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Impact of Online and Face-to-Face Education on Learning and Satisfaction Levels of Medical Students in the Medical Physiology Course

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A B S T R A C T

Introduction: Effective performance in online education increasingly impacts the quality of classes and, consequently, student learning outcomes. This study aims to compare satisfaction levels and learning rates between online and face-to-face methods of teaching medical physiology.

Material & Methods: This cross-sectional descriptive-analytical study involved 79 medical students divided into two groups. The first group received instruction on heart physiology (5 weeks, one session per week) online via the Navid system, while the second group received face-to-face instruction. At the study's conclusion, both groups underwent the same test to assess learning outcomes, and satisfaction with the teaching methods was evaluated through a questionnaire. Data analysis was conducted using Stata 14 statistical software, employing logistic regression and linear regression models.

Results: The two groups differed in terms of the course studied, student nativeness, and satisfaction levels with the educational method. Satisfaction with online education was reported at 69%, compared to 65% for the face-to-face method. The average learning score for students in the online group was 12.93±0.12, while in the face-to-face group, it was 13.48±0.47. However, the linear regression model revealed no significant relationship between students' scores and specific educational methods (p=0.32). Significant relationships were observed between age, nativeness, and dormitory accommodation with satisfaction levels in online education. Conversely, none of the variables showed a significant relationship with satisfaction levels in face-to-face education.

Conclusion: Both e-learning and face-to-face methods demonstrated relatively similar effects on students' learning outcomes. However, satisfaction levels with online education appear to be influenced by variables such as age, nativeness, and dormitory accommodation.

Keywords: conventional education, electronic learning, physiology, satisfaction, learning, students, medicine

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Introduction

The predominant approach to delivering theoretical courses is through lectures, conducted in a traditional manner with the instructor physically present in the classroom. Lecture-based instruction stands as one of the oldest pedagogical techniques (1). In optimal circumstances, this method incorporates PowerPoint presentations; however, these presentations often limit student engagement with visual aids, hindering their ability to comprehend and visualize concepts, while also constraining creative thinking (2). It is anticipated that if face-to-face instruction fails to effectively facilitate learning, it may lead to academic challenges such as poor performance, dropout rates, fatigue, or frustration, necessitating additional resources for remedial courses (3). The global prevalence of the coronavirus, including in Iran, has significantly impacted various facets of daily life, particularly the educational sector. Faced with numerous challenges, educational institutions have increasingly turned to online learning to ensure continuity and efficacy in student learning during the pandemic. Presently, online education is recognized as one of the foremost methods of instruction (4).

Online education encompasses the delivery of educational programs through electronic and information technology systems, leveraging the Internet for teacher-student interaction and emphasizing the distribution of course materials via digital platforms. This approach integrates advanced technology in educational planning, content design, and delivery, facilitating interactive communication between instructors and learners (5). The transition to online education has significantly impacted students and faculty in the medical field, imposing substantial challenges. Students are apprehensive about honing their skills in this new paradigm, while educators find themselves navigating unfamiliar territory in cyberspace to deliver educational services. Despite the proliferation of online resources and the availability of cutting-edge hardware and software in academic institutions, many students still rely on traditional face-to-face instruction and guidance (6). For numerous faculty members, the online learning environment presents a novel challenge and unfamiliar technological landscape (7). Teaching is a multifaceted endeavor encompassing both the instructional efforts of professors and the learning experiences of students. Despite its growing popularity, online education faces criticism from proponents of traditional teaching methods. Many educators argue that online instruction fails to address teaching and learning issues adequately and, consequently, withhold their support (8).

Poljak et al. conducted a study titled "Croatian medical students' attitudes and concerns about online education in the era of Covid-19" to explore students' perspectives and apprehensions regarding the shift from traditional face-to-face instruction to online learning. According to their findings, students exhibited heightened motivation to engage in virtual classes. However, less than half of the students expressed concerns regarding the feasibility of teaching practical courses online and felt deprived of hands-on learning experiences. The majority expressed a preference for a blended approach to education, combining both online and in-person instruction, in the future (9).

Therefore, acknowledging the increased utilization of online education post-COVID-19 and recognizing the distinct limitations and attributes of both online and face-to-face instruction, this study aimed to assess the effects of Online and Face-to-Face Education on the Learning and Satisfaction Levels of Medical Students enrolled in the Medical Physiology Course.

Materials and methods

The current investigation is a descriptive-analytical, cross-sectional study designed to compare the efficacy of online teaching versus face-to-face instruction in delivering the cardiac physiology course to medical students at Ilam University of

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Medical Sciences (ethics approval code: IR.MEDILAM.REC.1401.024). A total of 79 medical students enrolled in the cardiac physiology course during the second semester of the academic year 2020-2021, following a pre-established curriculum, were included in the study using a convenient sampling method. All participants provided informed consent prior to participation and were divided into two groups. The groups were matched in terms of academic year and course unit.

The students were divided into two groups, with the first group consisting of 40 students and the second group comprising 39 individuals. In the first group, the heart physiology course was delivered online over a period of 5 weeks, with one session per week conducted virtually on the Navid platform. The online curriculum was based on the educational syllabus of the course, utilizing materials sourced from the first volume of Guyton's medical physiology book. Instruction was provided through lectures, slide presentations, and interactive question-and-answer sessions. Conversely, the second group received face-to-face instruction from the same professor, also spanning 5 weeks with one weekly session. This traditional instruction method followed the educational curriculum of the course, employing materials from the first volume of Guyton's Physiology book and utilizing identical slides and question-and-answer sessions. At the conclusion of the semester, both groups underwent an identical test, comprising 25 multiple-choice questions aligned with the educational objectives outlined in the course plan. These questions were drawn from the specified source, communicated to students at the outset of the sessions.

Approval from medical physiology experts at the university was obtained prior to the commencement of the study. To gauge students' satisfaction levels in the two study groups—online and face-to-face education—a two-part researcher-developed questionnaire was utilized. The first part collected demographic information, including age, gender, nativeness, marital status, housing arrangements during the academic period, and enrollment status (free or fee-paying). The second part consisted of main questions aimed at comparing the characteristics of face-to-face and online teaching methods, utilizing a 5-point Likert scale (ranging from 1 to 5), encompassing responses such as "completely agree," "agree," "no opinion," "disagree," and "completely disagree." The assessment scope of students' satisfaction levels included the following aspects: the ability to motivate and engage students in learning, access to educational materials and interaction with the instructor, comprehension of concepts, responsiveness to queries, concentration during sessions, and ease of access to and participation in class sessions.

The questionnaire underwent thorough validation procedures, including content and format validity checks. Ten experienced professors in the relevant educational field provided feedback, necessary corrections were made, and the questionnaire was subsequently reviewed and approved by the same professors. Additionally, the reliability of the questionnaire was assessed using Cronbach's alpha coefficient, yielding a value of .82, indicating high internal consistency.

Statistical analysis was conducted using Stata 14 software to compare the learning outcomes and satisfaction levels of students in the two groups—online and face-to-face education. The grade achieved at the end of the semester and the level of satisfaction with each educational method were considered as dependent variables. The effects of other variables were analyzed using single and multivariate rank logistic regression models. Given the reduction in sample size, a significance level of 0.2 was adopted for entry into the final multivariate model.

Results

This study comprised 79 medical students divided into two groups based on the method of instruction:

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online or face-to-face. The online group consisted of 40 students, while the face-to-face group consisted of 39 individuals. The average score of students in the online group was 12.93±0.12, whereas in the face-to-face group, it was 13.48±0.47.

Significant differences were observed between the online and face-to-face education groups in terms of study duration, nativeness, and satisfaction levels with the educational method. To mitigate the impact of confounding variables, all relevant factors were included in the analysis. Satisfaction with the educational method was reported at 69% for online education and 65% for face-to-face education.

The demographic profiles of both groups, alongside the satisfaction levels regarding the respective educational methods and the average scores attained in each group, are detailed in Table 1.

Table 1. Demographic Information of Students in Two Educational Groups.

Variable	Online Education (N=40)	Face-to-Face Education (N=39)	P-value
Age (mean ± standard deviation)	22.1 (0.6)	22.8 (0.5)	0.29
Sex (%)			0.92
Male	23 (42.5)	22 (56.4)	
Female	17 (57.5)	17 (43.6)	
Marital Status (%)			0.92
Single	37 (92.5)	36 (92.3)	
Married	3 (7.5)	3 (7.7)	
Academic Period (%)			0.03*
Governmental	28 (70)	35 (89.7)	
Tuition Payer	12 (30)	4 (10.3)	
Housing (%)			0.88
Dormitory	15 (37.5)	14 (35.9)	
Non-Dormitory	25 (62.5)	25 (64.1)	
Native Status (%)			0.001*
Native	16 (40)	30 (76.9)	
Non- Native	24 (60)	9 (23.1)	
Level of Satisfaction with the Teaching Method (%)			<0.001*
Dissatisfied	6 (15)	2 (5.2)	
Indifferent	14 (35)	30 (79.0)	
Satisfied	20 (50)	6 (15.8)	
Satisfaction with the Teaching Method (mean ± standard deviation)	69.03 (2.9)	65.53 (1.6)	
Test Score (mean ± standard deviation)	12.93 (0.3)	13.48 (0.5)	0.32

Additionally, Table 2 presents the satisfaction levels with the educational method categorized by different variables.

Table 2. Average Satisfaction Scores of Online and Face-to-Face Training Methods Across Demographic Variables.

Variable	Frequency (%)	Satisfaction Score from Face-to-Face	Satisfaction Score of Online Education

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		Education (Mean ± Standard Deviation)	(Mean ± Standard Deviation)
Age			
Age> 22	34(43.1)	65.96 (3.9)	62.20 (3.8)
Age≤ 22	45(56.9)	73.63 (4.4)	66.71 (1.7)
Gender			
Male	45(56.9)	70.87(4.9)	64.95 (2.5)
Female	34(43.1)	66.53 (3.7)	66.24 (1.9)
Marital Status			
Single	73(92.4)	67.51 (3.1)	65.51 (1.7)
Married	6(7.6)	87.67 (5.8)	65.67 (5.9)
Academic Period (%)			
Governmental	63(79.8)	66.64 (3.7)	65.32 (1.7)
Tuition payer	16(20.2)	74.60 (4.8)	67.25 (4.6)
Housing			
Dormitory	29(36.7)	72.60 (5.3)	68.62 (2.2)
Non-dormitory	50(63.3)	66.88 (3.6)	63.92 (2.1)
Native status (%)			
Native	46(58.2)	62.25 (5.1)	64.63 (1.9)
Non-Native	33(41.8)	73.54 (3.4)	68.88 (3.2)

To assess the influence of certain factors on satisfaction rates in educational methods, univariate logistic regression analysis was conducted. Notably, a significant association was identified between satisfaction rates and variables such as age status, nativeness, and dormitory accommodation in the online education method (Table 3). However, none of the variables demonstrated a significant relationship with satisfaction rates in face-to-face education (Table 3).

Table 3. Logistic Regression Analysis of Univariate Variables Affecting the Level of Satisfaction with Online and Face-to-Face Education.

Face-to-Face Education				Online Education		
Variable	The Regression Coefficient	Confidence Interval	P-value	The Regression Coefficient	Confidence Interval	P-value
Age	-۰/۲۷ – ۰/۲۵	-۰/۰۱	۰/۹۵	۰/۳۴	۰-/۶۸ -۰/۰۱	۰/۰۴**
Gender						
Female	-	*۱	-	۱*	-	-
Male	-۲/۲۷ – ۰/۹۲	-۰/۶۷	۰/۴۱	-۰/۰۷	-۱/۱۳ -۱/۲۸	۰/۹۰
Marital Status						
Single	-	۱	-	۱	-	-
Married	-۳/۵۹- ۲/۲۶	-۰/۶۷	۰/۶۵	۱۶/۷۱	– ۴۴۴۱/۰ -۴۴۰۷/۶	۰/۹۹
Academic Period						
Tuition payer	-	۱	-	۱	-	-

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Governmental	-۳/۰۷ – ۱/۵۰	-۰/۷۸	۰/۵۰	-۰/۱۷	– ۱/۱۱ -۱/۴۴	۰/۷۹
Housing						
Non-dormitory	-	۱	-	1	-	-
Dormitory	-۱/۲۵ – ۱/۹۶	۰/۳۶	۰/۶۶	۰/۹۳	- ۲/۳۴ -۰/۳۷	۰/۱۶**
Native status						
Non-Native	-	۱	-	۱	-	-
Native	-۲/۷۲ – ۰/۸۷	-۰/۹۲	۰/۳۱	-۰/۸۵	– ۰/۳۹ -۲/۰۹	۰/۱۸**

To control for confounding variables, all significant variables at a p-value of 0.2 in the univariate analysis were incorporated into the final multivariable model. In this model, only age (p = 0.04) and nativeness (p = 0.07) demonstrated a relationship with satisfaction rates in the online education method. Specifically, for each year of increasing age, the logarithm of the chance of satisfaction rates in the online education method rises by 0.4. Additionally, the logarithm of the chance of satisfaction in the online education method among native individuals is 1.38 lower compared to non-native individuals (Table 4). Furthermore, the Pseudo R2 value of 0.15 in the final model indicates that this model predicts only 15% of the variance associated with the dependent variable of satisfaction in the online education method.

Table 4. Multivariate Logistic Regression Analysis for Variables Affecting the Level of Satisfaction with the Online Method.

Variable	The Regression Coefficient	Confidence Interval	P-value
Age	۰/۴۰	-۰/۰۲ – ۰/۷۷	۰/۰۴**
Housing			
Non-dormitory	۱*	-	-
Dormitory	۰/۴۲	-۱/۰۵ – ۱/۹۰	۰/۵۷
Native status			
Non-Native	۱*	-	-
Native	-۱/۳۸	-۲/۸۹ – ۰/۱۲	۰/۰۷

A linear regression model was employed to explore the association between students' grades and specific educational methods. However, no significant relationship was observed between these two variables in this model (p = 0.32).

Discussion

Based on the present results, a direct relationship exists between the basic science courses previously taught in medical school and subsequent student performance in medical courses thereafter (10). Given the significance of this course within medical departments, numerous studies have been conducted on the teaching and learning of this subject and students' academic achievements (10, 11). The heart physiology course constitutes a fundamental aspect of medical physiology, focusing on the structure and function of the heart, which can play a crucial role in identifying and diagnosing various cardiovascular diseases. This study aims to compare levels of satisfaction and learning among students who have undertaken this course through both face-to-face and online teaching methods.

Various factors, including teaching method, learning motivation, and the teaching environment, exert an influence on the learning process (12). The findings of this study indicate that both face-to-face and online education methods yield similar effects on students' satisfaction and learning outcomes, consistent with findings from previous research (13-15). Notably, the study was conducted during the

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COVID-19 pandemic, which necessitated the adoption of social distancing measures. Consequently, there has been a heightened emphasis on continuing educational activities while adhering to social distancing guidelines. As a result, there has been an increased demand for and adaptation to distance education and online learning methods (16). This surge in demand and the imperative nature of current circumstances can impact users' satisfaction levels and their utilization of online education methods to such an extent that they produce outcomes akin to face-to-face education.

According to the findings of the current study, satisfaction levels with the online education method exhibit a notable correlation with age, nativeness, and dormitory accommodation. Specifically, satisfaction with this educational approach tends to increase with age. Conversely, none of these variables demonstrated a significant relationship with satisfaction levels in the face-to-face education method. Satisfaction is a qualitative phenomenon that significantly influences the attainment of an individual's aspirations and goals. When students express satisfaction with the learning process and the educational setting, they are more inclined to actively engage in these environments (17). Previous research suggests that variables such as age and gender are associated with various aspects of online education (18).

To assess students' satisfaction rates, several characteristics were considered, including their ability to motivate and encourage students to study, the availability of educational materials, interaction among students, transferring of concepts, responsiveness to questions, and the ability to participate and concentrate during sessions. Research conducted by Jeffrey et al. (2014) demonstrated that increased participation in the learning process, particularly in education based on blended learning, is influenced by various technological factors. These factors include attracting attention, fostering interaction, and re-engaging learners in the event of disconnection or difficulties in participation (19).

Learners' satisfaction with online education is influenced by various factors, such as ease of use, gender, age, and learner temperament. Delshad et al. (20) highlighted in their research that satisfaction with web-based education significantly impacts overall satisfaction quality, attributed to factors like resource and content accessibility and the elimination of commuting stress due to reduced mobility. In 2012, Noorian et al. (21) conducted a comparative study between face-to-face and online education, revealing that online education effectively fosters motivation and a positive attitude among students (22).

The average satisfaction scores for both online and face-to-face education methods among male students were marginally higher than those for female students, although this difference was not statistically significant. This suggests that gender may not play a significant role in the effectiveness of these two educational approaches. Previous research on gender disparities in students' computer usage outside the educational context has indicated that males tend to use online systems more frequently than females. However, in our study, the lack of significance may be attributed to the fact that both male and female students in the medical field typically rank among the top performers in entrance exams, and their intrinsic motivation to learn is a crucial factor influencing their learning abilities (23). In certain studies, differences have been observed, likely influenced by various factors such as disparities in educational groups, among others. Examination of satisfaction levels with both online and face-to-face training methods revealed a higher inclination towards online education among married individuals, although this association was not deemed statistically significant. Married individuals typically shoulder greater responsibilities within their family and community settings, which may

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impact their participation in university classes. With online education, the reduction in commuting time allows them to allocate more time to non-academic activities outside the university environment. The popularity of online learning stems from its potential for flexible access to content and instruction, enabling individuals to engage with educational materials anytime, anywhere (24).

This heightened level of satisfaction among married individuals with online education can be attributed to their increased flexibility in managing familial and community obligations. A meta-analysis study revealed that individuals interested in online education tend to be older, employed, and parents, underscoring their need for flexibility to balance studies with work and family responsibilities (25). Conversely, students who opt for face-to-face courses typically prioritize their "learning priority." They often express concerns about reduced interaction with instructors in the online environment, which commonly influences their preference for face-to-face education courses (25).

Finally, it is important to acknowledge that the results of this study may only reflect a small subset of society due to the limited number of participants. Additionally, the virtual and online educational model has its own set of limitations, including potential unfamiliarity among both learners and teachers with the use of new technological devices and software in an educational setting. Therefore, it is recommended that trainers and educators enhance their professional capacities to effectively navigate and leverage the capabilities of online education.

Conclusion

Both online and face-to-face teaching methods yield comparable effects on students' satisfaction and learning outcomes. In this study, variables such as age, marital status, nativeness, and dormitory accommodation significantly influenced the level of satisfaction with the online education method. Specifically, increasing age was associated with higher levels of satisfaction with online education. This observation aligns with findings from previous studies, suggesting that online education offers the potential for more flexible access to educational content and instruction anytime and anywhere.

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Conflict of interest

The authors declare no conflict of interest associated with the publication of this article.

Authors' contributions

M.KH. and M.M. designed the study. M.V. collected the data. AA.M. analyzed the data. A.K. and MR.K. supervised the process, and reviewed and revised all sections of the manuscript. M.SH. and A.KH. drafted the manuscript. All authors have read and approved the final manuscript.

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