prepares, it is necessary to adopt ways of teaching that will encourage the involvement of these young people. It is in this context that active teaching methodologies, such as Game Based Learning, have emerged to include processes of experimentation and social interactivity. This work aims to identify and prioritize the practices inherent to Communication Management in Software Projects, that allow to perfect a game for teaching and learning. The steps of this research were: (1) identification of communication management practices and processes in the literature, (2) prioritization of practices and processes through the use of the AHP method, (3) conducting cycles of application of the object of study: an online board game and finally (4). The results allow to conclude that there was an improvement in the number of correct answers after the students played the game, especially in practices Communicate changes efficiently, Accurately collect requirements and Communicate frequently with interested parties. So, it is possible to prove statistically that the game increased students' knowledge about these practices.

Keywords

Game based learning · Communication management · Software projects management

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29.1 Introduction

The complexity of the business environment has demanded companies to develop the capacity to coordinate, manage and control their activities. Several actions are being taken in order to pursue this adaptation, and one of the main pillars of these processes is using project management techniques that focus on organizational communication [1, 2]. Using precise information at the right time, and in the hands of the right person, is a rare differential that most project management teams lack [3].

Statistically, more than 65% of IT projects are not successfully. The main factor which contributes to their failure is the lack of communication or inefficient communication [4]. Therefore, it is crucial to plan how the communication will flow in the project [5].

It is important to identify how the professionals are being prepared, given that projects usually encompass professionals with different education levels, especially when dealing with software development projects. There is an increased interest in the utilization of games as educational instruments to assist students' learning and teachers' teaching procedures [6].

In this regard, the present study contributes toward better understanding of communication management in software development projects.

This article is organized in the following sections: Sect. 29.2 contains the research development methodology; Sect. 29.3 discusses the results obtained and, finally, Sect. 29.4 deals with the final considerations and premises for future research.

29.2 Method and Research Proposal

The research method used in this study is the Action Research, since it uses a research that classifies and prioritizes the Communication Management practices by applying them

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Table 29.1 Research action cycle

Step	Research context
I	Identifying the gap between the market demands and what is taught regarding communication management in software projects
II	Literature review to identify the methods related to communication management in software projects
III	Interview with specialists and prioritization of the Communication Management practices using the *Analytics Hierarchy Process* (AHP)
IV	Development of a serious educational game that transmits the practices related to the Communication Management Process, prioritized by specialists
V	Previous measurement of the participants' knowledge in Communication Management
VI	Application of the game on undergraduate students of Computer Science, Administration and Information Systems courses
VII	Measurement of the Communication Management knowledge learned by the players
VIII	Evaluation and improvement of the serious educational game based on the students' reviews
IX	New round of game application

Table 29.2 Choice of specialists

Specialist	Position	Certifications	Hours of experience (h)
1	Engineering Director	No	>10,000
2	IT Project Manager	PMP, Prince2, SCRUM	>10,000
3	Professor	PMP	>10,000
4	Operations Director	No	>10,000
5	IT Manager	PMP, PMI-RMP, PSM	>10,000
6	IT Project Manager	No	>10,000

in a serious educational game. The participants are intentionally allowed to experience the management of communication in software projects. Table 29.1 shows the Research Action steps followed in this study.

The SCOPUS and ISI Web of Knowledge databases were used in steps I and II. The "Communication in Management of Software Projects" string was used, and filters related to Areas of Interest, Year of Publication, Language, and Type of Document were applied.

After applying these filters, 36 articles were selected based on how their objectives were aligned to the goals of this study, and 29 different Communication Management practices were identified.

In step III, 6 experts in Management of Software Projects from different Brazilian enterprises were interviewed. Table 29.2 shows the questions and answers of each specialist.

The specialists used the AHP method to prioritize the practices found in the step II. Data was collected using online questionnaires. The prioritization process is shown on Fig. 29.1.

The specialists prioritized the 29 practices according to their level of importance in Communication Management in software projects.

The most relevant Communication Management practices were detected using the Paretto Principle and are shown in Table 29.3.

Communication Management is composed of three processes: Planning the Communication Management, Managing Communication and Controlling Communication Management [7].

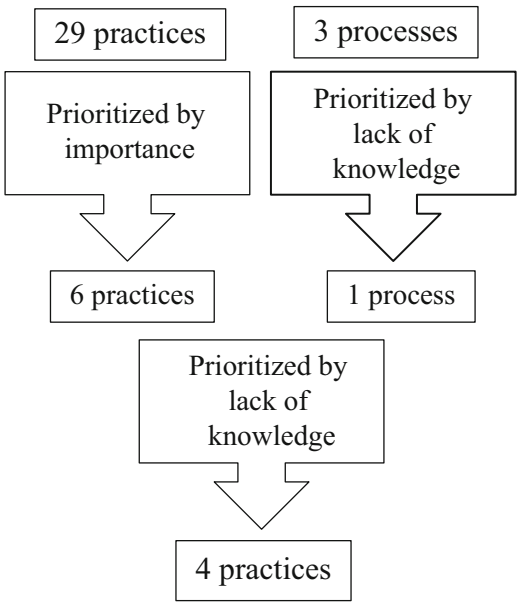

Fig. 29.1 Prioritization scheme of practices and processes

According to the interviewed specialists, Planning is the process where recent graduates usually have the highest deficit of knowledge.

The last prioritization concluded, with an 82.7% consensus rate between the specialists, which are the greatest knowledge deficits in the Communication Management Planning process regarding recent graduates (first four items in Table 29.3). These four practices were incorporated into the serious educational game.

Table 29.3 Important practices in communication management

ID	Communication management practices	Authors that reference these practices in steps I and II at Table 29.1
1	Communicate changes efficiently	[8, 9, 10, 11, 12, 13, 14, 15, 16]
2	Accurately collect requirements	[9]
3	Share information clearly	[15]
4	Communicate frequently with interested parties	[8, 17]
5	Have good communication and leadership skills	[18, 19, 20]
6	Communicate frequently with development team	[21, 22]

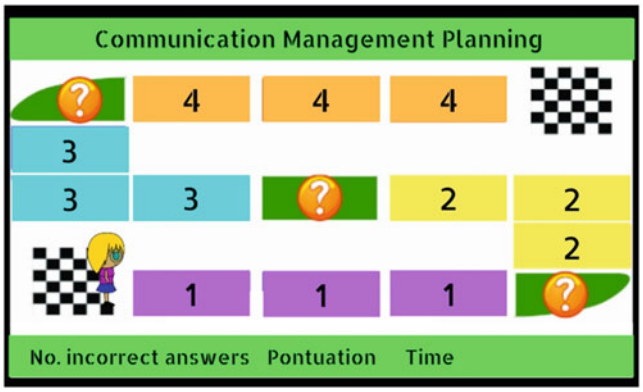

Fig. 29.2 Serious game design

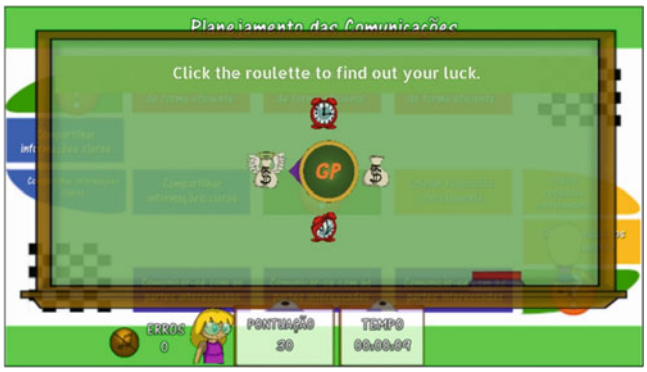

Fig. 29.3 Example of a random event

Step IV consisted of developing a serious electronic board game composed of questions and answers that aimed to present the practices prioritized by the specialists. The serious educational game was developed using the Unity3d platform.

The game was created based on the Game Based Learning (GBL) techniques, where the participants were submitted to a ludic environment [23]. The serious educational game was composed of twelve questions (three questions for each prioritized practices), as illustrated in Fig. 29.2.

Random events were included in order to increase Gamification, where participants won or lost points and/or time. The random events are shown in Fig. 29.3 and are represented by question marks in Fig. 29.2.

The participant had access to the number of incorrect answers, score, and time so he or she could track his performance. Only two students could win the game: The one with the highest score and the one that finished the game with the lowest time. Rewards, like chocolate, were given for their good performance.

An administrator panel was developed to store and access the following information for each participant:

- Score for each question.
- Time used to answer each question.
- Number of incorrect answers made by each player.
- Time gained or lost for each random event.
- Score gained or lost for each random event.
- Final score (Sum of score related to the questions and score gained or lost on random events);
- Final time (Sum of the time taken to answer the questions and time gained or lost through random events).

A questionnaire was used as a knowledge measurement instrument in steps V and VII. The questionnaire consisted of ten practical cases that the participants had to relate to each of the practices. The questionnaire was applied before and after the serious game, in order to detect any gain in knowledge.

Three application cycles of the serious game were performed, with students of the Information Systems, Computer Science, and Administration courses (step VI). At the end of each cycle, improvements were identified and implemented on the serious educational game (step VIII). Such advances were identified through observation, feedback and performance of the participants.

29.3 Results

The pared t hypothesis test was used to determine if there was a significant increase in the learning level of the participants after the serious educational game was applied. This test is useful to analyze the behavior of a sample that was submitted to two different treatments. The knowledge measurements were performed before and after the students played the serious educational game [24]. The t-hypothesis test was conducted using the following hypotheses:

Table 29.4 Performance of each application cycle

	Cycle 1	Cycle 2	Cycle 3
Number of participants	16	34	17
Mode of the number of correct answers before the game	4	3	3
Mode of the number of correct answers after the game	4	5	6
P-value	0.082	0.000	0.000
H0 Hypothesis	Not rejected	Rejected	Rejected

Table 29.5 Performance according to communication management practice

Practice ID	p-value Cycle 1	p-value Cycle 2	p-value Cycle 3
1	0.607	0.012	0.005
2	0.750	0.019	0.010
3	0.500	0.500	0.250
4	0.250	0.750	0.017

(H0) there was no knowledge gain after the students played the game:

- $\mathbf{StudentScore_{BeforePlay}} - \mathbf{StudentScore_{AfterPlay}} \geq 0$

(Ha) there was knowledge gain after the students played the serious game:

- $\mathbf{StudentScore_{BeforePlay}} - \mathbf{StudenScore_{AfterPlay}} < 0$

All samples considered a 95% confidence level (0.05 alpha). Table 29.4 shows a summary of each application cycle, as well as its respective p-value.

Table 29.5 summarizes each Communication Management practice approached by the serious educational game. This analysis was performed to determine which practices were improved in the participant's knowledge after the game. All values considered a 95% confidence level (0.05 alpha). Therefore, H0 is only rejected if its p-value is lower than 0.05.

The null hypothesis was not rejected when Cycle 1 was applied. There is no statistical evidence that there was an increase in the participants' knowledge.

When considering Cycle 2, there was statistical evidence that points toward the increase in the students' knowledge after playing the game. However, this increase was only seen in practices (1) Communicate changes efficiently, and (2) Accurately collect requirements.

The Cycle 3 had the best performance, and statistically showed improvements in three of the four considered practices: (1) Communicate changes efficiently, (2) Accurately collect requirements, and (4) Communicate frequently with interested parties.

It is believed that better results could have been obtained if the following aspects had been considered when planning the study object:

- The content of the serious educational game should be consistent with what is being taught by the professor. The game may not be capable of transmitting the knowledge by itself.
- Adapting the environment so that the game can be better implemented. A group with more than 20 participants demands a larger environment and the participation of moderators.
- Physical rewards for the game winners are not enough to make them feel engaged and involved. The students have to identify real value in the rewards. A good suggestion is to use their performance in the measurement questionnaire as part of their grade in the course.

The results suggest that the use of games can contribute to increase the knowledge of their participants.

However, serious educational games can also bring up questions and uncertainties about concepts that have already been learned, ratifying the need for the game to be properly planned.

The instrument chosen to evaluate the knowledge of the participants can be questioned. The combination of two or more measurement instruments would minimize the error rate.

Also, it is vital that the environment where the game is being applied is where the students can concentrate, so that they can be fully immersed and feel correctly motivated.

29.4 Conclusion

This study was able to identify which Communication Management practices recently-graduates most lack in the Computer Science, Administration and Information Systems courses, according to experts in the Communication Management for Software Projects context.

During the prioritization phase, 29 practices and three processes were analyzed. The practices a recent-graduate most

lacks in the Communication Management Planning process are: Communicate changes efficiently; Accurately collect requirements; Share information clearly; and Communicate frequently with interested parties.

After the prioritization phase, a serious electronic board game was developed to disseminate knowledge in Communication Management for Software Projects, along with an online questionnaire used to measure the students' knowledge. The evaluation questionnaire was applied before and after the game, in order to verify the progress in the number of correct answers.

Improvement opportunities were detected in each application cycle and incorporated into the serious educational game, so that it could be reassessed in the next cycle, even if there was no statistical indication that the serious educational game did not improve the students' knowledge in the matter.

It is possible to prove statistically that the gasification contributes positively to the students' learning, since after the game, there was an improvement in the amount of correctness of these practices (1) Communicate changes efficiently, (2) Accurately collect requirements, and (4) Communicate frequently with interested parties.

This research proposed itself to: (1) Identify and prioritize practices in Communication Management for projects. (2) Elaborate a serious educational game to teach these practices, (3) Apply the serious game in classrooms to promote knowledge in the participants. The object of study can positively contribute towards the conceptual and practical formation of the students, since it allows students to simulate problems encountered on a daily basis in real enterprises in a safe and ludic environment.

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