

# Gamification for Practical Engineering Education in Project and Risk Management

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**Abstract**—The paper makes insight in the current efforts of the universities to implement and perform practical knowledge to the engineering students in the business in a new economy of the new millennium and project environment they are working after graduation. The university education should be up-front in following the changes in the company' strategy orientated towards projects with various types, sizes and categories. This challenge, especially in the engineering curricula, the universities and professors are faced with, needs their creative approach in delivering practical knowledge and skills to the young professionals that will be needed in their workplace. The examples of introducing gamification method in solving assignments at FEIT are presented and analyzed, as an positive experience for both students and professors.

**Keywords**—Engineering education, Gamification, Project management, Risk management

## I. INTRODUCTION

A new project and economic environment needs to be understood by business and especially by the universities to educate good a skilled young professionals that should be successful in their profession as engineers. That new business environment is becoming very complex due to globalization, high level of concurrent entities, lack of money, investments throughout projects as new organizational strategy for doing business and emerging and dynamic developments in IC technology [1]. The professors, mentors and educators in general, should have a creative approach and research in applied methodology how to teach students of the new millennium. These students have changed the habits, vision and attitudes in comparison with the students from last decades of the 19th century. In the same time the project management skills and knowledge became inevitable in the engineering profession for their successful carriers. Moreover, the new trends in project management theory and practice such as: project risk management, application of the agile methodologies, etc. make the situation more complex and difficult for one unique project portfolio.

## II. PRACTICAL EDUCATION IN PROJECT MANAGEMENT AS CHALLENGING MISSION

Teaching engineering is a challenging mission/task and especially if we need educated professionals in engineering that are skilled to be successful and practice oriented, being prepared to make decisions and to take a risk in their workplace. In that sense introducing and teaching Project management on under-graduated level is very important to the young engineering professionals to be effective at work in a very dynamic and diverse new project environment the companies are running their business and in a New Economy of the new millennium [1].

As professors, in order to develop successful course in Project management and to make effective lectures, we should make an insight in the habits of the generation of students in question and analyze their potentials and needs in educational process. We should ask ourselves some questions like:

- What should we change in our lecturing to make the knowledge in Project management more attractive and keep them engaged to make an added value in studying and solving their assignment?
- What are their motivation drivers to focus on the needed scope of complex project environment?
- How to make the topics included in the course more interesting and motivational for them to be fully engaged in educational activities?
- What are the trends in professional theory and practice of project management currently that are needed for their competences on the workforce they are moving after graduation?

It is very important to find appropriate answers that will help us to lift as up to the educational environment students deserve and make them more motivated to participate. First of all, the students, as young generation, are very ambitious and there is a lack of attention economy searching for more and different tasks in the same time. In addition, they are striving for changes and challenges. Especially in engineering education, for them is much more important WHY a particular knowledge is important, comparing with previous importance of HOW particular knowledge could be acquired.

From our experience, it is very important to encourage the students not to be afraid of the projects as an unique undertaking and working in the project teams for particular project as an example. That could be done with carefully prepared, at first, simple examples in which the students can work successfully. "Keep it simple" should be the starting principle to make them to be successful in preparing the assignment [2]. However, in the beginnings, it is also important not to expect great things to be developed in certain project. These two principles with simple steps and lower expectations can make them to be much more motivated and engaged. The issue is "THEY SHOULD NOT BE AFRAID OF NEW COMPLEX AREA WHERE THE PROJECTS ARE IMPLEMENTED".

## III. INTRODUCING GAMIFICATION IN UNIVERSITY EDUCATION

The Gamification Research Network [3] is recognized as a communication hub for university researchers and students, as well as for young professionals in industry. The purpose

of the GRN is to continue research activities in the area by providing a repository of relevant people, projects, and publications, and by offering a shared space of discussion and publication. According to a 2011 Gartner Research Report it is estimated that by 2015, more than 50% of organizations (such as Cisco, Oracle and SAP) in the USA, that manage innovation process will Gamify those processes. As everyone knows, we all like to play, earn points and levels, and especially like the element of competition. In our efforts to make the practical part of the topics in core material of the course, we introduced method of "Gamification" in the solving the assignments with clear intention to make them PROACTIVE and they to feel the IMPORTANCE and CONTRIBUTION they can make in particular project.

The term "Gamification" relatively recently, is used in conjunction with "motivation" and "management" [4], and it is not a new idea. Gamification mechanisms for many years are used by companies or sectors of the different type of industry. For example: hotels for many years use loyalty card systems, which are collected points earned by customers through the use of hotel services for the network. Another example such as the aviation sector, has called the collection of miles, namely, after collecting a certain amount of customer's flight miles, it gains the right to one free flight. The change of the current perception of "gamification" is influenced by several factors, such is the success of newly established companies (Foursquare), who mastered to perfection the four main mechanisms of the "gamification": *points, levels, badges and leaders*. In addition, it is concluded that currently used methods and techniques of marketing are proving to be increasingly less effective. This is because that, currently, people are eager for more experience and experimentation. This concerns mainly the younger generation represented by people who are more familiar with the mechanics of games than the previous generation. Therefore, "gamification" serves to provide both one (experience) and second (experimental), in order to gain the attention of people and gain their commitment for a longer period of time.

As it is well explained in one embodiment, the invention may be a gamified computerized project management system [5] and method that harnesses the innate human desire for playful competition and continual skill advancement to improve organizational productivity. The system may allow team members to bidding on at least one project tasks (and even with different project options as well).

In other works, the researchers distinguishes five most common mechanisms of gamification [6]: Points - points have long been used in non-game applications, and they mean to obtain its objective. Points also measure the performance of a single user in comparison to the *points* earned by other users. Thus, they cause the user to increase the motivation to achieve their greatest possible number. Despite the fact that the *badges* are very popular in the real world, are now also very popular in the digital world. *Levels* - are used to motivate users to increase their efforts to achieve a progressively higher level. And also *challenges* can be very simple or very complex, very often require the involvement of the entire group of users. Gamification is also a very useful tool for solving problems such as too many e-

mails leading to overload mailboxes and servers, weight gain caused by dislike of society to exercise. To this end, a number of applications, such as The Game Email or Health Month, which aims to reduce the number of emails sent, or to convince people to exercise. Health Month in the application used gamification mechanism causes that make people feel less guilty in the case of failure. In games, as you know, the player has to defeat, which did not prevent him from playing. Games allow users to accept their failures.

Psychological and social foundations for primary motivation for gamification [7], is to enhance user or customer motivation to do a job or to increase and retain addiction to a service or a product using a game as a tool. Gamification can be explained by Fogg Behavior Model (FBM) [8], which claims that both, motivation to perform and ability to perform, must converge at the same moment for a behavior to occur. However, motivation should be supported by positive feedback from game mechanics that continuously moves on a user to perform specific actions and keeps him interested in the game. Psychological foundation of gamification has been elaborated further [9], with analysis why and how gamification is able to drive actions, and in [10], where extrinsic and intrinsic motivation is studied. Also, there is an analysis of its relationship with external incentives and rewards. Another motivation for gamification is *social competition*. In this case, gamification is driven by the need to interact with other players and compare one's results. Thus, gamification requires introduction of real-time multi-user games with complex rules of game that have some similarity to social networking platforms.

#### IV. PRACTICAL ASSIGNMENTS IN PROJECT MANAGEMENT USING GAMIFICATION

At the Faculty of Electrical Engineering and Information Technologies (FEIT), in the course of Project Management (<http://en.feit.ukim.edu.mk/faculty/education-programmes/undergraduate-programmes/undergraduate-programmes-2017/project-management>), we applied game mechanics and game dynamics to carry out laboratory exercises that have so far been performed classically. The classical way involves the individual work of the assigned task. In essence, the idea was to initiate teamwork, and also to create a competitive environment, in order to motivate students to be more engaged and to be more interested. A total of 15 students were divided into 4 groups (3 groups with 4 members and 1 group with 3 members). We have prepared 4 practical assignments, as follows:

*First assignment:* At first we randomly selected 4 students that we named as group leaders. We let each leader to choose their own team freely. The first exercise that was given to them was *to give ideas for initializing a project and to create PID (Project Initiating Document)*. Time limit was 15 minutes.

*Second assignment:* After the end of the first assignment, we re-grouped the teams randomly. Each group itself chose its' leader. The assignment consisted of *initiating a project using a brainstorming planning technique*. The tasks were clearly defined: (1) to determine the NEED to start a project, (2) define the parameters of the project management for scope of works to be fully implemented the mission of the

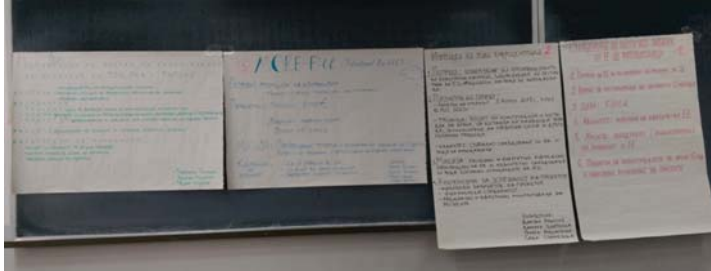


Fig.

project, (3) Defining the project' mission, (4) Determining the criteria for project success. Time limit for all 4 tasks was 30 minutes. Then, each group for a limited time of 10 minutes presented the solution for their assignment. Finally, each group was required to provide comments, remarks and suggestions for the assignments of the other three groups.

Each group had the opportunity to score 10 points (5 for the originality of the idea and 5 for the given comments). The winning group had the opportunity to decide whether the earned points would be added to the total exam points or to obtain a book in the field of project management. The results of the groups were shown on the board and become shared knowledge among groups.

The winner was Group 1, whose idea was supplying an existing fish farm supplied by photovoltaic power (electricity) plant, and, the leader of this group was nominated as the best group-leader. The chosen reward for successfully solved assignments was additional exam points. The remaining groups received two exam points equally, to keep them motivated.

*Third assignment:* In this assignment, the best group-leader (leader of the highest ranked group) was allocated in the lowest ranked group. The task in assignment was to create a WBS structure of the selected project from the previous assignment. Time limit for this task was 15 minutes.

*Fourth assignment:* The fourth assignment was to create a Gant Chart which was allowed to be done as homework. This means that they need to install appropriate software (MS Project or other) and learn how to use it themselves. Time limit was one week.

On Fig.1-4. are presented students and their work in teamwork atmosphere .

## V. THE ANALYSIS OF THE APPLIED GAMIFICATION AND STUDENTS FEEDBACK

After a certain time, when the impressions and operations from performed students' activities settled-up, we made a notes from our analysis - comparing the classical approach and gamification for some attributes of the practical assignments. In Table I. our findings are presented (adopted from [11]), comparing some characteristics (attributes) of classical and gamification method in education.

In the analysis , in order to evaluate the benefits of application of game elements and game dynamics in solving tasks fro the point of students' view, we made the questionnaire as short survey with the same students. The questionnaire for the students consists of a group of questions, such as: What is their opinion for applied gaming in solving tasks? What will change? What will add? Which motivational drivers could be used? etc.

The students answered the questions individually, not being in possibility to make each-other consultations. From this survey we concluded that using new approaches such gaming in this case – the exercises and practical training sessions are much more interesting for them, regarding the case of working alone on assignments. This new approach stimulate their creativity for generating ideas in group brainstorming sessions working on the particular assignment.

In addition, the Need for Achievement (A. Maslow, Motivational theory), and intention to win was fully explored. They were satisfied with teamwork and obtain basic experience working in a group. Mixing the group members, we done in assignments, make them to be more flexible, adaptive and enhance their willingness to work with others.

TABLE I. COMPARISON OF CLASSICAL EDUCATION AND GAMIFICATION FOR SOME ATRIBUTES

Attribute	Classical education	Gamification
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<i>Autonomy of student's work</i>	Low	High
<i>Collaboration in group</i>	No	Yes
<i>Failure in problem solving</i>	Punished	Expected, encouraged,
<i>Feedback from students</i>	After graduation or exam passed	Constantly
<i>Goals of learning</i>	Contradictory, vague	Clear
<i>Information needed</i>	Too much and not enough	Right amount at the right time
<i>Narrative expression</i>	Only if you are lucky	Common words
<i>Obstacles in work on task</i>	Accidental	On purpose
<i>Path to mastery</i>	Unclear	Clear
<i>Rules in learning progress</i>	Unclear, un-transparent	Clear, transparent
<i>Speed of solutions</i>	Low	High
<i>Status of Users</i>	Hidden	Transparent, timely
<i>Taking risk</i>	Afraid to make mistake	Encourage to take a risk, learn from mistake if happen
<i>Tasks to be solved</i>	Repetitive, dull	Original, fun

explored. They were satisfied with teamwork and obtain basic experience working in a group. Mixing the group members, we done in assignments, make them to be more flexible, adaptive and enhance their willingness to work with others. They learned that there is also capacity in them (assignment 2) to work with random assigned colleagues they have not develop friendship. With their ideas for new projects and their participation in a survey, they highly evaluate the possibility to give their feedback and participate in organization of Project management course. That way they have encouragement with the fact that they are important. In that context, besides the reward in the terms of points, they express the wish to visit real project and to analyze parameters, risks and other, and TO EVALUATE the project and to score the project with their previously established success criteria.

## VI. CONCLUSION

Introducing project and risk management in university education on under-graduated study, especially engineering, is a challenging mission. Such education should have to meet the needs of the students, industry and the entrepreneurs. It is well known that industry, companies and organizations will value and utilize project and risk management and attribute their success to it. However, the efforts that are making both University and industry working together, a common

engineering education in project management will find the way to ensure that our graduates have all of the tools they need to succeed and continue to contribute in economic and technological growth. In the last period, some creative approaches such as application of gamification is considered as a tool for project understanding and working in group or project teams.

The Engineering universities in their curriculum have to be up-front in the updating, understanding and applying new methods and techniques to teach the students of the new millennium. The results from application of gamification in team working for solving particular assignments at Faculty of Electrical Engineering and IT and the critical analysis that was performed by students are very useful for planning the educational activities. Such way, the creation of new methodologies and tools making project management discipline more interesting for students, become needed engagement for educators in dynamic business environment and habits of educated young individuals.

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