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The perception of dental students and educators about e-learning during COVID – 19 pandemic

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Abstract

Background The COVID-19 pandemic necessitated an abrupt shift to e-learning in higher education institutions worldwide to ensure educational continuity during lockdowns. The aim of this study was to evaluate dental students' and educators' perceptions of e-learning during the COVID-19 lockdown and their attitudes toward implementing blended learning in post-pandemic dental education.

Methods A cross-sectional survey regarding e-teaching during the COVID-19 pandemic was conducted at the College of Dentistry. Satisfaction and attitude towards technology-based learning (TBL) were assessed. Two binary logistic regression models were performed to assess the association of factors (age, gender, Grade Point Average, IT skills and experience in TBL) with educators and students' overall satisfaction and attitude towards TBL. The teaching staff attitude towards TBL was also assessed. Adjusted odds ratios (AOR), and 95% confidence intervals (CI) were calculated. Significance was set at p value < 0.05.

Results and conclusions The study included 431 students and 74 teaching staff (response rate = 92.1% and 75.6%). Most students and teaching staff rated their computer skills as intermediate ($\approx$67%), and most students (77.5%) reported a fair experience in TBL. Most students were satisfied and showed a positive attitude towards the TBL experience. Male and older students showed significantly higher overall satisfaction and attitude than female and younger students. Nevertheless, most teaching staff easily adapted to the shift from traditional to TBL (74.3%), and preferred blended learning after the pandemic (73%). However, only a few of them prefer TBL in all teaching activities.

Keywords Dental education, E-learning, Blended learning, COVID-19, Pandemics

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Background

Dental education includes theoretical, practical, and clinical courses. The required competencies to be acquired by dental students are the sum of knowledge, cognitive and psychomotor skills. In addition, professional interaction with patients, colleagues, assisting dental staff and educators are required [1].

The COVID-19 pandemic fundamentally transformed higher education delivery systems worldwide. During the peak of COVID-19 pandemic, complete lockdown was forced in many countries and educational institutions quickly shifted to e-learning to maintain continuity during lockdowns [2]. However, challenges emerged due to varying levels of preparedness and the practical nature of dental training, which requires hands-on experience not easily replicated virtually [3–5]. Therefore, the challenges faced by teaching staffs, students and parents were more significant in dental schools due to the nature of the practical and clinical curriculum [6]. However, later with partial lockdown blended learning, combining online and in-person methods, became more prevalent, even being adopted by dental schools that hadn't used it pre-pandemic, enhancing students' performance and confidence [7]. Recently multiple dental schools are considering blended learning in their curriculum to benefit from the advantages of e-learning which improved the students' performance and confidence [8–10].

The benefits of e-learning include the availability and accessibility to educational material at any time, enhanced students' self-directed learning together with the time and resources saving [11, 12]. However, lack of direct feedback and reduced students' concentration in addition to difficulty of teaching practical and clinical skills through online platforms are among the limitations of e-learning [12, 13]. Another challenge of e-learning is the students' assessment, higher rates of academic dishonesty can occur in online methods as students might communicate with each other [4]. Moreover, online exams might generate more anxiety and stress among students due to fear of network disconnection, high internet expenses, students' isolation and lack of physical communication and interconnection with peers and tutors [6, 14].

The forced e-learning during the pandemic made many dental institutions consider distance learning as an alternative to traditional teaching for some courses [15]. It could also be an adequate educational method to avoid interruption of study during environmental crises such as severe storms, floods, or earthquakes. Numerous studies have examined technology-based learning (TBL) during the pandemic, however they focused on either students or educators in isolation [15–18]. Therefore, our study simultaneously examines both groups within the same dental institution, allowing for a comprehensive understanding of both perspectives. Additionally, our investigation explores the correlation between factors such as IT skills, prior TBL experience, and demographic characteristics with satisfaction levels and attitudes toward TBL in dental education. Dental education requires a careful balance between theoretical knowledge and practical skills, making the evaluation of TBL acceptance by both learners and educators crucial for developing effective blended learning strategies post-pandemic.

The aim of the present study was to assess dental students' and educators' experiences with e-learning during COVID-19 lockdown and their perspectives on blended learning implementation post-pandemic. Additionally, parents' perspectives on e-learning were assessed as a secondary outcome.

Methods

Study design and sample size estimation

A cross-sectional study was conducted between April and May 2023, at the College of Dentistry, IAU. The survey included dental students, teaching staff, and the students' parents. The study was approved by the Institutional Review Board (IRB-2023-02-156).

The sample size was planned at 95% confidence level and 5% margin of error. According to El Bayoumi and Mahmoud [16], about 57% of the students were satisfied with TBL and 77% of them showed positive attitude towards TBL. The minimum sample size was calculated to range from 273 to 377 increased to ≈430 students to make up for non-response bias.

Study questionnaires

The questionnaires used in our study were adapted from previously published surveys [16–19]. To validate the adapted instruments, three experts in dental education reviewed the content. All three experts are senior faculty members at the College of Dentistry with years of involvement in teaching, curriculum development, and research in dental education. Their selection ensured that the questionnaire was reviewed by individuals with relevant expertise to validate its content and relevance to our study objectives. Modifications were made to align with the specific objectives of the study and to ensure cultural relevance, particularly in the parental survey, which included Arabic translations. Then piloting of the study questionnaires was conducted on a small sample of students, educators, and parents, were these results were not included in the final analysis. This process helped refine the questionnaires to align with the study's goals while maintaining methodological rigor.

The questionnaires were prepared to be completely online. The questionnaire link was sent to all the teaching staff working at the college of dentistry, via the institutional email with a follow-up reminder after two weeks.

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Regarding the students' questionnaire, the same procedure was followed but due to the very low response rate, hard copies of the students' questionnaire were distributed by administrative personnel. All questionnaires began with an overview of the study goals, and the expected time to complete the survey. Participants were informed that their anonymous responses would be kept confidential and that their participation was voluntary. Consent for participation was obtained by having participants select the "yes" option then to proceed with the survey.

Student questionnaire

The questionnaire was completely adapted from a previously published survey [17]. It included four sections the first section was the students' demographic data including; age, gender, Grade Point Average (GPA) score, grade, self-rated skills in using the computer and self-rated experience in TBL. The second section included eight questions about the satisfaction of students with TBL experience (satisfied versus not satisfied), the third section included nine questions designed to evaluate students' attitude towards TBL (positive versus negative

attitude), and the fourth section included seven questions for students' evaluation of their lecturers during TBL (on a 5-point Likert scale ranging from strongly disagree to strongly agree). The students were considered satisfied with the TBL experience if they responded positively to more than four satisfaction items. The overall attitude was considered positive if the student responded positively to ≥ five attitude items.

Teaching staff questionnaire

The questionnaire was modified from a previously published survey and contains two Sect. [19]. The first section included information of age, gender, courses, and self-rated skills in using the computer. The second section included 17 questions designed to assess the teaching staff attitude towards TBL on a three-point Likert scale (Disagree-neutral-agree).

Parent questionnaire

Parents' questionnaire was modified from the previously published survey [19]. It included three sections; the first section was about the demographic information of both the parents and their children. The second section included six questions for the parental assessment of the TBL experience on a three-point Likert scale (disagree-neutral-agree), while the third section included five questions assessing some parental concerns about the TBL experience. (supplementary materials)

Statistical analysis

Descriptive statistics were calculated as means, standard deviation (SD), median, interquartile range (IQR), frequencies (n) and percentages (%). Two binary logistic regression models were performed to assess the association of different factors (age, gender, GPA, computer skills and experience in TBL) with students' overall satisfaction and attitude towards TBL. Adjusted odds ratios (AOR), and 95% confidence intervals (CI) were calculated. Significance was set at p value < 0.05. Data were analyzed using IBM SPSS for Windows (Version 26.0).

Results

The mean (SD) age of included students, teaching staff and parents were 22.08 (2.12), 40.42 (11.85) and 53.11 (7.35), respectively. The response rate of the students was 92.1%, teaching staff was 75.6%, while the parents' response rate was 17.2%. Most students and teaching staff rated their computer skills as intermediate (≈ 67%), and most students (77.5%) reported a fair experience in TBL (Table 1).

Most students were satisfied with the TBL experience, 90% reported that websites help them with their learning, 81.4% reported that modern education is inconceivable without using computers, and 77.3% believe

Table 1 Demographic data of dental students and educators

| Students N=431	Age	Mean (SD)	22.08 (2.12)
		Median (IQR)	22.00 (21.00, 23.00)
	Gender: n (%)	Males	215 (49.9%)
		Females	216 (50.1%)
	GPA score	Mean (SD)	4.29 (0.36)
		Median (IQR)	4.31 (4.10, 4.50)
	Grade: n (%)	2nd	58 (13.5%)
		3rd	85 (19.7%)
		4th	81 (18.8%)
		5th	88 (20.4%)
		6th	109 (25.3%)
		Postgraduate	10 (2.3%)
	Self-rated skills in using the computer: n (%)	Basic	51 (11.8%)
		Intermediate	290 (67.3%)
		Advanced	90 (20.9%)
	Self-rated experience in TBL: n (%)	No experience	32 (7.4%)
		Fair experience	334 (77.5%)
		Advanced experience	65 (15.1%)
Educators N=74	Age	Mean (SD)	40.42 (11.85)
		Median (IQR)	40.00 (35.00, 46.50)
	Gender: n (%)	Males	28 (37.8%)
		Females	46 (62.2%)
	Courses you are teaching: n (%)	Preclinical	46 (62.2%)
		Clinical	51 (68.9%)
		Post-graduate	27 (36.5%)
	Self-rated skills in using the computer: n (%)	Basic	4 (5.4%)
		Intermediate	47 (63.5%)
		Advanced	23 (31.1%)
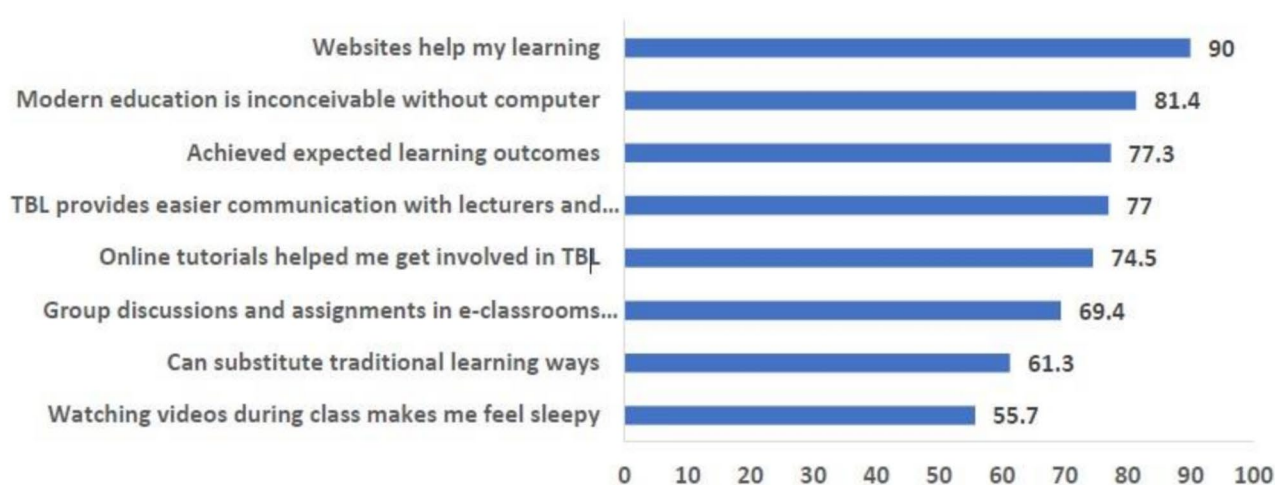
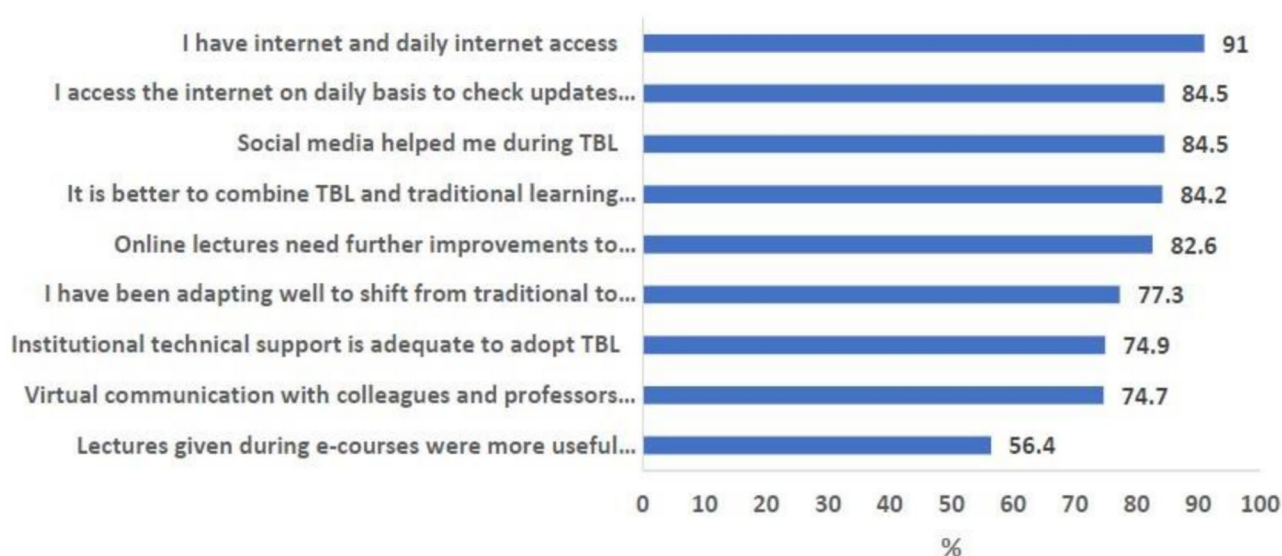**Fig. 1** Satisfaction of dental students with technology-based learning

Fig. 2 Attitudes of dental students towards technology-based learning

they achieved the expected learning outcomes. Students showed positive attitude towards the TBL experience, where 91% reported having daily internet access, 84.5% think that social media helped them during TBL and access the internet on daily basis (Figs. 1 and 2).

Males showed significantly higher overall satisfaction and attitude than females (AOR = 2.76, 95%CI = 1.17, 6.53, and AOR = 5.19, 95%CI = 1.88, 14.34, for satisfaction and attitude, respectively) (Table 2). Students from third to fifth grade showed significantly lower satisfaction than sixth grade and postgraduate students (AOR = 0.09, 95%CI = 0.02, 0.54, AOR = 0.08, 95%CI = 0.02, 0.39 and AOR = 0.15, 95%CI = 0.04, 0.62, respectively).

Teaching staff thought that virtual communication with students is boring were 78.4% and the cheating possibility is high in online assessments (75.6%). Most teaching staff easily adapted to the shift from traditional to TBL (74.3%), believe that institutional technical support is adequate to adopt TBL (71.7%), and prefer blended learning after the pandemic (73%). However, only 14.9% used TBL before the pandemic, 17.6% think that TBL has a positive influence on academic performance, and 19% prefer TBL in all teaching activities, (Fig. 4).

Parental observations indicated that 64.2% of their dental students-maintained interaction with teaching staff and peers during online classes, with 59.3% showing focus and do not need monitoring during online classes (63%). While only 38.3% of parents perceived their dental students interested in TBL, the majority (58%) favored

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Table 2 Logistic regression of the association between different factors and students' overall satisfaction and attitude towards TBL

		Overall satisfaction		Overall attitude	
		OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age		0.76 (0.56, 1.04)	0.09	1.05 (075, 1.47)	0.80
Gender	Male vs. female	2.76 (1.17, 6.53)	**0.02***	5.19 (1.88, 14.34)	**0.002***
Grade	2nd	0.17 (0.01, 1.96)	0.16	2.28 (0.14, 6.42)	0.56
	3rd	0.09 (0.01, 0.54)	**0.009***	0.38 (0.07, 2.19)	0.28
	4th	0.08 (0.02, 0.39)	**0.002***	0.33 (0.07, 1.48)	0.15
	5th	0.15 (0.04, 0.62)	**0.009***	0.36 (0.10, 1.31)	0.12
	6th / postgraduate	Reference category			
GPA		1.26 (0.42, 3.76)	0.68	1.41 (0.44, 4.55)	0.57
Skills in using the computer	Basic	1.62 (0.44, 5.97)	0.47	0.40 (0.09, 1.82)	0.24
	Intermediate	1.79 (0.65, 4.91)	0.26	0.59 (0.17, 2.10)	0.41
	Advanced	Reference category			
Experience in TBL	None	0.19 (0.03, 1.12)	0.07	1.17 (0.18, 7.43)	0.87
	Fair	0.35 (0.08, 0.14)	0.15	1.27 (0.32, 5.11)	0.74
	Advanced	Reference category			

*Significant difference at *P* value < 0.05
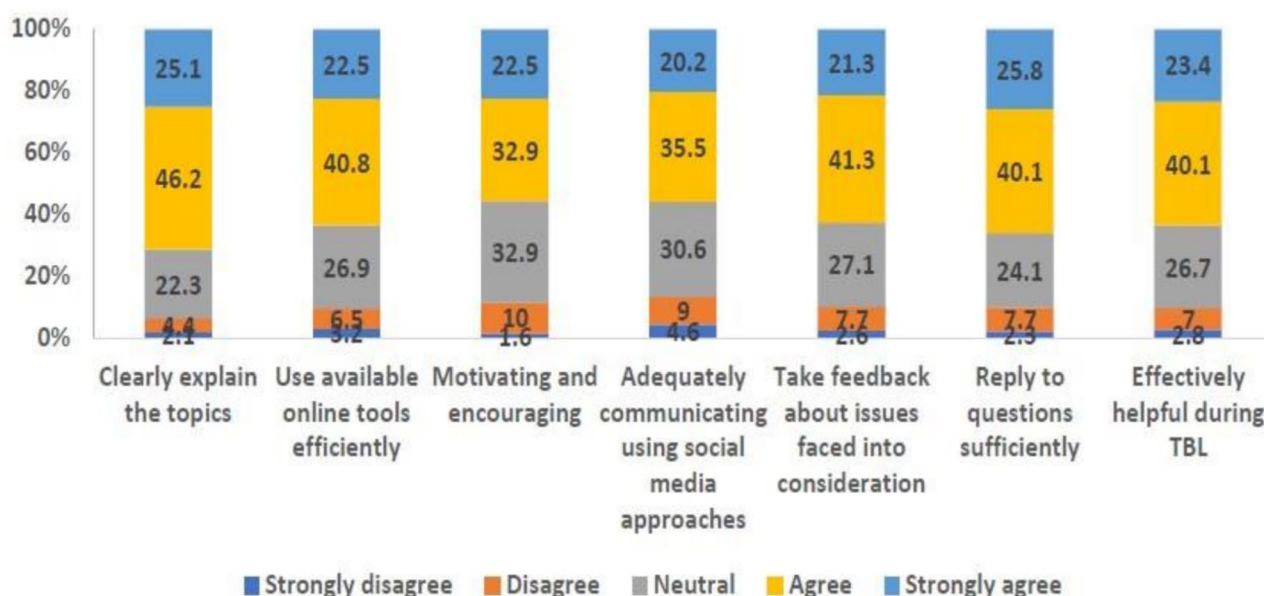
Fig. 3 Students' evaluation of lecturers during technology-based learning

a blended learning approach, with just 6.2% preferring exclusive e-learning.

Discussion

The COVID-19 pandemic forced quick transformation of educational institutions to complete virtual platforms thus, disrupted hands-on sessions such as laboratory and clinical skills instruction [20]. Although, most of the students in this study rated their experience in TBL to be fair, most of them demonstrated an easy shift to online learning. Young-aged students often use technology and access the internet and social media on a daily basis as shown by the present results. This might explain their satisfaction and positive attitude towards TBL. Similarly,

students and teaching staff agreed that e-learning is an effective and flexible method of teaching and learning since it facilitates remote learning, simplifies administration, and is easy to access with less resource and time requirements [12].

In the current study, most dental students showed satisfaction with the TBL experience with proper internet access. This comes in agreement with several studies carried out during the COVID-19 lockdown [21–23]. Khalil et al. [5] reported that medical students showed positive perception towards using e-learning methods. However, online methods were not applicable in case of hands-on and clinical sessions in most of the clinical colleges [24]. On the contrary, previous studies found that students
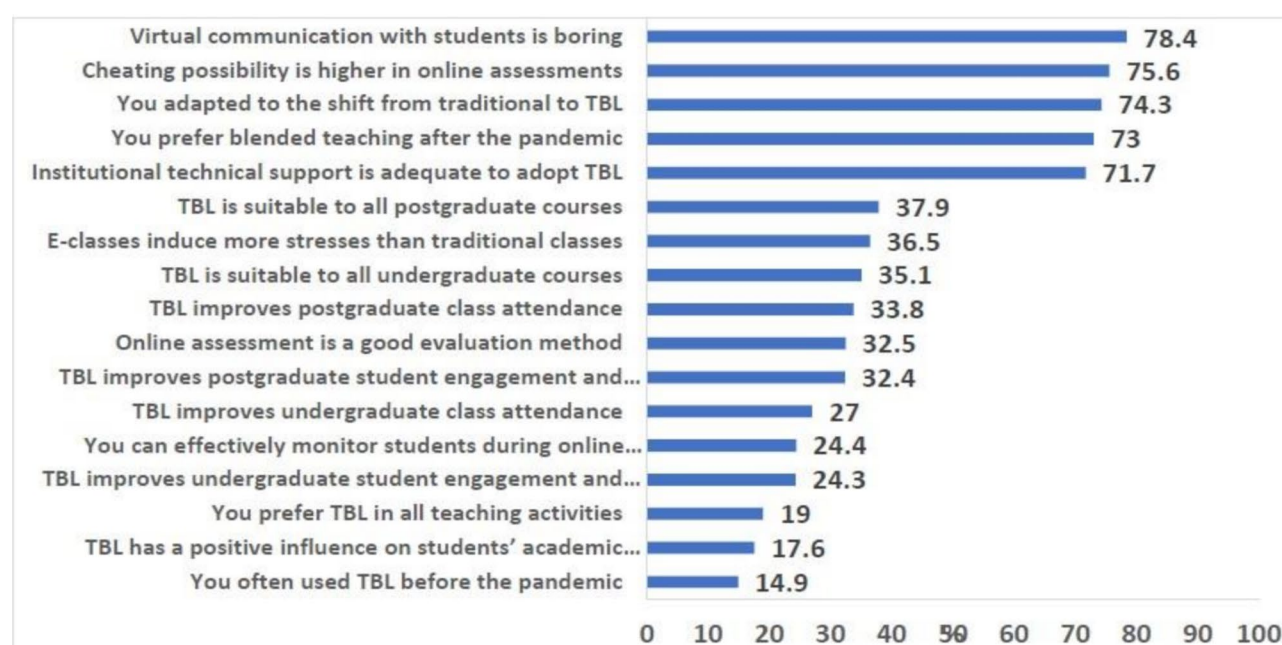
Fig. 4 Educators' attitudes towards technology-based learning

prefer traditional to online lectures and mentioned that online lectures were not as effective as face-to-face lectures [25, 26]. However, they demonstrated that e-learning was better than the complete ceasing of their studies during the pandemic. Students encountered various challenges during e-learning, including technical issues with platforms, poor internet access, expensive technology, unsuitable home learning environments, and isolation from peers and teachers [15, 27–29]. These difficulties, influenced by factors such as college policies, socioeconomic status, and country income levels, led to mixed feelings about online education.

Male students reported higher satisfaction with online education compared to females, attributed to better adaptation to digital learning environments and superior stress coping mechanisms [30]. Females showed higher levels of perceived stress, danger, and anxiety during the pandemic, coupled with additional household responsibilities, experienced reduced satisfaction and performance [31, 32]. In contrast, males have higher stress coping abilities and better skills in handling digital applications than females resulting in better adaptation and well-being [33].

Junior students showed significantly lower satisfaction than senior and postgraduate students. Similar findings were reported [33] where post-graduate students showed more satisfaction than undergraduates in using online educational methods. Another study found that first year dental students were less satisfied with e-learning compared to last-year and postgraduate students [25]. Previous reports showed that junior students often

get distracted by online chatting, gaming, and watching films during online classes, impacting their concentration and performance. In contrast, senior students display more maturity and self-discipline in managing their study schedules [33, 34]. Moreover, older students typically have better internet proficiency and technical skills, contributing to their higher satisfaction levels with online education [35].

Most teaching staff reported a smooth adaptation to TBL, despite only 15% having prior experience pre-pandemic. This contrasts with previous findings that both instructors and students struggled with new educational environments [6, 36]. The ease of transition could be attributed to the adequate technical support offered by the institutions, which alleviated stress and ensured uninterrupted lectures.

Nevertheless, most of the teaching staff found virtual communication with students unengaging and expressed concerns over the increased risk of cheating in online assessments. In agreement to previous report [12], they noted a lack of student feedback, which is crucial for understanding course material effectiveness. Research suggests that interactive, two-way feedback enhances student motivation and learning outcomes [37–39]. Despite higher grades in online settings, concerns about cheating persist [40, 41], leading many educators to prefer traditional assessment methods, especially for clinical skills [42].

In this study, a small percentage of teaching staff found that TBL positively impacts academic performance and favored its use across all educational activities. Most staff

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preferred blended learning post-pandemic. Evidence suggested that delivering educational content entirely through online sources reduced student engagement and motivation and being inefficient in teaching psychomotor skills [12, 41]. Blended learning, combining online and on-site methods, provides students with the best of both methods, enhancing student engagement and satisfaction compared to using a single teaching approach [43]. The COVID-19 pandemic has had significant consequences for working life in general and university activities in particular. Various forms of online courses are included in the curriculum worldwide [21, 24]. Our study suggests that blended learning, combining online and on-site methods, are preferable for dental education in line with [7, 23–25, 44].

The parents' response rate was low which limits the generalization of the present findings. However, we included their perception towards TBL as a secondary outcome of this study. It is common for university students in Arabic countries to reside with their parents during their studies and particularly during COVID-19, many students returned to their family homes during the lockdown, making parents direct observers of the e-learning transition and its challenges. As well as parents often represent significant stakeholders due to the substantial financial investment in their children's professional education. Most parents in the present study believed their dental students interacted with their teaching staff and peers during online classes, they were focused during online classes, and they did not require supervision during online classes. Similar findings were reported by previous studies, in which parents of school children showed satisfaction for e-learning provided during the COVID-19 pandemic [10, 45]. The preferred learning method by most parents was blended learning versus 6% preferred e-learning. In previous study, parents requested blended learning because their children were not paying attention at home, in addition to the increased screen time and the lack of technical assistance [46].

The results of this study showed that most of the students, parents and teaching staff preferred blended learning. The students gave the highest percentage followed by the teaching staff and parents, respectively. Blended learning consistently showed higher knowledge acquisition than the traditional learning methods [47]. Since the COVID vaccination rates increased and all countries resumed face-to-face interactions, educational institutions should consider the implementation of different educational methods and assess their effectiveness in order to integrate them in the learning process. Similar results of students' preference to combine online and conventional learning after the pandemic were previously reported [48].

The study assessed the perception of dental students and teaching staff, as well as the students' parents– fact which may be considered as a strength of this study. The study was conducted after the complete return of students and teaching staff to the college, so that their responses would not be affected by the negative psychological impact that might be caused by the pandemic lock down [49, 50].

The findings of this study have significant implications for the future of dental education. The high satisfaction rates among students and faculty's positive adaptation to TBL suggest that blended learning could become a sustainable pedagogical approach in dental education. However, the preference for selective implementation of TBL rather than complete adoption highlights the need for careful curriculum design that balances digital and traditional teaching methods. This is particularly crucial in dental education where hands-on clinical training remains essential [44]. The gender and age differences in satisfaction levels suggest the need for targeted support systems and differentiated training approaches to ensure equitable learning outcomes [30]. Additionally, the intermediate level of IT skills reported by both students and faculty indicates an opportunity for technological capacity building to maximize the benefits of blended learning [51]. Educational institutions should consider developing comprehensive faculty development programs focused on digital pedagogy and investing in robust technological infrastructure to support sustained blended learning implementation [52]. Furthermore, the findings suggest the need for regular assessment of learning outcomes and continuous refinement of blended learning strategies to maintain educational quality and student engagement [37].

Accordingly, our findings provide valuable understandings for dental institutions planning to integrate TBL into their curriculum beyond the pandemic period. The primary limitation of this study is that it was conducted at a single educational institution, which restricts the ability to generalize findings or compare them with other national or international dental colleges. While the student survey employed the original validated instrument, the educators' and parents' surveys were adapted to meet the specific objectives of the study. These adapted surveys underwent content validation but were not subjected to questionnaires comprehensive psychometric validation, which limits their reliability and comparability. In addition, the use of distinct tailored to students and educators allowed for targeted *insights* but may have hindered direct comparisons between groups. Future research should consider employing fully validated and standardized instruments across all participant groups to enhance consistency and robustness of findings. The low response rate among the parents is another limitation.

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Furthermore, expanding the sample size to include participants from multiple institutions would further improve generalizability and provide a broader understanding of the effectiveness of e-learning and blended learning in dental education. Moreover, such studies could evaluate the implementation of blended learning and its long-term impact on students' performance and learning outcomes.

Conclusions

Dental students showed a positive perception towards e-learning, while the teaching staff showed concerns regarding this teaching method. All study groups preferred implementing blended learning methods in dental education rather than solely e-learning.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-06152-6.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Author contributions
Conceptualization, S.F., M.M., and J.V.; methodology, S.F., M.M., A.E., J.V., and J. A.; validation, N.A. and A.E.; formal analysis, N.A. and A.E. investigation, M.M., H.B., and P.E; resources, P.E., J.H.; data curation, N.A; writing—original draft preparation, S.F., M.M., A.E. and P.E.; writing—review and editing, H.B., A.E., N.A., J.V., and J.A; supervision, J.V.; project administration, S.F., and J. A. All authors have read and agreed to the published this version of the manuscript.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study was approved by the Institutional Review Board of IAU (IRB-2023-02-156) and informed consent was obtained from all subjects involved in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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