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Attitude towards MOOC-based orthodontic education among dental interns: In India A multi-centric cross-sectional study

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Abstract:

Massive Open Online Courses (MOOCs) are emerging as a useful supplement to orthodontic education, but the awareness and preparedness of dental interns to use them remain uncertain. Hence, this multicentric cross-sectional questionnaire-based study included 304 dental interns from dental colleges in Central India and assessed awareness, digital readiness, attitude, willingness and perceived barriers toward MOOC-based orthodontic learning. The mean age of participants was 23.97 ± 1.15 years and 70.7% were female; 41.8% had heard of MOOCs, 36.5% had previously used online learning platforms, 71.1% reported reliable internet access and 76.4% had personal digital devices. A positive attitude was observed, with 72.4% stating that MOOCs improve conceptual understanding, 76% preferring blended learning, 69.7% supporting inclusion of MOOCs in undergraduate dental education and 72.4% agreeing that recorded modules should be used for revision.

Keywords: MOOCs, orthodontic education, e-learning, dental interns, online learning, blended learning, attitude

Background:

E-learning has become a revolutionary way of teaching in medical and dental education in India providing flexibility and accessibility to students [1]. In the future, blended learning can help to enhance the academic performance, engagement and learning outcomes of students, which can lead to an improved dental education curriculum [2]. E-learning is a pedagogical method that uses technology and electronic media as a means of transferring knowledge, which is based on the principles of connectivism learning theory [3]. E learning can be synchronous (everyone at the same time) or asynchronous (not at the same time). Synchronous e learning involves students from different places logging on to the training at a specific time and an instructor leading a discussion and presenting slides or writing on a “whiteboard” that is displayed on the students' computer screens. Asynchronous e learning is e learning that is “prerecorded” or can be accessed by students at any time during the day, from any place [4]. At present, the term that is in vogue is massive open online course (MOOC). By definition, MOOCs are massive courses considering the number of participants enrolled across the globe per course, are open accessed and are available online [5]. They are courses that are available on the Web and can be taken by anyone without specific requirements or restrictions on enrollment. The course registration and course materials are free of charge, although in some courses one can pay to obtain a certificate of participation or verified certificate. Independent educational technology companies [6]. Are often used to provide access to MOOCs. A variety of courses are offered on each website for a variety of students. MOOCs have huge potential to reach large number of learners from all over the world because they can be accessed by anyone from anywhere in the world who has Internet access, computer literacy and language proficiency [7]. MOOC were introduced in Malaysia by the Ministry of Education in 2014 and has been

documented and implemented as part of the Malaysian Education Blueprint 2015-2025 that emphasizes on Globalized Online Learning to align the national education system with the international education trend [8]. The term Massive open online course was framed by Dave Cormier, while christening a course developed by Siemens and Downes at the University of Manitoba. Over 2,000 students registered for the course (massive) and the course was taught using a range of open and free to use educational resources (open) including wikis, online forums and Google Docs, YouTube and Facebook groups [5]. MOOCs have the potential to bring education to millions who otherwise would not have access. Some students find this to be a good method of learning, with short video lectures, regular comprehension tests and engagement in an online community [9]. While e-learning in medical education has been studied, there are limited studies that focus on attitude and readiness towards MOOC-based learning in orthodontics among dental interns. Moreover, there are few multi-centric data assessing the differences between central India institutions. Therefore, it was of interest to determine the attitude and preparedness of dental interns to learn orthodontics through MOOCs, to find out the barriers they faced and to find out the factors that influenced their willingness to learn orthodontics through MOOCs. Questions assessing readiness, attitude and willingness were evaluated using a 5-point Likert scale ranging from strongly disagree to strongly agree [11]. Therefore, it is of interest to attitude and readiness towards MOOC-based orthodontic education among dental interns.

Materials and Methods:**Study design:**

A cross-sectional questionnaire-based survey was conducted online through Google forms to assess the attitude and readiness of dental interns towards MOOC-based orthodontic education.

The study was conducted among dental interns from different colleges of central India undergoing compulsory rotatory internship in recognized dental colleges across central India. Participants were recruited through convenience sampling using professional networks, academic institutions and social media platforms.

Sample size:

The sample size was calculated using Open Epi software (version 3.0) at 95% CI and 80% power with reference to study conducted by Zahid and Agou among dental interns [10]. Based on these parameters, the minimum sample size was determined to be 285. A total of 304 completed responses were included in the final analysis.

Inclusion criteria:

- [1] Dental interns undergoing compulsory rotatory internship in recognized dental colleges.
- [2] Participants willing to provide informed consent.
- [3] Participants who completed the questionnaire fully.

Exclusion criteria:

- [1] Undergraduate students from other academic years and postgraduate students.
- [2] Participants unwilling to provide consent.
- [3] Questionnaires which were partially or incompletely filled.

Survey administration:

The questionnaire was prepared and validated by experts, Google Forms containing pre-validated questions were distributed online through email, WhatsApp groups and social media platforms and data was collected.

Statistical analysis:

Statistical analysis was performed with Statistical Package for Social Sciences (IBM SPSS Statistic for window, version 26.0. Armonk, NY: IBM Corp.) Shapiro Wilk test was performed to check for normal distribution of the data. Descriptive statistics was performed in terms of Mean, Std Deviation, Frequency and Percentage. Chi Square test and unpaired t test was applied to analyze results statistically. Statistical significance was calculated at $p < 0.05$.

Results:

The descriptive statistics revealed that the study participants were 304 participants with a mean age of 23.97 ± 1.15 years. The age of the participants ranged from 22 to 27 years, which suggests that the participants were predominantly young adults within a relatively small age group. The majority of the 304 participants were females (215, 70.7%) and males (89, 29.3%). This means that there are more females than males in the study population. As far as the type of institution is concerned, the majority of the participants were from private institutions (262 participants, 86.2%) and only 42 participants (13.8%) were from government institutions. This is an increase in the proportion of students from private dental colleges. In terms of previous

experience in online courses, 252 participants (82.9%) indicated that they had never taken any online courses, while 52 participants (17.1%) indicated that they had taken one. This indicates that the respondents had not had much prior experience with formal online learning (Table 2). The awareness of Massive Open Online Courses (MOOCs) was evaluated, with 177 participants (58.2%) stating that they were not aware of MOOCs and 127 participants (41.8%) stating that they were aware of MOOCs. This indicates relatively low awareness about MOOCs among the study participants. Regarding awareness of online platforms providing dental courses, 211 participants (69.4%) reported being aware of such platforms while 93 participants (30.6%) were not. This suggests that most of the respondents knew about the online dental learning platforms. As far as the use of online learning platforms like Coursera or SWAYAM is concerned, 193 participants (63.5%) said that they had never used such platforms and 111 participants (36.5%) said they had used them. This is an indication that while awareness was relatively high, utilization was comparatively low. The majority of participants (260, 85.5%) felt that online education is gaining ground in dental training, with only 44 participants (14.5%) disagreeing. This is indicative of a high level of awareness that digital education is gaining significance in dental education. When asked about attending online orthodontic lectures or webinars, 205 participants (67.4%) indicated that they had never attended any online orthodontic lecture/webinar, while 99 participants (32.6%) indicated they had attended orthodontic lectures or webinars online. This indicates low engagement in online orthodontic learning activities (Table 3). When asked about the availability of reliable internet connection for online learning, the majority of participants responded positively, with 175 participants (57.6%) saying they agree and 41 participants (13.5%) strongly agree. In the meantime, 72 participants (23.7%) were neither for nor against, while only 12 participants (3.9%) disagreed and 4 participants (1.3%) strongly disagreed. This means that most participants had access to the internet at a level that would allow them to learn online. When asked about access to personal digital devices (laptop or tablet), 178 participants (58.6%) agreed and 54 participants (17.8%) strongly agreed that they had access to such devices. Thirty-eight participants (12.5%) were neutral, 22 participants (7.2%) disagreed and 12 participants (3.9%) strongly disagreed. Based on these results, it can be concluded that the majority of the participants had appropriate digital devices for online education. In terms of comfort in using online learning platforms, 187 participants (61.5%) agreed and 38 (12.5%) strongly agreed that they were comfortable using online learning platforms. A small minority disagreed or strongly disagreed (2.0% and 1.3% respectively) and 22.7% were neutral. This shows that participants have a relatively high level of technological comfort. In terms of being able to manage self-directed learning effectively, 186 participants (61.2%) agreed and 26 participants (8.6%) strongly agreed with the statement. Of the 74 participants (24.3%), 4.3% disagreed and 1.6% strongly disagreed. This means that the majority of participants felt they had the ability to self-regulate their learning process. When asked if participants could

commit time regularly to the online modules, 163 participants (53.6%) said they could and 18 participants (5.9%) strongly agreed. A significant number of respondents, however, were neutral (32.9%) and smaller numbers disagreed (5.6%) or strongly disagreed (2.0%). This indicates medium level of confidence of the participants about the regularity of time spent on online learning. With respect to confidence in troubleshooting minor technical issues, 170 participants (55.9%) agreed and 15 participants (4.9%) strongly agreed with the statement. 96 participants (31.6%) reported neutral responses, while only a few disagreed (5.3%) or strongly disagreed (2.3%). This means that the majority of participants were reasonably confident in their ability to manage minor technical issues (**Table 4**). When asked if MOOCs for orthodontics could improve their conceptual understanding, 199 participants (65.5%) agreed and 21 participants (6.9%) strongly agreed. Neutral responses were recorded by 78 participants (25.7%) and 1.0% disagreed and 1.0% strongly disagreed. The result is a very positive attitude towards the conceptual advantages of MOOC orthodontic education. 195 participants (64.1%) agreed and 22 participants (7.2%) strongly agreed that online case-based modules could enhance diagnostic skills. Sixty-five (21.4%) participants gave neutral responses, while only small percentages disagreed (4.9%) or strongly disagreed (2.3%). This indicates that the majority of the respondents believed that online case-based learning is useful for developing diagnostic skills. When asked about the flexibility of digital learning versus traditional lectures, 194 participants (63.8%) agreed and 27 (8.9%) strongly agreed. 71 participants (23.4%) reported neutral opinions, with very few disagreeing (3.3%) and 0.7% strongly disagreeing. This shows that the participants were mostly aware of the flexibility benefits of digital learning. Concerning the effectiveness of MOOCs in complementing classroom teaching, 175 participants (57.6%) agreed and 25 participants (8.2%) strongly agreed. There were 29.3% neutral responses and 4.3% disagreed and 0.7% strongly disagreed. This suggests that most felt MOOCs were a useful addition to traditional pedagogy. As for the preference of blended learning that combines online and offline teaching, 179 participants (58.9%) agreed and 52 participants (17.1%) strongly agreed. 64 participants (21.1%) reported neutral responses and very few disagreed (2.3%) or strongly disagreed (0.7%). This indicates that blended learning models are highly preferred by the participants. Of the 307 participants, 189 (62.2%) agreed and 28 (9.2%) strongly agreed that MOOCs promote self-paced learning. 83 participants (27.3%) gave neutral responses and 0.7% disagreed and 0.7% strongly disagreed. This means that the majority of participants saw MOOCs as a facilitator of self-paced learning. When asked if online orthodontic modules can enhance clinical reasoning, 181 participants (59.5%) agreed and 28 participants (9.2%) strongly agreed. 81 participants (26.6%) reported neutral responses, with very few disagreeing (3.9%) and 0.7% strongly disagreeing. The result indicates that the

respondents had a positive attitude towards the effect of online orthodontic modules on clinical reasoning skills (**Table 5**). In assessing willingness to achieve MOOC-based orthodontic courses, 178 participants (58.6%) agreed and 14 participants (4.6%) strongly agreed. Neutral responses were relatively high (31.3%) and only small percentages disagreed (3.0%) or strongly disagreed (2.6%). This is indicative of a positive attitude of the participants towards the MOOC courses in orthodontics. Concerning recommending MOOCs to peers, 182 participants (59.9%) agreed and 17 participants (5.6%) strongly agreed with the statement. 92 participants (30.3%) reported neutral responses, while very few participants disagreed (3.0%) or strongly disagreed (1.3%). This means that there is a positive overall perception and peer acceptance of MOOC-based learning. In terms of the use of MOOCs in the undergraduate dental curriculum, 191 participants (62.8%) agreed and 21 participants (6.9%) strongly agreed. Of the 83 participants (27.3%), 1.6% disagreed and 1.3% strongly disagreed. This shows a high level of support from participants for the use of MOOCs in undergraduate dental education. When asked if they would like to have recorded modules available for revision, 203 participants (66.8%) agreed and 30 participants (9.9%) strongly agreed. Of the 63 people who responded neutrally, only a small minority disagreed (2.0%) or strongly disagreed (0.7%). This suggests that participants strongly prefer to have educational content available in a recorded format to help them revise and learn again. Lastly, 200 participants (65.8%) agreed and 22 participants (7.2%) strongly agreed to being actively involved in structured online orthodontic modules. 71 participants (23.4%) reported neutral responses and very few participants disagreed (1.6%) or strongly disagreed (2.0%). This finding indicates that most of the respondents were open to actively participating in structured online orthodontic learning programs (**Table 6**).

Questionnaire (Table 1): The questionnaire consisted of 30 items which was pre validated. It was divided into different sections:

Table 1: Questionnaire design

Section A	Demographic details
Section B	Awareness regarding MOOCs
Section C	Digital readiness
Section D	Attitude toward MOOC-based orthodontic education
Section E	Willingness to adopt MOOCs
Section F	Perceived barriers and suggestions
Section G	Open ended

Table 2: Demographic details

Variable	Frequency	Percent
Age	Mean $\pm$ SD: 23.97 $\pm$ 1.15	-
Gender	Female: 215	70.7%
	Male: 89	29.3%
Type of Institution	Government: 42	13.8%
	Private: 262	86.2%
Completed Online Course Before	No: 252	82.9%
	Yes: 52	17.1%

Table 3: Awareness of MOOCs

Variable	Frequency (Yes)	Percent (Yes)	Frequency (No)	Percent (No)
Heard about MOOCs	127	41.8%	177	58.2%
Awareness of online platforms offering dental courses	211	69.4%	93	30.6%

Used any online learning platform (e.g., Coursera, SWAYAM, etc.)	111	36.5%	193	63.5%
Believe online education is increasing in dental training	260	85.5%	44	14.5%
Attended any online orthodontic lecture/webinar before	99	32.6%	205	67.4%

Table 4: Digital readiness

Variable	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Reliable internet access for online learning	41 (13.5%)	175 (57.6%)	72 (23.7%)	12 (3.9%)	4 (1.3%)
Access to personal digital device (laptop/tablet)	54 (17.8%)	178 (58.6%)	38 (12.5%)	22 (7.2%)	12 (3.9%)
Comfortable using online learning platforms	38 (12.5%)	187 (61.5%)	69 (22.7%)	6 (2.0%)	4 (1.3%)
Can manage self-directed learning effectively	26 (8.6%)	186 (61.2%)	74 (24.3%)	13 (4.3%)	5 (1.6%)
Can dedicate time regularly for online modules	18 (5.9%)	163 (53.6%)	100 (32.9%)	17 (5.6%)	6 (2.0%)
Confident troubleshooting minor technical issues	15 (4.9%)	170 (55.9%)	96 (31.6%)	16 (5.3%)	7 (2.3%)

Table 5: Attitude towards MOOC-based orthodontic education

Variable	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
MOOC-based orthodontic education can enhance conceptual understanding	21 (6.9%)	199 (65.5%)	78 (25.7%)	3 (1.0%)	3 (1.0%)
Online case-based modules would improve diagnostic skills	22 (7.2%)	195 (64.1%)	65 (21.4%)	15 (4.9%)	7 (2.3%)
Digital learning provides flexibility compared to traditional lectures	27 (8.9%)	194 (63.8%)	71 (23.4%)	10 (3.3%)	2 (0.7%)
MOOCs can effectively complement classroom teaching	25 (8.2%)	175 (57.6%)	89 (29.3%)	13 (4.3%)	2 (0.7%)
Blended learning (online + offline) is better than only traditional teaching	52 (17.1%)	179 (58.9%)	64 (21.1%)	7 (2.3%)	2 (0.7%)
MOOCs encourage self-paced learning	28 (9.2%)	189 (62.2%)	83 (27.3%)	2 (0.7%)	2 (0.7%)
Online orthodontic modules can improve clinical reasoning	28 (9.2%)	181 (59.5%)	81 (26.6%)	12 (3.9%)	2 (0.7%)

Table 6: Willingness to adopt

Variable	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Willing to attain MOOC-based orthodontic course	14 (4.6%)	178 (58.6%)	95 (31.3%)	9 (3.0%)	8 (2.6%)
Would recommend MOOC-based learning to peers	17 (5.6%)	182 (59.9%)	92 (30.3%)	9 (3.0%)	4 (1.3%)
MOOCs should be integrated into undergraduate dental curriculum	21 (6.9%)	191 (62.8%)	83 (27.3%)	5 (1.6%)	4 (1.3%)
Prefer having recorded modules available for revision	30 (9.9%)	203 (66.8%)	63 (20.7%)	6 (2.0%)	2 (0.7%)
Would actively participate in structured online orthodontic modules	22 (7.2%)	200 (65.8%)	71 (23.4%)	5 (1.6%)	6 (2.0%)

Discussion:

The use of digital learning and online educational platforms has grown in significance in traditional health professions education. The purpose of the present study was to evaluate the attitude and readiness of dental interns towards MOOC based orthodontic education among dental interns and to demonstrate their favorable perceptions towards online education. The average age of the participants in the present study was 23.97 years, indicating a relatively young population and their familiarity with digital technologies. The majority of the respondents were female. Knowledge about online learning platforms for dentistry was relatively high, but knowledge about MOOCs was comparatively low. The present study revealed that the majority of the participants were digitally ready, with a high level of access to the internet, personal digital devices and confidence in troubleshooting technical problems. Moreover, the participants indicated that they felt comfortable with online learning platforms and self-directed learning. A previous study by Schlenz *et al.* found that many students reported that they found it easier to participate in online learning than “face-to-face” courses [12]. The results suggest that the infrastructure and technological skills needed for the implementation of MOOC-based education are becoming more widespread among dental interns. According to previous study by Sreedevi A *et al.* to enhance self-efficacy and motivation, online classes involving face to face, two way communication has proven to be effective [9]. The attitudes of the participants were positive in terms of the educational value of MOOCs. The majority of the respondents felt that MOOCs-based orthodontic education can enhance conceptual understanding, diagnostic skills and clinical reasoning. Case-based learning modules were also seen as

positive online learning. Similarly, Bains *et al.* have conducted an earlier study on educational aspects of cephalometric learning that showed that interactive e-learning resources led to better student engagement and positive learning experiences [13]. The results are in line with the current educational literature which has stressed the effectiveness of blended and interactive learning approaches in medical and dental education. Our results align with prior studies, students and educators in our study recognized the advantages of flexibility, enhanced online teaching abilities and effective time management [14]. This study revealed that most of the respondents preferred blended learning methods over the conventional teaching methods. The same results were found by Jeganathan and Fleming who noted that high levels of learner satisfaction and similar knowledge gains were achieved when using blended orthodontic teaching methods [15]. This observation is in line with the current educational trend of integrating traditional classroom teaching with online education for blended learning. Blended learning can offer the benefits of flexibility, self-paced learning and accessibility, while also retaining the benefits of face-to-face interaction and clinical supervision [16]. Previous study by Li *et al.* showed that the attitude of the students towards blended learning was generally satisfactory in 2020, which is more than that in 2023 among the students in the final year of the undergraduate program [17]. It has also been reported in previous studies that blended learning could enhance the effectiveness of students' learning in dental education [18, 19]. Most of the participants were willing to join MOOC-based orthodontic courses and supported their inclusion in undergraduate dental education. The findings of the present study are consistent with those of Mahobia *et al.*, who identified

significant gaps in orthodontic diagnostic formulation, problem listing and treatment sequencing among dental interns, with experts showing strong consensus regarding the need for structured digital training through a MOOC-based educational intervention [20]. Previous research has emphasized the potential for enhancing communication between orthodontic departments, between teacher and student and factual standardization of course content between them with the use of online modules [21]. Although the results were positive, the study had some limitations. Convenience sampling and online survey administration may have resulted in selection bias. Moreover, the study focused mainly on self-reported perceptions and attitudes and not on actual educational outcomes. Comparing the academic performance of students in traditional and MOOC orthodontic education could yield more evidence for the effectiveness of online orthodontic education in the future.

Conclusion:

Dental interns showed positive attitudes toward MOOC-based orthodontic education, with generally good digital readiness and access to necessary devices and internet resources. However, awareness and utilization of MOOCs remained limited, despite strong support for blended learning and integration into the undergraduate dental curriculum. Online orthodontic modules may serve as effective supplements to traditional dental education and support more flexible undergraduate learning.

Advancement to knowledge:

This study shows that despite limited awareness, dental interns are digitally ready and receptive to MOOC-based orthodontic education, supporting its structured integration into undergraduate training.

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