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The impact of an instructional model with assistive technology on achievement satisfaction of people with physical-motor impairments

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Abstract

Background: The use of new technologies in education is a topic that has attracted the attention of educational experts over the past two decades. The purpose of this study was to investigate the effect of an instructional model enriched with assistive technology on the achievement satisfaction of people with physical-motor impairments in learning English.

Methods: The research method is semi-experimental, with a pre-test/post-test design using a control group. The statistical population consisted of male individuals with physical mobility impairments studying at Imam Ali Educational Center in Tehran. To determine the sample size, Cohen's (1986) table was used. Based on the sample size table, 16 people were selected. In this method, after drawing up a student list with a random number table, the sample was selected after checking criteria for entry and exit. The experimental group was trained in six sessions using an instructional model enriched with online and offline assistive technologies, and the control group was trained in the usual way.

Results: The mean ± standard deviation (SD) for pre- and post-test in the experimental group were 75.50 ± 5.90 and 82.25 ± 6.29, respectively, and was 75.38 ± 11 and 77.37 ± 11.91 in the control group. The results of the analysis of covariance between adjusted means of both groups for variable of academic satisfaction show a significant difference between the two groups ($F = 20.06$, $P<0.01$). The effect size was 0.60.

Conclusion: Using an instructional model enriched with assistive technology can be useful in teaching English to individuals with physical-motor impairments.

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Introduction

The use of new technologies in education is a topic that has been addressed by educators over the last two decades.[1] One area of activity among education professionals is empowering individuals with physical mobility impairments through new educational approaches, including technological approaches. One of these is to use technology-based approaches.[2] Individuals with physical mobility impairments are defined as those whose physical limitations cause them to be dependent on special services in education or learning in terms of instructional, equipment, materials or facilities.[3,4]

The term "assistive technology" refers to a wide range of tools and technologies (and associated services) that have the goal of helping people with disabilities and special instructional/rehabilitation needs to have better performance on a daily basis, to have an improved quality of life, to increase mobility and motion, to participate and to communicate, and finally to facilitate access to education and curricula.[5-7] Proper integration and combinations of technology can help these individuals to have access to the general curriculum.[8] Additionally, academic satisfaction

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is one of the most important issues and variables in the process of learning and teaching for individuals with special needs. Academic satisfaction is a psychological characteristic that affects individuals' perceptions of their learning experiences and their perceptions of the value of their education or even a specific course.[9] Academic satisfaction is a pleasant feeling created after experiencing success in academic life, and it can be seen in educational settings when individuals' expectations[10] are met, leading to increased value.[11,12]

Academic satisfaction among individuals with physical mobility impairments cannot be achieved without adequate facilities to provide services that meet the expectations and needs of such individuals, but it needs to be well established. Information and communication technology (ICT) is one of the most important factors in this field.[13] Therefore, using these capabilities in educational environments can potentially increase the satisfaction of individuals with physical impairments. However, researchers in new studies have found that high self-efficacy is associated with satisfaction, especially with academic and learning satisfaction among individuals with special needs.[14-16]

Numerous studies have all pointed out in their research that assistive technology such as mobile, multimedia and virtual social networks can play an important role in teaching individuals with special needs such as physical mobility, hearing, or visual impairments, or individuals with mental retardation.[17-27]

However, in the country of Iran, no activities to facilitate the learning of individual with physical mobility impairments using assistive and targeted technology have been reported. As noted above, there is interest in and use and integration of technology in various curricula. In this regard, we can refer to the *Objective 4* of the fifth program of Exceptional Education Development, which focuses on strengthening and improving the infrastructure in the field of Information and Communication Technology and Modern Educational Technologies, and as well, to *Operational Objective 5* of this program, which focuses on establishment of smart network management and the exploitation of Modern Educational Technologies.[28] It is also mentioned in the *Document of the Fundamental Transformation of Education*. For example, in chapter 7, the quality of the education process has been highlighted by relying on the smart use of modern technologies, and one of the strategies used to achieve this objective is the use of electronic content production approaches.[29] Therefore, assistive technology and ICT can be especially useful in learning and helping the academic satisfaction of individuals with physical mobility impairments as well as reducing their learning difficulties. Considering the above-mentioned research studies and their implications, the aim of this study was to investigate the effect of an assistive technology-enriched educational model on the academic achievement of individuals with physical mobility impairments in learning English.

Materials and Methods

Study design, Setting and participants

In this research, we used a semi-experimental pre- and post-test design in a control group (pretest-posttest design with control group). The statistical population consisted of male individuals with physical mobility impairments studying at Imam Ali Educational Center in Tehran. To determine the sample size, Cohen's (1986) table was used.[30] The sample size was determined using Cohen table with $\alpha = 5\%$, and the sample size was 14, with a probability of dropping a total of 16; thus, for each group, 8 was the optimal number. In this method, after drawing up a student list with random number table, 8 people were selected as the sample after checking the inclusion and exclusion criteria.

Inclusion and exclusion criteria

The inclusion criteria for the study included individuals who possessed average and higher intelligence (90 or more) who suffered from any traumatic brain injury, congenital impairment, spinal cord impairment, accidental or motor impairment, and, those who had speech, hearing, or visual impairments, or mental retardation and mental disorders, such as depression and schizophrenia. Exclusion criteria included students with below-average intelligence and students with multiple disabilities.

Research tool

Academic Satisfaction Questionnaire (ASQ): In this study, academic satisfaction is a score that individuals will earn in a researcher-made academic satisfaction test, which includes 30 items; its subscales include educational equipment and facilities; information and communication technologies; assistive technologies; curriculum; teaching and learning; school atmosphere; administrative facilities; policies and procedures. The 1-5 Likert-type scale ranges from *I totally disagree (1) to I totally agree (5)*. The score for the questionnaire is based on the 5-point Likert scale (I strongly agree, agree, do not comment, disagree, and strongly disagree), and each substance has a value between 1 and 5 (Table 1).

Content validity of the test was verified by experts and scholars such as supervisors and counselors as well as

Table 1. Scale scores and possible ranges

Dimensions of the questionnaire	Score range
Equipment and educational facilities	4-20
Information and Communications Technology	8-40
Curriculum	8-40
Instructional Design	8-40
Administrative infrastructure	2-10
Total score	30-150

teachers of two classes of both experimental and control groups, and its reliability was calculated at 0.79 using Cronbach α. A Cronbach α above 0.70 is generally held to indicate reliability.

Before running a covariance analysis test, its presumptions must be examined. Data obtained in dependent variables have a distance scale. The Kolmogorov-Smirnov test was used to ensure the normal distribution of data ($Z = 0.819$, $P > 0.05$). The Levene test was used to ensure equality of variances in data distribution ($F = 3.47$, $P > 0.05$). The analysis of variance (ANOVA) was used to ensure homogeneity of the regression line slope ($F=1.18$, $P > 0.05$) . Regarding the insignificant effect of the interactive effect between the pre-test and the group effect, the homogeneous assumption of regression coefficients was confirmed ($F = 1.18$, $P > 0.05$). The best way to eliminate the intervention effect (well-known and unknown intervening variables) in the research is to use a control group.[31] In this study, due to the use of a control group in terms of gender, age, educational level, and disability type, it can be established that the intervention variables are not affected.

Instructional model enriched with assistive technology

As seen in the conceptual model (Figure 1), five main categories (analysis, design, production, implementation, support, evaluation) should be considered in online and offline learning through auxiliary technology for people with physical motor impairments. It should be noted that in each of these categories, the review and refinement of the process take place as well as management and evaluation of the process. These factors have sub-components that form a pattern of training through auxiliary technologies for individuals with physical motor impairments. In accordance with the conceptual model of the elements affecting the training of individuals with physical-motor injuries with the technological approach and in order to prescribe training, a pattern along with all of the following components of these stages were included as essential elements as shown in the model depicted in Figure 2.

Intervention program and method of implementation

Due to the characteristics of individuals with physical-mobility impairment and their educational needs, and in consultation with supervisors and counselors as well as special instructional experts, two types of assistive technology were selected. For online education or web-based tutorials, we used *Quia* (https://www.quia.com), and for the offline component, we used researcher-created educational multimedia software for the English lessons. In the initial meetings, the researcher, in addition to conducting a pre-test, gave a brief description on the site and the method to enter for individuals and teachers, and in order to facilitate the registration process on the site, the researcher developed a manual for using the site. Throughout the educational process, the researcher supported the individuals and managed the process.

In explaining the stages of the research, in the first stage, after identifying the population and the statistical sample and conducting the correspondence and necessary coordination with Allameh Tabataba'i University, the Principal Department of Education of Tehran, and the Exceptional Education Office of Tehran, the researcher attended Imam Educational Complex for several sessions to be familiarized with individuals with physical mobility impairments, and studied their attitudes and cases closely. Implementation of the academic satisfaction pretest was

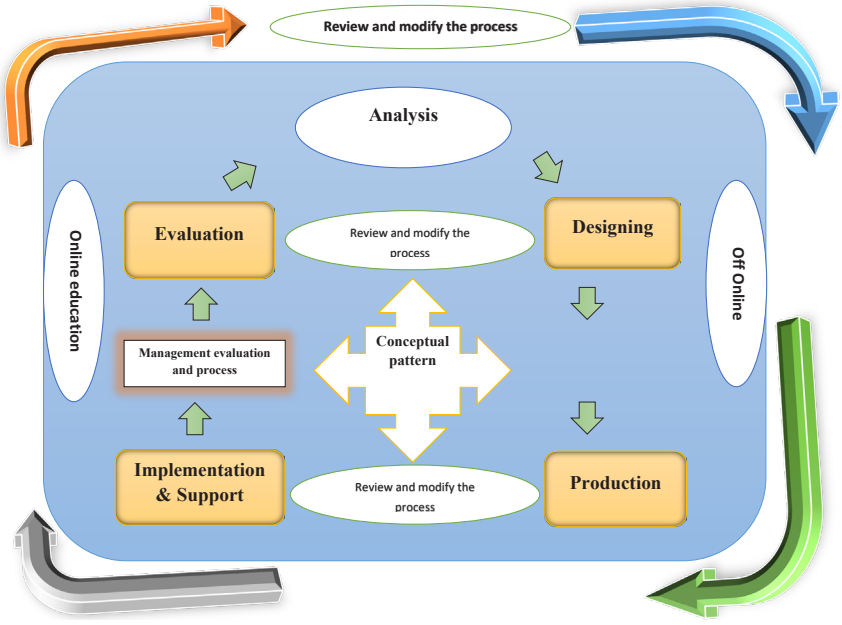

Figure 1. Instructional model enriched with assistive technology (conceptual).

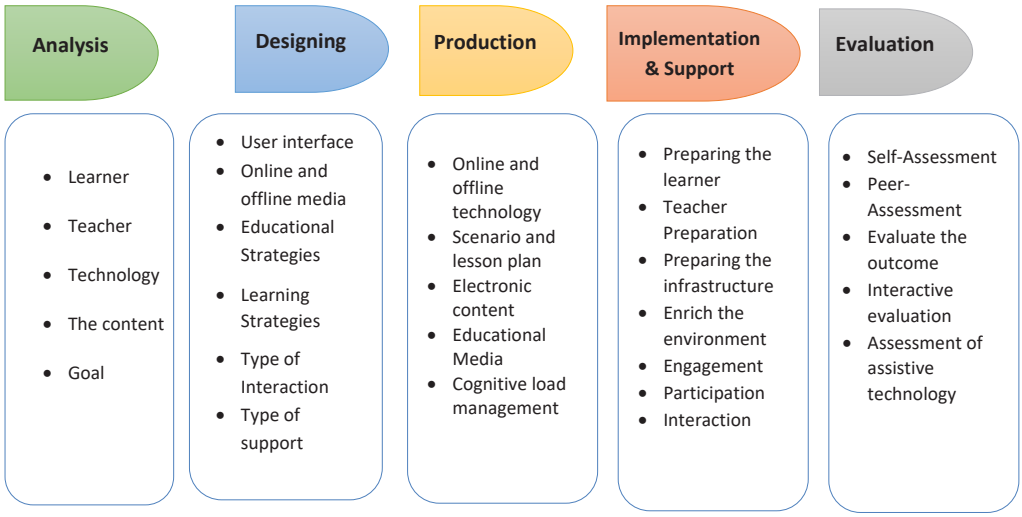

Figure 2. Instructional model enriched with assistive technology (procedural).

run simultaneously for both the intervention group and the control group in order to control possible factors that might have an adverse effect on the outcome of these tests. In the next step, the main task of teaching in the control group was the responsibility of the class teacher. The study protocol can be seen in Figure 3.

Results

Descriptive data analysis was performed using SPSS 18. Data are presented with means and standard deviations along with one-variable covariance analysis for academic satisfaction variables between both groups.

The descriptive statistics are presented first, followed by the results of the surveys. The demographic characteristics of participants are reported in Table 2.

As Table 3 shows, the mean and standard deviation of the pre-test variables of academic satisfaction for the experimental group was 75.50 and 5.90, and for the control group, 75.38 and 11, respectively. The mean and standard deviation of the post-test variables of academic satisfaction in the experimental group was 82.25 and 6.29, and in the control group, 77.37 and 11.91 respectively.

According to the table results of covariance analysis, ($F = 20.06$, $P < 0.01$), after adjusting for pre-test scores, the difference between the experimental and control groups in the academic satisfaction variable was significant; the mean of the experimental group in this variable was 82.18, and the mean of the control group was 77.44; therefore, the mean of the experimental group was higher than that of the control group. Based on the research constraints, it was concluded that the use of a technology-based education model contributed to increasing the academic satisfaction of the individuals with physical mobility impairments. The experimental variable, with an effect size of 60%, predicted 60% of the variance of the academic satisfaction variable.

Discussion

The purpose of this study was to investigate the impact of an instructional model enriched with assistive technology on the achievement satisfaction of individuals with physical mobility impairments in learning English. The results of the research hypothesis showed that the mean satisfaction of the experimental group was higher than that of the control group. Considering the research constraints, it is concluded that the use of an assistive

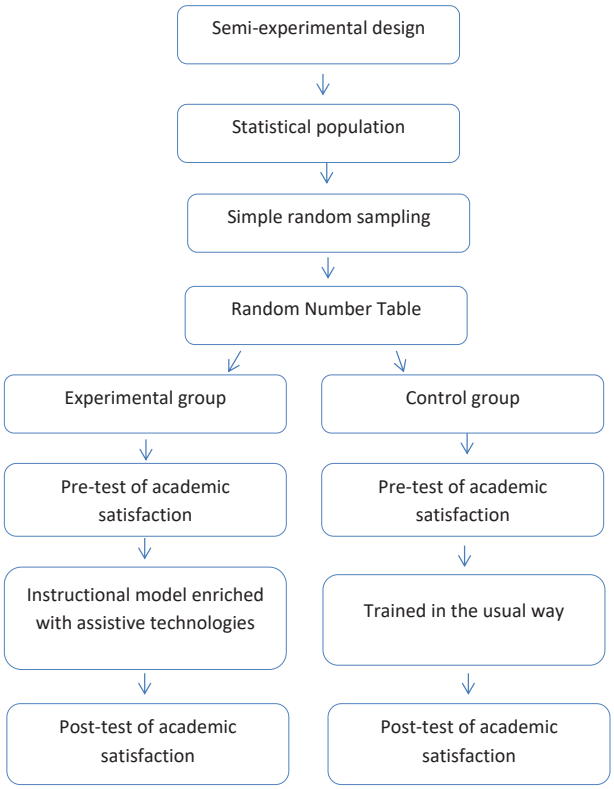

Figure 3. Study protocol flow chart.

Table 2. Demographic characteristics of participants in intervention and control groups

Variable	Control group		Experimental group	
	No.	%	No.	%
Age				
10 to 12	6	75	7	87.5
12 to 14	2	25	1	12.5
Gender				
Boy	8	100	8	100
Girl	0	0	0	0
Parental education level				
Diploma degree	3	37.5	4	50
Associate's degree	1	12.5	0	0
Bachelor's degree	3	37.5	2	25
Master's degree	1	12.5	2	25
Experience with technology				
Poor	3	37.5	2	25
Average	2	25	4	50
Good	3	37.5	2	25
Type of impairment				
Traumatic brain injury	2	25	1	12.5
Congenital impairment	3	37.5	3	37.5
Accidental and motorized impairment	2	25	3	37.5
Spina bifida impairment	1	12.5	1	12.5

Table 3. Descriptive statistics of academic satisfaction

Groups	Pre-test	Post-test	
	Mean ± SD	Mean ± SD	Adjusted mean
Experimental group	75.50 ± 5.90	82.25 ± 6.29	82.18
Control group	75.38 ± 11.00	77.37 ± 11.91	77.4

technology-based educational model has been effective in increasing academic satisfaction among individuals with physical mobility impairments. In sum, the results of this finding were well-matched with those of done by researchers such as Velayati,[17] Allahi et al,[18] Jangizehi Shastan et al,[19] and with those of conducted by foreign scholars such as Simoes et al,[12] Lee et al,[32] Lan and Sie,[33] Kuo et al,[34] Abdallah and Fayyoumi,[22] Hussein et al,[20] Kim et al,[27] Vereenooghe et al,[25] Chaurasia et al,[23] Lersilp et al,[26] and Toofaninejad et al.[24]

In explaining this finding, it can be argued that assistive technologies enable individuals with physical mobility impairments to enjoy all kinds of tools, and help them to practice and improve their academic and social skills.[35] Only a few technology applications exist that can be used for entertainment and education; for example, computer-aided instructional programs, assistive technology tools, virtual environments, video modeling, mobile technologies (iPad systems, touch pads, or iPhones) and computer games.[36] These technologies reduce academic failure, and they increase the ability of individuals with special needs to independently carry out their assignments, thus providing academic satisfaction.[6] The results of Lersilp's study showed that individuals have more access to educational services and supports with assistive technologies.[35] In the study conducted by Lersilp et al,[26] results showed that assistive technologies for individuals with disabilities were provided, foremost, for "services", then for "media" and then for "facilities". In addition, most individuals with physical disabilities can be helped with assistive technology.

In explaining this finding, assistive technology should be well designed and provide a proper educational framework in order to have a positive impact on the teaching and learning process and to take care that it does not cause any impairments.[37] An assistive technology-based educational model developed by researchers can play a proper role in this impact. In other words, technology-based instructional patterns can be effective in motivating learners, enhancing attention (as rewards and external reinforcement), increasing performance and social interaction, developing imitation, learning acquisition, and academic satisfaction.[38] When individuals with special needs from a social, scientific and educational point of view are more able to fit in with the school environment, and their unique needs are met, they are certainly more satisfied. On the other hand, it can be said that individuals' academic satisfaction has a positive and significant effect on academic achievement.[39]

In general, it can be concluded that paying attention to teaching people with special needs, especially individuals with physical mobility impairments, is one of the important public responsibilities. If there is a lack in this area, the state can be said to lose a part of their humanity.[40] In the present age, education and instruction, in general, constitute an important part of the lives of people with special educational needs. In addition, the quality and quantity of education for these individuals is one of the objectives of the United Nations and also of the Exceptional Education Organization. Despite the capabilities and competences of technology and its positive effects on the quantity and quality of teaching and learning, unfortunately, the field of teaching individuals with special needs has undergone few changes, and needs serious attention in this regard. Individuals with physical mobility impairments, as compared to others, are more likely to receive advanced education services and programs. Typically-developing individuals, if they do not learn in the classroom, can compensate for this lack of learning through self-learning, for example, through books. But individuals with disabilities often can only learn and attain knowledge when they have access to or have used appropriate methods, equipment and technologies in education.

From the limitations of this research, it can be noted that the model presented in this study is tailored to teach students with physical-motor injuries using assistive technological approaches. Therefore, for other learning environments and in environments where there are no technological capabilities, design, compilation and validation of another model are required.

The given educational model provides a framework for the Exceptional Education Organization to take advantage of the capabilities and competences of new technologies in a targeted and well-planned way. It is suggested that this model could be introduced as one of the main strategies for a major objective in the basic instructional process of education, that is, "the intelligent use of modern technologies in the public education system based on the Islamic criteria system". Some recommendations are provided for further studies as follow:

1. The proposed educational template in this study is designed for students with physical-motor injuries; therefore, it is suggested that further research in this field be aimed at other target groups, including students with visual impairments, hearing impairments, mental retardation, learning disabilities, etc.
2. Investigate the effect of technology-based educational patterns on other variables in the learning environment for people with special needs such as academic engagement, participation, academic self-efficacy, academic attitude, self-regulation etc.
3. Study and design of educational aids based on auxiliary technology for primary, secondary and higher education levels.
4. A feasibility study on the implementation of an educational model based on auxiliary technologies in the higher education system for students with special needs and model design in this field and its localization.

Conclusion

Based on the findings, it can be concluded that new approaches based on auxiliary technology as an active and innovative educational method with the potential of using several senses in the learning process, engaging the learner and creating academic satisfaction, making the learning environment more flexible, taking into account the particular needs of children with special needs, increasing learning motivation, is an example of the abundant potential of technology in special education that can be used in teaching English for students with physical-motor injury. Therefore, the use of this new way of reforming educational programs for students with physical-motor injuries provides a new horizon in our country's educational process.

Ethical approval

Permission of the authorities was obtained to start the research. Participants signed a consent form that informed them the nature of the project. There was no ethical barrier in this study because students completed anonymous questionnaires.

Competing interests

The authors declare that there is no conflict of interest.

Authors' Contributions

Study conception and design: EZZ. Acquisition of data: RM. Analysis and interpretation of data: AD. Drafting of manuscript: MRNA. Critical revision: PSD.

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