Assessing the Impact of Simulation Games on Education Operation Management and the Development of Pedagogical Effectiveness

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

Nour Issa and Hassan M. Khachfe
Department of Education
Business, Educational, and Medical Optimization Research Group (*BE-MORE*)
The Lebanese International University
Beirut, Lebanon
Email: Nour.issa28@hotmail.com, hassan.khachfe@liu.edu.lb

***Abstract*—With the development of the digital age, progress in innovation, and the pattern towards more experiential learning designs, simulation games are progressively used by pedagogical organizations today. This study uses a science simulation game, and evaluates the influence of this active learning method on education operation management. Data was gathered from 308 students in private schools, in south Lebanon, on which factor analysis, analysis of variance, and t-test were used. The findings revealed that simulation gaming provides competence and deeper level of learning. The study concludes that the use of simulation gaming in education would go a long way in enhancing students' perceptions toward the instructions, and stimulate their interest in learning science.**

Keywords-game; simulations; operations management; effectiveness.

I. INTRODUCTION

The recent generation of private school students is experiencing the world with their personal computers (PCs) and handheld devices. Many have invested much energy playing computer games and are presently highly skilled at learning and applying complex arrangements of standards through game playing. Experiencing simulation game by students is an effective method for improving education [1]. 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 [2]. 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.

The 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 [3]. Simulations and games are broadly utilized in different domains of educational courses. The utilization of simulation and games relies to a great extent on an 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 [4]. 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 stretch 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 [5]. Game is along these lines a chance to utilize one's aptitudes to 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 [6].

Simulations and interactive techniques allow students to practice something that is not quite the same as what they are familiar with [7]. 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 [8, 9]. The problem-based learning method requires educators to introduce students to real-world operation problems that demand to be evaluated and solved**.**

Simulations are set in the frame of games in pedagogic organizations to merge education with fun. Whereas the classical educational approaches used are reflecting uneven quality of education, most of the private schools are implementing simulation as a part of their education systems. However, these systems haven't developed monitoring and evaluation of the impact left after using simulation games.

This study seeks to mark this problem through providing quantitative and qualitative data that allows the stakeholders, including school administration, teachers, and learning assistants to evaluate the implementation of simulation games, and measure the delivery quality to students.

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, effectiveness along intrinsic motivation level and a critical review of related work. The fourth section investigates the research method upon discussing the data collection, measurements, findings, analysis of data, and hypothesis results. The paper concludes with a brief discussion of the results, recommendations, 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 board games, like chess, have dependably been well known. In Germany, during the 17th century, they were changed into more intellectual and composite games [10]. Also, war games assisted the testing and the organization of strategic moves during World Wars I and II. Web-established models appropriate to distance learning are presently used to prepare military planners [11]. In a related area, pilot simulators, which are nearly as old as the primary plane, were utilized broadly during World War II to prepare military pilots [12].

Games and simulation first appeared in the wide educational spot in the late 1950s. Until the mid-1970s, they did not exist in the instructional outline development. Rather, these activities were basically created by business, therapeutic training workforce, and sociologists, who adjusted instructional advancements pioneered by the military administrations [13].

Previously, medicine models were utilized as tools of anatomy; mainframe computer-based simulations were generally utilized during the 1960s. Within the recent advantage of technology, high-vitality human resigned simulators of health care providers are being utilized to improve their skills, and computer-based reality arrangements help to tutor students in surgical strategies [14]. Game simulations in nursing, such as The Ward [15], assist students in acquiring choice making, clinical skills, and teamwork capabilities. Ellington announced that computer-based simulations have been used in science education at all levels, including high schools, colleges, and universities. The latest software packages comprise chemistry [16], physics [17], and hydrology [18].

In the last ten years, new simulation games have evolved to educate marketing, financial management, project management, knowledge management, risk management, and microeconomics [19].

The scientific field is too substantial and demands more examination. Moreover, there has been no guidelines or fixed policy recommended by educational institutions or governments on the acquisition of simulations in education. This is the case in US, Europe, and Australia, where it has been the responsibility of the educational institutions or educators, throughout the past academic years, to integrate simulations into the curriculum [20]. This is the case of Lebanon, too.

III. PEDAGOGICAL SIMULATIONS

This section presents an extensive review of the literature on simulation games, and its effectiveness in the context of science education as an active learning strategy. Also, it reviews related work to clarify the most important scientific concepts related to the simulation game that was used in this study.

A. Virtual Simulations

Simulation games are interactional techniques that show social frameworks, and they are interrelated with the scientific and practical frameworks around them [21]. The utilization of computer in pedagogy fluctuates; it can be a device, a help apparatus, and a learning situation. 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 [22]:

- "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. In contrary to experimentation, in simulation, individuals are experimenting with a model, and not a phenomenon. Moreover, simulation devices are used to develop and run the application of the simulation games without data acquisition hardware. Information science incorporates the greater part of the above-mentioned employments of a computer and categories of simulation. This is vital for the improvement of long lasting learning, with an exceptional aspect of interactivity.

The improvement of simulations is a multi-step process and it must be intended to meet the necessities of the task. According to Zapalska, Brozik, and Rudd [23], simulation games must encompass the following structure:

a) Educational goal: the goal of the activity must be unambiguous. The objective might be to exhibit or take in a reality, a behavior, a skill or some blend of the three. A key part of an effective simulation is that it addresses a constrained arrangement of activities. Attempting to do a lot in a single exercise will make a simulation unsuccessful. Users must know that as the activity develops, the questions may change. This shows that the initial suggested questions were limited. It might also demonstrate that there are various aspects to the activity that should be addressed independently.

b) Knowledge: While it is most certainly not conceivable to determine precisely what to look for during playing the simulation, the accompanying inquires must be taken into consideration by the teacher: the time must be enough for the practice, the simulation instructions should work well, the players need to adjust to the rules with no troubles, the teacher can observe the unexpected practices that take place, and whether the practice accomplished its arranged or any unplanned objectives.

c) Social learning and environment: few lessons can be learned individually; however, many can be learned in a group setting. The utilization of groups simplifies scorekeeping in a simulation. It likewise requires players to utilize interpersonal skills in taking decisions. This connection is regularly a significant component, since the players are in fact teaching each other about the simulation. The size of a group is critical. Group sizes of three to five appear to give the best operational attributes [24]. These preparatory steps must be thoroughly considered before starting the execution of a simulation. Actual creation of the simulation ought to flow easily from the boundary conditions and the established goals. Every simulation occurs inside a conceptual framework. By characterizing a compact environment, which identify the environment related to the goal of the simulation and shows it in a simplified format; the learning objectives can be accomplished more effectively and quickly.

d) Students' perception toward instructions: the substance of a simulation is the arrangement of transactions among the players. It is vital to formulate a general idea of the arrangement of the role of every player in the simulation. All instructions must lead to the learning objectives. The instructions must be composed at this stage. The instructions tell the players the way in which exchange of transactions can or can't be executed. It is good to keep the instructions as straightforward as possible. The initial design of the simulation must have as few instructions and limitations as possible.

e) Evaluation: simulations don't create champs or losers however; show a procedure. In simulations, the evaluation framework is probably going to be more anecdotal. Also, it is vital to have the capacity to assess the circumstance. It is imperative to recognize the objectives and how they can be measured, numerically or something else. One approach is to measure them regarding how well a player's close to the set objectives are met by numbering terms or taking a general look at the overall portfolio of items. Another approach is to concentrate on practices and this can concentrate on how players communicated with each other or how achievement of the group meets the predefined goals.

The most essential piece of any simulation is reviewing the lessons gained from the play. This is the place the students' experiences are changed into education. Simply, playing a simulation in a classroom is not adequate, and there should be a review that strengthens the activity objectives. The debriefing may be the most difficult part of any simulation, since it is very conceivable that things happened in the simulation are not expected. The simulation leader must be aware of everything that is going on during a simulation, even the spontaneous situations, and have the capacity to make an interpretation of all the simulation steps into an arrangement of lessons learned. In case that there are various observers, each can include his/her perceptions to the debriefing and subsequently enhance the experience. Essential concepts that are learned and practiced, while playing the simulation turn out to be more important when they can connect them with their own experiences. Experience and practice, as fundamental components of simulation, help students fortify the learned material. As students embrace dynamic, systematic and effective data gathering, theories no longer end up as abstract concepts that are retained.

B. Effectiveness Along Intrinsic Motivation

The review of simulation educational games 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 [25][26][27]. Students who experienced game based learning domain exhibited higher statistical significance of intrinsic motivation than those who acquired education in conventional school environment [28].

Simulations not only help students to comprehend the material better, but also expand students' interest for the content of material. In 2011, Neumann, Neumann, and Hood [29] examined computer-based simulations in a school statistics 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.

In 2010, Struppert performed a multi-nation study. Students in an American, an Australian, and a Swiss secondary schools were offered access to a computer-based simulation and two arrangements of data over a couple months' time duration. Students in every one of the three nations expressed that the game was more interesting at the beginning when they played it, but the motivation and

interest fainted afterwards. When the review additionally asked how the students prefer to learn, evaluations were four or above out of five for every one of the three nations in both data focuses [30].

C. Critical Review of Related Work

The studies reviewed by the researcher were used to discuss the importance of integrating simulation games in education at different fields, and to emphasize on its effectiveness. In reality, this conducted study was built upon the directed methods proposed by the previous studies. Furthermore, the researcher tended to benefit from the analyses of their outcomes, suggestions and implications. Their limitations were used as a precaution that the researcher tried to overcome for a more successful experience.

The methodology used in the reviewed studies vary, four were quantitative and two qualitative. The first group used quantitative methodology through out the collection of data, and analyses of the findings. Nguyen (2015) compared web-based simulation gaming with traditional methods of education through experimental methodology [31]. The study revealed a higher level of education through enhancing the impact of motivation. Kikota et al. (2013) discussed how simulators support education using quantitative methodology and collection of data by holding interviews and questionnaire [32]. The study concluded that the simulator is able to overlap a valid solution and give better understanding of complex contexts. Abdullah et al. (2013) examined the influence of using business simulation as an approach in teaching strategic management [33]. The findings obtained from interview and questionnaire showed that simulation enriches problem solving analytical skills, transfer of knowledge, decision-making, cross-functional skills, and adaptable learning. Arias-Aranda and Bustinza-Sa'nchez (2009) compared simulation games with traditional teaching method quantitatively [34]. The results recorded positive impact on personal control and self esteem upon the use of simulation games.

The second group composed of two studies that used qualitative methodology. Fallatah (2016) evaluated the importance of simulation gaming through IPE. The results expressed that IPE system reduce medical errors and improves patient outcome [35]. Moore (2012) showed the difference between simulation games and other teaching methods [36], its results demonstrated a higher interest in the subject along with improvement in students' accomplishment. In conclusion, the six discussed studies and even other studies that were reviewed by the researcher emphasize on the positive impact of simulation on education, especially with the developing world technology, and the challenges faced by the educational system.

IV. METHODOLOGY

The virtual simulation that was employed for this study, 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, while utilizing specific structured equipment [37][38]. It was particularly employed for this study, since it is the one available at the examined schools, and it fits the research participants. In contrary to the other two simulation methods, the virtual simulation requirements such as the computer lab and software were found in the schools. In this simulation, students examine the theory of how divergent elements and their personal decisions may influence large operations.

'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'. It teaches students about proper animal habitat, and their position in the food chain. The fourth grade simulation is entitled 'Life Cycle'. It illustrates plant parts and their functions. These simulations are present on BBC website [39].

This study is classified as descriptive quantitative as it analyzes data collected from questionnaires and quantifies variations using Statistical Package for the Social Sciences (SPSS) software-version 21, where participants were generally measured once with the intention of studying the impact of using simulation game as an intervention to enhance the academic achievement of science as independent variable (IV), and development of the framework of simulation game practices and competencies in the following dimensions: (1) educational goal, (2) knowledge, (3) social learning and environment, (4) students' perceptions toward instruction, (5) evaluation, as dependent variable (DV).

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; along with their teachers, learning support assistants, and principals. The researcher chose this sample as school principals are responsible for giving the permission of using this educational method in the classrooms and monitoring its outcomes, especially the ones concerned with education management, teachers as they execute simulation games and compare the results through the grades, and learning support assistants since they are present in the classrooms and in direct contact with the students. Data was collected from March 20, 2017, till April 25, 2017.

Students were recruited from the science classes at cycles one and two. The researchers selected the sample for the study using stratified random sampling method. Robson [40] contends a sampling theory that 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.

As stated by Brayman [41], studies that rely on qualitative and quantitative configurations are called mixed method designs. This combination is considered to be an enriching method. A major feature of triangulation method is the integration matter. For these reasons, the researcher chose a descriptive quantitative research design, and employed a mixed mode questionnaire survey instrument.

First, greater comprehensive data is acquired in which several sources yield validity and verification while enhancing similar data. Second, results can be minimized to a few numerical statistics and interpreted in shorter statements. Finally, it helps in raising the consistency, depth and scope in methodological proceedings [42].

The data collection included both control/test and pre/post test 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. The control/test group had a different topic then the pre/post test group.

B. Measurements

In this study, the researcher recruited a set of instruments to obtain the required measurements.

- The researcher enumerated a sample of 158 students as a control group to pilot the study. 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.
- Both schools shared the same grading system for the science subject, with a 0-10 scale where the passing grade is 5 out of 10. Below 5 is considered failure, from 5 to 6 is acceptable, from 6 to 7 is adequate, from 7 to 8 is good, from 8 to 9 is very good, and from 9 to 10 is excellent.
- In this study, the researcher recruited questionnaire survey computing the effectiveness of using simulation game as a teaching method in cycles one and two based and taken from Copenhagen University and the American Journal of Business Education. 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 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 University's Committee on Research Ethics (LIU-CRE) has validated the questionnaire before being used by the researcher in the field.
- The researcher used other instruments too, the academic achievement test of each one of science topic selected: Pre-test and Post-test. This instrument supplied the opportunity of comparing grades before, and after the simulation. It was done through two parts; in the first part students took the lesson " Shapes of Leaves" in a traditional method, and got pre simulation game grades, then they experienced the simulation "Helping Plants to Grow Well" and took post grades. 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.
- Semi-structured approach situated around an interview plan was employed to assess the management's

Table I. STUDENTS' PERCEPTION ON THE SIMULATION GAME

Construct Educational goal	Agree (%)	Neutral (%)	Disagree (%)
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

perspective and point of view toward the implementation of interactive learning method of simulation gaming in cycles one and two. The interview targets the school administration with 16 different questions, in addition to a focus group discussion of 15 questions, learning support assistants, lower elementary education specialist, and school counselor to elicit in-depth information on how they are supporting the education of students and its consequence.

- To get closer insight at the implementation method a structured observation was performed by the researcher. This helped along with the semi-structured approach to determine the barriers that students went through upon experiencing the simulation game.

V. RESULTS AND DISCUSSION

The questionnaire was distributed to students, to measure the impact of simulation game on their academic achievement. The science teachers upon reading the preceding items assisted students in Cycle One.

Table I lists the perceived intrinsic motivation through out 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 didn't 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.

Table II. DEMOGRAPHICS OF PARTICIPANTS IN TERMS OF FREQUENCY AND PERCENTAGE

Demographic Variable		***Frequency***	***Percentage***
Gender	Male	179	58.1%
	Female	129	41.9%
	Total	*308*	*100.00%*
Grade	1	90	29.2%
	2	74	24%
	3	65	21.1%
	4	79	25.6%
	Total	*308*	*100.00%*

In this examination, the gender percentages show that (58.1%) of members were males, and (41.9%) were females. As for the grade, (29.2%) of members were in grade 1, (24%) them were in grade 2, (21.1%) were in grade 3, and (25.6%) were in grade 4. Students involved in this study were mostly from cycle one (74.3%), while (25.6%) were from the second cycle.

A. Data Analysis

All statistical analyses were carried out using the SPSS, version 21. The analyses that were examined in the study included:

- Grade comparison – To measure the academic variation among students, and emphasize on the effectiveness of simulation games in academic achievement.
- Descriptive analysis – To analyze the perceptions of participants towards simulation gaming outcome practices and competencies in the following five domains: (1) educational goal, (2) knowledge, (3) social learning and environment, (4) students' perception toward instruction, and (5) evaluation
- Cronbach Alpha – To view the reliability of the questionnaire
- Factor analysis – To measure the validity of the questionnaire, i.e., whether it contributes significantly to the factor it measures and to group items accordingly to the factor they measure.
- Analysis of variance (ANOVA) and T-Test – To see whether there is an effect for demographic variables of title and academic qualification of participants on their perceptions towards simulation game outcome practices and competencies in the afore mentioned five dimensions.

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 III shows that the average mean of the control group was lower than that of the test group (7.932< 8.512).

Table III. DESCRIPTIVE STATISTICS SUMMARY FOR CONTROL/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

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, it revealed academic progress of the test group students. The researchers executed a study quality appraisal on pre-post test groups, relying on the basics of the investigated related work listed in the study literature. In which the researcher benefited from their limitations and went beyond it as much as possible.

Table IV. 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

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 IV shows the grading 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 V 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 students' perception toward instruction (0.706>0.654>0.605>0.580>0.490), indicating that the practice of simulation games enhance the students' recognition of provided instructions. It also, indicates the instructions in the used simulation game were straightforward and suitable for the students as mentioned previously at the explained frame works in the literature review. The use of computerized instructions within the simulation game provided a higher academic achievement [43].

Table V. DESCRIPTIVE STATISTICS SUMMARY FOR THE STUDENTS' QUESTIONNAIRE

Factor	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	141.292%

Table VI. RESULTS OF CRONBACH'S TEST FOR RELIABILITY OF QUESTIONNAIRE

Factor	Cronbach's Alpha	Number of Items
Educational goals	0.811	5
Knowledge	0.710	5
Social learning and environment	0.944	4
Students perception toward instructions	0.798	3
Evaluation	0.893	4
Total Whole of the Questionnaire	**0.831**	**21**

The researcher held a couple of tests to ensure the reliability and validity of the used questionnaire. For reliability cronbach's alpha is used. As for the reliability, the researcher assures that the survey is valid by using different statistical measures. For validity, two measures calculated: the Kraiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of Sphericity

Reliability comes to the forefront when variables developed from summated scales are used as predictor components in objective models. It is very important to know whether the same set of items would elicit the same responses, and if the same questions are recast and re-administered to the same respondents. Cronbach's alpha is a measure of internal consistency that is, how closely related sets of items are as a group.

Table VI displays the result of Cronbach's Alpha Test for reliability of questionnaire**.** Alpha coefficient ranges in value from 0 to 1. The higher the score, the more reliable the generated scale is. The result indicates that Cronbach's Alpha for the whole questionnaire is 0.831 (greater than 0.7). So, the questionnaire is considered reliable.

The initial stage involved checking the factorability of the data. To this end, two tests were performed the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and

TABLE VII. RESULTS FOR KMO TEST

Factor	KMO Measure of Sampling Adequacy
Educational goals	0.718
Knowledge	0.663
Social learning and environment	0.681
Students perception toward instructions	0.789
Evaluation	0.795
Total Whole of the Questionnaire	**0.729**

Table VIII. RESULTS OF BARTLETT'S SPERICITY TEST

Factor	Approximate Chi-Square	Significance
Educational goals	43.856	0.000
Knowledge	40.500	0.000
Social learning and environment	59.342	0.000
Students perception toward instructions	16.747	0.001
Evaluation	52.708	0.000

the Bartlett's test of sphericity. KMO values usually vary between 0 and 1. For the Bartlett's test of sphericity, a value of ($p< 0.05$) is essential for adopting the results as acceptable. Both tests were performed to test the scale items in the questionnaire used for the data collection.

Table VII displays the results of KMO test. The result indicates that KMO test of Sampling Adequacy is 0.729, which is above the required level of 0.6 for recognizing the acceptability of the results. Hence, the results of the KMO test are significant for all five factors.

Table VIII displays the results of Bartlett's Sphericity test. The result indicates that values of the Bartlett's Sphericity test are also significant for all five factors with ($p=0.000$), and accordingly factor analysis is regarded as appropriate.

Table IX. RESULTS FOR EIGENVALUE TEST

Factor	Number of components	Initial Eigenvalues	
		Total	% of Variance
Educational goals	1	3.512	70.230
Knowledge	1	2.526	50.515
Social learning and environment	1	2.509	62.708
Students perception toward instructions	1	2.235	74.504
Evaluation	1	2.558	63.951

Eigenvalues are numbers that specify how spread out the data is. Table IX displays the results of Eigenvalues test. The results of the Eigenvalues test expose that a high percentage of the variance in the sample is clarified by the factors involved in the scale.

The highest percentage of variance was at the student perception toward instruction's domain (74.504 %), while the lowest was at the knowledge domain (50.515 %). This shows that the students' answers varied mostly, when they were asked about their perception toward the simulation instructions. As such, the results are observed as suitable.

Sad indicated that communalities illustrate how various issues can affect the design of the research variables [44]. It is the amount of variance a variable shares with all the other variables being considered. This is also the proportion of variance explained by the common factors. A value of variance that is below (0.3) might be a sign that the item does not belong with the other items measuring the variable. In practice, variables with a value of communality of (0.500) and above are retained. As a result, this validated the items used in not only with standardized questionnaire but also, the results that correlated with it.

Table X. RESULTS FOR COMMUNALITIES TEST

Factor	Initial	Extraction
Educational goal	5	0.702
Knowledge	5	0.525
Social learning and environment	4	0.532
Students' perceptions toward instructions	3	0.745
Evaluation	4	0.639

Table X displays the results of communalities for the five dimensions. The results indicate that value of communalities of all five simulation gaming framework are above 0.500, so these variables are retained.

B. Hypothesis results

The researcher attempts to study the relation between learning in social environment and succession of simulating gaming that is illustrated by the four factors (dimensions): (1) Educational goals, (2) Knowledge, (4) Students perception toward instructions, and (5) Evaluation.

The research questions related to the impact of simulation game on education operation management through the above four dimensions is:

- What is the relation between simulation gaming and learning in social environment?

To study the effect of these variables, the researcher used chi-square test for independence; also called Pearson's chi-square test or the chi-square test of association, is a non-parametric test used to discover if there is a relationship between two categorical variables, which are the observed

distribution with a theoretical distribution. This test was applied since the variables are ordinals.

For the interpretation, *p*-value is compared with α (error ratio = 5%, i.e., 0.05). If *p*-value > α → The researcher considers the difference insignificant and vice versa.

$H_0$1: There is no statistically significant difference at the 0.05 level between students' perception and learning in a social environment such as the one provided by the simulation game.

Table XI displays the result of the relation between students' perception and social learning toward simulation gaming. The result indicates that *the total p*-value is 0.128 (greater than 0.05). *Result: $H_0$1 is accepted.*

However, p-value between educational goals and learning in social environment is equal to 0.003, which is less than 0.05. Also, p-value between knowledge and learning in social environment is equal to 0.035, which is less than 0.05. These two factors have a direct relation on learning in social environment.

Table XI. RESULTS OF THE RELATION BETWEEN STUDENTS' PERCEPTION AND SOCIAL LEARNING TOWARD SIMULATION GAMING

	Pearson chi-square	P-value	N of Valid Cases
Educational goals	15.899	0.003	308
Knowledge	10.352	0.035	
Students perception toward instructions	4.029	0.402	
Evaluation	5.972	0.201	
Total of Factors	**7.250**	**0.128**	

The researcher studied the effect of demographic variables of students (gender and level of grade) on the education operation management that is illustrated by the five factors (dimensions): (1) Educational goals, (2) Knowledge, (3) Social learning and environment, (4) Students perception toward instructions, and (5) Evaluation. In order to answer the following research question:

- How does simulation gaming affect education operation management toward two demographic variables gender and grade?

To study the effect of these variables, the researcher used ANOVA test; it's a parametric test used to compare more than two means, and to study if the difference is significant or not. Also, the student T-test was applied to compare two means. These two tests were applied since the general questions are ordinals.

For the interpretation, *p*-value is compared with α (error ratio = 5%, i.e., 0.05).
If *p*-value > α → The researcher considers the difference insignificant and vice versa.

Table XII. RESULTS OF THE EFFECT OF GRADE VARIABLE OF STUDENTS ON THE FACTORS OF THE STUDY

Grade Factor	Grade 1	Grade 2	Grade 3	Grade 4	P-value
Educational goals	0.66	0.70	0.82	0.75	0.170
Knowledge	0.67	0.64	0.72	0.78	0.197
Social learning and environment	0.58	0.62	0.68	0.54	0.593
Students perception toward instructions	0.77	0.82	0.77	0.78	0.838
Evaluation	0.76	0.72	0.78	0.82	0.531
Total of Factors	**0.688**	**0.700**	**0.754**	**0.734**	**0.465**

Knowing that the level of significance for ANOVA Test and independent t-test is 0.05, the results of hypotheses were as the following:

Table XII displays the result of the effect of the grade of students on the factors of the study in simulation gaming. The result indicates that *p*-value is 0.465 (greater than 0.05).

$H_0$2: There is no statistically significant difference at the 0.05 levels between effective simulation games and education operation management toward two demographic variables grade. There is no statistically significant difference at the level of 0.05 between the demographic variable of students' grade and the effect of simulation gaming in the explained five dimensions.

Table XIII. Results of the Effect of Gender Variable of Students on the Factors of the Study.

Gender Factor	Female	Male	P-value
Educational goals	0.70	0.74	0.389
Knowledge	0.66	0.73	0.183
Social learning and environment	0.57	0.63	0.396
Students perception toward instructions	0.78	0.79	0.719
Evaluation	0.78	0.76	0.663
Total of Factors	**0.698**	**0.73**	**0.470**

Result: $H_0$2 is accepted.

Table XIII displays the result of the effect of gender of students on the factors of the study in simulation gaming. $H_0$3: There is no statistically significant difference at the 0.05 levels between effective simulation games and education operation management toward two demographic variables gender.

The result indicates that *p*-value is 0.470 (greater than 0.05).

There is no statistically significant difference at the level of 0.05 between the demographic variable of students' gender on the effect of simulation gaming in the explained five dimensions. *Result: $H_0$3 is accepted.*

The school administration, learning support assistants, lower elementary education specialist, school counselor, and the researcher recited the barriers that hinder the usefulness of simulation gaming in education during the interview, focus group discussion, and structured observation as following:

a) Active cooperation: simulation games require active cooperation of the students if they are to succeed, however, this cooperation might not be forthcoming.
b) Time demands: comparing the time convoluted in using simulation games to the learning benefits established is essential. Certain simulation games demand much time during experiencing that would exceed the benefits established.
c) Student's outcome: upon experiencing simulation games students might raise a higher interest in playing the game. A potential outcome of using simulation in a lesson is that the student's education level might be affected, when they concentrate more on the game itself than the intended lesson.
d) Technology issues: simulation games face hurdles with technology, such as the impotence to preview, and the deficiency of accessibility to disabled students.
e) Stress: the feeling of uncertainty, and physiological pressure upon decision-making lead to stress among participants. This might cause problems with classroom management, and disorder in student's behavior.
f) Cost: certain requirements of simulation games are expensive which set a barrier on implementing it.

These barriers have a negative consequence on the effectiveness of simulation games.

$H_0$4: Barriers portrayed in the simulation games does not correlate with its effectiveness on students' education.

Results: $H_0$4 is rejected. Hence, the researcher accepts the alternative hypothesis H_A4.

VI. Conclusion and Further Work

In this section, the analysis of the obtained results under the optic of the research questions and sub-questions is carried out. Moreover, the chapter reviews the firmness and fragility of the current study with a specific end goal to include essential recommendations, and implications for future research in this field, as proposed by the findings.

A. Conclusion

In respect to the relation between students' perception and learning in social environment, the outcome clearly showed there is negative relation, yet much emphasis on the decision-making, and instruction need to be addressed as they are major limitations.

In regard to the barriers faced during the implementation of simulation games in science education, their quantitative impact on learning outcome wasn't assessed due to the required time frame to brace behavioral variables. However, they are expected to be negative, especially the active cooperation, since cooperation is vital to trigger the intrinsic motivation of students and obtain the basic goal of using the simulation game. Time demands are another vital barrier, teachers should consider allowing more time at the implementation phase, since the student centered and technical aspects of the simulation game demands more effort than traditional method of education does.

In relation to the effect of the simulation game on education operation management toward the two demographic variables gender and grade, the outcome clearly showed that there is no statistically significant difference at the level of 0.05 between the demographic variable of students' gender and grade with the effect of simulation gaming in the explained five dimensions.

The researcher concludes that students have the highest perception toward instructions with the highest total mean value (0.706) in the five dimensions, and the lowest CV (79.5%). While the social learning and environment had a negative impact on the implemented simulation game with the lowest total mean value (0.492) in the five dimensions.

The researcher concludes that the students consider that the simulation game represents their decisions as indicated by item 18 with the highest mean (0.876) in the five dimensions. In contrast few students find that the simulation game demands more effort upon implementation than the expected of a mean value (0.13) in the five dimensions.

The researcher concludes that the students consider that the simulation game as interesting and enjoyable with a mean value of (0.860), although practical skills transferred to them throughout the simulation game weren't at a significant level, in which the obtained mean value of item 4 was (0.337). This reflects that the use of simulation games doesn't eradicate the practical application of science topics that could be assigned through lab work. Furthermore, the fusion of simulation game with acquirement of the practical skills would enhance, and facilitate the quality of operations used in education management.

B. Recommendations

In light of the review of the literature and results of the present study, the researcher would provide the accompanying pedagogical recommendations:

1. Simulation games are very significant for a professional development of educational systems, and for

the process of education operation management at different levels. So, the government should ensure incorporating simulation games as a part of the education system. Also, the preparation for the simulation game should take into consideration the barriers and start decreasing their negative impact through enabling informal learning, facilitating access to networks, and providing resource support for better outcome.

2. The simulation game requires more time than the traditional method of education. If the assigned time for the simulation isn't fitting, at that point learning is probably not going to happen, at any rate to a similar degree. Extra time should be apportioned in class for the simulation, and the curriculum must be re-organized to enable this new teaching method to take up enough time in the class. Hence, the set-up of the curriculum requirements to represent the exchange off between practical skills and theoretical establishment can be represented consequently through lab sessions and simulation games.

3. Teachers should contemplate the preconception of students through the simulation program. Also, a specialist ought to be available in the school or be made accessible to lead a preparation to course for science educators on the most proficient method to settle any essential rising inconveniences, to guarantee that the lesson proceeds, as it should.

4. Planning a simulation for advancing operations management education ought to think of some of the issues, for example, the simulation site engaging quality, the ingress to a supervising framework, and individual execution appraisal. Appraisal of team execution should be supplemented with individual execution assessment to guarantee reasonableness in checking. The utilization of this simulation should be formally incorporated into the operations management course syllabus for consistency over scholarly semesters.

5. Innovation is the future; it is fundamental that specialists discover approaches to interface instructions to address the issues and eventual fate of the present advanced students. Scientists must keep on discovering the best techniques to enhance instructions. Basically paying little respect to the innovation accessibility, the subtitles arrangement, and the instructors' character, upon choosing the proper simulation games for each lesson.

C. Complications and Limitations of this Study

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

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.

D. Implication 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.

Moreover, simulation games are applicable through the learning process from the school and university levels to the long-lasting learning circumstances.

The researchers suggest that the issue of simulation games in science education has two fundamental aspects.

First, they should be used as a supplement to the educational process. Subsequently, the simulation games should be included in the science education curriculum, at all educational levels. Moreover, the use of simulation games should be considered an imperative factor for comparing the quality educational curricula that uses it from the educational curricula that don't use simulation games. Second, science curricula should, at the higher levels of study, include a course about simulation games itself.

ACKNOWLEDGMENT

The researchers would like to extend their gratitude to the students (who were involved in this study), the instructors, and the administrations of the *Family School* and *The National Evangelical School in Nabatieh*.

REFERENCES

[1] N. Issa, A. Kawtharani, and H.M. Khachfe, "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," in The Ninth International Conference on Emerging Networks and Systems Intelligence, November 12-16, 2017, Barcelona, Spain.

[2] L. Proserpio and A. Gioia, "Teaching the virtual generation. Academy of Management Learning and Education," vol. 6(1), pp. 69–80, 2007.

[3] E. Clarke, "Learning outcomes from business simulation exercises: Challenges for the implementation of learning technologies," Education + Training, vol. 51 Issue: 5/6,

pp.448-459, 2009. Available from: https://doi.org/10.1108/00400910910987246

[4] M. Lewis and H. Maylor, "Game playing and operations management education," International Journal of Production Economics, vol. 105, pp. 134–149, 2007.

[5] J. Bloomer, "What have simulations and gaming got to do with programmed learning and educational technology? Programmed learning & educational technology," vol. 10(4), pp. 224–234, 1973.

[6] C. Abt, "Serious games". New York: Viking Press, 1970.

[7] A. Struppert, "It's a whole new fun different way to learn," Students' perceptions of learning with an electronic simulation: Selected results from three case studies in an Australian, an American and a Swiss middle school. The International Journal of Learning, vol. 17, pp. 363 – 375, 2010.

[8] J. Kanet, "Problem-based Learning - Lessons learned from an undergraduate operations management program," Paper presented at the POMS 18th annual conference, Dallas, Texas, USA, 2007.

[9] B. Naik, "Using PBL assignments in undergraduate operations management course," Journal of higher education theory and practice, vol. 11(2), pp. 84-90, 2011.

[10] J. Wolfe, "A history of business teaching games in English-speaking and post-socialist countries: the origination and diffusion of a management education and development technology," Simulation & Gaming, vol. 24, pp. 446–463, December 1993.

[11] M. Gredler, "Educational games and simulations: A technology in search of a (research) paradigm." In D. H. Jonassen (Ed.), Handbook of research for educational communications and technology, pp. 521-39, 1996.

[12] F. W. Moroney and W. B. Moroney, "Flight simulation". In D. J. Garland, J. A. Wise, & V. D. Hopkin (Eds.), Handbook of aviation human factors. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 355–388, 1999.

[13] E. Gredler, "Educational games and simulations: A technology in search of a (research) paradigm". In D. H. Jonassen (Ed.), Handbook of research for educational communications and technology, pp. 521-39, 1996.

[14] P, Bradley, "The history of simulation in medical education and possible future directions". Medical Education, 40(3), pp. 254–262, 2006.

[15] D. Stanley and K. Latimer, "The Ward: a simulation game for nursing students". Nursing Education in Practice, 11(1), pp. 20–25, 2010.

[16] M. Stieff and U. Wilensky, "Connected chemistry – incorporating interactive simulations into the chemistry classroom". Journal of Science Education and Technology, 12(3), pp. 285–302, 2003.

[17] E. K. Chang, L. Y. Chen, Y. H. Lin and T. Y. Sung, "Effects of learning support in simulation-based physics learning". Computers & Education, 51, pp. 1486–1498, 2008.

[18] R. B. D'Artista and F. Hellweger, " Urban hydrology in a computer game," Environmental Modelling and Software, 22, 1679–1684.Education, 29(1), pp. 25–33, 2007.

[19] H. Gold and S. Gold, "Beat the market: an interactive microeconomics simulation". The Journal of Economic Education, vol. 41(2), 2, p. 216, 2010

[20] D. Vlachopoulos, and A. Makri, "The effect of games and simulations on higher education: a systematic literature review". International Journal of Educational Technology in Higher Education, 14, 2017, pp. 1-33. Retrieved from: https://doi.org/10.1186/s41239-017-0062-

[21] J. H. Klabbers, "On the architecture of game science". Simulation & Gaming, 2018, 49, pp. 207-245. Retrieved from: https://doi.org/10.1177/1046878118762534

[22] H. Stančić, S. Seljan, A. Cetinić, and D. Sanković, "Simulation Models in Education," In Međunarodna Znan. Konf. Futur. Inf. Sci, January 2007, pp. 469-481.

[23] A. Zapalska, D. Brozik and D. Rudd, "Development of active learning with simulation and games," Online Submission, 2012.

[24] A. Zapalska., and D. Brozik, "Learning market skills through simulation". Journal of Private Enterprise, pp. 56-70, 2001.

[25] J. Burguillo, "Using game theory and competition-based learning to stimulate student motivation and performance. Computers & Education," vol. 55(2), 2010, pp. 566-575. Retrieved from: http://dx.doi.org/10.1016/j.compedu.2010.02.018.

[26] D. Cordova and M, Lepper, "Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice". Journal of educational psychology, vol. 88(4), 1996, p. 715. Retrieved from: http://dx.doi.org/10.1037/0022-0663.88.4.715.

[27] H. Tüzün, M. Yılmaz-Soylu, T. Karakuş, Y. İnal, and G. Kızılkaya, "The effects of computer games on primary school students' achievement and motivation in geography learning. Computers & Education," vol. 52(1), 2009, pp. 68-77. Retrieved from: http://dx.doi.org/10.1016/j.compedu.2008.06.008.

[28] N. Vos, H. Meijden, and E. Denessen, "Effects of constructing versus playing an educational game on student motivation and deep learning strategy use," Computers & Education, vol. 56(1), 2011, pp. 127-137. Retrieved from: http://dx.doi.org/10.1016/j.compedu.2010.08.013

[29] L. Neumann, M. Neumann, and M. Hood, "Evaluating computer-based simulations, multimedia and animations that help integrate blended learning with lectures in first year statistics," Australasian Journal of Educational Technology, vol. 27(2), pp. 274-289, 2011.

[30] A. Struppert, "It's a whole new fun different way to learn." Students' perceptions of learning with an electronic simulation: Selected results from three case studies in an Australian, an American and a Swiss middle school. The International Journal of Learning, 17, pp. 363 – 375, 2010.

[31] N. Nguyen, "Motivational Effect of Web-Based Simulation Game in Teaching Operations Management". Journal of Education and Training Studies Vol. 3, No. 2. 2015. Retrieved from: http://dx.doi.org/10.11114/jets.v3i2.565

[32] T. Kikota, G. Costab, R. Magalhãesc, S. Fernandesd, "Simulation Games as Tools for Integrative Dynamic Learning: The Case of the Management Course at the University of Algarve" , 2013 . Retrieved from: doi:10.1016/j.protcy.2013.12.002

[33] L. Abdullah, H. Hanafiah, and A. Hashim, "Developing Creative Teaching Module: Business Simulation in Teaching Strategic Management". International Education Studies; Vol. 6, No. 6; 2013. Available from: Canadian Center of Science and Education. Retrieved from: hp://dx.doi.org/10.5539/ies.v6n6p95.

[34] D. Arias-Aranda, and O. Bustinza-Sanchez, "Entrepreneurial attitude and conflict management through business simulations". Industrial Management & Data Systems, 109(8), pp. 1101–1117, 2009.

[35] I. Fallatah, "Introducing inter-professional education in curricula of Saudi health science schools: An educational projection of Saudi Vision 2030". Journal of Taibah University Medical Sciences (2016) .Retrieved from: http://dx.doi.org/10.1016/j. jtumed.2016.10.008.

[36] L. Moore, "American history simulations, reenactments, and educational games: a supplemental middle school curriculum", 2012. Retrieved from https://dspace.sunyconnect.suny.edu/.../Kerrie_Moore_Masters_Project_May2012.pdf.

[37] H. Ellington, "Games and simulations – media for the new millennium." In D. Saunders and N. Smalley (Eds.), The International simulation and gaming research yearbook. London: Kogan Page Vol. 8, pp. 13-32, 2000.

[38] A. Piu and C. Fregola, "Transcoding Pattern and Simulation Games in Learning Geometry." A Research in Primary School. In S. A. Meijer and R. Smed (Eds.), Frontiers in Gaming Simulation, 2014, pp. 21-28, Switzerland: Springer International Publishing.

[39] "Helping Plants Grow Well" British Broadcasting Corporation (BBC) (http://www.bbc.co.uk/schools/science-clips/ages/7_8/plants_grow.shtml)

[40] C. Robson, "Real World Research. A Resource for Social Scientists and Practitioner Researches, 2nd edition. Blackwell: Oxford," 2002.

[41] A. Bryman, "Integrating quantitative and qualitative research: how is it done? Qualitative Research", 6(1), pp. 97-113, 2006.

[42] M. Fetters and D. Freshwater, "The 1+1=3 integration challenge". Journal of Mixed Methods Research, 9, pp. 115–117, 2015.

[43] O. Serin, "The effects of the computer-based instruction on the achievement and problem solving skills of the science and technology students. TOJET: The Turkish Online Journal of Educational Technology," vol. 10(1), January 2011.

[44] N. S. Sad, "An attitude scale for smart board use in education: Validity and reliability studies," Computers & Education, 58 (3), pp. 900-907, 2012.