Humanities and Educational Sciences Journal
ISSN: 2617-5908 (print)
مجلـــــة العلـــــوم التربـــــوية والدراســـات الإنســـانيـــة
ISSN: 2709-0302 (online)

Technology - Based Simulation Learning of Classroom Enhancing Students' Learning & Teachers' Practical Performance(*)

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*) تاريخ تسليم البحث 2/9/2023 تاريخ قبوله للنشر 25/10/2023
*) موقع المجلة: http://hesj.org/ojs/index.php/hesj/index

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Abstract

Using Technology-based simulations that are interesting, easy to use by participants, and shorting the time of technical teachers in bringing the technical materials to be used in learning anywhere and anytime. The technology of simulation learning is the most significant tool of the information age and has increasingly been used in each stage of the education system. The main objective of this study is to enhance students' learning performance depending on using simulation techniques. The participants were three hundred participants participated in this study. Using simulation suggestions for participants' opinions and attitudes were discussed.

This paper has been designed to study the development that is happening for the participants of the classroom towards the simulation lab usage in three dimensions which are abilities, practical skills, and knowledge they have. The interaction between these dimensions is the key purpose of this study to merge technology in existing education and introduce simulation technology as an important tool to support new ways of practical studies.

A model, that explains the effect of TSU, TAS, and TPU on learning, is generated and tested. Using the AMOS 18 (Analysis of Moment Structures) program, it explains (70%) of TSU TOOLS, (77%) of TPU TECHNOLOGY, and (60 %) of TAS, with good model fit. The findings accept all hypotheses.

Keywords: *Simulation Labs - Technology Simulation Usage (TSU) - Technology Ability of Simulation (TAS) - Technology Practical Usage (TPU).*

INTRODUCTION AND Related Work:

Over many years, quick development in computer technology has engendered simulation - based laboratory (lab) in addition to the traditional hands - on lab. Many higher education institutions have edited simulation labs, replacing some existing physical lab experiments. The creation of new systems for conducting engineering lab activities has raised concerns among educators on the merits and shortcomings of both physical and simulation labs; at the same time, many difficulties'' arguments have been raised on the differences between both labs. Investigating the effectiveness of both labs is complicated, as multiple factors should be considered. Given this challenge, a study on students' perspectives on their experience related to key aspects of education laboratory exercise was conducted. This study was utilized to measure the students' cognitive styles. The findings revealed that there are significant differences in most of the aspects of physical and simulation labs [1].

Objective to explore if a virtual laboratory simulation (vLAB) could be used to replace a face – to - face tutorial (demonstration) to prepare students for a laboratory exercise in microbiology. A total of (189) students who were participating in an undergraduate biology course were randomly selected into a vLAB or demonstration condition. In this lab condition students could use it at home to 'practice' in a virtual environment. In the demonstration condition, students were given a live demonstration from a lab tutor showing them how to streak out bacteria on agar plates. All students were evaluated on their ability to perform the technical streaking in the physical lab and were administered a pre and post - test to determine their knowledge of microbiology, intrinsic motivation to study microbiology, and self - efficacy in the field of microbiology before, and after the experiment. Results showed that there were no significant differences between the two groups on their lab scores, and both groups had similar increases in knowledge of microbiology as well as self - efficacy in the field of microbiology. Concluding that our data show that vLABs function just as well as face - to - face tutorials in preparing students for a physical lab activity in microbiology. The results imply that vLABs could be used instead of face – to - face tutorials, and a combination of virtual and physical lab exercises could be the future of science education. [2]

Simulation - based medical education (SBME) is gradually becoming an inseparable part of medicine. The demand to use this training approach in healthcare is increasing every year to meet the Department of Health's Standards for Better Health (NESC, 2008). As an alternative training approach, SBME provides medical students and practitioners with near real-life opportunities to practice and improve clinical and non-clinical skills and improve health care services as a result. Although SBME is already a very popular training approach, Kneebone (2005) argues it is "often accepted uncritically, with undue emphasis being placed on technological sophistication at the expense of theory - based design" (549). SBME is "a complex service intervention" (McGaghie, 2009, 50), which includes much more than a series of advanced technologies utilized for simulating an event. SBME is actualized by a network of closely knit human, non - human, and "conceptual and symbolic" (Bleakley, 2012, 464) actors that work in an interrelated manner "as a basis to promoting learning and innovation" (Bleakley, 464). What is required to develop a 'healthy' and 'growing' network that promotes learning and innovation (Bleakley, 2012) or hinders effective learning has not widely been investigated. Bleakley argues that actor-network theory (ANT) "serves to repair the historical separation of theory and practice" (465). To understand SBME as a complex process involving technology, people, objects, artifacts, actions, and places, ANT may introduce new insight, "an interruption or intervention, a way to sense and draw nearer" (Fenwick & Edwards 2010) to the phenomenon of SBME. Outcomes provide insight into the design of a simulation session, describe the assemblage of blended learning in an SBME (B-SBME) actor - network, and illustrate an example of the network effects of mediators' and intermediaries' capacities to form alliances between a B-SBME networked assemblage and broader Trust networks.

Simulation is a general term for achieving educational objectives through experiential learning acquired through an artificial display of a real - world representation. Medical simulation is relatively new, and simulators have long been used in other high - risk professions such as aviation. Medical simulation allows clinical skills to be acquired through deliberate practice rather than a trainee learning approach. The trainee can make mistakes and learn from them without fear of harming the patient. There are different types and classifications of simulators and their cost varies depending on their degree of similarity to reality or "fidelity". Simulation - based learning is expensive. However, it is cost - effective if utilized properly. The objective of this review article is to highlight the importance of simulation as a new teaching method in undergraduate and postgraduate education.

In general terms, simulation is a technical approach that attempts to create characteristics of new learning. Simulation allows the educator to control the learning environment through scheduling practice, providing feedback, and introducing environmental distractions [2].

In health care, simulation may refer to a device representing a simulated patient or part of a patient; such a device can respond to and interact with the actions of the learner. [3]

Simulation also refers to activities that mimic the reality of a clinical environment and that are designed for use in demonstrating procedures and promoting decision-making and critical thinking [4].

In the system of education, simulation can take many forms, from relatively simple to highly complex

Research Background:

According to [1], [2], [5] simulation services can be divided into three broad categories: Simulation Labs, Technology Simulation Usage (TSU), Technology Ability of Simulation / (TAS), and Technology Practical Usage (TPU).

In the first category, Technology Simulation Usage (TSU), the files are compressed and stored on a server. A client can download the files through the Internet. This is sometimes referred to as on - demand simulations.

The second category, Technology Ability of Simulation (TAS) explores the participants' abilities for using simulations freely.

In the third category, Technology Practical Usage (TPU) gives practical results and concentrates on the usability of simulation labs.

Objectives:

1- To interact with the best way of Technology Simulation Usage (TSU),
2- To study the important effects of Technology Ability of Simulation (TAS), on education.

3- To highlight the use of online multimedia through the Internet.

4- To extract the benefits of Technology Practical Usage (TPU) in helping students and practical teachers.

Methodology:

The method which is modified for the present study was empirical and statistical. It provides a flexible framework for selecting materials and participants, defining criteria and measures, and implementing evaluation techniques. By editing these different techniques, the proposed structure model for TSU, TAS, and TPU aims to assess the relationship between them.

To assess the relationship between interactive TSU TAS, and TPU; Different statistical techniques were used including instrument development, a confirmatory factor analysis (CFA), an exploratory analysis (Mean (M), Standard Deviation (SD), Principal Component Factor and Cronbach’s alpha, (exploratory factor analysis (EFA) is used to determine how many latent variables would be used)), Construct Reliability, and a test of a structural model. Convergent validity and Discriminant validity were used in this research according to the recommendations of [11]and [23].

There are twenty-six observed (endogenous) variables, which are TSU1 … TSU8, TAS1 … TAS8 and TPU1 … TPU8.

and there are three unobserved (exogenous) variables, which are TSU8, TAS8, and TPU8 respectively.

To assess the fit of the model to the data, Chi-square per degrees of freedom, GFI, AGFI, CFI, RMSR, RMSEA, and MI were computed. If the model fits the data adequately, the t-values of the structural coefficients will be evaluated to test the research hypotheses. Figure 1 illustrates the proposed SIMULATION LABS Model below.

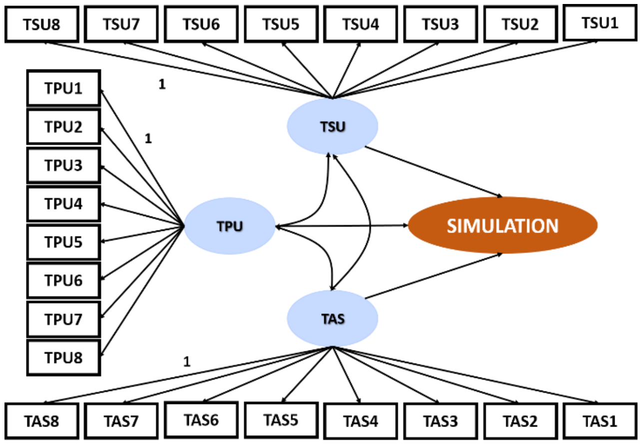

Fig (1) SIMULATION LABS Model

1-1 Population and Sample

The difficulty of studying the whole population forces the researcher to choose randomly a sample of (300) students.

Out of which (80) were of Basic English Language, (80) were of Basic Mathematics, (80) were of Basic Biology and (60) were of Basic Science.

Before this study, all of the participants had enough knowledge of the Internet and Simulations and searched for information using different engines (Google and Yahoo search engines).

Therefore, the total of usable responses was (300) which means there were no missing responses, and whole the questionnaire for (300) participants was completed successfully.

2-1 Description of the tool used and construct measures

In this study, the data were collected via a questionnaire survey of Likert 5-point scale format (1= strongly disagree, 2= disagree, 3= neutral, 4= agree and 5= strongly agree). The design of the questionnaire follows the stages outlined by ([30]; [29]; [21]; [12]; [9]; [5]; [18]) in the case of simulation.

Content validity was ensured through a comprehensive review of the literature and interviews with practitioners, i.e., the indicators in the questionnaire were based partially on previous studies. Interviews and discussions with practitioners and several experts in simulation.

The items in the questionnaire were judged as relevant by (8) indicators for each of the TSU TAS and TPU factors. Therefore, the total of observed variables is 24.

The interviews resulted in minor modifications to some words provided in some measurement items, which were finally accepted as possessing content validity. The refined measurement items were included in the final survey questionnaire administered to the target respondents.

3-1 Data Collection

Various difficulties are generally felt by the investigators whole collecting data. In the present study, the data were to be collected from four departments of basic class final year in Taiz University (TU) – Yemen Country.

To collect the systematic data, it was essential to approach subjects and the investigators did the same. After contacting participants, the investigators explained the objectives of the study to them. The respondents were assured that the information provided to them would be kept strictly confidential.

The questionnaire was used for SIMULATION LABS and included three parts (for TSU, TAS, and TPU) tests, which consisted of a total of twenty-four questions.

Then the investigators distributed the questionnaire among the participants. They were asked to go through the general instructions given on the top of them before filling in the given entries.

Lastly, the participants were asked to read the statements carefully and requested to give their responses to every statement.

The investigators gave full freedom to the participants to ask the meaning of the words or sentences that were beyond their understanding.

4-1 Statistical Techniques Used

The analysis of data was done by using statistical techniques, which were chosen only after the investigators found them to be most appropriate and compatible with the collected data. This analysis depended on the previous studies of ([30]; [29]; [21]; [12]; [9]; [5]; [18]), [22] and [23]. These statistical techniques included instrument development, a confirmatory factor analysis (CFA), an exploratory analysis (Mean (M), Standard Deviation (SD), a Principal Component Factor, and Cronbach's alpha, (exploratory factor analysis (EFA) used to determine how many latent variables would be used)), Construct Reliability, and a test of a structural model.

However, convergent validity was assessed by examining the significance of individual item loadings through t - tests. The overall fit of a hypothesized model can be tested by using the maximum likelihood Chi - square statistic provided in the Amos (a software package for SEM).

The output and other fit indices such as the ratio of Chi - square to degrees of freedom, goodness-of-fit index (GFI), adjusted goodness – of - fit index (AGFI), comparative fit index (CFI), root mean residual (RMR), the root mean square error of approximation (RMSEA), and The Tucker Lewis Index (TLI).

Discriminant validity was assessed by comparing the average variance extracted (AVE) to the squared correlation between constructs.

The AVE estimate is a complementary measure to the measure of composite reliability ([11] ; [23]).

5-1 Research hypotheses

Based on the research framework (see Figure 1), the SIMULATION LABS model originally defined Technology Simulation Usage (TSU), Technology Ability of Simulation (TAS), and Technology Practical Usage (TPU) as three main factors.

Many studies concentrated on efficiency, influences, ability, and achievement of using interactive computer technology, the Internet, and attitudes towards simulations ([30]; [29]; [21]; [12]; [9]; [5]; [18]).

It is therefore reasonable to expect that there is a positive relationship between interactive TSU, TAS, and TPU.

Thus, the researchers’ hypotheses are:
H1: There is a positive relationship between interactive TSU and TAS;
H2: There is a positive relationship between interactive TSU and TPU;
H3: There is a positive relationship between interactive TAS and TPU;

6-1 Instruments

As mentioned above the questionnaire was composed of 24 questions concerning the SIMULATION LABS (Cronbach's Alpha α= 0.950).

Analysis and results

6-1 Coefficient alpha and reliability

Cronbach's alpha is used for evaluating reliability [22]. The Cronbach's alpha value for each measure is shown in Table (1). The reliability value for each construct was well above the value of (0.7), which is considered satisfactory for basic research ([7]; [27]). Nevertheless, Cronbach's alpha has several disadvantages, one of them being that Cronbach's alpha cannot be used to infer unidimensional [14].

TABLE (1) CRONBACH ALPHA VALUES FOR EACH FACTOR

Measures	Cronbach alpha
Factor 1: Technology Simulation Usage	TSU 0.70
(TSU1, TSU2, TSU3, TSU4, TSU5, TSU6, TSU7, TSU8, TSU9, TSU10)	
Factor 2: Technology Ability of Simulation	TAS 0.60
(TAS1, TAS2, TAS3, TAS4, TAS5, TAS6, TAS7, TAS8)	
Factor 3: Technology Practical Usage	TPU 0.77
(TPU1, TPU2, TPU3, TPU4, TPU5, TPU6, TPU7, TPU8)	

7-1 Construct reliability and variance extracted measures

Construct reliability means that a set of latent indicators of constructs are consistent in their measurement. In more formal terms, this reliability is the degree to which a set of two or more indicators share the measurement of a construct.

Highly reliable constructs are those in which the indicators are highly inter- correlated, indicating that they are all measuring the same latent construct. The range of values for reliability is between 0 and (1). Computations for each construct are shown in Table (2).

The reliability of the constructs of TSU, TAS, and TPU were (0.978543, 0.966944), and (0.970596), respectively. All constructs exceeded the recommended level of (0.70) [15].

TABLE (2) DESCRIPTIVE STATISTICS AND CONSTRUCT RELIABILITY FOR EACH CONSTRUCT

Measures	Mean[a]	S.D.[b]	Construct
			reliability
TSU	21.6855	9.85122	0.978543
(TSU1, TSU2, TSU3, TSU4, TSU5, TSU6, TSU7, TSU8, TSU9, TSU10)			
TAS	19.1532	8.63632	0.966944
(TAS1, TAS2, TAS3, TAS4, TAS5, TAS6, TAS7, TAS8)			
TPU	14.3952	7.45700	0.970596
(TPU1, TPU2, TPU3, TPU4, TPU5, TPU6, TPU7, TPU8)			

a	The mean scores of streaming live audio/video, streaming stored audio/video, and interactive audio/video
b	SD = standard deviation.
c	Construct reliability = (sum of standardized loadings)^2/[(sum of standardized loadings)^2 + (sum of indicator measurement error)].

8-1 Results of hypothesis testing

The model's overall fit with the data was evaluated using common model goodness - of - fit measures estimated by the AMOS (18) (Analysis of Moment Structures) program; it explained (70%) of TSU, (60%) of TAS, (77%) of TPU, and (90%) of SIMULATION, with good model fit see figure (2) bellow. Overall, this model exhibited a reasonable fit with the data collected.

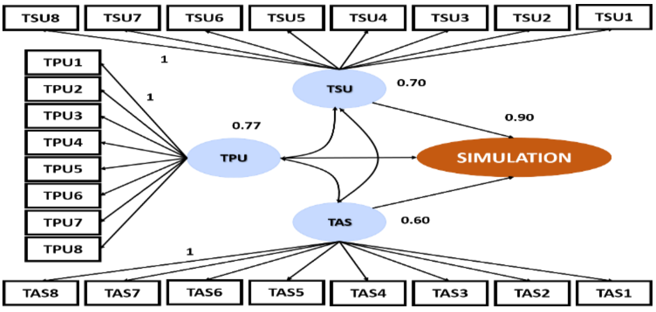

Fig (2) SIMULATION LABS Unstandardized Model

Based on the data, the AMOS estimation of this model showed a value of (1.582) in the Chi-square to the degree of freedom ratio, which is satisfactory concerning the commonly recommended value of less than (2.0). We assessed the model fit using other common fit indices: goodness - of - fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), root mean square residual (RMSR), root mean square error of approximation (RMSEA), standardized residual, and modification index (MI). The model exhibited a fit value exceeding or close to the commonly recommended threshold for the respective indices, e.g., values of (GFI=0.96), (AGFI=0.910), (RMR=0.044), (CFI=0.932), (TLI=0.945), (RMESA=0.057), satisfactory concerning the commonly recommended values.

The hypotheses also were tested as shown in Figure (3). As summarized in Table (3), H1 was supported by the data, as indicated by a significant critical ratio (C.R. = 4.291). The C.R. is a t-value obtained by dividing the estimate of the covariance by its standard error. A value exceeding (1.96) represents a level of significance of (0.05).

This reflects that (H1) was the most important determinant of SIMULATION LABS throughout this research. (H2) was supported by this study (C.R. = 2.111 (H2)). In addition, H3, was significant (C.R. = 3.698 (H3).

In sum, the tests of the structural model showed that the six hypotheses were fulfilled in this research as shown in the table below.

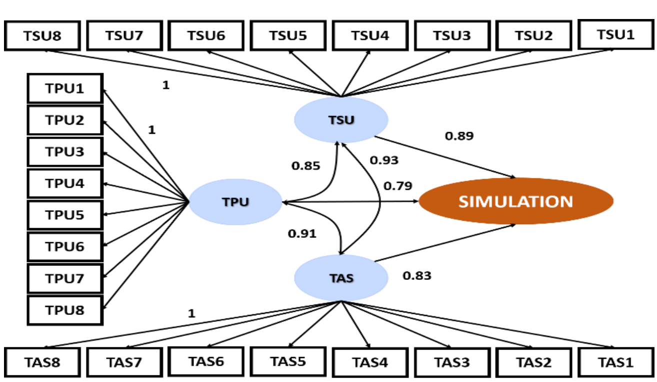

Fig (3) SIMULATION LABS Standardized Model

Table (3) Result of the structural equation modeling

Variables			Estimate	S.E.	C.R.
SIMULATION LAB	<---	SL	2.510235	.585	4.291
TSU	<---	tsu	1.365817	.647	2.111
TAS	<---	tas	1.985826	.537	3.698
TPU	<---	tutu	1.475955	.585	2.523

Fit	Indices	Chi-square (v2 =230.368), p=0.184, df=212, v2 / df=1.087
GFI=0.96, AGFI=0.910, RMR=0.044, CFI=0.932, TLI=0.945, RMESA=0.057		
a	S.E. is an estimate of the standard error of the covariance.	
b	C.R. is the critical ratio obtained by dividing the covariance estimate by its standard error.	
c	Values are critical ratios exceeding (1.96), at the (0.05) level of significance.	

9-1 Calculated variance extracted(AVE)

Evidence of discriminant validity is provided by the TSU method. The SIMULATION lABS for the latent variables via TSU, TAS, and TPU were (0.760688), (0.82041), and (0.7973), respectively. The results have demonstrated evidence of discriminant validity for the study constructs.

DIscussionand Conclusion:

This study tends to identify, within the framework of ([30]; [29]; [21]; [12]; [9]; [5]; [18]).

It has investigated the underlying relationships between TSU, TAS, and TPU which support learning and teaching for class. All hypotheses postulated by the structural model are supported. As a result, H1 is stronger than other HYPOTHESIS in this study.

Having its stronger impact on ability, practical skills, and knowledge, it is emphasized that computer is required in the basic class, particularly for receiving knowledge through practical simulation anywhere and anytime in academics and research. Using the Internet connection of many Journals and Magazines encourages teachers of class and their students to interact with simulations.

In addition, researchers may build on this model to identify and examine other factors that may influence learning to use simulation such as the math, biology, chemistry, and science skills that support e-learning, including the different levels of information technology of organizations and computer resources.

The integration of these constructs into the model will help researchers to further grasp the factors influencing the development of electronic learning in schools and universities.

Therefore, it is significant that simulation as a technique or a tool of learning would be more widespread, faculty members in higher education and school teachers would be supported with technical and technological equipment and the process would be institutionalized via the policies and strategies of Schools and Universities [13].

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