Article

Team Organization Method Using Salary Auction Game for Sustainable Motivation

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Abstract: In performing team-based projects in engineering class, students usually face many problems, such as free-riding, lack of responsibility, boredom, and insufficient initiative. This papers proposes a new method for performing team-based projects in engineering class—specifically, a gamified method for team organization using a salary auction game. On the description of the design and use of a salary auction game in engineering class, a case study conducted using a survey method is reported to validate the practical value of the proposed auction game. The salary auction game proposed in this paper demonstrates that a gamified team organization method in engineering class could be used as an effective tool to enhance motivation and to improve learning outcomes of engineering students.

Keywords: salary auction; gamification; motivation; engineering education

1. Introduction

As shown by Jarvenpaa and Leidner, a team-based project in undergraduate education helps to develop students' cooperative abilities and improve their problem-solving skills [1]. Kim suggests that, while performing a team-based project, students in engineering class frequently encounter many problems, such as free-riding, lack of responsibility, boredom, and insufficient initiative [2]. One of the most important factors in educational environments is students' motivation [3]. Furthermore, it is more difficult to sustain the motivation for a long time [4,5]. There are two reasons why the teachers feel it is difficult when they are trying to create sustainable motivation for students as described below. Firstly, the assessment and grading systems of most higher education programs focus on extrinsic motivation which

is less sustainable than intrinsic motivation [6,7]. Secondly, most higher education programs do not provide the flow model [8]. According to Csikszentmihalyi, the ability or skill of students and their learning difficulty should stay in the flow channel to sustain motivation [9]. If the learning difficulty is too low compared to the ability or skill of students, they grow bored of learning experiences. On the contrary, if the learning difficulty is too high compared to the ability or skill of students, they feel frustrated and give up studying.

According to Papastergiou, the gamified approach may be used to improve students' knowledge and to motivate them in classroom [10]. Kim and Ko show that engineering students have various needs for fun and pleasure that could be provided in a gamified class [11]. Based on 20 factors of the PLEX (Playful Experiences) model, Kim shows that, regarding preferences for fun and pleasure, engineering students prefer challenge, exploration, relaxation, completion, and discovery over competition, eroticism, suffering, sadism, and control [12]. Kim provides evidence that gamification can be used as a new and more effective tool to motivate the desire to learn, improve the level of communication and understanding, and to reduce learning stress in engineering education [13]. According to the big data analysis results provided by Google Trends, gamification of learning and education draws the most interest among gamification fields. Especially, global interest on gamification of learning and education has been increased sharply since February 2012 and Google Trends forecasts that the global interest will be increasing continuously.

This paper proposes a new method for team organization in engineering class with gamification to create sustainable motivation for students. The proposed method is based on the auction scheme and aims to improve engineering students' motivation and learning outcomes. To explore the effects of the proposed auction game, a survey method is used. The respondents of the present study are 33 undergraduate students at K University in South Korea.

The remainder of this paper is organized as follows. Section 2 provides an overview of previous work on motivation theory, gamification cases, and types of gamers. In Section 3 presents the salary auction game designed using existing auction schemes and gamification methods. Section 4 reports the results of a case study that validates the practical value of the proposed auction game. Finally, Section 5 presents the implications of the present study and discusses further research perspectives.

2. Literature Review

This section overviews previous research on motivation theory, gamification cases, and types of gamers.

2.1. Motivation Theory

McGregor at the MIT (Massachusetts Institute of Technology) Sloan School of Management proposes Theory X and Theory Y which have two contrasting models of human motivation [14]. Theory X is based on the belief that employees are fundamentally lazy and are in the habit of avoiding work because they do not like working for organization. Theory Y is based on the belief that employees have ambition, and are self-motivated and self-controlled. Thus, employees like their job duties and enjoy their work. Maslow suggests a five-stage model of human needs where stage 1 embraces biological and physiological needs (air, food, drink, shelter, warmth, sex, sleep); stage 2 consists of safety needs (protection from the elements, security, order, law, limits, stability); stage 3 includes social needs

(belongingness and love, work group, family, affection, relationships); stage 4 consists of esteem needs (self-esteem, achievement, mastery, independence, status, dominance, prestige, managerial responsibility); and, finally, stage 5 contains self-actualization needs (realizing personal potential, self-fulfillment, seeking personal growth and peak experiences) [15]. Lower stages of needs should be mostly satisfied before people have a desire for the next higher stage of need. Alderfer further develops Maslow's five-stage model of human needs [16]; in the revised model, called ERG (Existence, Relatedness, and Growth) theory, the five stages of needs by Maslow are classified into three categories: existence, relatedness, and growth.

2.2. Gamification

It is impossible to explain all the cases of gamification because there are numerous cases of gamification. This review aims to introduce some cases in the different lines of study and draw gamification mechanics from those cases. Schonfeld summarizes the mechanics, using SCVNGR's card decks, into achievement, appointment dynamic, avoidance, behavioral contrast, behavioral momentum, blissful productivity, cascading information theory, chain schedules, communal discovery, companion gaming, contingency, countdown, cross situational leaderboard, disincentives, endless games, envy, epic meaning, extinction, and so on [17]. Nielson classifies the mechanics of SCVNGR's card decks into the three categories of behavioral, feedback, and progression [18]. Duggan and Shoup provide the key mechanics such as a leaderboard, point, level, mission, challenge, quest, and feedback [19]. Werbach and Hunter summarize the mechanics into an avatar, achievement, badge, boss fight, collection, combat, content unlocking, gifting, leaderboard, level, and point [20]. Zichermann and Linder provide key mechanics such as a badge, point, level, leaderboard, and reward [21]. Table 1 describes the elements for gamification mechanics derived from the previous works [17–21]. The game designer can use some or all elements for the gamification mechanics.

Table 1. Elements for gamification mechanics.

Categories	Elements
Rewards	Points, Levels, Progression, Badge, Authority, Virtual Items, Physical Goods, Severance, Gifting, Free Items, Virtual Money
Reward Schedules	Fixed Interval Reward Schedules, Fixed Ratio Reward Schedules, Variable Interval Reward Schedules, Variable Ratio Reward Schedules
Avoidance	Disincentives, Leaky Bucket
Leader Board	Macro Leader Board, Micro Leader Board, Indirect competition, Direct Competition
Status	Avatar, Social Graph
Quests	Content Unlocking, Countdown, Lottery, Communal Discovery, Scaffolding

This paper summarizes four cases on home life, corporate human resource training, business marketing, and software tutorial. PowerHouse is an online game tracking personal energy use in the real world. A home smart meter sends information on personal energy use to the online game system; then, this information influences the abilities of players in the online game system. It provides a leaderboard display which compares the ranking of individuals or team performances. Real-life energy challenges provide further points and rewards to game players. It also provides multiple online mini-games which

motivate the players to help others save energy [22]. The leaderboard system used in PowerHouse is applied to design the salary auction game. Roadwarrior is SAP's (Systems, Applications & Products in Data Processing) training solution for sales representatives. It provides a simulated meeting with a virtual customer. In the simulated meeting, a sales representative should choose his/her own answer among multiple choices to respond to the customer's specific questions. A proper question, answer, and meeting preparation give new badges and points to sales representatives, so they can progress and unlock new levels [23]. The badge system used in Roadwarrior is applied to design the salary auction game. Plantville is an online game, launched by Siemens, which provides an opportunity to learn about industrial plant management. This software deals with both technical and business problems of plant management. The goal of Plantville is to improve awareness of Siemens technologies among future customers, employees, and students [24]. The virtual money system used in Plantville is applied to design the salary auction game. Ribbon Hero is a software tutorial developed by Microsoft (Redmond, MA, USA). Using Ribbon Hero, users explore the key functionalities of Microsoft Office while solving some interactive challenges [25]. Clippy is the name of the virtual character in Ribbon Hero who guides the game. The virtual character used in Ribbon Hero is applied to design the salary auction game.

Thiagarajan summarizes various games for team-building such as Secret Coaches, Switch, Equal Air Time, Wang and Give, Easy Money, Survivor, Garbage, Fight Right, Newton, Hidden Agenda, Three-Way Sudoku, Virtual Team Tips, and Crowd Wisdom [26]. According to Thiagarajan, there is no game which applies an auction game theory to team-building processes. The gamified feedback system using Class123 in the classroom was proved to be effective in motivating students and increased the students' perception of correctness and fairness in the teacher's feedback [27]. Class123 is a gamified application which manages students' behavior in the classroom and shares students' daily lives with their parents. It consists of a PC (Personal Computer) web service and a mobile web/app service for teachers, parents, and students. However, Class123 focuses on extrinsic motivation which is less sustainable than intrinsic motivation [6,27].

2.3. Types of Gamers

In the original player types model of Bartle, game players are classified into four categories using two axes [28]. The horizontal axis captures a player's degree of preference for the virtual world itself or for other players. The vertical axis refers to a player's degree of preference for acting alone or interacting. According to these two axes, game players are classified into the following four groups: achievers, explorers, socializers, and killers. Furthermore, Bartle suggested an improved model which adds a third dimension: that of implicit and explicit action [29]. Bartle specifies: "Implicit action is that which is done automatically without the intervention of the conscious mind; explicit action is that which is considered or planned for, generally as a means to achieve some desired goal or effect". The characteristics of eight player types are summarized in Table 2.

Kim and Ko provide the classification of engineering students based on Bartle's game player types using the online survey which consists of 24 questions [11]. While game player types such as planners, hackers, and friends are dominant, griefers and politicians are in the minority in engineering class. That there are few griefers among engineering students complies with the distribution of player types in the general population.

Table 2. Bartle's game player types.

Game Player Type	Key Characteristics
Opportunists	They are implicit achievers. They do not miss a chance. They look around to find something to do without knowing what it is until they find it. If they encounter an obstacle, they do something else instead.
Planners	They are explicit achievers. They like setting a goal and achieving it. They design a large plan and perform actions for that plan. If they encounter an obstacle, they avoid it. They persistently pursue their idea.
Scientists	They are explicit explorers. They make theories using experiments. They acquire knowledge methodically. They explain phenomena.
Hackers	They are implicit explorers. They want to reveal meaning by experiment. They try to discover new phenomena faster than others. They have a strong intuitive understanding of the virtual world.
Networkers	They are explicit socializers. They try to find people to interact with. They think of other players as fellows and want to know their fellow players. They learn who and what their fellow players know.
Friends	They are implicit socializers. They want to interact with players they already know. They have a deep understanding of their fellow players. They never mind the human weakness of fellow players.
Griefers	They are implicit killers. They always like attacking others. They are daring and brave. They hope to get a big and notorious reputation from other players. It is very difficult to explain why they act as griefers.
Politicians	They are explicit killers. They always act with forethought and foresight. They foxily manipulate people. They try to justify their decisions and actions in terms of their contribution and sacrifice for the virtual world. They aim to get a good reputation and raise awareness.

3. Salary Auction Game

Among Maslow's five stages of needs, the salary auction game focuses on levels 1 and 4 [15]. Considering the actual average salary of new recruits in South Korea, the students working as team members may estimate whether they receive enough pay from team leaders. Considering the difference of pay with their friends, the students working as team members may estimate they are esteemed. The game mechanics or tools such as a leaderboard, display, virtual money, characters, random selection

of auction scheme, and badges for team leaders are used for the salary auction game. According to Kim and Ko, while game player types of planners, networkers, and friends are dominant, griefers and politicians are in the minority in the engineering class [11]. There are few griefers among engineering students, which complies with the general distribution of player types. Team leaders of each team are expected to work as Bartle's planners. Team members of each team are expected to work as Bartle's networkers or friends. The beginning of the game starts with the selection of team leaders. Some students volunteer to play as the team leaders in the order of arrival. The overall process of the salary auction game is shown in Figure 1. Firstly, an instructor randomly selects a student's letter of self-introduction from the box. The self-introduction letters were written by each student to introduce their strength, attended lectures, and plan for the project work. Secondly, an auction scheme, which is an English auction or fixed-price bidding, is determined using the roulette software. Thirdly, the team leaders bid to hire five team members according to the auction scheme determined in the second step. The number of members in a team is six, including the team leader. Fourthly, if bidding is successful, a letter of self-introduction comes into the possession of the highest bidder. If bidding fails, a letter of self-introduction is put back into the box of self-introduction letters. This loop is repeated until the box of self-introduction letters is empty.
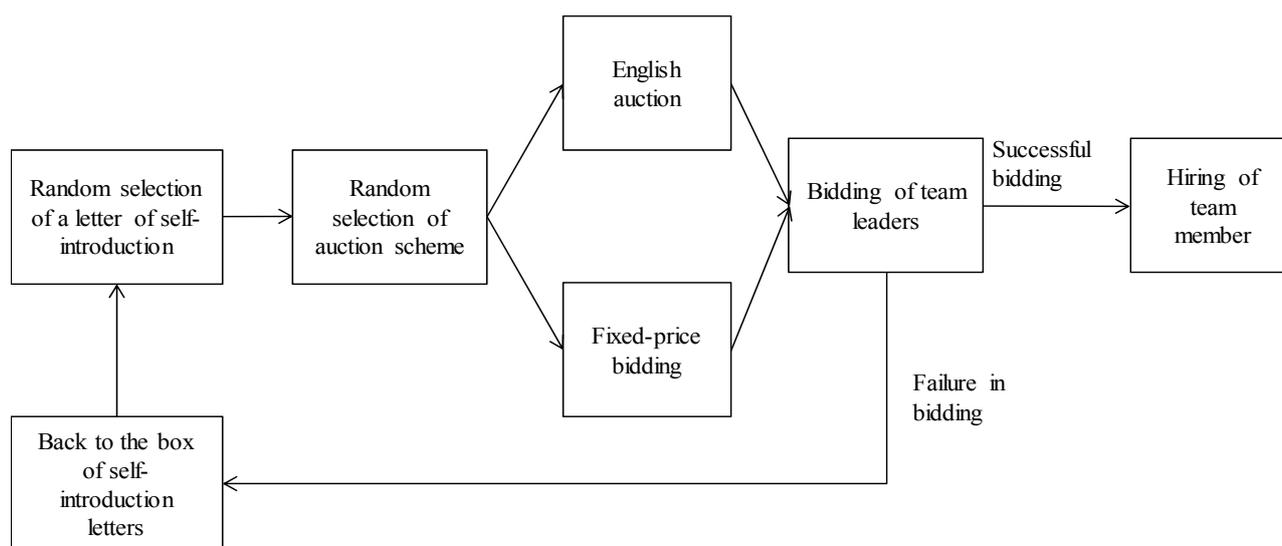

Figure 1. Process of the salary auction game.

The average annual salary of new recruits in 2012 in South Korea was about $30,000. Team leaders should hire five team members. Thus, in the beginning of the salary auction game, each team leader has $150,000 ($30,000/man × 5 men) which does not include his own salary. In the salary auction game, there is no fixed rule which affects the further process of the project works.

4. A Case Study

At K University, one major class in the fall semester used the salary auction game for team projects. Firstly, six teams were organized using the salary auction game. Secondly, the teams performed five team-based projects. Thirdly, a survey targeting 33 students was conducted. Fourthly, the survey results were statistically analyzed using SPSS software. The team organization process using the salary auction

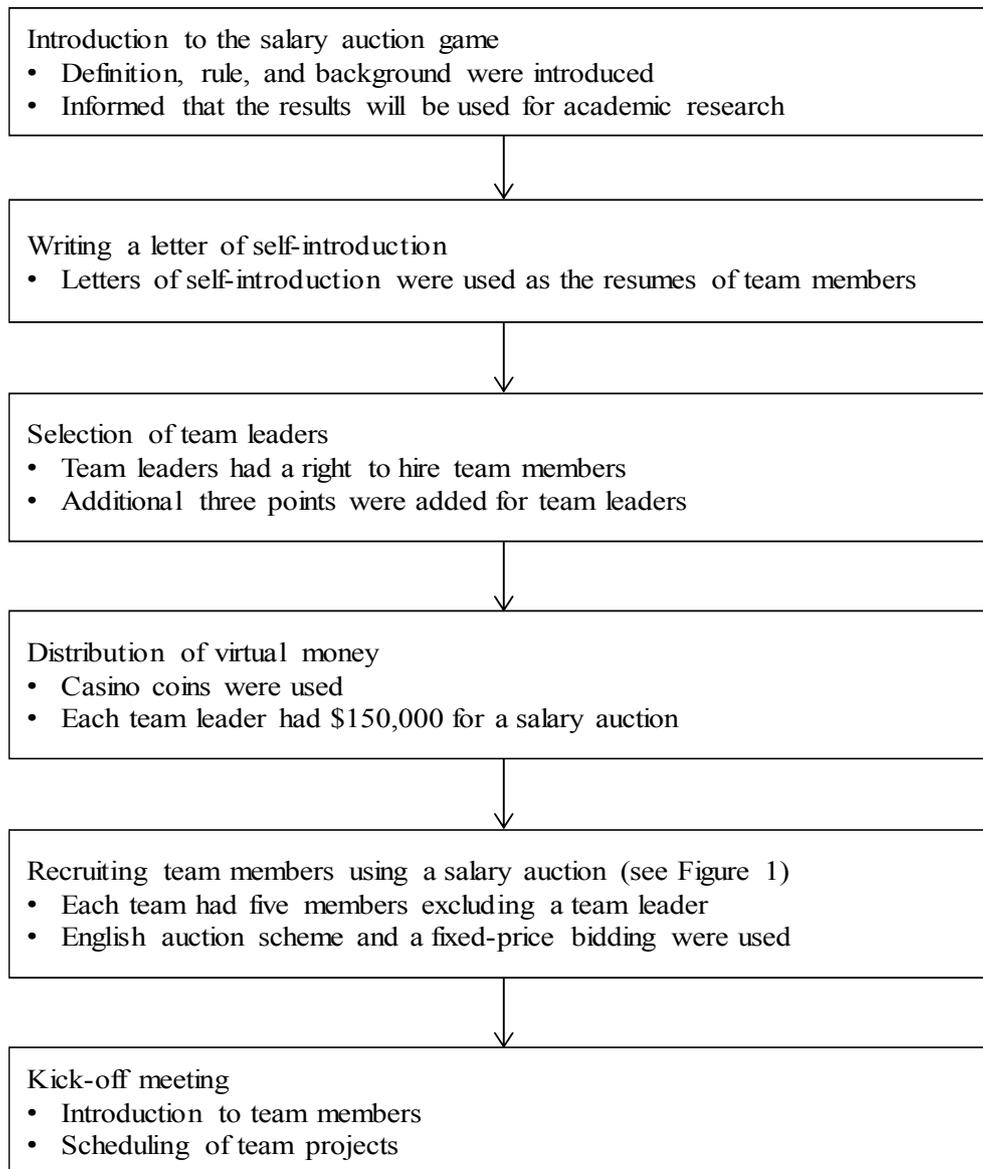game is shown in Figure 2. Team leaders recruited team members using the salary auction game (see Figure 1).

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┌─────────────────────────────────────────────────────────────┐
│ Introduction to the salary auction game                      │
│ • Definition, rule, and background were introduced           │
│ • Informed that the results will be used for academic research│
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                              │
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┌─────────────────────────────────────────────────────────────┐
│ Writing a letter of self-introduction                        │
│ • Letters of self-introduction were used as the resumes of team members│
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│ Selection of team leaders                                    │
│ • Team leaders had a right to hire team members              │
│ • Additional three points were added for team leaders        │
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│ Distribution of virtual money                                │
│ • Casino coins were used                                     │
│ • Each team leader had $150,000 for a salary auction         │
└─────────────────────────────────────────────────────────────┘
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│ Recruiting team members using a salary auction (see Figure 1)│
│ • Each team had five members excluding a team leader         │
│ • English auction scheme and a fixed-price bidding were used │
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│ Kick-off meeting                                             │
│ • Introduction to team members                               │
│ • Scheduling of team projects                                │
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Figure 2. Process of team organization using the salary auction game.

4.1. Evaluation Using Self-Assessment.

The survey that explored the effects of the salary auction game consisted of 10 questions. These included three questions on the characteristics of respondents, two questions on the team organization process, three questions on the performing process of team projects, and two questions on the overall learning outcomes and satisfaction. Questions on the characteristics of respondents surveyed the grade (year), gender, and average grade from former semesters.

Questions on the team organization process were as follows:

Q4: Does the salary auction game increase your concern for team members?

Q5: Does the salary auction game increase the initiative of the student in the team-building process?

Questions on the performing process of team projects were as follows:

Q6: Does the salary auction game let you have fun while learning?
Q7: Does the salary auction game improve the sense of responsibility of team members?
Q8: Does the salary auction game make you feel you are having fun in performing team projects?

Questions on the overall learning outcomes and satisfaction were as follows:

Q9: Does the salary auction game improve the quality of team projects' outcomes?
Q10: Would you like to recommend the salary auction scheme to other classes?

The respondents of this survey were 36 undergraduate students (eight females) at the engineering school of K university. All students participated in the class as either team leaders or team members. Of all students in the class, 33 were surveyed as survey respondents. All questions, except for three questions targeting the respondents' characteristics, were responded to using a five-point Likert scale (where 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree).

Students' responses on the salary auction game were analyzed using SPSS (version 20). Table 3 summarizes the results of the descriptive statistics.

Table 3. Descriptive statistics of students' responses on the salary auction game.

	N	Mean	Std. Deviation	Std. Error Mean
Q4	33	3.4848	0.71244	0.12402
Q5	33	3.5455	0.75378	0.13122
Q6	33	3.8485	0.83371	0.14513
Q7	33	3.0909	0.94748	0.16494
Q8	33	3.4848	0.93946	0.16354
Q9	33	3.3636	0.65279	0.11364
Q10	33	3.4545	0.93845	0.16336

Table 4 summarizes the one-sample *t*-test results. The test value for the one-sample test is 3, which means neither agree nor disagree as defined by the Likert scale. The test value means that there are no meaningful effects of the salary auction game.

Based on the statistical analysis results reported in Tables 3 and 4, the effects of the salary auction game are summarized below.

Table 4. One-sample *t*-test for students' responses on the salary auction game.

			Test Value = 3			
	t-Value	Degree of Freedom	Significance Probability (two-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Q4	3.909	32	0.000	0.48485	0.2322	0.7375
Q5	4.157	32	0.000	0.54545	0.2782	0.8127
Q6	5.846	32	0.000	0.84848	0.5529	1.1441
Q7	0.551	32	0.585	0.09091	−0.2451	0.4269
Q8	2.965	32	0.006	0.48485	0.1517	0.8180
Q9	3.200	32	0.003	0.36364	0.1322	0.5951
Q10	2.782	32	0.009	0.45455	0.1218	0.7873

4.1.1. Does the Salary Auction Game Increase Your Concern for Team Members?

The *t*-value of Q4 is 3.909, so it can be assumed that the salary auction game increased the students' concern for team members. To hire a man of ability, the students paid close attention to others' letters of self-introduction and this increased their concern for others.

4.1.2. Does the Salary Auction Game Increase the Initiative of the Student in the Team-Building Process?

The *t*-value of Q5 is 4.157, so it can be assumed that the salary auction game increased the students' initiative in the team-building process. If an instructor leads a team organization process, students generally take a passive attitude. In the present salary auction game, an instructor only acted as an auction broker, which made the students feel that they had the initiative.

4.1.3. Does the Salary Auction Game Let You Have Fun While Learning?

The *t*-value of Q6 is 5.846, so it can be concluded that the salary auction game let the students have fun while learning. Basically, the salary auction is a game that was interesting to the students. Based on 20 factors of the PLEX model, Kim shows that, regarding preferences for fun and pleasure, engineering students prefer challenge, exploration, relaxation, completion, and discovery over competition, eroticism, suffering, sadism, and control [12]. However, the specific kind of fun the students experienced while playing the salary auction game is not certain.

4.1.4. Does the Salary Auction Game Improve the Sense of Responsibility of Team Members?

The *t*-value of Q7 is 0.551, so it can be assumed that the salary auction game did not improve the responsibility of team members. To explore this issue further, personal interviews with several students were conducted. There were two unusual cases. Firstly, some students thought that, considering their skills and knowledge, the final contract salary determined in the salary auction game by the team leader was undervalued; therefore, they insisted that the team leader made a mistake and should show more responsibility than them. In contrast, other students thought that, considering their skills and knowledge, the final contract salary determined in the salary auction game by the team leader was overestimated due to the unskilled team leader or defects in the auction scheme. They thought that even if they were paid double of what other members received, they did not need to take more responsibility than other members.

4.1.5. Does the Salary Auction Game Make You Feel You Are Having Fun in Performing Team Projects?

The *t*-value of Q8 is 2.965, so it can be assumed that the salary auction game made the students feel they were having fun in performing team projects. In performing team projects, the salary of each member played a role as a story subject.

4.1.6. Does the Salary Auction Game Improve the Quality of Team Projects' Outcomes?

The *t*-value of Q9 is 3.200, so it can be concluded that the students thought that the salary auction game improved the quality of team projects' outcomes. From the instructor's point of view, the average score of the team projects using the salary auction game, as rated by the instructor, was 8.58/10, which

is slightly higher than the average score (8.2/10) of the team projects that did not use the salary auction game in the previous class. From the students' point of view, they thought that the salary auction game was helpful in improving the quality of team projects. However, in the instructor's view, that the salary auction game was helpful in improving the quality of team projects was not certain, because the sample was too small and other factors might have contributed to the improvement of the average score as rated by the instructor.

4.1.7. Would You Like to Recommend the Salary Auction Scheme to Other Classes?

The *t*-value of Q10 is 2.782, so it can be assumed that the students were fully satisfied with the salary auction game and wanted to use the salary auction game in other classes.

4.2. Evaluation by the Third Party

An evaluation by the third party was carried out with the help of two teaching assistants and one lecturer. These three people compared the projects performed by the teams that were organized using the salary auction game with the projects performed by the teams that were organized randomly in the same class of the last semester.

In the class of the fall semester of 2013, six teams were organized randomly. In the class of the fall semester of 2014, six teams were organized using the salary auction game. The students that attended the classes of 2013 and 2014 performed the projects with the same topic and grading policy. Two teaching assistants and one lecturer evaluated the six projects of 2013 and the six projects of 2014. They assessed each project independently on the responsibility of team members during the project and the quality of the project results. The responsibility and quality were assessed using a 10-point scale where "1" means a very negative result and "10" means a very positive result. Table 5 summarizes the assessment results.

The average responsibility from 2013 was assessed as 5.4 points. The average responsibility from 2014 was assessed as 6.7 points. It is observed that there is a 25% growth in the responsibility of team members. The average quality from 2013 was assessed as 6.0 points. The average quality from 2014 was assessed as 6.8 points. It is observed that there is a 13% growth in the quality of project results.

Table 5. An evaluation by the third party.

Subject	Assessor	A	B	C
2013	Responsibility	5.3	5.3	5.5
	Quality	5.7	6.2	6.2
2014	Responsibility	6.3	6.7	7.2
	Quality	6.5	7.2	6.7

5. Conclusions

Efficient and effective satisfaction of human needs is a key to an organization's success. Recently, gamification has come to the forefront as one of the new widely used solutions for human motivation in various areas. Bunchball shows that there is a close connection between human desires and game

mechanisms [30]. One of the important factors in education environments is students' motivation [3]. This paper provides the overall scheme of the salary auction game that could be used as a gamified tool in engineering class to motivate students to perform better in team-based projects. The salary auction game is designed to support the team organization process for team-based projects.

The novelty and innovativeness of this paper can be summarized as follows:

- It is the first gamification case that applies an auction game theory to the team-building process;
- Considering the rapidly increasing interest in the gamification of learning and education, the proposed team organization method using the salary auction game could receive great attention from school teachers, educationalists, and gamification researchers;
- The proposed salary auction game proved to be an effective tool which motivates students and makes them have fun and could be applied to the higher educational field.

The implications of this paper can be summarized as follows:

- This study blended different fields of motivation theory and game mechanism to suggest an innovative method for team organization in engineering class;
- The proposed salary auction game enhances the intrinsic responsibility of the students, which creates sustainable motivation;
- A team organization method using the salary auction game is helpful to improve the quality of team-based projects from the point of view of the students.

Limitations and further research perspectives can be summarized as follows:

- The reason(s) why a team organization method using the salary auction game is not helpful in enhancing the responsibility of team members should be further investigated;
- The positive value and side effects of each game mechanism in the salary auction game should be studied item by item;
- The difference of learning effects or motivation regarding Bartle's player types of planner, networker, and friend should be analyzed.

Acknowledgments

Conflicts of Interest

The author declares no conflict of interest.

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