Developing Pedagogical Effectiveness by Assessing the Impact of Simulation Gaming on Education Operation Management:

Experimental Study on Cycles One and Two at Two Private Schools in Lebanon

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***Abstract*— This study presents a science simulation game, and evaluates in great depth its impact on education operation management. The suggested simulation was empirically examined by investigating the nature and composition of its framework. The descriptive quantitative methodology was appointed to answer the research questions. Data was collected from 308 student participants in both Cycles One and Two, along with their parents, learning support assistants, and teachers. The findings revealed that the students who played the game experienced a deeper level of learning by the action of intrinsic motivation. Furthermore, simple decision-making skills could be acquired with traditional teaching methods, but simulation games were more effective when students had to develop decision-making abilities for managing complex and dynamic situations.**

Keywords-simulations; interactive learning environment; intrinsic motivation.

I. INTRODUCTION

The recent generation of private school students is experiencing the world with their personal computers (PCs). Many have invested much energy playing computer games and are presently highly skilled at learning and applying complex arrangements of standards through game playing. Proserpio and Gioia claimed that the pedagogical method of the new virtual generation varies from the previously used methods. It is significantly more visual, intelligent, and concentrated on critical thinking [1]. While this could be viewed as a danger to the traditional learning methods, it could likewise be viewed as a chance to develop simulation games that empower the learning of management practices and standards.

Creators utilize diverse wordings to characterize simulation technologies that range from top administration, to pilot test programs, to business test systems, to simulation games, to large and small scale universes, to learning research facilities [2]. Simulations and games are broadly utilized in different domains of educational courses. The utilization of simulation and games relies to a great extent on educator's personal capabilities, learning goal and familiarity with the courses instead of their basic knowledge. The confusion between simulations and games has been available from the time that simulation was invented [3]. Since game based learning is becoming more important in teaching, there is a need to verify the utilization of simulation and games.

Despite the fact that there have been numerous endeavors at elucidation, it is still essential to stress the contrasts between the two concepts and to characterize a simulation game. Webster characterizes a simulation as "the illustration of the action or qualities of one framework using another framework, esp. utilizing a PC". strictly speaking; simulation involves the description of a part of reality in view of an improved, and reflective model.

Game is any challenge (play) among players working under imperatives (rules) for a goal, winning, triumph or payoff is a game [4]. Game is along these lines a chance to utilize one's aptitudes and contend with others. The nomenclature additionally proposes a simulation and pleasant action, despite the fact that in academic setting diversions ought not to be utilized chiefly for entertainment. In reality, Abt (1970) alludes to educational games as "significant games." A game is not inevitably a simulation [5].

Simulations, interactive techniques, allow students to practice something that is not quite the same as what they are familiar with [6]. This new experience can prompt more noteworthy appreciation of the content as well. Upon teaching operation management, simulation games embrace a problem-based learning method [7][8]. The problem-based learning method requires educators to introduce students to real-world operation problems that demand to be evaluated and solved.

This paper is organized into five sections as follows: Section two contains a historical view of simulation. Section three portrays a literature review of the pedagogical simulation, through describing the type of simulation used in the study, and effectiveness along intrinsic motivation level. The fourth section investigates the research method upon discussing the data collection, measurements, findings, and analysis of data. The paper concludes with a brief discussion

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of the limitation of the research and next steps to be taken into account.

II. HISTORICAL VIEW OF SIMULATIONS

From a long time ago, simulation and games have been employed for training purposes. Their creation is tracked to war games that were used in ancient China. War games, mainly in the sort of wide games, like chess, have been well known. In Germany, during the 17th century, they were changed into more intellectual and composite games [9]. Game and Simulation first appeared in the wide educational spot in the late 1950s. However, Lane declared in 1995 that management diversions and simulations were in the news and their utilization was expanding after fifteen years. Until the mid-1970s, they did not exist in the instructional outline development [10].

In the past, medical models were used as tools in the study of anatomy; mainframe computer-based simulations were generally utilized within the 1960s [11]. Ellington announced in 1981 that computer-based simulations have been used in science education at all levels.

In the last ten years, new simulation games have evolved as teaching tools in marketing, financial management, project management, knowledge management, risk management and microeconomics [12].

III. PEDAGOGICAL SIMULATIONS

A. Types of pedagogical simulations

Computer simulation for pedagogic purposes, which utilizes the computer as a learning domain, is called computer-assisted learning (CAL). Those alleged "training simulations" commonly come in one of three classifications, according to Stančić [13]:

- "Live" simulation – real individuals utilize the simulated device in the real setting,
- "Virtual" simulation – real individuals utilize the simulated device in a virtual setting, and
- "Constructive" simulation – simulated individuals utilize the simulated device in a virtual setting.

It is imperative to notice that in every one of the three cases individuals manage the simulated device and that demonstrates the distinction among simulation and experimentation. Data of science incorporates the greater part of the above-mentioned employments of a computer and classifications of simulation. That is vital for the improvement of long lasting learning, with an exceptionally noteworthy part of between actions. The virtual simulation was employed for this study that is framed around a prototype of reality in which the children act, perform certain roles, and make decisions essential to deal with the intrinsic problematic cases and utilizing specific structured equipment [14][15].

'Helping Plants Grow Well' is the title of simulation employed, which allows students in both grades one and two to investigate various quantities of the variables needed for plant growth. The third grade simulation game is entitled 'Habitat' and teaches students about proper animal habitat, and their position in the food chain. The fourth grade simulation is entitled 'Life Cycle' and illustrates plant parts and their functions. These simulations are present on BBC website [16].

B. Effectiveness along intrinsic motivation

Simulations based reviews have specified that it is a compelling educational technique for theoretical advancement in science and additionally formative appraisal system, and suggested that it would have an advantageous effect on reasonable change. Numerous experimental studies revealed that simulation games intensify their motivation, including ability, intrigue or interest, and endeavors [17-19].

Students who experienced game based learning domain exhibited higher statistical significance of intrinsic motivation than those who acquired education in conventional school environment [20].

Simulations not only help students to comprehend the material better, but also expand student's interest for the content of the material. In 2011, Neumann, Neumann, and Hood [21] examined computer-based simulations in a school statistic's course where 38 students consented to take part. After the class, the students were reached for a 20 minutes telephone call and their responses were put into defined categories when possible. Utilizing the computer based simulation assisted 66 % of students to experience the actual-world application of the specific subject, assisted 60.5 % to comprehend and gain knowledge about the material, created interest and attentiveness in 29 % of the students, motivated 18 % of the students to discover and expanded enjoyment in 16 % of the students.

IV. RESEARCH METHOD

A systematic review comprised of five stages: (1) recognition of research, (2) choice of primary studies, (3) study quality appraisal, (4) data extraction and observing, and (5) data analysis [22] was used. The main research objective was to analyze the impact and execution of simulation games in private schools and to investigate the interrelationships between the barriers and the impact of other contextual factors in the pedagogic environment.

A. Data collection

The target population for the current study was students at cycle's one and two (6 -10 years old) from Family School in Magdouche and National Evangelical School in Nabatieh. Data was collected from March 20, 2017, untill April 25, 2017.

Participants were recruited from the science classes at cycles one and two. The researchers selected the sample for the study using stratified random because Robson [23] contends that sampling theory supports stratified random sampling as an efficient choice since the means of the

stratified samples are likely to be closer to the mean of the population overall.

The method of collecting data included both control/test and pre/post groups, in addition to a hard copy of the questionnaire, which was filled with the assistance of each classroom teacher. A total of 158 responses were collected from control/test group, and 308 responses at pre/post test groups.

B. Measurements

- The control/test group results were compared and discussed to prove the effectiveness of the research. Through obtaining the mean, mode, standard deviation and standard error.
- The student's questionnaire included three-likert scale response (i.e., -1=disagree, 0=neutral, 1=agree). A smiling face indicated that the students agree. A null face indicated that the student is unaware of the answer, and an unhappy face pointed for disagreeing. It was used with all items.
- The questionnaire was divided into five domains, and within lays 21 items. The obtained results present the mean, mode, standard deviation, and coefficient of variation of each item with their total values.
- The pre/post test grades were compared to emphasize on the pedagogic impact of the simulation game. The obtained results presented the mean, standard deviation, and standard error.
- All students had no previous preparation for pre/post test.

C. Findings

The questionnaire was distributed to students, to measure the impact of the simulation game on their academic achievement. Students in cycle one were assisted by the science teachers upon reading the preceding items.

TABLE I. STUDENTS' PERCEPTION ON THE SIMULATION GAME

Construct	Agree (%)	Neutral (%)	Disagree (%)
Educational goal			
1. The simulation game is helpful and useful for you current lesson.	80.2	11	8.8
2. The simulation game covers the important topics in the lesson.	70.8	21.8	7.5
3. The simulation game has increased your knowledge in the lesson.	80.2	12.3	7.5
4. The simulation game has transferred some practical skills to you.	56.5	20.8	22.7
5. The simulation game is interesting and enjoyable	88.6	8.8	2.6
Knowledge			
6. The simulation game enables you to apply the lesson.	86	8.8	5.2
7. Playing simulation game demands more effort than you expected.	37.8	11.4	50.8
8. Playing simulation game engaged you more in the lesson.	80.8	10.7	8.5
9. The simulation game was good in testing your decision-making.	82.8	9.1	8.1
10. The simulation game provided you with the knowledge that you can use in real life.	81.5	12.3	6.2
Social learning and environment			
11. I worked more with other group members.	69.2	1.9	28.9
12. My group and I dealt with the game challenges perfectly.	62.3	16.3	21.4
13. I had fun while playing the game with my group.	66.2	15.6	18.2
14. Teamwork is important for performing well in the simulation game.	74.6	18.9	6.5
Student perception toward instruction			
15. The simulation game instructions were well organized.	70.8	25.3	3.9
16. The simulation game organization is acceptable.	81.5	14.9	3.6
17. The simulation game was easy to understand and play.	75.3	16.6	8.1
Evaluation			
18. The simulation game results represent your decision.	90.6	6.5	2.9
19. The performance report is easy to read.	55.8	23.4	20.8
20. The time to take the decisions was enough.	57.5	18.8	23.7
21. The animation of the simulation game is helpful.	89.9	6.2	3.9

Table I lists the perceived intrinsic motivation throughout the game. On one hand, the majority of the students (88.6%) agreed that the game developed interest. On the other hand, a few students (2.8%) disagreed with that. Concerning the effort exerted, the students' perception was positive, in which (50.8%) disagreed that the experienced game demanded more effort. Explicitly, (74.6%) agreed that simulation enhances social learning. Most of the students (75.3%) agreed that the game instructions were easy to understand, which made them do better. Only a few (2.9%) of students did not agree that the game results represented their decision, therefore the hypothesis suggesting that simulation games enhance the decision-making capacity of students has been corroborated.

D. Data Analysis

The researchers started with comparing control-test groups at the baseline, through a sample of 158 students from National Evangelical School in Nabtieh. The stratified random sample continued students from both cycle one and two.

TABLE II. DESCRIPTIVE STATISTICS SUMMARY FOR CCONTROL/TEST GROUP

	Mean	Mode	Standard deviation	Standard error	Sample size
Control group	7.392	7	1.894	0.150	158
Test group	8.512	10	1.534	0.122	158

Table II shows that the average mean of the control group was lower than that of the test group (7.932< 8.512). The average score obtained by the control group is lower than that of the test group (7<10), showing that the group learned through simulation game achieved a better outcome. However, the standard deviation of the control group was higher than that of the test group (1.894> 1.534).

After comparing the control and test groups, which revealed the academic progress of the test group students, the researchers executed a study quality appraisal on pre-post test groups. The same topic was taught to students at both schools, where the pretest was done at the end of the traditional educational method, while the post-test was done at the end of the simulation.

TABLE III. DESCRIPTIVE STATISTICS SUMMARY FOR PRE/POST TESTS

	Mean	Standard deviation	CV	Sample size
Pre-test	7.355	1.986	16.2%	308
Post-test	9.020	1.068	8.7%	308

Table III shows the grade results from both intended schools. The pre and post-test were the same to exclude any possible contamination. The mean value clearly reveals the progress that students made upon the practice of simulation game, in which their average increased by two grades (7.355>9.020). However, the standard deviation was used to measure the amount of variation of the set of pre/post data values. It shows that the variation in pre-test group (1.986) was higher than that of post-test group (1.068). Hence, the simulation game experienced by the students was effective.

At the end of the science course, present students gave their response to the questionnaire.

TABLE IV. DESCRIPTIVE STATISTICS SUMMARY FOR THE STUDENTS' QUESTIONNAIRE

	Mean	Mode	SD	CV
Educational goal	0.654	1	0.494	111.4%
Knowledge	0.580	0.8	0.64	203.26%
Social learning and environment	0.492	1	0.775	168.7%
Students perception toward instruction	0.706	1	0.553	79.5%
Evaluation	0.605	1	0.623	143.6%
Total Whole of the Questionnaire	0.6074	0.96	0.617	141.29%

Table IV summarizes the result of participants' responses to questionnaire items in the five domains: (1) educational goal, (2) knowledge, (3) social learning and environment, (4) student perception toward instruction, and (5) evaluation. This summary indicates that students practice simulation games at their schools with an overall mean of (0.607), mode of (0.96), SD of (0.617), and CV of (141.29%). The highest average value is obtained upon testing the student's perception toward instruction (0.706>0.654>0.605>0.580>0.490), indicating that the practice of simulation games enhance the student's recognition of provided instructions. The use of computerized instructions within the simulation game provided a higher academic achievement [24].

To study the effect of certain variables, the researchers used the ANOVA test; it ia a parametric test used to compare more than two means and to study if the difference is significant or not. For the interpretation, *p*-value is compared with α (error ratio = 5% i.e. 0.05). If *p*-value > $\alpha \rightarrow$ the researchers consider the difference insignificant and vice versa.

Upon performing the ANOVA test, the obtained p-value for students' perspective toward simulation game in relation with learning in a social environment was 0.00002, showing that the null hypothesis is rejected and there is a significant difference. The students who enjoy the simulation game don't necessarily perform better in teamwork.

While answering the hypothesis that tests the relation between simulation game effectiveness and education operation management, the p-value obtained was 0.058, which indicates that the null hypothesis is significant, and therefore, the effectiveness of simulation game is affected by the proper education operation management organization.

V. CONCLUSION

The analyzed results recommended experiencing a simulation game for enhancing operations management in regard to some issues, such as the game engaging quality, appraisal system, and decision-making assessment. Appraisal of group performance should be supplemented with the individual performance assessment to guarantee decency in checking. The utilization of this simulation should be formally coordinated in the operations management course syllabus for consistency over the academic years.

A. Complications and limitations in this study

There were several limitations that the researchers encountered in this study. The two principal limitations are:

1. The lack of studies in Lebanon that have examined simulation, and
2. The insufficiency of prior research studies evaluating the effectiveness of embedding simulations as a part of science education in primary schools.

Moreover, diverse studies discussing dissimilar pedagogical programs and cultures, stated earlier, were homogenous and similar to the findings of this research. A further crucial reason is the lack of any study in Lebanon done at the same time of this research that uses simulation in the classroom to make use of its results and overcome the possible obstacles faced by the researchers.

Consequently, in order to determine the effectiveness of simulation gaming in science education in primary school, further research is needed, which must focus on:

a) Teachers perspective against the utilization of simulation

b) How encouraging the school administration is in utilizing ICT

c) Teacher skills in utilizing ICT, especially the ones concerned with simulation gaming.

B. Implications for further study in Lebanon

There is a deficiency of studies in Lebanon and other Arab countries with the close pedagogical environment that evaluates the degree of effectiveness of simulation games in primary schools for science teaching. Consequently, researchers require supplementary studies to decide which factors might reinforce or obstruct the implementation of simulation in science teaching.

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