



Evaluation of Anatomy Course Teaching and Learning Outcomes for Iraqi Pharmacy Students: Internet-based Learning versus Blended Learning During the Pandemic

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Abstract

BACKGROUND: Academic courses of human anatomy need to be reviewed periodically by students to ensure better learning outcomes, especially when the teaching process became internet-dependent during the pandemic.

AIM: Our study aims to explore pharmacy students' opinions concerning the theoretical and practical elements of the anatomy course taught in the College of Pharmacy at Al-Rafidain University.

MATERIALS AND METHODS: The ethical committee of the College of Pharmacy at Al-Rafidain University approved the study. We prepared a questionnaire (Cronbach's Alpha = 0.735) to evaluate the positive and negative aspects of the teaching process. The questionnaire was presented as an online survey to pharmacy students (n = 305) who finished their anatomy course in two learning modalities, Internet-based learning (n₁ = 105, 34.43%) and blended learning (BL) (n₂ = 200, 65.57%).

RESULTS: Participants of both groups were satisfied with the syllabus, using internet-based materials, and problem-based learning concerning the theoretical aspect of the course. Concerning practical knowledge, both groups preferred using cadavers instead of dummies, and they verified the beneficial effect of online educational materials and computer-based applications. Pharmacy students demanded more than one anatomy course, while students from the BL group considered the anatomy course duration insufficient. Concerning the practical knowledge, students' marks were superior for students using BL, and the opposite was the case with theoretical knowledge.

CONCLUSIONS: BL is favored by Iraqi undergraduate pharmacy students; perhaps, it is attributed to the lively interaction between students and the teaching staff. We conclude that internet resources can be supportive of the classical teaching of anatomy.

Edited by: Branislav Filipović
Citation: Farhan SS, Al-Imam A, Motyka MA. Evaluation of Anatomy Course Teaching and Learning Outcomes for Iraqi Pharmacy Students: Internet-based Learning versus Blended Learning During the Pandemic. Open Access Maced J Med Sci. 2021 Sep 19; 9(A):782-788. <https://doi.org/10.3889/oamjms.2021.6771>
Keywords: Academies and Institutes; Anatomy; Coronavirus disease-19; Internet; Learning; Medical education; Pandemic; Pharmacy students; Severe acute respiratory syndrome coronavirus-CoV-2; Teaching
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Received: 04-Jul-2021
Revised: 08-Sep-2021
Accepted: 09-Sep-2021
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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Introduction

Human anatomy is an essential basic medical science; it has importance for medical and paramedical students, including pharmacy students [1]. Sound knowledge of Anatomy is mandatory for pharmacists due to their critical role in decision-making within clinical and healthcare institutes [2]. Teaching human anatomy for undergraduate pharmacy students can be a standalone educational program or integrated with histology or physiology courses [3]. Human anatomy is not only merely about knowledge of anatomical structures but also its profound relevance to medical practice, clinical studies, and health-care research [4]. Internationally, medical schools perpetually audit and revise their curriculum and educational methods, albeit the profound organizational and economic challenges, to achieve

better learning outcomes and satisfaction among their students [5].

Before the pandemic, the Internet was an auxiliary learning tool in teaching human anatomy and anatomical sciences [6], [7], [8], [9]. The coronavirus disease 2019, responsible for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), imposed novel restrictions on social norms and day-to-day activities, including education, and resulted in unprecedented anomie of the social structure [10]. In 1938, Robert King Merton defined social anomie as a process occurring in societies that, due to sudden dynamic changes, deprive the members of a given community of the possibility of realizing culturally imposed goals (e.g., education, development, and self-determination) by means hitherto accepted [11]. During the changes taking place (caused, for example, by an economic crisis, war, ecological disaster, and pandemic), people must adapt to new conditions to

achieve socially accepted goals; however, they do it, having at their disposal completely different possibilities of achieving them. They then “activate” new ways of adapting to new circumstances [10], [11].

Merton listed five such ways, only one of which (conformism) means accepting both new goals and new possibilities of achieving them; the others, including innovation, ritualism, rebellion, and escape, are actions in which either the goals or the means of achieving them, or both, are not accepted [10]. These actions may give rise to deviant behavior, which, according to this theory, is a “normal” reaction to anomic states (chaos, feelings of confusion, helplessness, existential anxiety) for those who engage in such behavior; some of these states may be unconscious so to speak, “forcing” the activation of psychological defense mechanisms that impede the correct assessment of the situation [12].

The need for auditing and reviewing educational programs of human anatomy, as a core basic medical science, has been carried worldwide, including in Japan (Rao and Rao, 2009), Italy (Snelgrove *et al.*, 2009), Sweden (Edgren *et al.*, 2010), and Korea (Kim and Kee, 2010) [13], [14], [15], [16]. In 2019, Ngan and colleagues found that blended learning (BL), implementing a combination of traditional and online (virtual) learning, is preferable by students [17]. Distance-learning and on-campus human anatomy programs were already conducted successfully for pharmacy students [18]. At the faculty of pharmacy (Al-Rafidain University, Iraq), the duration of the human anatomy course is 16 weeks for the theoretical and practical teaching; anatomy instructors convey both as a single course. The practical course has only one weekly credit hour, using anatomical dummies rather than cadavers. In the last few years, assisted technology relying on websites of the world wide web, including YouTube, and computer-based applications, had a growing role in teaching human anatomy. Therefore, educational institutes adopted BL globally; however, this year, strict Internet-based learning (IBL) was approved by the Iraqi Ministry of Health due to the emerging pandemic event.

Our study aims to explore the opinions of pharmacy students concerning the theoretical and practical elements of the anatomy course taught at the College of Pharmacy (Al-Rafidain University, Iraq). Accordingly, we conducted a survey regarding the two modalities of learning anatomy, blended versus Internet-based, to evaluate the theoretical basis, practical aspects, and the learning outcomes of the educational process.

Materials and Methods

Using a questionnaire, we conducted an online survey from June to September 2020 among

305 ($n = 305$) undergraduate students from the College of Pharmacy at Al-Rafidain University. We divided the participants into two groups; 200 students ($n_1 = 200$, 65.57%) who passed the course using BL and 105 students ($n_2 = 105$, 34.43%) who passed the course using IBL. The ethical committee of the College of Pharmacy at Al-Rafidain University approved the study. We distributed the electronic form of the questionnaire via the Google Classroom platform.

The study followed strict inclusion and exclusion criteria; only Iraqi students who were undergraduates, including males and females, from the faculty of pharmacy were allowed to access the survey based on their student ID number; hence, duplicate answers were prohibited. Nevertheless, we implemented a convenience sampling method due to the inherent nature of the online survey tool. Missing data were neglected, i.e., not included in subsequent data analyses.

The questionnaire had three main sections. The first section had yes (or) no questions, while the second one had a five-level Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree); the third section had multiple-choice questions. We circulated the online survey, implementing three types of questions, including yes (or) no questions, 5-point Likert scale, and Multiple-choice questions. We also incorporated an additional aspect to survey the learning outcome, i.e. students' marks in practical and theoretical exams.

We conducted an internal consistency analysis concerning the questionnaire's validity and found that it had good reliability (Cronbach's Alpha = 0.735, Standardized Cronbach's Alpha = 0.721). Further, each of the three sections of the questionnaire had strong internal consistency (Cronbach's Alpha > 0.7). We processed raw data gathered by the survey tool using IBM-SPSS version 26 and Microsoft Excel 2016 with Analysis ToolPak add-in. We implemented Fisher's exact test, Mann-Whitney U test, and the independent Student's t-test. Given the sample size, we deployed an alpha (α) value of 0.05, i.e. 95% confidence interval.

Results

Concerning the theoretical teaching of anatomy (Table 1), the majority of the IBL group (85.7%) and the BL group (71.5%) showed their satisfaction with the curriculum ($p = 0.003$). Students from the BL group (67.5%) declared that the anatomy course duration was insufficient compared to the IBL group (40%); the difference was statistically significant ($p = 0.0001$). Students from both groups preferred BL over IBL at 61.5% and 64.7%, respectively; however, no significant difference existed between the two groups. Further,

both groups favored problem-based learning, at 91% and 88.5%, respectively. Statistically significant differences existed regarding the satisfaction with the syllabus and the course duration ($p < 0.001$ and < 0.001 , respectively).

Table 1: First section of the survey: Questions with Yes or No

Question	Blended		Internet		Fisher's exact test (p-value)
	Yes (%)	No (%)	Yes (%)	No (%)	
Satisfied with the syllabus of the anatomy course?	71.5	28.5	85.7	14.5	0.003*
The anatomy course duration is sufficient?	32.5	67.5	60	40	0.0001*
Prefer blended over internet learning?	61.5	38.5	64.7	35.3	0.33
Prefer to use problem-based learning?	91	20.4	88.5	11.5	0.31

*Significant P values are marked with an asterisk.

Concerning the practical teaching of anatomy (Table 2), students from the BL group showed that 44.5% agreed and 28% strongly agreed, preferring the use of cadavers instead of anatomical dummies, compared to 24.8% who agreed and 51.4% who strongly agreed from IBL group ($p = 0.001$). BL and IBL students agreed (44.5% vs. 32%) and strongly agreed (42% vs. 68%) to incorporate the use of illustrative anatomical movies from websites, including YouTube, in addition to three-dimensional computer and mobile-based applications ($p < 0.001$). A higher percentage of BL students were not satisfied with the weekly credit hours of the anatomy laboratory ($p < 0.001$). Students from both groups confirmed (strongly disagreed) the insufficiency of the course duration (37.5% vs. 33.3, $p = 0.043$). Participants from both groups showed similar results related to satisfaction with the laboratory teaching staff ($p = 0.984$). BL Students preferred small-group teaching ($p = 0.004$).

The third part of the questionnaire surveyed specific preferences by the participants (Table 3). Concerning the favorite anatomy subject, the highest percentage of BL students (32.8%) favored the cardiovascular system, while the nervous system (neuroanatomy) had the lowest percentage (11%). IBL group participants had a similar opinion; 38.1% favored the cardiovascular system, while the urogenital system had the lowest interest among IBL students (1.9%). Contrary to BL students, almost one-third of IBL students (36.2%) showed interest in studying neuroanatomy. Another topic is the number of courses required to study the anatomy curriculum effectively;

both BL and IBL groups suggested undertaking two courses at 44.5% versus 58.1%, respectively. Only a minority of students declared that they mandate four courses, at 16.5% and 11.3%, respectively.

We also evaluated the learning outcome by comparing the students' final marks in the theoretical and practical exams (Table 4). Concerning the practical knowledge of anatomy, BL students achieved higher scores than IBL students (74.7 vs. 65.5, $p = 0.881$). On the contrary, IBL students had higher marks concerning the theoretical knowledge of anatomy (72.1% vs. 66.2%, $p = 0.011$). Nevertheless, none of these results was statistically significant.

To summarize, the students favored BL (Table 5). However, BL students mandated a longer course duration, needed more weekly hours for the practical teaching, preferred to study anatomy in two courses, and found the cardiovascular system was the most interesting to study.

Discussion

Our study is the first to evaluate anatomy course teaching among undergraduate pharmacy students from Iraq. We distributed the survey via Google Classroom virtual platform to assess the effectiveness of teaching the human anatomy course instructed for pharmacy students. We opine that students who learn human anatomy potently are more capable to efficiently comprehend related medical subjects, including physiology, pathology, and pharmacology.

Researchers conducted several studies on using the Internet as a supplementary teaching method; participants preferred adding additional Internet sources to traditional learning [6], [7], [8], [9]. In 2014, Hoffmann and Swales studied integrated versus internet-based anatomy learning among dentistry students; however, they could not detect any statistically significant results [19]. In 2019, Singh and coworkers evaluated students connected with a single system, the muscular system; they found that an integrated learning modality was effective [20].

Table 2: Second section of the survey: Five-point likert scales for practical anatomy

Question	Group	Strongly disagree(%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree(%)	Mann-Whitney U test (p-value)
Using the cadavers instead of dummies?	Blended	3.5	9.5	14.5	44.5	28	0.001*
	Internet	0	5.7	18.1	24.8	51.4	
Adding application and YouTube movies?	Blended	3.5	3.5	6.5	44.5	42	0.0001*
	Internet	1	2	2	32	68	
Weekly credit hours of the laboratory is sufficient?	Blended	8.5	37	28	23	3.5	0.0001*
	Internet	0	8.6	36.2	40	15.2	
Is course duration not sufficient to list all the practical anatomy topics?	Blended	8	37.5	28	23	3.5	0.043*
	Internet	2.9	33.3	27.6	32.4	3.8	
The teaching staff in the laboratory covered the topics of the curriculum?	Blended	5	21.5	30.5	35	8	0.984
	Internet	6.7	17.1	35.2	32.4	8.6	
Depending on small teaching groups?	Blended	4.5	8	13.5	49	25	0.004*
	Internet	2.8	4.6	13	39.8	39.8	

*Significant P values are marked with an asterisk.

Limpach *et al.* (2008) suggested that both on-campus and distance-learning students learned effectively [18]; however, our results differed. On-campus students ought to perform better, which may relate to more robust interaction at the non-virtual teaching environment within the classroom between students and the teaching staff. Further, Ngan *et al.* (2018) claimed that students' affinity for BL is analogous to those reported in our results [17]. The heterogeneity of results among studies might relate to an abundance of factors, including the study design, the internal and external validity, and data analytics' reliability or interpretations.

Table 3: Third section of the survey: Questions with specific answers

Question	Blended group (%)	Internet group (%)	Mann-Whitney U test (p-value)
Which topic was more interesting?	Cardiovascular (32.8)	Cardiovascular (38.1)	0.068
	Nervous (11)	Nervous (36.2)	
	Gastrointestinal (21.6)	Gastrointestinal (15.2)	
	Urogenital (19.5)	Urogenital (1.9)	
	Others (15.1)	Others (8.6)	
How many courses are needed for the anatomy subject?	One course (18.5)	One course (11.5)	0.789
	Two courses (44.5)	Two courses (58.1)	
	Three courses (20.5)	Three courses (19)	
	Four courses (16.5)	Four courses (11.3)	

IBL students showed higher scores in theory exams, which agrees with Zand *et al.* (2016), who claimed that Internet-associated technologies effectively improved the knowledge of anatomical sciences [21]. Regarding the survey on practical anatomy, participants preferred practical training on a cadaver, which is in unison with Kang *et al.* (2012), who advised using tasks related to cadaver dissection, especially in integrated learning [22]. Artificial dummies had a limited role in learning, although teachers implement these in most pharmacy colleges in Iraq.

Table 4: Final marks comparison: Blended vs. internet learning group

Element of anatomy course	Group	Mean (± Std. Deviation)	Student's t-test (p-value)
Marks (Practical)	Blended	74.7 (± 9.7)	0.881
	Internet	65.5 (± 9.7)	
Marks (Theoretical)	Blended	66.2 (± 8.8)	0.011*
	Internet	72.1 (± 10.9)	

*Significant P values are marked with an asterisk.

Darras *et al.* (2019) concluded that using computer-based and mobile-based applications, rendering virtual and realistic anatomical dissection movies, had high acceptance among students and had improved cadaveric dissection skills [23]. Nevertheless, Saltarelli *et al.* (2014) required a careful alignment of learning tasks versus performance measures and meticulous monitoring of the transition between

Table 5: Blended versus IBL comparison

BL	IBL
Needed longer course duration	The course duration was enough
Preferred by students, especially for the practical part	BL is preferred, although IBL offered enough time for studying; still, the practical part was weak
Needed more weekly hours for the laboratory	Online laboratory weekly hours were enough
Higher marks in the practical part	Higher marks in the theoretical part
Preferred to study anatomy in two courses	Same
The most exciting subject for students was cardiovascular system	Same

*BL: Blended learning, **IBL: Internet-based learning.

simulated and cadaveric dependence in anatomical science education [24].

Our study showed that the highest percentage of BL students found that weekly credit hours for practical learning were insufficient to comprehend the subject of anatomy thoroughly and that they needed more time to correlate practical and theoretical knowledge. However, students from the IBL group opinionated differently; they declared that the weekly practical session was satisfactory, which might be attributed to the efficient self-management and allocation of time when studying via the Internet. Further, the highest percentage of both groups' participants revealed that teaching staff in the laboratory covered all the curriculum topics; still, students, in their notes, suggested prolonging the time for the laboratory to get maximum benefit. Concerning the small-group teaching in the laboratory, both groups were equally satisfied. In small-group teaching, the teaching staff can exercise more control, test the acquired information, diagnose defects in the learning process, and focus on subjects that mandate re-explanation or better interaction.

Participants of both groups were more interested in studying the cardiovascular system than others; perhaps, due to the widespread cardiovascular diseases in the community and other factors related to the ease of comprehension and visual appreciation of the cardiovascular system itself. In 2020, Mustafa and fellow researchers also confirmed the role of animated visual aids, specifically YouTube educational videos, including recorded lectures and tutorials, to enhance their students' learning experience, which agrees with our results [25]. A recent study also conveyed similar findings among postgraduate students [26]. On the other hand, the highest percentage of both groups suggested dividing the current anatomy syllabus to comprehend demanding subjects of human anatomy, including neuroanatomy and anatomy of the urogenital system, to secure more time for the learning process.

Concerning the practical knowledge of anatomy, our students had better marks when enrolled in the BL group, which is in unison with Singh *et al.* (2019), who claimed that students should have appropriate practical training to appreciate musculoskeletal anatomy better [19]. Further, Zargarani *et al.* (2020) suggested that traditional cadaveric teaching still represents the cornerstone choice for medical students, while technological interventions, using internet videos and virtual dissection tools, should support cadaver-oriented teaching [27]. Estai and Bunt (2016) also suggested multimodal learning by implementing plastination and anatomy prosections for more efficient learning [28]. Nevertheless, earlier in 2009, Tam *et al.* claimed no evidence to verify that IBL could be an adequate substitute for the classical way of teaching human anatomy [29].

Our study has some limitations, including implementing a cross-sectional study design, the

relatively small sample size, and the inherent limitations of statistical analysis [30], [31]. Cross-sectional surveys frequently suffer from nonresponse bias; nonetheless, we excluded missing data from our data analytics. Another form of bias in cross-sectional studies is the recall bias; the unintentional falsification of results is one of the crucial limitations of research conducted during a pandemic. Although we conducted the present study with the highest standards and methodological rigor, unconscious defense mechanisms, triggered in almost all people, may cause incorrect self-perception and, at the same time, inadequate evaluation of the acquired skills. Future research requires larger samples, evaluating the heterogeneity among populations of interest, including pharmacy students and (para)medical students. Studies should aim for robust evidence by exploring longitudinal study designs, controlled trials, systematic reviews, and meta-analytic while deploying robust data analysis tools and methods [32], [33], [34].

Preparing pharmacy students for their future duties is a highly responsible task for teachers and students studying in this field. Thanks to high requirements, observed especially during direct contact (practical classes) between lecturers and students, it is possible to maintain a high level of education necessary to perform medical professions properly. Unfortunately, during the pandemic, practical classes at many universities were reduced to the necessary minimum or replaced by online learning. At the same time, the increase in negative consequences of the coronavirus pandemic (infections and deaths), caused a state of permanent tension in people [35], which in turn, as mentioned earlier, can lead to anomie [10].

With the development and growth of pandemics, several confirmatory research of human anomic states surfaced [36], [37]. The mental condition of the global community has deteriorated, as confirmed by numerous studies, for example, by Javed *et al.* (2020), Xiong *et al.* (2020), Khan *et al.* (2021), and Passavanti *et al.* (2021) [35], [38], [39], [40]. The extent to which the new pandemic circumstances may have affected students' self-assessment of the knowledge they acquired by learning almost exclusively online during the collective trauma (conditions unbearable for everyone, therefore for them too) needs meticulous scrutiny. Therefore, it is imperative to help people restore the necessary well-being in the new post-pandemic reality (both improved physical and psychological well-being).

Finally, we opine that the current study will add to the cumulative knowledge of understanding, predicting, and managing the human resources for combating the pandemic and its adverse effects [41], [42]. As of August 8, 2021, SARS-CoV-2 infected 222,788,994 humans and claimed the lives of 4,600,327, while in Iraq, it infected 1,928,930 and led to the death of 21,220 individuals. The novel coronavirus disease 2019 affected countries from developed and developing nations, including the United States, India,

Brazil, the United Kingdom, Russia, France, Turkey, Argentina, Iran, and Columbia [43]. Therefore, during the pandemic, humanity should strive at all frontiers, from vaccine and therapeutics development to enhancing teaching and educational methods, including medical education.

Conclusions

The anatomy course for pharmacy students needs to be revised periodically to ensure better learning outcomes for the main stakeholders in the educational process. Our study elucidated the positive and negative aspects of IBL and BL. The students favored BL. However, BL students mandated a longer course duration, needed more weekly hours for the practical teaching, preferred to study anatomy in two courses, and found the cardiovascular system was the most interesting to study. Overall, Iraqi undergraduate pharmacy students favored BL, which may relate to the non-virtual (live) interaction between the students and the teachers, and the distinct practical training method. Therefore, we conclude that internet resources can be used as collateral modalities for studying human anatomy but not as substitutes.

Contribution of Authors

SSF developed the study concept, reviewed the literature, and wrote the first draft of the manuscript. AA developed the discussion section, conducted proofreading, enhanced the scholarly presentation of the article, and revised the final version of the manuscript. MAM contributed to developing the introduction and the discussion sections of the article.

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