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Perceptions Of Digital Prosthodontics Training Adequacy In The Dental Curriculum: A Questionnaire-Based Study

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Abstract
Background:
The advent of digital technologies has brought a transformative change in the field of prosthodontics. Innovations such as intraoral scanners, computer-aided design and computer-aided manufacturing (CAD/CAM) systems, virtual articulators, digital facebows, and computer-guided implant planning have enhanced the accuracy, efficiency, and predictability of prosthodontic treatment outcomes. As digital workflows are increasingly being adopted in routine clinical practice, it has become essential for dental graduates to possess adequate knowledge and skills in digital prosthodontics. However, the extent to which the current dental curriculum provides sufficient theoretical understanding and practical exposure to these digital technologies remains unclear, particularly in developing countries.
Aim:
The aim of this study was to evaluate dental students' perceptions regarding the adequacy of digital prosthodontics training incorporated in the existing dental curriculum.
Objectives:
1. To assess the adequacy of theoretical teaching related to digital prosthodontics among dental students.
2. To evaluate the extent and effectiveness of practical and clinical training in digital prosthodontics.
3. To determine the level of integration between digital and conventional prosthodontics teaching.
4. To assess students' perceptions regarding the relevance of digital prosthodontics for future clinical practice.
Materials and Methods:
A descriptive cross-sectional questionnaire-based study was conducted among undergraduate and postgraduate dental students. A structured, self-administered questionnaire was developed based on a review of relevant literature and expert opinion. The questionnaire was distributed electronically using Google Forms. Participation was voluntary, and responses were collected anonymously. The collected data were subjected to descriptive statistical analysis.
Keywords: *Digital prosthodontics; Dental education; CAD/CAM; Dental curriculum; Questionnaire-based study*

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I. Introduction

Prosthodontics is a core discipline in dentistry that focuses on the restoration and replacement of missing teeth and associated oral structures to restore function, esthetics, comfort, and oral health. Traditionally, prosthodontic treatment has relied on conventional impression techniques, manual laboratory procedures, and clinician-dependent workflows. Over the past two decades, rapid advancements in digital technology have revolutionized prosthodontic practice by introducing digital impressions, virtual designing, and automated manufacturing processes.

Digital prosthodontics encompasses a wide range of technologies, including intraoral scanners, extraoral scanners, CAD software, CAM milling machines, three-dimensional printing, virtual articulators, and digital implant planning systems. These technologies offer several advantages over conventional methods, such as improved accuracy, reduced chairside time, enhanced patient comfort, and better communication between clinicians and dental laboratories.

Globally, dental education systems are undergoing a transition to incorporate digital dentistry into undergraduate and postgraduate curricula. In many developed countries, structured digital dentistry modules are already integrated into dental training programs. In contrast, in developing countries such as India, the incorporation of digital prosthodontics into the dental curriculum remains variable and largely dependent on institutional infrastructure, faculty expertise, and availability of digital equipment.

The Dental Council of India has emphasized competency-based education; however, specific guidelines regarding digital prosthodontics training are still evolving. As a result, students may experience inconsistencies in exposure to digital workflows, leading to differences in confidence and preparedness for

clinical practice. Assessing students' perceptions regarding the adequacy of digital prosthodontics training is therefore crucial for identifying existing gaps and planning curriculum modifications.

Although several international studies have explored dental students' attitudes toward digital dentistry, there is limited literature focusing specifically on prosthodontics-related digital training within the Indian dental curriculum. Hence, this study was undertaken to evaluate the perceptions of dental students regarding theoretical knowledge, practical training, curriculum integration, and future relevance of digital prosthodontics.

II. Aim And Objectives

Aim: To assess dental students' perceptions regarding the adequacy of digital prosthodontics training in the dental curriculum.

Objectives:
- To evaluate students' perceptions of theoretical knowledge provided in digital prosthodontics.
- To assess the adequacy of hands-on and clinical training in digital prosthodontics.
- To determine the effectiveness of integration of digital prosthodontics with conventional teaching methods.
- To evaluate the perceived importance of digital prosthodontics for future clinical practice.

III. Materials And Methods

Study Design: A descriptive cross-sectional questionnaire-based study was conducted to evaluate dental students' perceptions regarding digital prosthodontics training.

Study Setting and Population: The study population consisted of undergraduate dental students (third year and final year), dental interns, and postgraduate students in prosthodontics. Participants were recruited from government and private dental colleges. Inclusion of students from different academic levels enabled a comprehensive assessment of perceptions across varying stages of clinical exposure.

Inclusion Criteria:
- Undergraduate dental students who had commenced prosthodontics training
- Dental interns and postgraduate students
- Participants who provided informed consent

Exclusion Criteria:
- Students who had not yet been exposed to prosthodontics teaching
- Incomplete or partially filled questionnaires

Questionnaire Design and Structure

A self-administered structured questionnaire consisting of 20 items was developed to assess the perception of digital prosthodontics training adequacy among dental students and clinicians. The questionnaire was categorized into seven domains including demographic details, knowledge and conceptual understanding, practical training and skill development, curriculum structure and integration, institutional resources and barriers, perception and future readiness, and open-ended responses. Responses for closed-ended questions were recorded using a 5-point Likert scale.

Questionnaire Domains and Variables Assessed

Section	Domain	Variables Assessed
I	Demographic details	Academic status, gender, type of institution
II	Knowledge and conceptual understanding	Understanding of digital workflows, theoretical concepts, confidence in differentiating conventional and digital workflows
III	Practical training and skill development	Hands-on exposure, adequacy of training time, confidence in equipment handling, clinical preparedness
IV	Curriculum structure and integration	Curriculum integration, timing of introduction, balance between conventional and digital teaching
V	Institutional resources and barriers	Accessibility of digital resources, barriers to learning, institutional support
VI	Perception and future readiness	Future clinical benefit and importance of expanding digital prosthodontics training
VII	Open-ended responses	Challenges faced and suggestions for improvement

Data Collection: The questionnaire was distributed electronically using Google Forms to facilitate wider reach and ease of participation. Prior to accessing the questionnaire, participants were provided with an information sheet explaining the purpose of the study, and informed consent was obtained electronically. No personally identifiable information was collected to ensure anonymity.

Ethical Considerations: The study was conducted in accordance with ethical principles outlined in the Declaration of Helsinki. Participation was voluntary, confidentiality of responses was maintained, and participants were free to withdraw from the study at any time without any consequences.

Statistical Analysis: Data collected through Google Forms were exported to Microsoft Excel and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize the data in terms of frequencies and percentages. Inferential statistical analysis will be performed as appropriate and reported in the Results section.

Table 1. Demographic Distribution of Participants (n = 328)

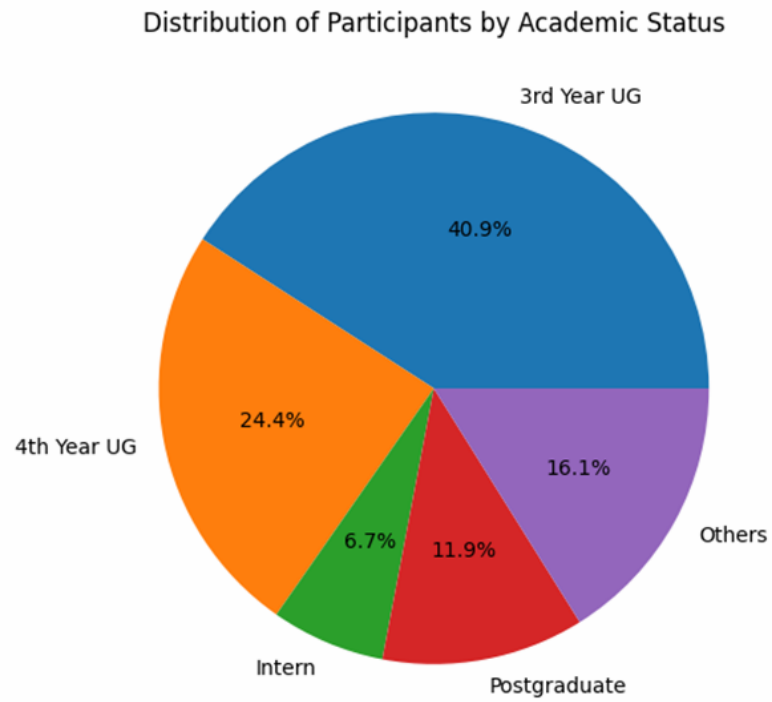
Variable	Category	n	%
Qualification	Third year undergraduate	134	40.9
	Fourth year undergraduate	80	24.4
	Internship	22	6.7
	Clinicians	53	16.2
	Postgraduate	39	11.9
Gender	Male	102	31.1
	Female	226	68.9

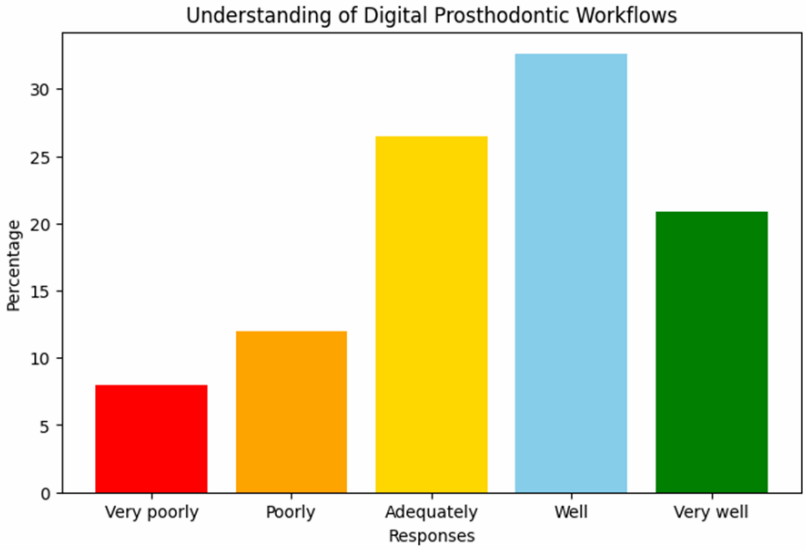
Table 2. Participants' Perception Toward Digital Prosthodontics Training (n = 328)

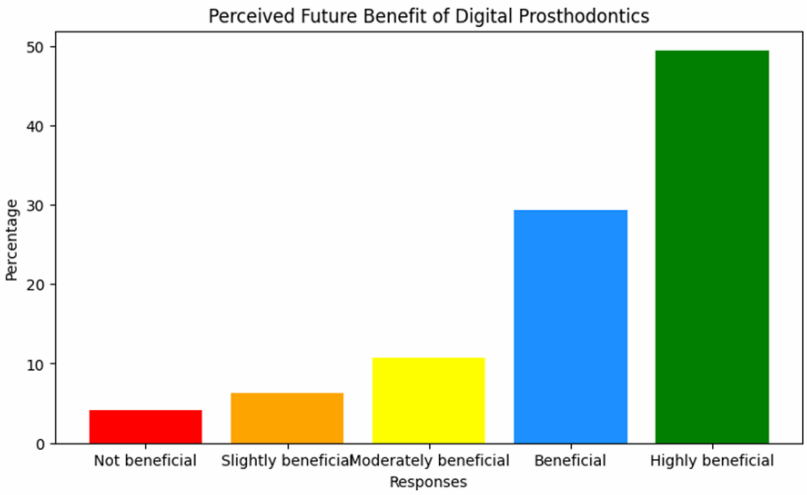
Domain	Variable Assessed	Predominant Response(s)	n (%)	p-value
Knowledge & Understanding	Curriculum explanation of digital workflows	**Well**	**107 (32.6)**	<0.001*
	Understanding of digital prosthodontic principles	**To a large extent**	**112 (34.1)**	<0.001*
	Confidence in differentiating conventional and digital workflows	**Moderately confident**	**103 (31.4)**	<0.001*
Practical Training & Skills	Adequacy of hands-on exposure	**Good**	**103 (31.4)**	<0.001*
	Sufficiency of practical training time	**Sufficient**	**108 (32.9)**	<0.001*
	Confidence in operating digital equipment	**Moderately confident**	**119 (36.3)**	<0.001*
	Preparedness for independent clinical application	**Slightly prepared**	**100 (30.5)**	<0.001*
Curriculum Integration	Integration of digital with conventional teaching	**Well**	**111 (33.8)**	<0.001*
	Appropriate stage of curriculum introduction	**Appropriate**	**182 (55.5)**	<0.001*
	Balance between traditional and digital training	**Acceptable**	**176 (53.7)**	<0.001*
Institutional Resources	Accessibility of digital resources	**Accessible**	**122 (37.2)**	<0.001*
	Institutional support for digital education	**Adequate**	**96 (29.3)**	<0.001*
Future Readiness & Perception	Benefit of digital prosthodontics for future practice	**Highly beneficial**	**162 (49.4)**	0.007*
	Importance of expanding digital training	**Very important**	**169 (51.5)**	0.029*

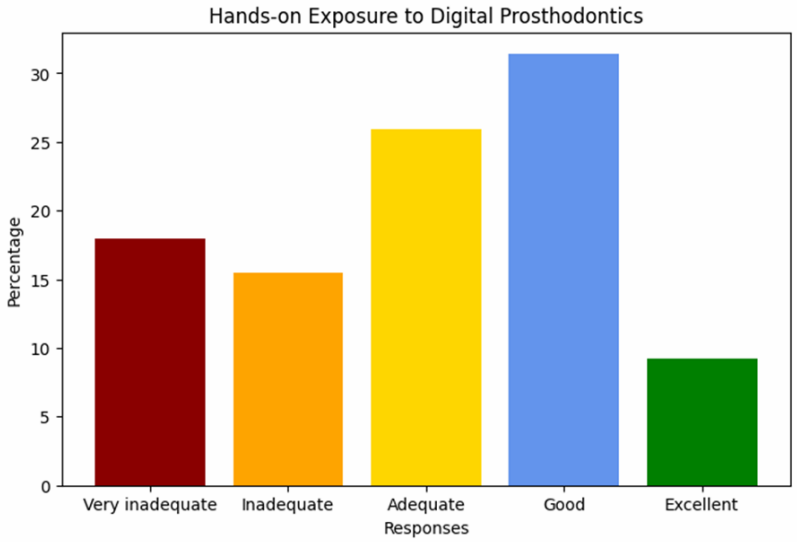
Table 3. Perceived Barriers in Learning Digital Prosthodontics

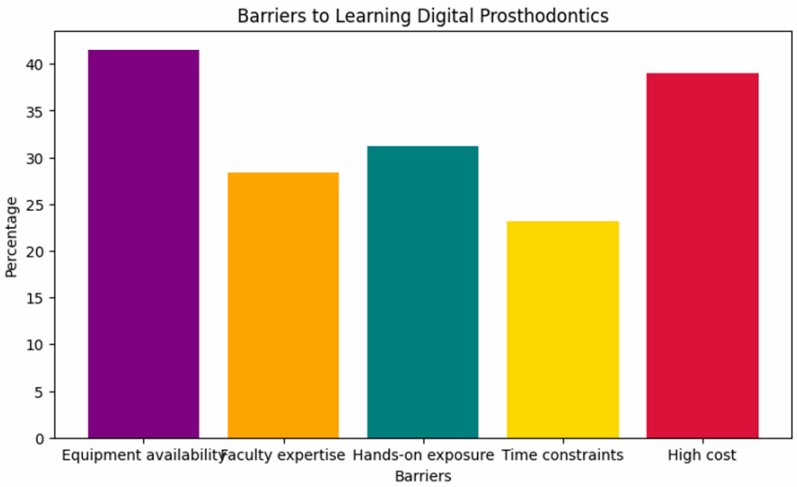
Reported Barrier	Frequency (n)	Percentage (%)
Limited availability of digital equipment	**136**	**41.5**
High cost of digital technologies	**128**	**39.0**
Time constraints within curriculum	76	23.2
Inadequate hands-on opportunities	60	18.3


Distribution of Participants by Academic Status
3rd Year UG
40.9%
4th Year UG
24.4%
16.1%
Others
6.7%
11.9%
Intern
Postgraduate


Understanding of Digital Prosthodontic Workflows
Percentage
0
5
10
15
20
25
30
Very poorly
Poorly
Adequately
Well
Very well
Responses


Perceived Future Benefit of Digital Prosthodontics
Percentage
0
10
20
30
40
50
Not beneficial
Slightly beneficia
Moderately beneficial
Beneficial
Highly beneficial
Responses





IV. Results

A total of 328 participants completed the questionnaire-based survey. The demographic distribution demonstrated that third year undergraduate students constituted the largest study group (40.9%), followed by fourth year undergraduate students (24.4%), clinicians (16.2%), postgraduate students (11.9%), and interns (6.7%). Female participants represented the majority of the study population (68.9%), whereas males accounted for 31.1%.

Regarding knowledge and conceptual understanding, 32.6% of participants reported that digital prosthodontic workflows were explained well within the curriculum, while 26.5% considered the explanation adequate. Approximately 34.1% of participants stated that they had learned the principles underlying digital prosthodontic technologies to a large extent, whereas 27.7% reported moderate understanding.

Evaluation of theoretical confidence revealed that 31.4% of respondents were moderately confident in differentiating between conventional and digital workflows, while 29.3% were confident. Only a smaller proportion reported being very confident.

In relation to practical training, 31.4% of participants considered their hands-on exposure to digital prosthodontic procedures to be good, whereas 25.9% considered it adequate. However, 18.0% still reported very inadequate exposure. Concerning time allocation for practical training, 32.9% considered it sufficient, while 23.8% considered it insufficient.

Assessment of confidence in operating digital prosthodontic equipment revealed that 36.3% of participants were moderately confident and 20.4% were confident following training. In contrast, 22.3% remained not confident. Furthermore, 53.7% of participants considered the balance between traditional and digital prosthodontics training to be acceptable.

Regarding curriculum integration, 55.5% of respondents stated that digital prosthodontic concepts were introduced at an appropriate stage of the curriculum. Similarly, 37.2% reported that digital prosthodontic resources at their institution were accessible, while 25.9% considered them moderately accessible.

Institutional support for digital prosthodontics education was considered adequate by 29.3% of participants, whereas 22.0% rated it as excellent. Nevertheless, 19.2% perceived institutional support to be inadequate.

Perception regarding future relevance demonstrated highly positive responses. Approximately 49.4% of participants believed that digital prosthodontics training would be highly beneficial for future clinical practice, while 29.3% considered it beneficial. In addition, 51.5% of respondents felt that expansion of digital prosthodontics training within the curriculum was very important.

Analysis of open-ended responses identified major barriers to effective learning of digital prosthodontics. Limited availability of digital equipment (41.5%) and high cost of digital technologies (39%) were the most commonly reported challenges. Time constraints within the curriculum (23.17%) and inadequate hands-on opportunities were also identified as significant concerns.

V. Discussion

The present questionnaire-based cross-sectional study evaluated dental students' perceptions regarding the adequacy of digital prosthodontics training in the dental curriculum. The findings of the study demonstrated an overall positive attitude toward digital prosthodontics education, although several limitations related to infrastructure, practical exposure, and curriculum integration were identified.

In the present study, the majority of participants reported that digital prosthodontic workflows were explained adequately or well within the curriculum. This finding suggests that theoretical awareness regarding digital dentistry is gradually increasing among dental students. Similar observations were reported by Revilla-León et al., who emphasized the growing incorporation of digital dentistry concepts into dental education programs.

The results further demonstrated that many participants possessed moderate confidence regarding theoretical understanding and differentiation between conventional and digital workflows. However, only a smaller proportion reported being very confident. This may indicate that while theoretical teaching is being incorporated, greater emphasis on practical reinforcement is still required.

With respect to practical training, a considerable number of students considered their hands-on exposure adequate or good. Nevertheless, a substantial percentage still reported inadequate practical exposure and insufficient training time. These findings are consistent with previous studies by Al-Johany et al. and Abduo and Lyons, who reported that limited hands-on opportunities remain a major challenge in digital dentistry education.

Institutional resources and accessibility to digital technologies were also found to influence student perceptions. Although many participants reported moderate accessibility to digital prosthodontic resources, lack of equipment availability and high costs were identified as major barriers. The high financial investment associated with digital equipment may limit implementation in several institutions, particularly in developing countries.

The majority of respondents believed that digital prosthodontics training would be beneficial for future clinical practice and emphasized the importance of further expansion of digital prosthodontics within the curriculum. This positive perception may reflect increasing awareness among students regarding the growing role of digital workflows in contemporary prosthodontic practice.

The findings of the present study highlight the need for improved curriculum integration, increased practical exposure, faculty training, and enhanced institutional infrastructure. Incorporation of workshops, simulation-based learning, and clinical demonstrations may further improve student confidence and preparedness.

Despite providing valuable insights, the present study had certain limitations. Responses were based on self-reported perceptions and may therefore be influenced by subjective bias. In addition, variations in institutional facilities and participant exposure may have affected the responses.

VI. Conclusion

The present study demonstrated that dental students possess an overall positive perception toward digital prosthodontics training and recognize its importance in modern clinical practice. Although theoretical understanding of digital workflows was found to be satisfactory among most participants, limitations still exist in practical exposure, accessibility to digital resources, and institutional support.

The findings of this study emphasize the need for improved curriculum integration, enhanced hands-on training, and increased availability of digital technologies within dental institutions. Strengthening digital prosthodontics education may improve student confidence, clinical preparedness, and readiness to adapt to evolving prosthodontic practices in the future.

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