Effectiveness of Gamification-Based Learning Environment on Computer Skills of First Grade Intermediate Students in Jeddah

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Abstract

The study aimed to identify the effect of a gamification-based learning environment on first-grade intermediate students' performance of computer skills. The study used computer skills observational sheet. A sample of 52 students was selected cluster-randomly from all first-grade intermediate students in public intermediate schools in Jeddah. The sample was divided into a control group (n=24) and an experimental group (n=28). Results showed statistically significant differences at the level ($\alpha \geq 0.05$) between the mean scores of the students of the experimental group and the control group in the post observational sheet in favor of the experimental group. Similarly, there was a statistically significant correlation at the level of ($\alpha \geq 0.05$) between the mean scores of the experimental group students in the post observational sheet of computer skills. The study recommends training computer and information technology teachers on the use of gamification environments in teaching and designing various courses at all stages of education.

Keywords:
learning environment, gamification, computer skills.

Introduction

Electronic learning (E-learning henceforth), an outcome of scientific technological advances, is one of the modern learning-teaching methods, presenting academic content and communicating skills and concepts to learners by means of information and communication technologies and their multimedia in a way that allows the learner to actively interact with the content, the teacher and colleagues synchronously or asynchronously in the appropriate time, place and speed [1, p. 177].

In this context, learning computer skills becomes an imperative that should be taken care of by teachers and learners alike. Several studies point out that learning computer skills has proven its effectiveness in teaching many academic courses in various disciplines [2, 3, 4, 5, 6, 7].

There are up-to-date ways through which E-learning ignites a burning desire to benefit from modern technologies, increase learner's motivation and keep pace with new developments in teacher's roles. Digital gamification, as Sandusky [8, p. 1] reports, has emerged as a topic of interest among many scholars, on grounds of its significant impact on learners' achievement when used in classroom in one form or another, including game elements, such as: rewards and points in contexts different from those of traditional educational games. It is in this context that this study focuses on digital gamification with an aim of developing the performance aspect of computer skills for first-grade middle school students in Jeddah, KSA.

Research problem

Driven by its ambitious 2030 vision, the Kingdom of Saudi Arabia has sought to develop its academic courses and update courses in line with the stage and its needs, including developing content and setting standards for it. The development of content and standards covers five aspects: computer and information technology, English language, scientific centers, professional development, science, technology, engineering and mathematics. This indicates the growing interest in developing and updating the computer and information technology course.

Supervising students of Educational Practicum, a remarkable weakness among teachers and learners' in the use of modern technologies in the classroom has dawn the researcher's attention to this problem, calling for creating an electronic learning environment based on digital gamification that contributes to developing the performance aspect of learners' computer skills. In doing the pilot survey study on a sample of first-grade middle school students in Jeddah to identify the level of some computer skills, it was revealed that 80% of the sample did not master computer skills, which strongly indicates low poor level among learners in using computer technology.

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Research Questions

The study tries to find answers to the following major question: What is the effectiveness of an educational environment based on digital gamification in developing the performance aspect of computer skills among first-grade middle school students?

Procedures

First: Methodology

The study follows the experimental method with its quasi-experimental design known as the design of the two groups: the control and the experimental with pre and post measurements (Quasi-Experimental Methods). As this study seeks to identify the impact of the independent variable (digital gamification environment) on the dependent variable (computer skills) among first graders average in the Kingdom, the experimental method is used to answer its questions.The quasi-experimental design of the study is illustrated in the following table:

Table 1. Quasi-experimental Design of Study

Groups	Pre Measurement	Experimental trial	Post measurement
Control group	Computer skills observation Sheet	Traditional teaching method	Computer skills observation sheet
Empirical group		Digital gamification teaching method	

Second: Variables

The variables of the study come in two forms:

1. **Independent variable:** Experimental trail for digital gamification environment
2. **Dependent subordinate variable:** Performance aspect of computer skills

Third: Tools and instrumentation

For the purpose of the study, the following tools were built and prepared:

Table 2. Study corpus and tools

NO	Corpus	No.	Tool
1	Digital Gamification Environment	1	Computer Skills Observation Sheet
2	Digital Gamification Use Teacher's Manual		
3	Digital Gamification Use Student's Manual		

The following section presents a detailed description of the study tool preparation steps:

Observation Sheet preparation for computer skills among first grade middle school students.

A number of already prepared observation sheets for measuring computer skills performance in previous studies were reviewed and consulted especially in aspects very similar to the present study. The present study observation sheet for measuring students' computer skills performance was built based on the steps listed hereunder:

1. Identification and setting of observation Sheet objectives

The sheet was designed with the aim of measuring the computer skill performance of first-grade middle school students in Jeddah associated with the two units (Computer is my Friend & I Write my Achievements) included in the Computer and Information Technology course. The sheet was also built for answering the study questions.

2. Formulation of the observation items

The items were formulated as short behavioral statements describing a single behavior in the present tense for ease and simplicity of observation. When formulating the sheet items and clauses, it was ensured that they match with its objectives and nature on the one hand, and the performance to be evaluated on the other hand. In its initial form, the sheet consisted of (97) behavioral sub-items that fall under (13) main skills as illustrated in the following table:

Table 3. Indicators for Computer Major Skills

Major Skills	No. of Indicators
Importing audio to computer	12
Listening to audio files on computer	3
Importing images to computer	11
Scanned images / pictures printing	2
Touch typing using Typing Tutor	10
Dealing with word processor / libre office writer	13
Text editing	10
Text formatting	4
Paragraph formatting	4
Table creating	9
Dealing with pictures / images	9
Page layout	6
Page print	4
Overall Total	97

3. Formulating instructions

When drafting sheet items, it was ensured that they are clear for the user to easily observe first grade middle

school students performance, so that the observer can quantitatively estimate the level of the students' performance. It was instructed to note down the details of each student. Instructions also included the following:

♣ Demonstrating the general purpose of the sheet.

♣ Elucidating how to quantify students' performance on items / clauses.

4. Performance Level Evaluation Method

In consulting several previous studies observation sheets, the method of performance was designed in light of only two levels:

♣ Only one score: When the student performs the skill correctly, alone or without errors.

♣ Score zero: for incorrect performance or when the student does not perform the skill.

Thus, the observation sheet maximum grand score is (97). The scores are calculated for each item respectively. Adding together these scores, the student's total score is obtained, through which his / her performance can be judged in relation to the skills included in the sheet. The observer puts a tick mark (✓) against the perfect or imperfect participant's performance in the given space, where the (perfect) level represents the correct performance of the skill by the student without help from anyone or without errors, or student's correction of his mistake in performing the skill after making a mistake, while the (imperfect) indicator represents the wrong performance of the skill or participant's inability to perform it.

5. Observation sheet face validity

After preparing the sheet in its initial form, it was presented to a group of arbitrators specializing in the field of curricula, teaching methods and educational technology, as well as a number of computer and information technology teachers. Some slight modifications were made in terms items deletion or addition based on experts remarks.

6. Pilot trial of computer skills observation Sheet

The observation sheet was administered to a 20-student pilot exploratory sample, of the same study population, all in first grade middle school stage at Jabal Al-Noor Intermediate School in Jeddah. The purpose of administering the sheet to the pilot sample was to:

♣ Calculate the internal consistency of the observation sheet.

♣ Calculate the stability of the observation sheet.

A - Calculating observation sheet internal consistency

To find out internal consistency, Pearson correlation coefficients were calculated for the score of each item and the total score of the sheet. Pearson correlation coefficients were also calculated for the score of each major skill and the overall total of the sheet. The clarified in following two tables illustrate such scores:

Table 4. Pearson's Correlation Coefficient for each Item Score and Observation Sheet Overall Scores N=20

No.	Correlation Coefficient	Item No.	Correlation Coefficient	Item No.	Correlation Coefficient
1	0.662 **	34	0.645 **	66	0.482 *
2	0.662 **	35	0.688 **	67	0.451 *
3	0.586 **	36	0.446 *	68	0.457 *
4	0.482 *	37	0.675 **	69	0.715 **
5	0.496 *	38	0.463 *	70	0.602 **
6	0.485 *	39	0.694 **	71	0.834 **
7	0.721 **	40	0.666**	72	0.675 **
8	0.825 **	41	0.448 *	73	0.639 **
9	0.476 *	42	0.745 **	74	0.678 **
10	0.457 *	43	0.682 **	75	0.451 *
11	0.536 **	44	0.754 **	76	0.465 *
12	0.672 **	45	0.776 **	77	0.477 *
13	0.814 **	46	0.473 *	78	0.444 *
14	0.645 **	47	0.655 **	79	0.501 *
15	0.599 **	48	0.468 *	80	0.866 **
16	0.498 *	49	0.624 **	81	0.458 *
17	0.824 **	50	0.451 *	82	0.460 *
18	0.681 **	51	0.482 *	83	0.471 *
19	0.615 **	52	0.466 *	84	0.512 *
20	0.693 **	53	0.732 **	85	0.493 *
21	0.839 **	54	0.592 **	86	0.492 *
22	0.456 *	55	0.711**	87	0.468 *
23	0.812 **	56	0.554 **	88	0.814 **
24	0.702 **	57	0.644 **	89	0.615 **
25	0.776 **	58	0.456 *	90	0.823 **
26	0.614 **	59	0.732 **	91	0.802 **
27	0.637 **	60	0.652 **	92	0.456 *
28	0.765 **	61	0.601 **	93	0.812 **
29	0.624 **	62	0.493 *	94	0.772 **
30	0.765 **	63	0.814 **	95	0.825 **
31	0.488 *	64	0.765 **	96	0.771 **
32	0.475 *	65	0.743 **	97	0.753**
33	0.530 *	———	———	———	———

As illustrated in Table 4, it is observed that there was a direct correlation between the observation sheet items and their overall total. Statistically significant correlation coefficients for all items were noticed at the levels (0.05), (0.01), ranging between (0.444-0.839) and thus confirming the observation sheet enjoys a high degree of internal

consistency validity. Pearson correlation coefficients were calculated for each major sheet skill score and their overall total as shown in Table (5) below:

Table 5. Pearson's Correlation Coefficient for each Item Score and Observation Sheet Overall Scores N=20

Skill	No. of Indicators	Correlation Coefficient
Importing audio to computer	12	0.830 **
Listening to audio files on computer	3	0.501 *
Importing images to computer	11	0.814 **
Touch typing using Typing Tutor	2	0.491 *
Dealing with word processor / libre office writer	10	0.802 **
Dealing with word processor	13	0.765 **
Text editing	10	0.853 **
Text formatting	4	0.625 **
Paragraph formatting	4	0.787 **
Creating tables	9	0.755 **
Dealing with pictures / images	9	0.910 **
Page layout	6	0.466 *
Page printing	4	0.611 **

Table 5 illustrates a direct correlation between the skills of the main observation sheet and its overall total. It is also evident that statistically significant correlation coefficients for skills were shown at the level (0.05), (0.01), ranging between (0.466 -0.910). This indicates that the observation sheet has a high degree of internal consistency, which confirms its validity and reliability.

B-Calculating observation sheet reliability

The reliability of the observation sheet was calculated for the exploratory sample of first-grade middle school students using the Cronbach alpha coefficient method. The following table illustrates the reliability coefficients values using alpha Cronbach's coefficient for the observation sheet as a whole, and for each major skill respectively.

As illustrated in Table (6) above, Cronbach's alpha reliability value for the observation sheet computer skills as a whole was high at (0.966). The reliability coefficient values for the main skills of the sheet were also high, ranging between (0.669-0.935). These underscore the sheet's high reliability level.

7. Final form of computer skills observational sheet

Having finalized the preparation steps, the observation sheet in its final form consisted of (97) behavioral sub-item that fall under (13) main skills.

Table 6. Observation Sheet Reliability Coefficient Values, Using Alpha Cronbach Coefficient N =20

Skill	No. of Indicators	Reliability Correlation Coefficient
Importing audio to computer	12	0.928
Listening to audio files on computer	3	0.761
Importing images to computer	11	0.901
Scanned pictures printing	2	0.669
Touch typing using Typing Tutor	10	0.883
Dealing with word processor / libre office writer	13	0.935
Text editing	10	0.874
Text formatting	4	0.725
Paragraph formatting	4	0.717
Creating tables	9	0.835
Working with pictures / images	9	0.810
Page layout	6	0.746
Page printing	4	0.751
Total	**97**	**0.966**

Results

The results of this study have found an answer to the question: What is the effectiveness of an educational environment based on digital gamification in developing the computer skills performance aspect among first-grade middle school students?

Verifying the effectiveness of a digital gamification environment in developing computer skills performance aspect among first-grade middle school students in Jeddah, a computer skills performance observation sheet was applied and administered afterwards on the two groups of the control and experimental study. Then the arithmetic means and standard deviations were calculated, and the t-test values were calculated for the independent samples to indicate the differences between the mean scores of the students of the control and experimental groups. Effect was calculated using relationship strength between the two variables (explained variance size), from which the value of the Eta square (ή2) was calculated, The standard

difference index between two averages was calculated, from which the Cohen index (d) was also calculated as illustrated in Table 7. The results presented in the table can be encapsulated into the following points:

Table 7. Difference Significance T-Values for Experimental and Control Groups Students Mean Scores in Computer Skills Observation Card Post-Test

Skill	Group	N	Mean	Standard Deviation	Degree of Freedom	T	(Sig)	$\acute{\eta}^2$ V	d V
								Effect Size	
mporting audios to computer	Experimental	28	11.06	2.67	50	6.11	0.000	0.43 high	1.71 high
	Control	24	6.58	2.55					
Listening to audios	Experimental	28	2.46	1.17	50	2.26	0.002	0.18 high	0.68 average
	Control	24	1.42	1.13					
mporting Pictures to computer	Experimental	28	9.61	2.38	50	6.69	0.000	0.47 high	1.86 high
	Control	24	5.33	2.2					
Picture Print	Experimental	28	1.68	0.72	50	2.62	0.011	0.12 high	0.73 average
	Control	24	1.13	0.79					
Touch typing	Experimental	28	9.68	1.86	50	11.8	0.000	0.74 high	2.49 high
	Control	24	5.08	1.82					
Working with word processor	Experimental	28	12.54	1.6	50	4.16	0.000	0.26 high	1.16 high
	Control	24	9.58	3.35					
Text editing	Experimental	28	9.75	1014	50	6.46	0.000	0.45 high	1.71 high
	Control	24	5.96	2.86					
Text formatting	Experimental	28	3.96	0.19	50	6.6	0.000	0.47 high	1.79 high
	Control	24	2.63	1.05					
aragraph formatting	Experimental	28	3.86	0.45	50	5.04	0.000	0.34 high	1.41 high
	Control	24	2.58	1.24					
Creating tables	Experimental	28	8.67	0.55	50	7.84	0.000	0.55 high	2.18 high
	Control	24	5.13	2.32					
orking with pictures	Experimental	28	8.64	1.1		6.27	0.000	0.44 high	1.74 high
	Control	24	6.33	1.55					
Page layout	Experimental	28	5.32	1.87		3.68	0.002	0.27 high	1.76 high
	Control	24	3.5	1.64					
Page Print	Experimental	28	3.75	0.93	50	3.76	0.001	0.22 high	1.04 high
	Control	24	2.5	1.44					
Total	Experimental	28	90.96	5.83	50	15.6	0.000	0.83 high	4.36 high
	Control	24	75.75	9.29					

There are statistically significant differences at the level ($\alpha \geq 0.05$) between the mean scores of the students of the experimental group and the control group in the post observational sheet as a whole in favor of the group with the highest mean values (the experimental group).

The t-value is 15.6, which is a statistically significant value. The calculated statistical significance value was 0.000, and this is less than the significance level value (0.05).

Similarly, there are statistically significant differences at the level ($\alpha \geq 0.05$) between the mean scores of the experimental and control group students in the post-observational sheet of the computer skills in favor of the group with the highest mean value (the experimental group) in the thirteen skills of the observation sheet. The t-values ranged between (2.26-11.8), which are statistically significant values; The calculated statistical significance value ranged between 0.000-0.011, and all of them are less than the significance level value of 0.05.

The size impact of a gamification-based learning environment on the performance of computer skills was large. The eta square ($\acute{\eta}2$) for the skill observational was 0.83. This means that 83% of the total (explained) variance of the dependent variable (computer skills) is influenced by the independent variable (the educational environment based on gamification). This result confirms the corresponding value of the Cohen index (d), which amounted to 4.36, which is much greater than the minimum significant effect according to Cohen's indicators of the size of the effect (0.8).

The effect size of the gamification-based learning environment on the primary skills of the computer included in the observational sheet was large. The values of eta square (ή2) ranged between (0.12-0.74), which means that (12-74%) of the total (explained) variance for each computer skill is due to the independent variable (the educational environment based on gamification). This result confirms the corresponding value of the Cohen index (d), which ranged between (0.68-2.49). The Cohen index (d) value was average for my skills (listening for sounds, printing pictures). Its value was, respectively, (0.68 and 0.73). In contrast, the values of the Cohen index for the rest of the skills were much greater than the minimum significant effect according to Cohen's indicators of the effect size (0.8).

In light of the presented results, they indicate the effectiveness of the educational environment based on gamification in developing the performance aspect of computer skills for first-grade intermediate students in Jeddah.

Recommendations

In light of the findings, the following recommendations are put forward:

1. Training computer and information technology teachers to use gamification environments in their teaching.
2. Including some topics of gamification-based learning in courses of computer and information technology teacher preparation program.

Based on the results, the researcher suggests conducting the following studies:

- The requirements of using gamification in education within the Saudi environment.
- Effectiveness of educational environments designed according to gamification in developing technological concepts in a computer and information technology course.
- Training competencies necessary for computer teachers to use and employ gamification in teaching their courses.
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