Influence of gamification on student engagement in education

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Abstract: - Rapid development of new technologies offers great potential in improving the educational process. One of the popular and entertaining methods nowadays is gamification, which allows students to learn through entertainment and competition in an easier matter and to stay motivated during the class for a longer period of time. The goal is to maximize student engagement in class, welcome positive competitiveness and making learning fun. In this paper, we will describe an example of gamification tool named Kahoot on Zagreb School of Economics and Management (ZSEM). Research was made by questioning both professors and students perspective on gamification in order to determine the satisfaction level of both sides in the education process. The analysis have shown positive attitude towards the use of gamification in lectures and it encourages further use of it on more and different courses. In order to back up this "positive wave" of gamification on ZSEM, we examined student's engagement on Kahoot on Information and Communication Technologies course and analyzed the data with final grades of the course.

Key-Words: - gamification, education, classroom, motivation, Information and Communication Technologies, Kahoot

1 Introduction

The use of new technologies in education provides lecturers a variety of features that streamline the process of education and motivate students to be active regardless of whether it is a classical education in the classroom or distance learning education [1]-[4]. Gamification allows students to engage more in education through playing a game and having competition between themselves [5], which makes gamification a new way of motivating students to become more active in the classroom, as well as in e-learning [6]. In paper "Note Taking: A Critical Review" authors said that the motivation of students in class is growing in the first 10 minutes [7]. On the other hand, it is known that "gamers" can play various video games for several hours a day [8].

This game-related phenomenon of keeping the concentration for hours and losing track of time for the sake of progress could be an area that education was looking for a long time, grasping students in a new, fun and competitive environment for the sake of learning and knowledge utilization. Gamification in education is trying to capture exactly those elements which define games as source of fun and motivating players to continue playing with the aim of progression. By using same elements in a non-game context in education [9], gamification tries to influence that behavior in students in order to strengthen their desire to learn more, to enhance the competitiveness and to motivate them for future development. This points out a solid reason of using gamification benefits in education – as in one of the activities that are not closely related to games, but different educational areas [10,11].

The following will analyze the usage of gamification tool named Kahoot on Information and Communication Technologies (ICT) [12], a first semester course at the Zagreb School of Economics and Management (ZSEM).

2 Gamification on ZSEM

As ZSEM was founded 15 years ago, some of the world's best practices in systematic process implementation of new technologies were able to merge and combine with the education processes from the very beginning [13, 14].

2.1 Lecturers and gamification

In a study conducted over 50% of ZSEM lecturers [15,16], 32% of them confirmed that they are using some form of gamification in their lectures. Professors that do not use gamification, 53,8% of them were not familiar with the gamification tools at that time, 23,1% believe that gamification can't be applied within their lectures, while 7,8% are not interested in this form of education. (Figure 1) However, 92% of lecturers who do not use gamification in their lectures stated that they are most likely to use it in the near future.

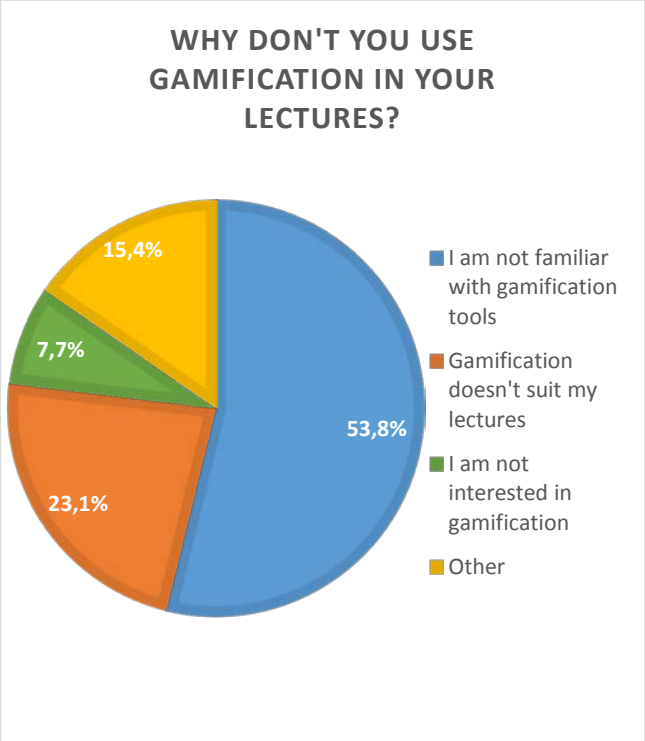

Fig. 1. Reasons why professors don't use gamification

Out of all lecturers that use gamification in their lectures, 67% of them started using gamification since 2016, after the first workshop where professors were introduced and got familiar with gamification tools – Plickers and Kahoot. Although, some professors were using various forms of gamification since 2011, like Lego game and Sokrat. Now all of them consider gamification as a strong motivation factor – 50% with score 4 and 50% with score 5 on Likert scale from 1 to 5. However, only 16,7% of lecturers analyze the responses of all students, while 66,7% analyzes only top 5 student responses in quizzes. On some courses gamification already forms a certain percentage in grading formation and 83% of the professors consider that gamification should be an integral part of their syllabus. In open answers lecturers stated that they think that gamification is highly motivating students to be more active in class and that it creates a competitive nature among students.

2.2 Students and gamification

Students have similar assumptions to lecturers regarding gamification. A research was conducted in the winter semester of an academic year 2016/2017 where 20% of ZSEM students participated from undergraduate level. 80% of students which were surveyed said that they were using gamification at least on one course. On Likert scale from 1 to 5, students expressed their satisfaction using gamification on their courses - 67% of students scored their satisfaction with a 5, 26,8% scored 4,while only 5,2% scored 3 and only one student stated his dissatisfaction with gamification. (Figure 2)**.**

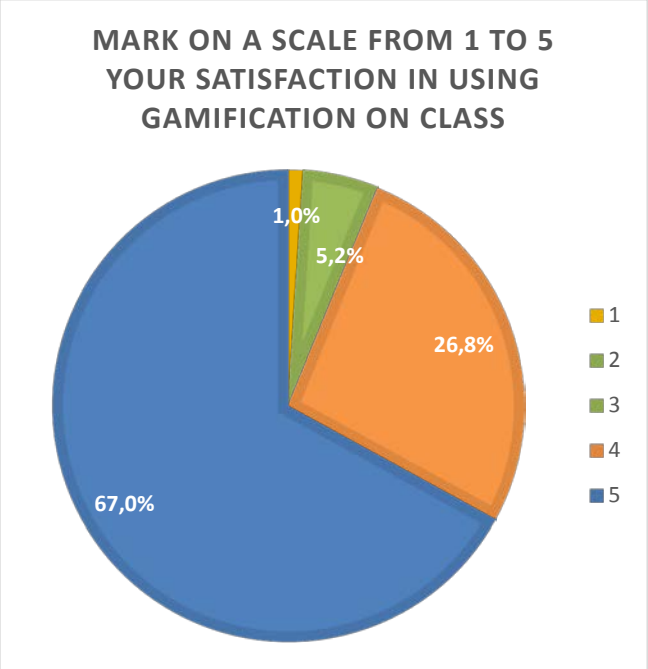

Fig. 2. Student satisfaction in using gamification in class

When students were asked how much did gamification help them in motivation towards lectures, 90% of scores were 4 or 5, and there were even 86% of students who stated that gamification helped them get better grades. Also, most of the students agree that gamification should be an integral part of most of the courses. In open answers students expressed their positive attitude towards gamification in class because they revise their lectures through a fun game and it also provides extra motivation.

2.3 Gamification on ICT course

Gamification is used on ICT for the sake of revising lectures at the beginning of the class or before mid-term exam and it is done with a quiz tool, Kahoot. During the semester, 7 Kahoot quizzes were held, but due to some technical difficulties on one of them, 6 Kahoots were analyzed. Our Kahoot quizzes were mostly designed with 6 to 8 questions with multiple answers, and points earned are based on the correctness and speed of answering. On Figure 3 is shown a typical question with 4 offered answers. [11]

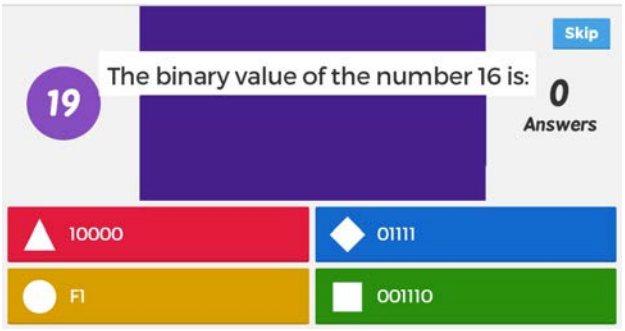

Fig. 3. Kahoot question

After every question, lecturer discuses it in order for students to revise and learn in a simple matter through game and fun. Gamification is not an integral part of the ICT Syllabus, it is solely an additional activity which symbolically rewards students based on their engagement – first place is awarded with 1,5% of the grade, from second to fifth place is 1%, where everyone else who participated get 0,5%. Kahoot enables the lecturer to follow a detailed statistics and to analyze the level of difficulty of a specific question regarding students.

3 Data analysis

Six Kahoot quiz tests were performed among the students. Every student reached a total score by answering the questions in every Kahoot quiz test, as depicted in Figure 4. Student attempts are on X axis, grouped by Kahoot (100-199 = first Kahoot, 200-299 = second…), and score is on Y axes. Zero score values represent the students without data for that Kahoot.

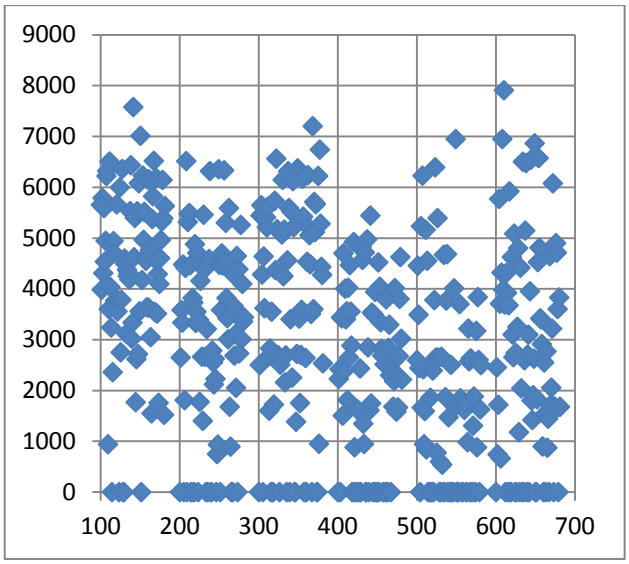

Fig. 4. Raw data scatter

The number of points achieved varies in total from 540 to 7907, and descriptive statistics for data points recorded in each Kahoot are presented in Table 1. When the student didn't attend the class, result is recorded as blank.

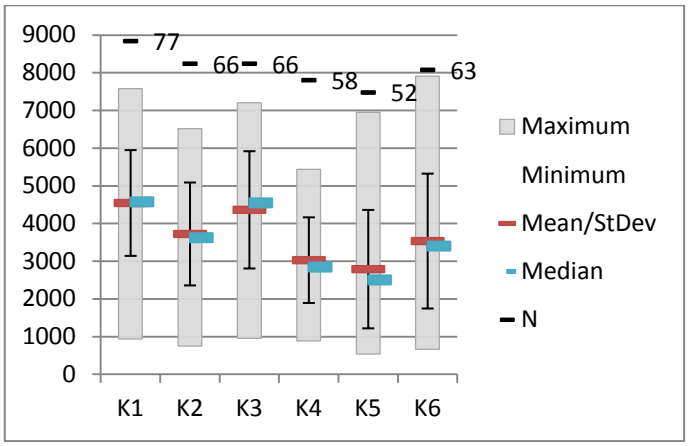

Fig. 5. Spread, means and medians

Means and medians are close, but differing variances and mostly negative kurtosis point towards different spreads and distributions in each Kahoot. Matrix of Pearson's correlation (Table 2) shows that the relationships between Kahoot pairs are low, or just in a couple of cases moderate.

Table 1. Descriptive statistics of each Kahoot

	K1	*K2*	*K3*	*K4*	*K5*	*K6*
Mean	4542,428571	3720,5	4360,621212	3026,258621	2787,903846	3532,31746
Standard Error	159,8684988	168,0164955	191,4281545	149,1071138	217,8251583	225,3119415
Median	4573	3622	4545,5	2843,5	2501,5	3400
Mode	-	3582	5407	-	2648	-
Standard Deviation	1402,840384	1364,972462	1555,169679	1135,565947	1570,759555	1788,358094
Sample Variance	1967961,143	1863149,823	2418552,731	1289510,02	2467285,579	3198224,672
Kurtosis	-0,21451059	-0,3479493	-0,957287063	-0,839447977	0,105648243	-0,574190091
Skewness	-0,350290766	-0,066722469	-0,330911142	0,161814035	0,83275645	0,435916115
Range	6635	5765	6250	4559	6407	7243
Minimum	942	749	951	883	540	664
Maximum	7577	6514	7201	5442	6947	7907
Sum	349767	245553	287801	175523	144971	222536
Count	77	66	66	58	52	63
Confidence Level (95,0%)	318,4057103	335,5521125	382,3084242	298,581845	437,3022526	450,3921535

Table 2. Kahoot correlation matrix

	K1	K2	K3	K4	K5	K6
K1	*1,00000*	*0,29869*	*0,08254*	*0,16784*	*0,22697*	*-0,01314*
K2	*0,29869*	*1,00000*	*0,23413*	*0,15975*	*0,39703*	*0,47725*
K3	*0,08254*	*0,23413*	*1,00000*	*0,19914*	*0,09183*	*0,14753*
K4	*0,16784*	*0,15975*	*0,19914*	*1,00000*	*0,46803*	*0,36469*
K5	*0,22697*	*0,39703*	*0,09183*	*0,46803*	*1,00000*	*0,29676*
K6	*-0,01314*	*0,47725*	*0,14753*	*0,36469*	*0,29676*	*1,00000*

Classification of the results was performed by calculating quantile values for each Kahoot, and assigning q-values (1 for 1st quantile in which lower 25% of students' results reside, 2 for 2nd quantile, 3 for 3rd and 4 for 4th quantile) to each student result, i.e. if the student achieved the result that is better than 75% of other students in that Kahoot, it is assigned the q-value of 4. The average q-value is obtained as sum of q-values per student divided by number of Kahoots student has taken, and we can consider average q-values proportional to the student's knowledge of the subject.

Blank values from raw dataset represent student's absence from Kahoot testing, so each student was assigned the number (1-6) of Kahoots attended, and this is considered to be proportional to student's dedication and effort and taken as second set of data points.

At the end of term, students took the exam, and got the grade (2-5). Students that have not yet taken the exam got the grade recorded as 0. The final grades represent the third variable.

About 20% of students have grade value of 0 (didn't took the exam yet) and they are excluded from the descriptive statistics of these variables (Table 3).

Q-values are slightly skewed towards lower values, with the longer tail on the higher end, which is consistent to the scatter plot of the raw values. Since 63% of students attended 5 or 6 Kahoots, negative skew and large variance was expected. Grades are spread widely across their range, and after all students pass the exam, it is expected that they will approach normal distribution.

Table 3. Descriptive statistics of classified variables

	Q-values	*Dedication*	*Grade*
Mean	2,585365854	4,658537	3,417910448
Standard Error	0,083132041	0,163906	0,142899568
Median	3	5	3
Mode	2	6	2
Standard Deviation	0,752792653	1,484234	1,169683378
Sample Variance	0,566696778	2,202951	1,368159204
Kurtosis	-0,364455223	-0,07661	-1,444509158
Skewness	0,146637836	-0,94411	0,17468662
Range	3	5	3
Minimum	1	1	2
Maximum	4	6	5
Sum	212	382	229
Count	82	82	67
Confidence Level (95,0%)	0,165406686	0,326122	0,285308194

If we take average of q-values and dedication for each student, we can suppose that such value, q-average, will represent the combination of student's knowledge and dedication, in range 1 - 5. We can test that the difference between q-average and final grade (range 2-5) means will be 0.5 (null hypothesis). The results of the paired two sample t-test (Table 4) show P values > 0.05 suggesting that null hypothesis can't be rejected. Also, Pearson Correlation of 0,517 is considered as moderate correlation between two variables.

Table 4. t-test q-average and grade

t-Test: Paired Two Sample for Means		
	Q-average	*Grade*
Mean	3,798507463	3,417910448
Variance	0,629240163	1,368159204
Observations	67	67
Pearson Correlation	**0,516702529**	
Hypothesized Mea Difference	0,5	
df	66	
t Stat	-0,95904144	
P(T<=t) one-tail	**0,170519031**	
t Critical one-tail	1,668270514	
P(T<=t) two-tail	**0,341038061**	
t Critical two-tail	1,996564419	

Based on this statistical analysis, we depicted the dependency of final exam grades (2-5) on q-values (1-4) representing knowledge and dedication values (1-6) representing effort. Number of students who achieved respective grade is represented by the bubble area. In order to present the results more clearly, lower final exam grades (2 and 3) are drawn on Figure 6 separated from higher final exam grades (4 and 5) on Figure 7.

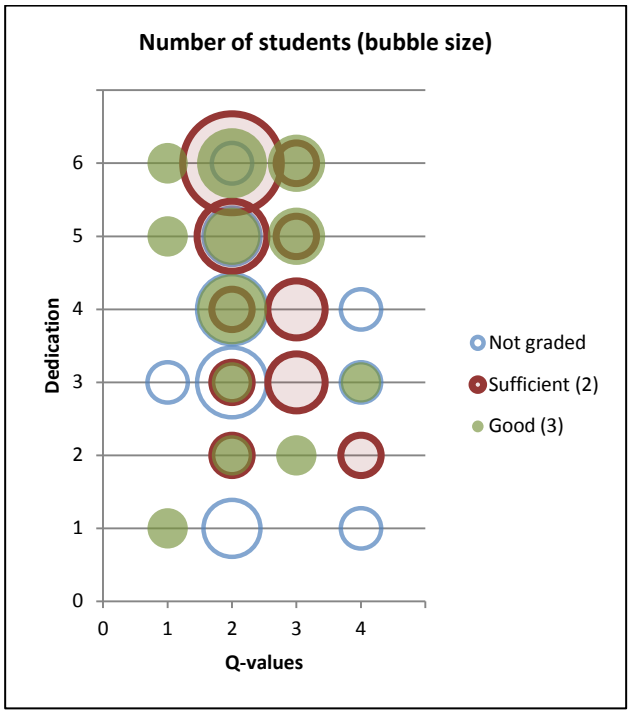

Fig. 6. Lower grades

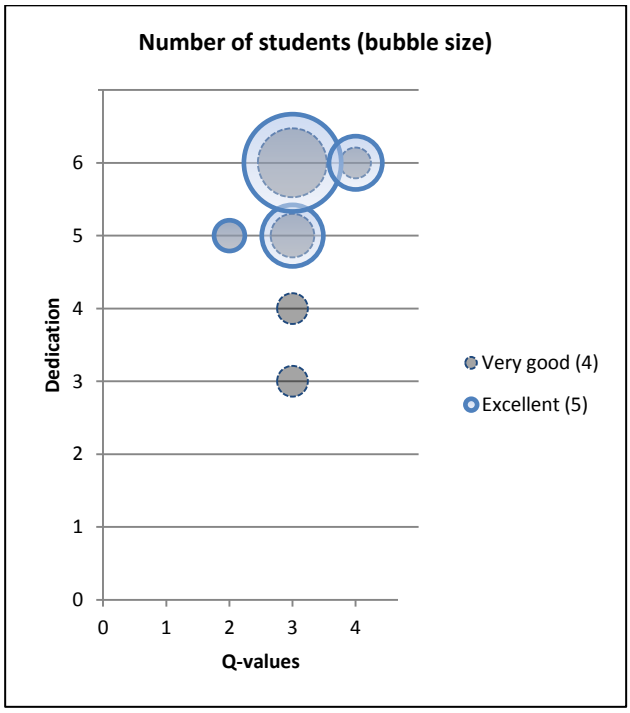

Fig. 7. Higher grades

Large dark blue rimmed circle on Figure 7 represent majority of students graded as excellent on the final exam, having q-value of 3 and dedication value of 6. Comparing these two charts, it is evident that all students with higher final grades (4 and 5) also had combination of higher Kahoot results for both knowledge (3 and 4) and dedication (5 and 6).

4 Conclusion

This paper shows an efficient way to motivate students for higher engagement on class by using gamification tool Kahoot. Conclusions of this research are:

- There is no correlation between individual Kahoot quizzes, that is, if a student has a good score on one Kahoot, it is not necessary to have a good score on the other quiz. This is a good result since gamification should provide competitiveness and all students have same ground in making an impact on a new quiz, regardless of the previous score.
- Students with high final grades (4 and 5), typically have good scores in Kahoot - for both knowledge (3 and 4) and dedication (5 and 6).

Some guidelines for further research:

- To analyze motivation of the same student group in gamification on different courses to see if there is some kind of correlation
- To compare how gamification influences motivation of students of different level and different intrinsic motivation – e.g. 1st year undergraduate program vs 1st year graduate program
- Motivation analysis using different gamification tools, comparing individual engagement, student group engagement, etc.

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