


Effectiveness of E-Learning among Hospitalized Elementary Students with Chronic Diseases

Zohreh Aghakasiri^{1*}, PhD candidate;  Mohammad Reza Nili Ahmadabadi², PhD; Esmaeil Zareii Zavaraki², PhD; Behnoosh Esteki³, MD

¹Department of Educational Technology, Faculty of Education and Psychology, Allameh Tabataba'i University, Tehran, Iran

²Department of Instructional Technology, Allameh Tabataba'i University, Tehran, Iran

³Pediatric Department, Isfahan University of Medical Sciences, Isfahan, Iran

ABSTRACT

Background: Hospitalization of elementary students with chronic illnesses could limit their engagement in school activities and result in academic failure. The purpose of the present study was to determine the effectiveness of e-learning on these students' academic performance in mathematics.

Methods: This was a pretest-posttest semi-experimental study with control group. The population included all the fifth or sixth-grade elementary school students hospitalized at least once in the school year 2019-2020 in Imam Hussain Pediatric Hospital of Isfahan, Iran. The sample size consisted of 60 students (26 in 5th grade and 34 in 6th grade) who were selected by convenience sampling and divided equally into experimental and control groups. Data gathering tools included two researcher-made mathematical quizzes designed to assess the students' academic achievement in mathematics. Each quiz was about Decimal Numbers as covered in the corresponding grade level. Data were analyzed through an analysis of covariance using SPSS 21 software.

Results: In terms of academic achievement, the mean and standard deviation of post-test scores in the experimental groups (8.26 ± 1.22) were higher than in the control group (6.60 ± 1.47). In addition, ANCOVA test results revealed that after the elimination of the pretest effect, the F of the independent variable (59.461) was significant at the confidence level of 99% ($P < 0.001$). Thus, posttest scores of experimental and control groups were significantly different.

Conclusion: Given the significant impact of e-learning on the mathematical performance of hospitalized elementary school students, it is recommended to use this approach for hospitalized learners.

Keywords: E-learning, Chronic diseases, Hospitalization, Academics achievement

*Corresponding author:

Zohreh Aghakasiri, PhD candidate;

Department of Educational Technology, Faculty of Education and Psychology, Allameh Tabataba'i University, Tehran, Iran

Tel: +98 9132109921

Email:

zohrehaghakasiri@gmail.com

Please cite this paper as:

Aghakasiri Z, Nili Ahmadabadi MR, Zareii Zavaraki E, Esteki B. Effectiveness of E-Learning among Hospitalized Elementary Students with Chronic Diseases. *Interdiscip J Virtual Learn Med Sci.* 2020;11(3):191-199. doi: 10.30476/IJVLMS.2020.86703.1038.

Received: 26-05-2020

Revised: 26-08-2020

Accepted: 26-08-2020

Introduction

Education is considered as one of the fundamental rights of all children. Therefore, providing children with adequate education is deemed as a fundamental principle in every society. In this regard, governments provide some educational opportunities for different age groups in their formal education system. Nevertheless, to fulfill the aims of public education, special measures should be taken to provide alternative schooling to those students who face difficulties in attending schools. These measures should be designed and implemented in accordance with the special conditions of this group of students. In addition, they should receive proper support for accessing training opportunities and overcoming obstacles. These efforts provide special needs students with the opportunity to receive high-quality education and thrive alongside their peers.

Students suffering from chronic diseases usually have to deal with frequent long-term hospitalizations, and may find it challenging to participate in school activities. Therefore, these children often fall behind in school, and might have difficulty establishing a long-term working relationship with friends, classmates, and sometimes, even their familiars. Hospitalization affects an ailing child's performance and growth, and may have undesirable consequences such as physical weakness, depression, isolation from friends, and inability to establish social relations (1). In addition, this group of children struggle with these circumstances at a critical age when friendship and interaction with their peers play a more important role in their development (2, 3). In general, children with chronic conditions experience lengthy hospital stays and may require continued follow-up after going home, causing major problems in their lives and that of their families. Some patients do well at home but may not be physically able to return to school. They lose a lot of school time, which deprives them of vital social experiences (4-6). Furthermore, isolation from school causes stress, anxiety and academic problems in the short term, and the

inability to cope with this situation in the long term leads to learned helplessness behavior in these children. According to Seligman's theory, 'learned helplessness' occurs when individuals cannot give appropriate response to environmental stimuli and cannot resolve their frustrations in the long term, which leads to a sense of ineffectiveness in their efforts to change affairs and cope with problems. In this situation, they resort to any course of action and will eventually accept their failures in advance despite the possibility of success.

Learned helplessness threatens an individual's sense of control over their fate. In education, as in other areas of human life, learners suffer from learned helplessness when their efforts do not lead to success, and this can decrease their motivation to learn (7). Therefore, all circumstances considered, long term hospitalization diminishes the children's chances of cultivating their talents, leading to their academic failure.

Numerous hospitalized children in Iran are currently undergoing long-term therapies away from home and school, and usually lag behind others in these periods. It appears necessary to adopt special policies aimed at facilitating coordination between these students and educational system in different settings (home, school and hospital). By providing access to educational facilities and resources, these policies are meant to address the children's problems including their social (isolation), mental and psychological (stress and anxiety), educational (harmony with classroom), and physical (difficulty in hearing and concentration) problems. In addition, these strategies should be implemented in natural settings in which the children have a stable and continuous relation with their classmates and friends during hospitalization (8).

Researchers in different countries have studied the existing academic obstacles facing these learners, and have also proposed appropriate instructional methods to support this group of patients.

Chen et al. (9) concluded in their research that education in hospitals is often delivered through voluntary teaching. However, hospital

staffs are not fully aware of the requirements for creating an environment similar to schools so that the child patients can have access to interactive resources (9). Hopkins investigated the available education support services for students with chronic conditions in some major hospitals of Australian states. A model of best-practice was developed for this purpose. However, the study shows that the lack of an integrated policy has hindered the execution of this supporting strategy in the entire country (10).

A study was conducted in the classroom of a university hospital (equipped with PC, books and toys), and the results showed that computer games, besides entertainment, allow students to learn and enhance social relations among themselves (11). Aldiss et al. conducted a review of research literature and showed that supportive technologies increase the patients' awareness of their illness and improve their psychosocial function (12). Nevertheless, Amer showed that the application of supportive technology in this field could be affected by such obstacles as poor education, poor marketing, time constraints, misperceptions about the benefits of technology, and the undesirable experiences of service providers and patients (13).

It might initially appear that using traditional methods of education, such as voluntary in-person training for individuals or groups, are an appropriate strategy to solve these children's training problems. This solution, however, requires recruiting volunteer teachers who can teach a wide range of subjects in various grade levels, and maintain a continuous and planned presence in hospitals. Considering the hospital regulations and limitations of formal education, scheduled teaching activities in a hospital are not always possible for both teachers and students (14). In addition, training hospitalized children through lectures has some disadvantages such as the lack of opportunity for them to think deeply and retain the learned material. A suitable environment and sufficient time are also required, while these conditions are not often met in hospital settings. Furthermore,

nowadays face-to-face or traditional education are highly criticized for reasons such as ignoring students' active participation in learning process, disregarding their individual differences and needs, and lack of attention to high-level thinking skills (15).

Considering the limitations of traditional teaching methods in fulfilling the educational needs of hospitalized children, it is necessary to apply alternative methods to achieve these objectives. On this basis, the application of information and communication technology in curriculums has substantially increased. In this respect, e-learning has emerged as an advanced educational approach that can overcome the obstacles and limitations of traditional education. E-learning is a product of the fast and widespread development of modern media, and involves the exploration of web and internet technologies to create learning experiences. Khan defines e-learning as a system comprising three main features, namely openness, flexibility, and distributed environment (16). In view of these advantages, an e-learning approach can be regarded as a suitable alternative approach in tackling the problems associated with hospitalized children. In this regard, some models have been presented for identifying the best supportive practices, such as using information technology to support traditional teaching strategies (10), or deploying Distance Information Technologies to provide child patients with healthcare services (13).

Aslan & Reigeluth define Instructional Design as the provision of strategies for using optimal instruction methods to achieve the intended changes in the learners' knowledge, tendencies and skills (17). In other words, ID encompasses the "entire process of instructional planning and implementation" (18). Based on this definition, implementing e-learning requires integrated planning as well as instructional design to reach the intended goals. It should also be noted that the problems of hospitalized children cannot be addressed in their entirety unless an integrated framework is developed which fully acknowledges the conditions

and obstacles facing these children in their relations with each other, and draws a smooth path for their success in learning.

However, a review of the literature indicates that no special instructional design model has so far been developed based on e-learning approach and the special conditions of hospitalized students. Major issues to be covered by a model should include social isolation, lack of desire to engage in group activities, and disinterest in learning due to the learned helplessness.

Therefore, researchers in this study implemented an e-learning program for hospitalized students aimed at evaluating the impact of the program, eliminating the educational problems of the learners, and proposing new strategies in this regard.

Materials and Methods

The present study was conducted using a pretest-posttest semi-experimental design with a control group. The study population included all the elementary school students who were hospitalized at least once in 2019-2020 school year in pediatric hospitals of Isfahan, Iran. Isfahan's Imam Hossain pediatric hospital is the only pediatric hospital in the city, and therefore, it was selected for research due to accessibility of location and convenience of data collection in Isfahan. The hospital is affiliated to Isfahan University of Medical Sciences. Therefore, in coordination with the University officials, the researchers were granted access to the hospital archive. Then a full review of the children's characteristics and their illness history was conducted, and 76 people were selected. The inclusion criteria in this study included having a chronic condition such as diabetes, renal and pulmonary diseases, and CF, with long-term health effects (at least a few years) or even lifetime effects. As a result the child patients were regularly hospitalized and had to cope with long-term school absences (at least a few days a week). In addition, all of the participants were elementary school students in the final grade levels (the last two years). Their parents were fully informed of

the study objectives, and were asked to help their children participate in the e-learning program and other stages of the study. The parents' reluctance was considered as the exclusion criteria of the study. The final sample size consisted of 60 students (26 pupils in 5th grade and 34 in 6th grade). They were selected through convenience sampling, and were equally allocated to experimental and control groups using random assignment. For this purpose, at first all students in both levels were each randomly assigned a code (codes 1-26 for 5th grade, and 1-34 for 6th grade students). Then, based on the assigned codes (even or odd), students were placed in experimental and control groups. In this way, the two groups had equal distributions of students from both grade levels (each group comprised 13 pupils from 5th grade and 17 from 6th grade).

An important factor in using e-learning for hospitalized students is to pay close attention to the nature of the instructed subject matter and its compatibility with the children's characteristics and needs. In the present research, mathematics was selected as the e-learning content for this groups of students, due to following important reasons:

- Mathematics is one of the most essential subject matters in primary education.
- Mathematical content has a logical and cohesive structure, so that failing to grasp a topic or concept hinders the learning of the subsequent topics.
- Given the special conditions of hospitalized students, learning mathematics is among their biggest challenges during the treatment period.

Based on the above-mentioned points, an e-learning model was designed and implemented. The instructed topic was the mathematics lesson on Decimal Numbers for elementary 5th and 6th graders (in accordance with the textbook content in each grade). This study therefore attempts to address the research question as to whether the e-learning approach can significantly improve the academic performance of hospitalized students with chronic illness in mathematics.

The research instruments for data collection included two researcher-made online tests on Decimal Numbers in 5th and 6th elementary school levels (based on the textbook content in each grade level). Each test comprised a total of 10 questions. Each question was scored 1 for a correct answer and 0 for an incorrect answer, with a maximum possible score of 10. The tests were administered as pretest and posttest for both groups.

The test questions were reviewed by several math teachers in 5th and 6th grades, and the face and content validity of the tests were verified after making some revisions. Their reliability in pretest and posttest were established using Kuder–Richardson method (0.74 for 5th grade test and 0.80 for 6th grade test).

The research began at the end of the first semester of 2019-2020 academic year. Online pretest links were sent to the social media accounts of the children's parents (WhatsApp or Telegram). After taking the online pretest, the special mathematics e-learning programs were implemented for experimental group. The program included using special multimedia for ill students, mathematical questions and drills, educational films, math learning software application, animation, web-based classes, and problem solving through social networks. After two weeks, a posttest was administered to both groups and the data were collected and analyzed. ANCOVA statistical technique was used to analyze the findings ($P=0.01$)

Results

The participants in this study were suffering from chronic conditions like diabetes ($n=15$, 25%), renal diseases ($n=30$, 50%), pulmonary diseases ($n=10$, 17%) and CF ($n=5$, 8%), causing frequent hospitalizations (at least once a month). Among the students, 19 were female (31.7%) and 41 were male (68.3%). They were in 11-14 age group, with 26 pupils in 5th grade (43.3%) and 34 in 6th grade (56.7%). The subjects from both grades were equally distributed in each group (13 from 5th grade and 17 from 6th grade).

Table 1 shows the mean and the standard deviation of the achievement scores on the online learning math tests in both groups.

Table 1 shows that the mean and the standard deviation of academic achievement (dependent variable) was significantly improved in the experimental group compared to the control group.

The Analysis of Covariance (ANCOVA) was used to evaluate the effectiveness of the e-learning approach. Prior to conducting this analysis the required assumptions of the ANCOVA were examined. Normality of distribution of data was measured at the error level of 0.05 and verified using the Kolmogorov-Smirnov test ($P>0.05$). The variance homogeneity of the dependent variable was also determined during the study ($P>0.05$). Furthermore, the linearity relationship between Pretest and Posttest at the level of 0.05 was statistically significant ($P<0.05$). Thus, considering the verification

Table 1: Descriptive data of achievement scores on the online learning math tests

Variable	Stage	N	Mean±SD	
			Control	Experimental
Achievement	Pretest	30	5.66±1.68	5.53±2.01
	Posttest	30	6.60±1.47	8.26±1.22

Table 2: Analysis of covariance of the online learning math scores

Effect Source	Sum of Squares	Degree of Freedom	Mean of the Sum of Squares	F	P	Effect Size
Pretest	63.502	1	63.502	83.085	<0.001	0.593
Group	45.446	1	45.446	59.461	<0.001	0.511
Error	43.565	57	3.7			

of ANCOVA assumptions, the test results are presented in Tables 2.

Table 2 results indicate that after eliminating the pretest effect, the F of the independent variable (59.461) is significant at the confidence interval of 99% ($P < 0.001$). Thus, there is a significant difference between the observed values of the dependent variable in experimental and control groups.

Discussion

The aim of the present study was to investigate the effect of the e-learning approach on the academic achievement of hospitalized students with chronic illnesses in mathematics. The result revealed that the average score in mathematics (as the dependent variable) was significantly higher in experimental group than in control group. Accordingly, e-learning approach has a positive effect on the academic performance of hospitalized students in math lesson. This result is in line with the findings in a number of other studies. For instance, Hopkins (10), González et al. (11), Aldiss et al. (12) and Amer (13) have all pointed to the adoption of information and communication technology (ICT) in the form of e-learning as an appropriate means of addressing mental, social, or instructional problems arising from the hospitalization of children. This will in turn improve their performance in mathematics.

In terms of helping hospitalized students deal with their social isolation, e-learning provides easy and low-cost access to learning resources and opportunities at any time and place. This is in line with a study by Aldiss et al. (12), which highlights the role of technology in increasing the patients' awareness of their disease and improving their mental and social abilities. In this process, e-learning facilitates further communication, interaction and cooperation between these children and the people with whom they are in contact, thereby enabling fast and widespread exchange of relevant information between them.

In addition, e-learning supports

students in their struggle with mental and instructional challenges that may result in learned helplessness. It provides effective instructional strategies such as applying collaborative activities along with personal study, customizing learning paths according to the learners' needs, and enhancing learner motivation by means of simulation and games. This is in line with Gonzales et al.'s. (11) emphasis on the importance of computer games in learning.

Based on the results and considering the special nature of the instructed subject matter in this study (mathematics), one should note that aligning content and activities with the intended learning objectives, and following different principles derived from learning theories in curriculum planning are the other critical factors in designing an appropriate e-learning approach for hospitalized children. In this regard, it should be noted that many students understand mathematical concepts only if they find them interesting and engaging. Therefore, motivational factors play an essential role in their progress. Hence, math teaching methods are essential in attracting students' interest in this field (19). On the other hand, earlier success would further motivate students to improve their performance in mathematics (20).

Based on the above discussions, self-learning multimedia approach, as a key component of an e-learning program for hospitalized children, enables them to receive immediate feedback, identify their mistakes, actively engage in the learning process, and develop the motivation for creative thinking and problem solving (21, 22).

In this respect, given the nature of mathematics, a multimedia-based drill and practice model can be used for consistent provision of examples and instruction of repetitive skills such as the four basic mathematical operations. This process will eventually enable learners to perform these skills automatically.

The other sections of the instructed content require the learners' cognitive effort in terms of using memory, contemplation, thinking,

motivation, and meta-cognition. In these sections the content can be divided into short sequenced chunks (steps), corresponding to the stages of the learning process (from simple to complex).

These steps facilitate gradual storage of information in memory, along with an organized and meaningful cognitive development based on an earlier design. In addition, some content topics enable learners to construct their own knowledge of the concepts and principles of mathematics based on their own interpretations or teachers' guidance.

Conclusion

Based on the results of this study, the e-learning approach offers an appropriate strategy to address the problems arising from the long-term absences of hospitalized elementary school students. This strategy helps them keep pace with their peers in this sensitive and important stage of their development. Accordingly, a more widespread use of this model is recommended to help mitigate the learning problems of this group of learners in other subject areas and grade levels. Therefore, an e-learning approach that is based on the integration of communication technologies and self-learning multimedia, is an alternative approach that helps hospitalized students make up for the hours of school absence. In this approach, various parts of the content are designed appropriate to the special nature of the subject matter and the intended learning objectives, which are based on different learning theories. In this sense, given the nature of mathematics, the model of repetition and practice can be used for repetitive skills such as the four basic mathematical operations. This model can be applied to the extent that the given skill turns into an automatic skill for the learner. As for those activities that involve using memory, contemplation, thinking, motivation and meta-cognition, the tasks can be divided into the short stages of a learning process (from simple to complex). This process paves the way for cognitive development based on

an earlier design, and gradual storage of information in memory in an organized and meaningful fashion. In addition, at some points in the teaching process, learners are allowed to construct their own knowledge of mathematical concepts and principles using their own interpretations or teachers' guidance.

Acknowledgement

We wish to express our gratitude to the students, their parents, and also the staff of children's training and therapeutic center of Imam Hossein Hospital who assisted us in performing this research.

Ethical Confirmation

After obtaining permission from Imam Hossein Training and Therapeutic Center, the researchers introduced themselves and explained the objectives of the study to the students and their parents. Participation in this study was voluntary, and the participants were also assured that their personal information will remain confidential.

Funding/support

No outside funding was provided for this work.

Conflict of interests

The author declares that they have no conflict of interests.

Reference

- 1 González C, Toledo P, Alayón S, Muñoz V, Meneses Fernández M. Using Information and Communication Technologies in Hospital Classrooms: SAVEH Project. *Knowledge Management & E-Learning : an International Journal*. 2011;3. <https://doi.org/10.34105/j.kmel.2011.03.008>
- 2 Hopkins L, Moss J, Green J, Strong G. Embedding learning in a paediatric hospital: Changing practice and keeping connected. *International Journal of Inclusive Education*. 2014;18. <https://doi.org/10.1080/13603116.2012.752877>.
- 3 Bell MF, Bayliss DM, Glauert R, et al.

- Chronic Illness and Developmental Vulnerability at School Entry. *Pediatrics*. 2016;137(5): <https://doi.org/10.1542/peds.2015-2475> PMID: 27244787
- 4 Fuengfoo A, Leelathanaporn S, Mekrungharas T. Effectiveness of the Hospital Learning Center (Queen Sirikit National Institute of Child Health): Satisfaction with service and parents' F1000Research. 2019; 8:1616 ·<https://doi.org/10.12688/f1000research.18846.1>
 - 5 Wijlaars LP, Gilbert R, Hardelid P: Chronic conditions in children and young people: learning from administrative data. *Arch Dis Child*. 2016; 101(10): 881–5. <https://doi.org/10.1136/archdischild-2016-310716>
 - 6 Lum A, Wakefield CE, Donnan B, *et al.*: Understanding the school experiences of children and adolescents with serious chronic illness: a systematic metareview. *Child Care Health Dev*. 2017; 43(5):645–62. <https://doi.org/10.1111/cch.12475>
 - 7 Pour Mar, Goharvi Sab, Nasrabadi Hab. Pathology of the educational system with emphasis on learned helplessness, factors and strategies. *Knowledge Monthly*. 2009; 17 (12): 83.
 - 8 Nisselle A, Hanns S, Green J, Jones T. Accessing flexible learning opportunities: children's and young people's use of laptops in a paediatric hospital. *Technology, Pedagogy and Education*. 2012;21(1):3-20. <https://doi.org/10.1080/1475939x.2012.659883>
 - 9 Chen DF, Tsai T-C, Su Y-T, Lin C-W. Hospital-based school for children with chronic illness in Taiwan. *Journal of the Formosan Medical Association Taiwan yi zhi*. 2014;114. <https://doi.org/10.1016/j.jfma.2013.12.006>.
 - 10 Hopkins LJ. Hospital-based education support for students with chronic health conditions. *Australian health review : a publication of the Australian Hospital Association*. 2016;40(2):213-8. <https://doi.org/10.1071/ah15032>
 - 11 González-González C, Toledo-Delgado P, Collazos-Ordoñez C, González-Sánchez JL. Design and analysis of collaborative interactions in social educational videogames. *Computers in Human Behavior*. 2014; 31: 602-11. <https://doi.org/10.1016/j.chb.2013.06.039>
 - 12 Aldiss S, Baggott C, Gibson F, Mobbs S, Taylor RM. A critical review of the use of technology to provide psychosocial support for children and young people with long-term conditions. *Journal of pediatric nursing*. 2015;30(1):87-101. <https://doi.org/10.1016/j.pedn.2014.09.014>.
 - 13 Amer K. Innovations in Pediatric Health Care Technology: A Multidisciplinary Conceptual Framework for Using and Evaluating Information Systems. *Children's Health Care*. 2006; 35:5-10. https://doi.org/10.1207/s15326888chc3501_2.
 - 14 Reyhani T, Pourghaznain T, Mousavi Z, Ghorbani M. The effects of presence and guidance of a teacher on the anxiety of hospitalized children. *Evidence Based Care*. 2014;4(3):15-22. <https://doi.org/10.4103/1735-9066.185610>
 - 15 Dargahi H, Ghazi Saidi M, Ghasemi M. The role of e-learning in Medical Sciences Universities. *Payavard Salamat*. 2008;1(2):20-9.
 - 16 Badrul K, editor. *Managing E-Learning Strategies: Design, Delivery, Implementation and Evaluation*. Hershey, PA, USA: IGI Global; 2005. <https://doi.org/10.4018/978-1-59140-634-1>
 - 17 Aslan, S., & Reigeluth C.M. Examining the challenges of learner-centered education. *Phi Delta Kappan*. 2016; 97(4): 63-68. <https://doi.org/10.1177/0031721715619922>.
 - 18 Schott, F., Seel, N.M.,. *Instructional Design*. In: James D. Wright (editor-in-chief), *International Encyclopedia of the Social & Behavioral Sciences*, 2015; 2nd edition, Vol 12. Oxford: Elsevier. pp. 196–200. <https://doi.org/10.1016/B978-0-08-097086-8.92032-4> .
 - 19 Yarmohammadi Vassel, M. Rashid, K. Bahrami, F. The Effectiveness Of Instruction Through The Play In Improving Mathematics Attitude Of

- Primary Girl Students. *Journal Of School Psychology*. 2014 ; 3(3): 122-135.
- 20 Massoud K., Alireza K, Dr. Elahe H. The role of personal variables in mathematical development according to socio-cognitive theory. *Contemporary Psychology*. 2006; 1 (1): 11-.
- 21 Qingsong L. The Application of Multimedia Technology in Web Education. *Physics Procedia*. 2012;33:1553-7. <https://doi.org/10.1016/>
- 22 Wiener, L., Kazak, A. E., Noll, R. B., Patenaude, A. F., & Kupst, M. J. Standards for the psychosocial care of children with cancer and their families: An introduction to the special issue. *Pediatric Blood & Cancer*, 2015;62(5), 419-424. <http://dx.doi.org/10.1002/psc.25675>.