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Research Article



Effect of Dental Practicality Index training using an online video on decision-making and confidence level in treatment planning by dental undergraduates

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ABSTRACT

Objectives: The purpose of this study was to evaluate the effect of Dental Practicality Index (DPI) training using an online video on the treatment planning decisions and confidence level of dental undergraduates (DUs).

Materials and Methods: Ninety-four DUs were shown 15 clinical case scenarios and asked to decide on treatment plans based on 4 treatment options. The most appropriate treatment plan had been decided by a consensus panel of experienced dentists. DUs then underwent DPI training using an online video. In a post-DPI-training test, DUs were shown the same clinical case scenarios and asked to assign the best treatment option. After 6 weeks, DUs were retested to assess their knowledge retention. In all 3 tests, DUs completed the confidence level scale questionnaire. Data were analyzed using the related-samples Wilcoxon signed rank test and the independent-samples Mann-Whitney *U* test with the level of significance set at $p < 0.05$.

Results: DPI training significantly improved the mean scores of the DUs from 7.53 in the pre-DPI-training test to 9.01 in the post-DPI-training test ($p < 0.001$). After 6 weeks, the mean scores decreased marginally to 8.87 in the retention test ($p = 0.563$). DPI training increased their confidence level from 5.68 pre-DPI training to 7.09 post-DPI training.

Conclusions: Training DUs using DPI with an online video improved their decision-making and confidence level in treatment planning.

Keywords: Confidence; Decision making; Dental Practicality; Diagnosis; Treatment planning

INTRODUCTION

Treatment planning is one of the most important skills for dental undergraduates (DUs) to develop in preparation for clinical practice [1]. It can be challenging and requires the clinician to consider many interrelated factors to devise a coherent treatment plan. Ali *et al.* [2] observed that DUs were relatively unconfident in formulating a comprehensive treatment plan and knowing when to refer a case.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Author Contributions

Conceptualization: Parolia A, Patel S;
Data curation: See ZW, Lee MS, Gunjal S;
Formal analysis: See ZW, Lee MS, Gunjal S;
Methodology: Parolia A, Patel S; Project administration: Parolia A, See ZW, Lee MS;
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Various guides for treatment planning have been published, but they have often been considered either too time-consuming or complex to be of practical benefit, resulting in a poor uptake among clinicians. Similarly, multiple treatment planning tools have been in use; however, they have been limited to single aspects of dental treatment instead of providing the holistic approach necessary for comprehensive treatment planning [3-6].

The Tooth Restorability Index (TRI) quantifies the volume of the remaining dentin and its position as a numerical score to determine the restorability of a tooth [7]. However, this index only focuses on the restorability of a tooth and does not include any other aspect, such as the patient's oral health.

The American Association of Endodontists Endodontic Case Difficulty Assessment takes 17 aspects of endodontic treatment-related factors into consideration and assesses the difficulty of each aspect. It includes patient factors, such as medical history, as well as treatment considerations, such as tooth position and radiographic findings [6]. However, due to its complexity and time-consuming nature, the guide is used by fewer than 10% of American general dental practitioners [3].

The Restorability Dentistry Index of Treatment Need is an index that identifies dental restorative treatment needs and then ranks them by complexity. The complexity of each need is scored as low, moderate, or high. A modifying factor specific to each component can be applied. However, due to the lack of reproducibility of the root canal treatment assessment component, the uptake of this index is low [8,9].

Dawood and Patel [10] introduced the Dental Practicality Index (DPI), which aims to provide clinicians with a TRI that takes into account the structural integrity, periodontal status, endodontic status and weighs these factors in relation to the status of the tooth within the dentition as a whole, as well as any relevant medical or dental history and the patient's unique dental needs (Table 1). The score of each aspect is then added to give the DPI score. According to the DPI, a score of 0 refers to no treatment, a score of 1 refers to simple treatment is required, and a score of 2 suggests that treatment is more complex, perhaps requiring treatment delivered by individuals with enhanced skills, training, and experience. A score of 6 in any category denotes that the tooth is considered untreatable. The

Table 1. Explanation of the Dental Practicality Index (Dawood and Patel [10])

| Weighting | Tooth structure integrity | Periodontal treatment need | Endodontic treatment need | Context |
|------------------------------|---|--|--|--|
| 0 No treatment required | Unrestored Existing restoration is acceptable | Probing < 3.5 mm (BPE 0-2) Periodontal disease treated | Vital pulp Existing RCT is acceptable | Local: Adjacent teeth are healthy General: History of intravenous bisphosphonates, head & neck radiotherapy |
| 1 Simple treatment required | Simple direct or indirect restoration Suitable for GDP | Probing 3.5-5.5 mm (BPE 3) | Simple RCT | Local: Will this tooth be a bridge abutment? |
| 2 Complex treatment required | Minimal sound tooth, subgingival margins, post-core | RSD suitable for hygienist or GDP | Canal(s) visible, straight | General: Planned radiotherapy of head & neck region immunocompromised patient |
| 6 Impractical to treat | Inadequate structure for ferrule | Probing > 5.5 mm (BPE 4), short root, crown lengthening, grade 2 mobility, grade 2-3 furcation involvement | Untreatable root canal system | Local: Prosthodontic treatment planned of multiple teeth General: High caries rate, Poor oral hygiene, Parafunctional habits, Extensive tooth surface loss, Active periodontal disease Local: Keeping the tooth would compromise a simple plan e.g., 1 remaining over-erupted tooth affecting denture construction General: Potentially life-threatening medical conditions where the objective of dental treatment is pain relief only |

GDP, general dental practitioner; BPE, Basic Periodontal Examination; RSD, root surface debridement; RCT, root canal treatment.

DPI is applicable to everyday clinical practice as it encourages clinicians to plan treatment methodically and holistically. It also helps to improve confidence in assessing which treatments are within the clinician's competency and when additional training or referral to another clinician may be required to complete the treatment.

The effectiveness of the DPI in predicting the outcome of root canal retreatment and restoration of root-filled teeth has been reported in clinical studies [11-13]. The lack of a systematic protocol could lead to incorrect clinical decision-making. The DPI provides a methodical approach by assessing factors pertaining to restorability, endodontics, periodontics, and patients' unique needs [14].

A multi-center study involving undergraduate and postgraduate students demonstrated that training with the DPI improved the consistency of treatment planning involving a variety of restorative dental problems, when compared to the decisions made by a consensus panel of experienced dental clinical educators. The study methodology utilized a test-retest method and a confidence questionnaire, using a 10-point Likert scale [15].

Over the past 2 decades, there has been an exponential growth in the demand for online-based teaching and learning, and this trend has been exacerbated by the COVID-19 pandemic [16]. There has also been a shift in the delivery of education towards a blended approach of traditional and online-based teaching and learning [17].

Therefore, the current study was conducted to evaluate the effect of DPI training using an online video on the treatment planning decisions and confidence level of DUs.

MATERIALS AND METHODS

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval (BDS I-01/2021[18]) was obtained from the University Joint Committee on Research and Ethics at the International Medical University, Malaysia to conduct this prospective interventional study, which utilized test-retest reliability and a confidence questionnaire. Convenience sampling was chosen to ensure accessibility to the entire population. Therefore, 94 year 4 and year 5 DUs were invited to voluntarily participate in this study. All participants were given a study information leaflet and consent form outlining the purpose of the study and their voluntary involvement. They were briefed about the privacy and confidentiality of their data in this study and informed that they could withdraw at any time.

The consensus panel

The consensus panel consisted of 3 panel members who had a minimum of 10 years of experience in both undergraduate and postgraduate teaching. All members of the consensus panel had undergone training on assessing these clinical cases using DPI. The pilot study was carried out using 10 sample clinical cases. All observations were performed by the examiners independently, and the best treatment plan for each case scenario was assigned out of the 4 options given based on the DPI (no treatment needed, simple treatment needed, complex treatment needed, leave/extract the tooth). Inter-observer reliability testing was carried out using Cohen's kappa test. A final consensus was reached when the inter-rater agreement kappa value was found to be within almost perfect agreement (> 0.80).

Preparation of training material

The training materials consisted of a pre-recorded online-based video using a storyline and PowerPoint (Microsoft Corp., Redmond, WA, USA) presentation slides with case-based discussion, which was supplementary to the online-based video. The PowerPoint presentation slides covered the introduction of DPI, how to use it, and its indications. The case-based discussion slides included a few case scenarios, with 4 treatment options given. All these cases had been assigned a treatment plan by the consensus panel and used during a discussion at the end of the DPI training.

The online-based video was created using Articulate Storyline 360 (Articulate Global, LLC, New York, NY, USA), and it lasted approximately 45 minutes. This storyline discussed the potential difficulties in assessing restorability and how DPI may be beneficial for treatment planning. All aspects of DPI—structural integrity, periodontal status, endodontic status, context, and its indications—were covered in the video. In Articulate Storyline 360, the virtual interaction was created as the DUs were able to click, hover over, or select any object in the storyline to trigger any action. It then responded to the DUs with dynamic, personalized content related to the DPI. A voiceover was given to the storyline to further explain the content of the online-based video, and 3 clinical case scenarios were added at the end of online DPI training for the DUs to practice. An access link to the interactive video is provided as follows: <https://360.articulate.com/review/content/0b1d8848-a7eb-4ccd-9b7e-2a18acfd2e80/review>.

DPI training

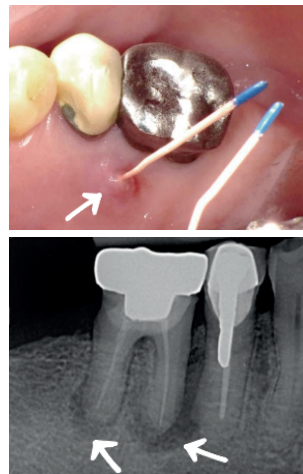
The DPI training was standardized. Examiners were trained and calibrated to carry out DPI training and to collect, insert, and interpret the data. In this research, all DUs participated online. To assess their baseline knowledge, they were shown 15 clinical case scenarios (pre-DPI training test, which is the control) and instructed to decide on appropriate treatment plans based on 4 treatment options: no treatment needed, simple treatment needed, complex treatment needed, leave/extract the teeth (**Figure 1**). The most appropriate treatment plan for these clinical case scenarios had been decided by the consensus panel, similar to a previous study [14]. They then underwent DPI training by using the online-based interactive video and PowerPoint presentation slides. After that, DUs were shown the same clinical case scenarios and asked to assign one of the 4 treatment plan options according to the DPI (post-DPI training test). The pre-DPI training test, DPI training, and post-DPI training test were held on the same day. For all tests, the 15 case scenarios were shown on Microsoft Teams (Microsoft 365, Microsoft Corp.). The DUs were requested to choose the appropriate treatment option and answer through Microsoft Form (Microsoft 365, Microsoft Corp.). One minute was given for reading and answering each case scenario to avoid any discussion among students.

After 6 weeks, the DUs were retested to assess their knowledge retention (retention test). They were required to retake the test by using the same set of case scenarios in a different sequence to avoid any memory-based bias. In all 3 tests, DUs completed the 10-point Likert confidence level scale questionnaire based on Academic Behavioral Confidence (ABC) scale using Microsoft Forms.

Data collection

Data was collected via Microsoft Forms and transferred to a spreadsheet in Microsoft Excel (Microsoft Corp.) database. SPSS version 26.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. The Kolmogorov-Smirnov test was used to check the normality of the data,

Case 1

**63 years old male**

Chief concern: Gum swelling on lower right back tooth region.

HOP: On and off swelling for past 2 months. No pain. RCT done 10 years ago.

Medical history: Healthy

Investigation: #46 showed negative response in pulp sensibility test. Sinus tracing revealed #46 as origin.

Clinical findings: #46- Full metal crown and GIC restoration with irregular margin at buccal side. Periodontally sound.

Radiographic findings: #46- Unsatisfactory root canal filling with peri-radicular radiolucency.

| Treatment option | Explanation |
|-----------------------------|---|
| A: No treatment needed | No treatment or review condition |
| B: Simple treatment needed | Simple treatment (General dental practitioner level) |
| C: Complex treatment needed | Complex treatment (Clinicians have to recognise the complexities of treatment. Additional training/referral to secondary or tertiary care might be needed if beyond competency) |
| D: Leave/extract the teeth | Impractical to treat (Leave or extract) |

Figure 1. A clinical case scenario used in the tests, with 4 treatment options assigned. RCT, root canal treatment.

and the p value was found to be < 0.05 . One score was given for each clinical scenario if the response from DUs coincided with the consensus panel answer. The total treatment planning scores of each dental undergraduate in all 3 tests were recorded. To assess the responses of DUs and the consensus report, frequencies were used. The related-samples Wilcoxon signed-rank test was used to compare the mean difference in treatment planning scores of the study participants' pre-DPI training test, post-DPI training test, and retention test. The independent-samples Mann-Whitney U test was used to compare the treatment planning scores between both cohorts (year 4 and year 5 DUs) before DPI training; and after DPI training. The Spearman ranked correlation test was used to evaluate the correlation between test scores and the self-reported confidence level. The level of significance was set at $p < 0.05$.

RESULTS

After checking individuals' eligibility, a total of 94 DUs participated in the study (included in the study, completed follow-up, and analyzed) (**Figure 2**). From that, there were 53 (56.4%) and 41 (43.6%) participants from the year 4 and year 5 cohorts, respectively. The study participants consisted of 24 (25.6%) men and 70 (74.4%) women, with an age range of 22–28 years.

DUs' responses

Overall, the total mean treatment planning scores increased from the pre-DPI training test (control) (7.53) to the post-DPI training test (9.01) and the difference was found to

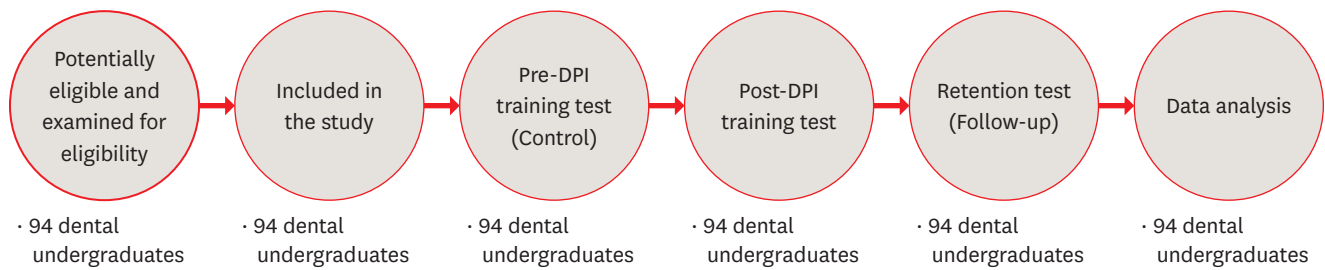


Figure 2. Number of dental undergraduates who participated in each stage of the study. DPI, Dental Practicality Index.

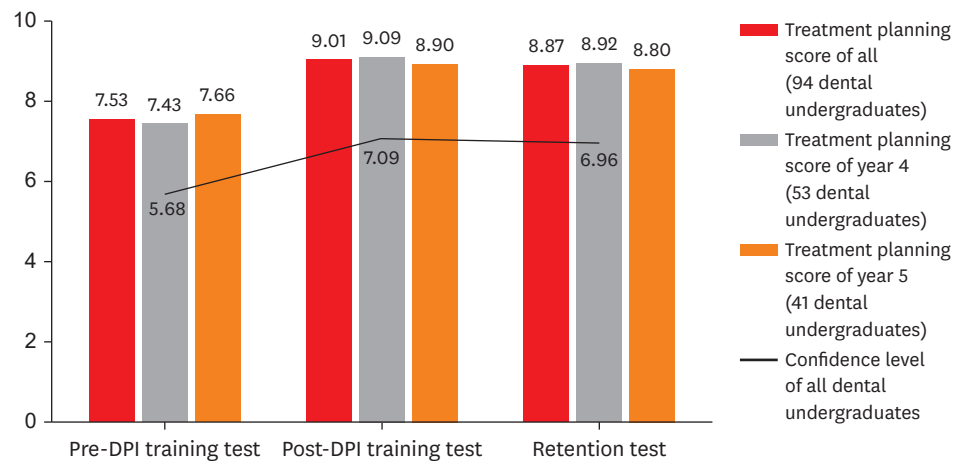


Figure 3. Mean treatment planning scores of year 4 and year 5 dental undergraduates and self-reported confidence level for all dental undergraduates. DPI, Dental Practicality Index.

be statistically significant ($p < 0.001$). After 6 weeks, the mean treatment planning scores decreased marginally from the post-DPI training test score of 9.01 to the retention test score of 8.87, and the difference was found to be statistically not significant ($p = 0.563$) (Figure 3).

The mean treatment planning scores for the year 4 and year 5 DUs in the pre-DPI training test (control) were found to be 7.43 and 7.66, respectively. Following the DPI training, the treatment planning scores increased to 9.09 and 8.90 for year 4 and year 5, respectively. There was a statistically significant difference between the mean pre-DPI training test (control) and the post-DPI training test scores for the year 4 ($p = 0.001$) and year 5 ($p = 0.004$) cohorts. For the retention test after 6 weeks, both cohorts scored slightly lower than the post-DPI training test, with the scores of 8.92 and 8.80 for the year 4 and year 5 DUs, respectively (Figure 3), showing statistically no significant difference for both cohorts (year 4: $p = 0.631$; year 5: $p = 0.709$).

The independent-samples Mann-Whitney U test showed no statistically significant differences between the cohorts in any of the 3 tests (pre-DPI training test: $p = 0.528$; post-DPI training test: $p = 0.580$; and retention test: $p = 0.930$).

Dental undergraduates' self-reported confidence levels

The 94 DUs mean self-reported confidence levels in making treatment planning decisions in the pre-DPI training test (control) was 5.68, and it increased to 7.09 after the DPI training. Meanwhile, for the retention test, the mean self-reported confidence level of the DUs reduced to 6.96 out of a maximum confidence score of 10 on the Likert scale (Figure 3).

The Spearman ranked correlation test showed no significant correlation between DUs' self-reported confidence levels and their scores on either the pre-DPI training ($p = 0.446$) or post-DPI training tests ($p = 0.571$).

Comparison of dental undergraduates' responses

A comparison of 94 DUs' answers in the pre-DPI training (control), post-DPI training, and retention tests to the consensus panel answers is given in **Tables 2-4**.

In the pre-DPI training test (control), most DUs agreed with the consensus panel in 8 out of the 15 clinical scenarios. The percentage of agreement varied from 16.0% to 91.5% (**Table 2**). After DPI training, the results improved, as the majority of DUs agreed with the consensus panel in 10 out of the 15 clinical scenarios in both the post-DPI training test and the retention test. The percentage of agreement varied from 30.9% to 86.2% in the post-DPI training test (**Table 3**), while it varied from 28.7% to 90.4% in the retention test (**Table 4**).

There was a high degree of intra-rater reliability, with a range of 29.8% to 75.5% (mean 49.3%) of the DUs giving the same answer to a clinical scenario in the pre-DPI training test

Table 2. Comparison of responses from the consensus panel with responses from DUs in the pre-Dental Practicality Index (DPI) training test

| Ninety four DUs' answers in pre-DPI training test (control) | | | | | | |
|---|-------------------|--------------|------------------|-------------------|---------------|-------------|
| No. | Expected answer | No treatment | Simple treatment | Complex treatment | Leave/extract | % Agreement |
| 1 | Simple treatment | 0 | 78 | 15 | 1 | 83.0 |
| 2 | Leave/extract | 0 | 7 | 28 | 59 | 62.8 |
| 3 | Complex treatment | 3 | 22 | 60 | 9 | 63.8 |
| 4 | Simple treatment | 3 | 15 | 62 | 14 | 16.0 |
| 5 | Complex treatment | 0 | 13 | 65 | 16 | 69.1 |
| 6 | Leave/extract | 1 | 4 | 35 | 54 | 57.4 |
| 7 | Complex treatment | 2 | 46 | 44 | 2 | 46.8 |
| 8 | Leave/extract | 6 | 18 | 53 | 17 | 18.1 |
| 9 | No treatment | 38 | 18 | 28 | 10 | 40.4 |
| 10 | Complex treatment | 13 | 7 | 36 | 38 | 38.3 |
| 11 | Simple treatment | 13 | 52 | 17 | 12 | 55.3 |
| 12 | Leave/extract | 1 | 27 | 51 | 15 | 16.0 |
| 13 | Leave/extract | 5 | 21 | 39 | 29 | 30.9 |
| 14 | Complex treatment | 0 | 16 | 70 | 8 | 91.5 |
| 15 | Simple treatment | 11 | 75 | 6 | 2 | 79.8 |

DU, dental undergraduate.

Table 3. Comparison of responses from the consensus panel with responses from DUs in the post-Dental Practicality Index (DPI) training test

| Ninety four DUs' answers in post-DPI training test | | | | | | |
|--|-------------------|--------------|------------------|-------------------|---------------|-------------|
| No. | Expected answer | No treatment | Simple treatment | Complex treatment | Leave/extract | % Agreement |
| 1 | Simple treatment | 2 | 81 | 10 | 1 | 86.2 |
| 2 | Leave/extract | 0 | 0 | 19 | 75 | 79.8 |
| 3 | Complex treatment | 1 | 15 | 70 | 8 | 74.5 |
| 4 | Simple treatment | 1 | 29 | 55 | 9 | 30.9 |
| 5 | Complex treatment | 0 | 8 | 72 | 14 | 76.6 |
| 6 | Leave/extract | 0 | 2 | 27 | 65 | 69.1 |
| 7 | Complex treatment | 1 | 25 | 62 | 6 | 66.0 |
| 8 | Leave/extract | 3 | 8 | 36 | 47 | 50.0 |
| 9 | No treatment | 35 | 13 | 38 | 8 | 37.2 |
| 10 | Complex treatment | 7 | 2 | 40 | 45 | 42.6 |
| 11 | Simple treatment | 3 | 56 | 34 | 1 | 59.6 |
| 12 | Leave/extract | 0 | 7 | 56 | 31 | 33.0 |
| 13 | Leave/extract | 2 | 9 | 49 | 34 | 36.2 |
| 14 | Complex treatment | 2 | 16 | 69 | 7 | 73.4 |
| 15 | Simple treatment | 14 | 77 | 2 | 1 | 81.9 |

DU, dental undergraduate.

Table 4. Comparison of responses from the consensus panel with responses from DUs in the retention test

| No. | Expected answer | Ninety four DUs' answers in the retention test | | | | % Agreement |
|-----|-------------------|--|------------------|-------------------|---------------|-------------|
| | | No treatment | Simple treatment | Complex treatment | Leave/extract | |
| 1 | Simple treatment | 3 | 76 | 13 | 2 | 80.9 |
| 2 | Leave/extract | 0 | 5 | 15 | 74 | 78.7 |
| 3 | Complex treatment | 2 | 12 | 74 | 6 | 78.7 |
| 4 | Simple treatment | 4 | 27 | 52 | 11 | 28.7 |
| 5 | Complex treatment | 0 | 6 | 71 | 17 | 75.5 |
| 6 | Leave/extract | 3 | 2 | 24 | 65 | 69.1 |
| 7 | Complex treatment | 1 | 25 | 63 | 5 | 67.0 |
| 8 | Leave/extract | 1 | 7 | 38 | 48 | 51.1 |
| 9 | No treatment | 28 | 14 | 39 | 13 | 29.8 |
| 10 | Complex treatment | 4 | 6 | 42 | 42 | 44.7 |
| 11 | Simple treatment | 6 | 47 | 31 | 10 | 50.0 |
| 12 | Leave/extract | 1 | 11 | 53 | 29 | 30.9 |
| 13 | Leave/extract | 1 | 21 | 33 | 39 | 41.5 |
| 14 | Complex treatment | 1 | 12 | 67 | 14 | 71.3 |
| 15 | Simple treatment | 6 | 85 | 3 | 0 | 90.4 |

DU, dental undergraduate.

Table 5. Summary of intra-rater reliability and how DUs changed their answers following Dental Practicality Index (DPI) training

| Cases | DUs agreed with the consensus panel in the pre- and post-DPI training tests | Changed answer to agree with the consensus panel after DPI training | Intra-rater reliability | DUs maintained the answer to agree with the consensus panel in post-DPI training test and retention test |
|-------|---|---|-------------------------|--|
| 1 | 69/94 | 12/94 | 71/94 | 66/94 |
| 2 | 48/94 | 27/94 | 55/94 | 60/94 |
| 3 | 46/94 | 24/94 | 51/94 | 56/94 |
| 4 | 6/94 | 23/94 | 44/94 | 12/94 |
| 5 | 51/94 | 21/94 | 54/94 | 55/94 |
| 6 | 40/94 | 25/94 | 51/94 | 46/94 |
| 7 | 29/94 | 33/94 | 41/94 | 41/94 |
| 8 | 8/94 | 39/94 | 31/94 | 28/94 |
| 9 | 13/94 | 22/94 | 28/94 | 13/94 |
| 10 | 16/94 | 24/94 | 39/94 | 20/94 |
| 11 | 32/94 | 33/94 | 39/94 | 30/94 |
| 12 | 5/94 | 26/94 | 36/94 | 13/94 |
| 13 | 12/94 | 22/94 | 35/94 | 18/94 |
| 14 | 49/94 | 20/94 | 52/94 | 53/94 |
| 15 | 65/94 | 12/94 | 70/94 | 68/94 |

DU, dental undergraduate.

(control) and post-DPI training test. Following DPI training, 12.8% to 41.5% (mean 25.7%) of the DUs changed their answers to agree with the consensus answer in the post-DPI training test. There were 12.8% to 72.3% (mean 41.0%) of them who maintained the answers that agreed with the consensus panel in the retention test when compared to the post-DPI training test (**Table 5**).

DISCUSSION

Clinical decision-making is an essential aspect of treatment planning for dentists; however, this can be challenging without the use of a systematic framework. A dentist's training, competency, and confidence are the main factors that impact decision-making. Studies have reported considerable inter-clinician variability in decision-making for managing endodontic conditions based on postgraduate training [18,19]. The secondary factors are patient preferences, environmental factors, and resource-related factors such as equipment and material availability. Considerable bias arises from many sources of uncertainty, including the limitations of human memory and judgment [20].

The current study observed a significant improvement in the treatment planning decision-making of DUs following training on DPI, achieving a greater level of agreement with the consensus panel. In this study, 2 different cohorts of DUs were chosen to minimize the sampling bias. The knowledge of DUs was taken into account by conducting a baseline test that served as the control in the research and measuring the change in scores for each dental undergraduate following DPI training. The internal validity was improved by managing confounding variables, such as by restricting the time to answer each question in test to prevent DUs from discussing and influencing each other. The pre-DPI training test and post-DPI training test were conducted on the same day, which ensured 100% participation throughout the study. We discussed administering the pre-DPI training test and post-DPI training test on 2 different days, to allow more time for the DUs to become familiar with utilizing the DPI; however, it would have been very difficult to ensure that the other teaching and learning activities would not affect the accuracy of the results and further compromise the outcome of the research. Therefore, to reduce this risk, pre-DPI training test and post-DPI training test of the study were conducted on the same day.

Retention of knowledge from the DPI training was assessed with a retention test 6 weeks after the post-DPI training test. Previous research has suggested that the rate of knowledge retention could decrease substantially after the post-test and even be equivalent to the pre-test after approximately 2 months (55 days) [21]. Taking the research findings into consideration, we chose 6 weeks as the time frame for conducting the retention test.

The use of a consensus panel to define a level of agreement on a subject has been reported [22]. Correctly employed consensus strategies can provide a more justified and credible solution to a problem than other methods. However, the reliability and validity of the consensus rely on appropriately selecting the panel members, deciding on acceptable levels of agreement, obtaining professional support, and disseminating results. The panel members were chosen for their wealth of experience in teaching and treating patients in specialist restorative practice, and there was high internal agreement between the panel members.

The study found high levels of agreement between the DUs' treatment plan answers and the consensus panel treatment plan answers. There was a significant difference between pre-DPI training test (control) and post-DPI training test ($p < 0.001$), suggesting that the DUs' treatment planning decision skills improved after the DPI training. Moreover, there was no significant difference between the post-DPI training test and the retention test ($p = 0.563$), suggesting that the DUs retained their knowledge even after 6 weeks. This study demonstrated that the DPI was able to aid DUs in assessing the clinical scenarios through a systematic and holistic approach. However, even with the DPI training, some variations in treatment planning decisions were still present, especially if there were additional challenges in the clinical scenario. Variations in clinicians' treatment planning decisions have been attributed to the ambiguity of the clinical data, variations in their interpretation, the presence of local factors as well as systemic diseases, and the possible complications of dental treatment [20].

When comparing the effect of DPI training on the treatment planning decisions made by both year 4 and year 5 DUs, both cohorts showed improvement from pre- to post-DPI training ($p < 0.05$) with no significant difference ($p = 0.05$) in between year 4 and year 5 DUs. This could be due to the highly similar clinical exposure and ability to make treatment planning decisions.

Participants' confidence levels increased significantly ($p < 0.05$) following DPI training, and this increase was maintained during the retention test 6 weeks after the DPI training. The confidence level was assessed by using a self-reported confidence level scale questionnaire based on the ABC scale, which was first published as the Academic Confidence Scale. It is a psychometric means of assessing the confidence that undergraduate students have in their own anticipated study behaviors in relation to their degree program. The ABC scale can provide a general measure of a student's confidence in undertaking their academic course. It has been shown to be valid and can be useful to teachers in understanding their students, enabling the design of more effective teaching sessions [23].

In our research, a 10-point Likert scale was chosen, as it offers more variance and a higher degree of measurement precision than a 5- or 7-point scale. A 10-point scale is favored as it provides a better opportunity to detect small changes and greater strength for the DUs to explain their point of view. It also helps to minimize leniency and the central tendency bias [24]. The study found no significant correlation between the DUs' self-reported confidence and the treatment planning scores in the pre-DPI training test and post-DPI training test. The results of the current study are in agreement with a previous study and a systematic review on self-reported levels of competence in medical doctors [15,25]. The systematic review concluded that clinicians have a limited ability to accurately self-report their level of competency. The ability of self-evaluation is specific to each individual and other influencing factors including their beliefs and values. It is crucial for a clinician to be confident in performing procedures with clinical uncertainty. Meanwhile, their confidence level should never be so high that they ignore the potential risk and harm that may be associated with the procedure and do not evaluate their own competency. Therefore, a clinician should be able to temper confidence with a knowledge of their personal limitations and weaknesses and have the ability to self-evaluate their own competence. This is the best way to help clinicians analyze their work practices and to promote reflection on performance [26].

Online-based teaching and learning are becoming a necessity for education around the world. The advantages of online-based teaching and learning include the ability to learn across nations, the availability of more opportunities for learning, and improved accessibility and flexibility for students to seek education [17]. However, online-based teaching and learning come with limitations, such as the need for students' self-discipline and motivation for learning and limited interaction or discussion between educators and students. Even with these limitations, the benefits of online-based teaching and learning outweigh the drawbacks [16]. According to the results of our study, the DUs' treatment planning decisions and their confidence levels both improved, highlighting the success of online-based teaching and learning, which concurred with a previous study [16].

Decision-making is undoubtedly one of the most important skills in the healthcare profession. Overtreatment may involve a more invasive procedure, whereas undertreatment may lead to incomplete resolution of the disease. Therefore, dentists are required to master the skill of treatment planning to avoid overtreatment and undertreatment. There are several methods to prevent overtreatment and undertreatment, such as by reflecting upon and discussing complicated cases to highlight issues in treatment planning that may not have been initially apparent and aid the clinician in providing practical and predictable treatment [27]. Other than that, a structural framework such as decision aids can provide guidance in treatment planning. Decision aids decrease decisional conflict related to feeling uninformed, leading to a positive effect on patient-clinician communication. Decision aids

also allow dentists to play a more active role in decision-making and have more accurate risk perceptions [27].

The DPI serves as a decision guide that provides a structured format to allow dentists to assess the inter-related factors that should be taken into consideration during the dental treatment planning process, which includes a patient's medical condition during the assessment of a case, therefore providing holistic patient-centered care. The index can also assist dentists in the decision-making process, rather than providing rigid guidelines that would be overly restrictive. The index improves dentist-patient communication, as the treatment plan can be discussed with the patient before treatment begins, and it enables better prediction and prognosis in order to manage the patient's expectations for each and every unique case.

Although the current results displayed a promising outcome regarding the positive effects of DPI training using an online video on treatment planning skills and confidence level, a larger sample size would be preferred to ensure a better representation of the population.

CONCLUSION

DPI training using an online-based video improved the treatment planning skills and confidence levels of DUs in the decision-making process. Further large-scale multi-center studies will be needed to strengthen the validity of the results.

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