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# Perceptions of Team-Based Learning among Periodontic and Endodontic postgraduate residents

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## Abstract

**Introduction:** Team-Based Learning (TBL), grounded in constructivist learning theory, promotes active engagement among learners. This study aimed to explore postgraduate residents' perceptions and attitudes toward learning about periodontal-endodontic lesions using TBL as an educational method.

**Methods:** A total of 8 Periodontic residents and 11 Endodontic residents received pre-reading articles related to periodontal-endodontic lesions. On the day of the workshop, they were divided into four mixed-specialty groups. They completed individual and group readiness assurance tests, followed by facilitated discussions on three simulated clinical cases. Feedback was collected through an online anonymous survey that included 32 Team-Based Learning Student Assessment Instrument (TBL-SAI) items, eight on programme content, four on skills contributions, seven on faculty, and four on learning outcomes, all scored on a 5-point Likert scale (1-strongly disagree to 5-strongly agree) and analysed with descriptive and Cronbach's alpha analysis.

**Results:** Fifteen of 19 residents attended the workshop. TBL-SAI scores (max 40) reflected strong accountability, with overall mean scores around 29 across both Periodontic and Endodontic residents. Learning preference scores (max 80) averaged approximately 50, and student satisfaction scores (max 40) were similarly positive, averaging just under 30. Programme content, learning outcomes, and faculty performance received high ratings, with mean scores above 4 out of 5. Internal consistency was strong across all subscales (Cronbach's alpha: 0.69–0.99). Qualitative feedback highlighted the value of clinical case applications in enhancing engagement and understanding.

**Conclusion:** Residents reported positive perceptions of Team-Based Learning, noting high engagement, accountability, and satisfaction. The findings support its effectiveness as a valuable instructional approach in postgraduate dental education.

**Keywords:** Dental Education, Endodontics, Periodontics, Residency, Team-Based Learning

## I. INTRODUCTION

Team-Based Learning (TBL) is an instructional strategy that promotes active, collaborative learning and encourages students to take responsibility for their education by engaging deeply with content, peers, and instructors. The TBL process includes three core phases: pre-reading, readiness assurance (individual and group), and application. The application phase uses the 4S framework—significant problem, same problem, specific choice, and simultaneous reporting—to drive critical discussion, often resembling a faculty-facilitated

debate. TBL has demonstrated positive results in pre-clinical dental education, with improved diagnostic skills and examination scores (Pileggi & O'Neill, 2008). However, most available research focuses on undergraduate learners. There is a lack of data on how TBL impacts dental postgraduate students, who are typically mature, self-directed learners. The aim of this study was to address this gap by exploring residents' perceptions and attitudes toward learning complex, interdisciplinary topics—specifically periodontal-endodontic lesions—through the Team-Based Learning

(TBL) approach, given the diagnostic and treatment challenges these lesions often present in clinical practice.

## II. METHODS

### A. Study Design and Population

This descriptive study was exempted from formal Centralised Institutional Review Board review by SingHealth Institutional Review Board. The study included all 19 postgraduate residents from the National University of Singapore's three-year Master of Dental Surgery programme through convenient sampling—11 in Endodontics (four first-year, three second-year, four third-year) and eight in Periodontics (three first-year, three second-year, two third-year), and absentees of the workshop were excluded. No formal sample size calculation was conducted due to the small, fixed cohort size. Despite the small sample size ( $n=19$ ) limiting generalizability, this pilot study aimed to gain preliminary insights into residents' perceptions of Team-Based Learning for complex topics like periodontal-endodontic lesions.

### B. Team-Based Learning (TBL) Workshop

A 4.5-hour TBL workshop was conducted on 7<sup>th</sup> December 2022. Two weeks prior, participants received pre-reading materials, including 14 journal articles and a book chapter covering key aspects of periodontal-endodontic lesions, such as diagnosis, radiographic features, and the updated classification system (Herrera et al., 2018).

On the workshop day, participants completed a seven-question Individual Readiness Assurance Test (IRAT) to assess their foundational knowledge in diagnosis, investigation, and management. They were then divided into four teams to complete the same questions as a Team Readiness Assurance Test (TRAT), administered via Google Forms (<https://www.google.com/forms/about/>) and Fyrebox ([www.fyrebox.com](http://www.fyrebox.com)) facilitate efficient data collection and real-time feedback during the workshop. This was followed by three clinical case discussions designed using the 4S framework—significant problem, same problem, specific choice, and simultaneous reporting—to apply pre-reading concepts to clinical scenarios.

Verbal consent was obtained, and participants completed an anonymous online survey. Using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), they responded to 32 TBL-SAI items (TBL-SAI) (Mennenga, 2012), eight other questions on the course content, four on skills, seven on faculty, and four on learning outcomes. Participants also rated workshop components as 'Poor', 'Fair', 'Satisfactory', 'Very Good', or

'Excellent', and selected their favourite component. and answered two open-ended questions on the most useful aspects and suggestions for improvement. The TBL-SAI included three subscales: accountability ( $\geq 25$ ), learning preference ( $\geq 49$ ), and satisfaction ( $\geq 28$ ), with a total score  $>102$  indicating positive perception. Permission was obtained to adapt the instrument (Mennenga, 2012), excluding item 31 ("I think Team-Based Learning helped me to improve my grade") due to the non-graded nature of the workshop. Qualitative data was collected through open-ended questions on valuable workshop moments and suggestions for improvement, and were thematically reviewed to identify common reflections, without formal qualitative analysis. Data was collected anonymously and analysed using descriptive statistics. Cronbach's alpha assessed the instrument's reliability.

## III. RESULTS

### A. Study Population Demographics

Fifteen out of 19 participants attended the workshop, with two absentees from each of the Periodontics and Endodontics residency programmes. The 15 participants were divided into four teams, with balanced representation of year one, two, and three residents in each group. All participants (four males and 11 females, mean age  $28.3 \pm 2.326$ , range 25-34) responded to the post-workshop survey (100% response rate). The average IRAT score was  $67.6 \pm 12.6$ , and the TRAT score was  $80.4 \pm 6.8$  (Appendix 1). All data is deposited at Figshare at (<https://doi.org/10.6084/m9.figshare.28366964>).

### B. Workshop Ratings

Participants rated the workshop components highly. Pre-reading materials were rated 'very good' or 'excellent' by 73.3% (11/15), IRAT by 80% (12/15), TRAT by 93.3% (14/15), and clinical case application by 80% (12/15). Most (93.3%) chose the clinical case discussion as their favourite component.

### C. TBL-SAI Results

The cohort's mean TBL-SAI score was  $109 \pm 0.98$ , indicating a strong positive perception (Table 1, Appendix 2, Appendix 3 and Appendix 4).

#### 1. Accountability

Periodontic residents scored highest in year 3 ( $30.5 \pm 2.1$ ). Endodontic residents in year 1 ( $34.0 \pm 4.4$ ). Combined cohort mean was  $30.1 \pm 2.1$ . Cronbach's alpha was 0.83 (Periodontics) and 0.75 (Endodontics), indicating good internal consistency. Most residents (86.7%) prepared beforehand and contributed actively.

## 2. Preference for Lecture or TBL Subscale

Periodontic residents showed consistent preference (mean  $50.7 \pm 4.1$ ). Endodontic residents varied. Year three scored highest ( $53.3 \pm 6.1$ ). Combined mean:  $49.8 \pm 13.5$ . Cronbach's alpha was 0.69 (Periodontics) and 0.78 (Endodontics). Most (86.7%) reported better understanding and retention through TBL.

## 3. Student Satisfaction Subscale

Periodontics year three residents had a mean score of  $30.0 \pm 2.8$ , resulting in an overall mean of  $28.3 \pm 1.9$ , while Endodontics year three scored slightly lower at  $29.3 \pm 0.0$  resulting mean of  $29.6 \pm 9.5$  for the Endodontic residents. The overall cohort mean was  $29.1 \pm 1.9$ . Cronbach's alpha analysis showed 0.69 (Periodontics), 0.68 (Endodontics). Most (86.7%) found the workshop enjoyable and effective; 93.3% preferred learning in teams. Only one participant viewed TBL negatively.

## D. Programme Content

Programme content was rated highly for both Periodontic and Endodontic residents ( $4.3 \pm 0.5$ ;  $4.6 \pm 0.5$ , total mean  $4.6 \pm 0.5$ ). Cronbach's alpha was notably high at 0.94 for Periodontic residents and 0.98 for Endodontic residents, indicating excellent internal consistency. All agreed materials and objectives were appropriate.

## E. Programme Learning

Learning subscale scored slightly lower for both groups (Periodontics  $3.6 \pm 0.8$ , Endodontics  $4.0 \pm 1.0$ , total mean  $3.9 \pm 0.9$ ). The Cronbach's alpha values for the programme learning subscale were 0.95 for Periodontic residents and 0.99 for Endodontic residents. Majority of the participants (12/15, 80%) agreed they could apply the knowledge to their work respectively.

## F. Faculty

Both Periodontic and Endodontic residents scored highly for the faculty performance ( $4.5 \pm 0.5$ ;  $4.4 \pm 0.5$ , total mean  $4.4 \pm 0.5$ ). Cronbach's alpha values were 0.98 for Periodontic residents and 0.96 for Endodontic residents, all participants unanimously agreed faculty were engaging and communicated clearly.

## G. Qualitative Feedback

Majority (12/15, 80%) of the participants valued clinical cases and group discussion. One participant quoted "enjoyed the interactive sessions", while another praised the "use of TBL pedagogy for active learning". One participant said, "Case discussions, hearing from my

colleagues as well as supervisors on various treatment options". Suggestions included more time for discussion and aligning articles discussed with pre-reading.

## IV. DISCUSSION

This descriptive study explored postgraduate residents' perceptions of Team-Based Learning (TBL) in teaching the diagnosis and management of periodontal-endodontic lesions. The positive reception of TBL among residents may be attributed to its focus on clinical relevance, active participation, and peer collaboration.

Both Periodontic and Endodontic residents preferred TBL over traditional lectures (scores >49), consistent with previous studies (Takeuchi et al., 2015). Qualitative feedback emphasized the value of real-life case discussions and interactive sessions, supporting the idea that TBL fosters engagement and critical thinking aligned with adult learning principles. The format encouraged residents to take ownership of their learning while benefiting from team-based decision-making following constructivist learning theory, where exposure to differing viewpoints during discussion facilitates deeper understanding (Hrynchak & Batty, 2012).

Despite overall satisfaction, suggestions for longer discussion time and better alignment of pre-reading with session content indicate a need for improved facilitation and onboarding. Slightly lower preferences among Endodontic residents may reflect differences in prior exposure. High ratings for faculty support and the effectiveness of mixed-level resident teams further highlight the importance of guided facilitation and peer learning. Mixing junior and senior residents within teams promoted mentorship and dynamic learning, reflecting real-world clinical team structures. This structure leverages diverse academic levels to enhance small-group learning outcomes. These findings support TBL as a relevant and effective approach in dental residency education, promoting clinical reasoning, interdisciplinary learning, and professional development.

The 32-item TBL-SAI and 22-item programme surveys may have contributed to survey fatigue and response bias; shortening these in future studies could enhance data quality. Although the study lacked a control group and relied on self-reported data from a small cohort, bias was minimized by assuring participants that responses would not affect exam results. Peer evaluation was excluded due to the single-session format.

| Items   | Periodontic Residents | Endodontic Residents | Whole Cohort |
|---|-----------------------|----------------------|--------------|
| Accountability<br>(Max: 40, mean± s.d.)               | 28.3 ± 2.8            | 31.3 ± 3.1           | 30.1 ± 2.1   |
| Cronbach's alpha                                      | 0.83                  | 0.75                 | 0.81         |
| Preference for Lecture / TBL<br>(Max: 80, mean± s.d.) | 50.7 ± 4.1            | 49.2±6.2             | 49.8 ± 13.5  |
| Cronbach's alpha                                      | 0.69                  | 0.78                 | 0.74         |
| Student Satisfaction<br>(Max: 40, mean± s.d.)         | 28.3 ± 1.9            | 29.3 ± 0.0           | 29.1 ± 1.9   |
| Cronbach's alpha                                      | 0.69                  | 0.68                 | 0.66         |
| Programme Content<br>(Max: 5, mean± s.d.)             | 4.3 ± 0.5             | 4.6 ± 0.5            | 4.6 ± 0.5    |
| Cronbach's alpha                                      | 0.94                  | 0.98                 | 0.96         |
| Programme Learning<br>(Max: 5, mean± s.d.)            | 3.6 ± 0.8             | 4.0 ± 1.0            | 3.9 ± 0.9    |
| Cronbach's alpha                                      | 0.95                  | 0.99                 | 0.98         |
| Faculty<br>(Max: 5, mean± s.d.)                       | 4.5 ± 0.5             | 4.4 ± 0.5            | 4.4 ± 0.5    |
| Cronbach's alpha                                      | 0.98                  | 0.96                 | 0.97         |

Table 1. Learners' feedback and Cronbach's alpha scores based on Team-Based Learning student assessment instrument, programme content, programme learning and faculty

Future research could incorporate independent faculty follow-up to assess residents' clinical performance in diagnosing and managing periodontal-endodontic lesions (Kirkpatrick Level 3). Despite its limitations, this study suggested that TBL can be an effective approach for teaching interdisciplinary topics in dentistry. It fostered active engagement, deepened learning, and reinforcing the power of structured peer-supported learning in postgraduate education.

## V. CONCLUSION

Residents reported positive perceptions of Team-Based Learning (TBL), with high scores for accountability, engagement, and satisfaction. Consistent quantitative outcomes and corroborating qualitative feedback reinforce its effectiveness. Real-life cases enhanced clinical relevance and critical thinking, while TBL's collaborative format promoted interdisciplinary learning—ultimately strengthening clinical preparedness and teamwork among dental residents.

### Notes on Contributors

Dr Lean Heong Foo is a Consultant Periodontist in Department of Restorative Dentistry, National Dental Centre Singapore. LHF reviewed the literature, contributed to the study conception, data acquisition, data analysis, drafted and critically revised the manuscript.

Dr Pei Yuan Chan is a Senior Consultant Endodontist in Department of Restorative Dentistry, National Dental Centre Singapore and Associate Director, Master of Dental Surgery Endodontic Residency programme. PYC contributed to the study conception, data acquisition, and critically revised the manuscript.

Dr Jeen Nee Lui is a Senior Consultant Endodontist in National Dental Centre Singapore. JNL contributed to the data acquisition and critically revised the manuscript.

Dr Marianne Meng Ann Ong is a Senior Consultant Periodontist in National Dental Centre Singapore Associate Director, Master of Dental Surgery Periodontics Residency programme. MO contributed to the data acquisition and critically revised the manuscript.

All authors gave their final approval and agreed to be accountable for all aspects of the work.

### Ethical Approval

This study was exempted from formal Centralised Institutional Board review by SingHealth Institutional

Review Board (CIRB Ref: 2024-4153).

### Data Availability

Data is deposited at Figshare repository (<https://doi.org/10.6084/m9.figshare.28366964>).

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### Declaration of Interest

The authors declare no conflict of interest.

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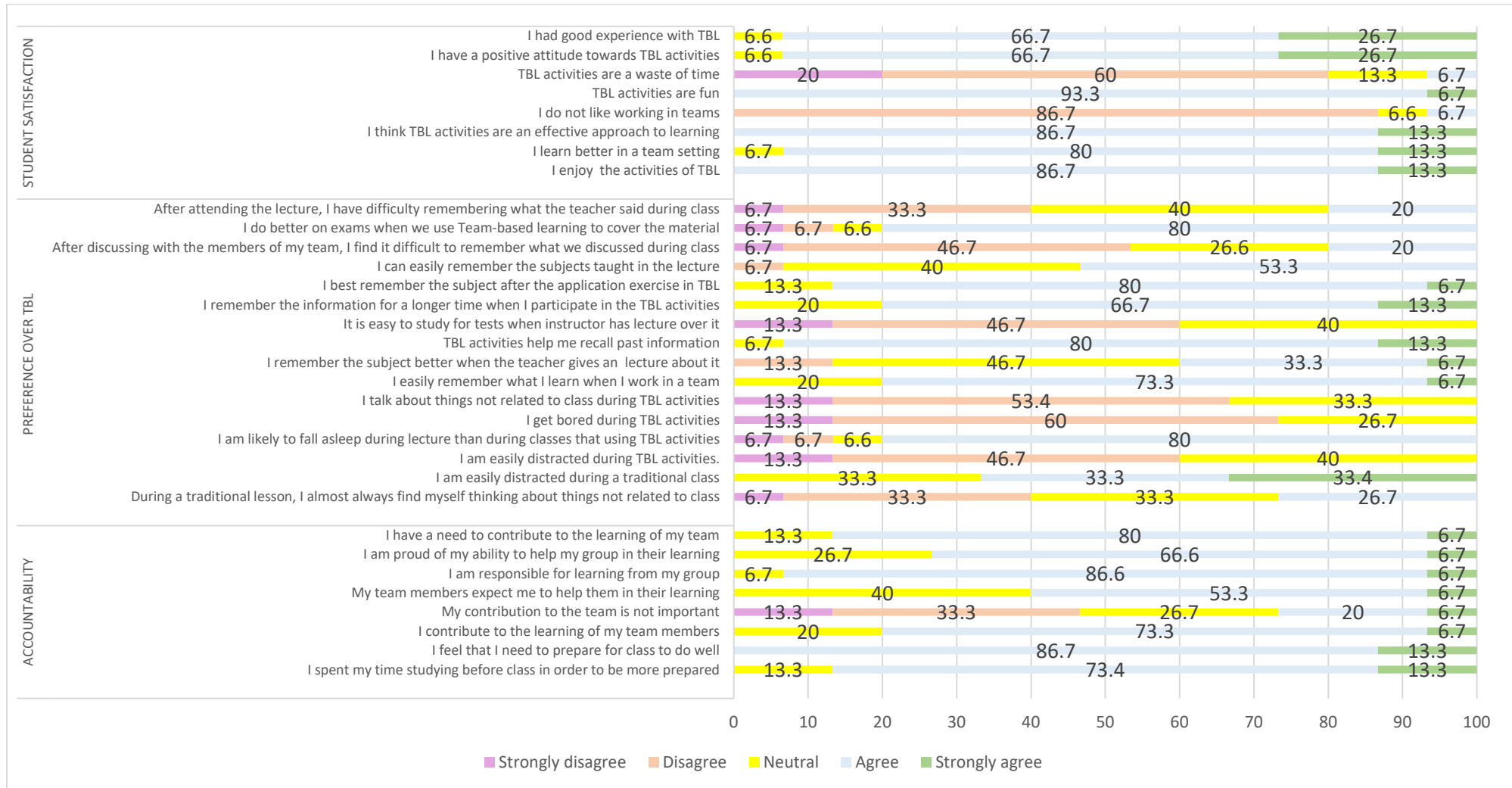
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## Appendix 1. Participants' demographic data

| <b>Participants' Demographic</b> | <b>No (%)</b> | <b>Periodontic Residents (Year 1, 2, 3)</b> | <b>Endodontic Residents (Year 1, 2, 3)</b> |
|----------------------------------|---------------|---|--|
| Gender                           |               |   |  |
| Female                           | 11(73.3)      | 6 (2,2,2)                                   | 5 (2, 1, 2)                                |
| Male                             | 4 (26.7)      |   | 4 (1, 2, 1)                                |
| Age (year)                       |               |   |  |
| 25-30                            | 12(80.0)      | 5 (2,2,1)                                   | 6 (2, 2, 2)                                |
| 31-34                            | 3 (20.0)      | 1 (0,0,1)                                   | 2 (0, 1, 1)                                |
| IRAT score                       | 67.6±10.1     | 66.6 (71.4, 71.4,57.1)                      | 68.2 (71.4, 66.6, 66.6)                    |

Appendix 2. Team-Based Learning Student Assessment Instruments for the Learners (% Of Learners)



Appendix 3. Learners' Feedback On Programme Content, Programme Learning and Faculty Subscale (% Of Learners)



Appendix 4. Detailed Learners' Feedback and Cronbach Alpha Score Based on Team-Based Learning Student Assessment Instrument, Programme Content, Programme Learning and Faculty

| Items  | Periodontics Residents |            |            |            | Endodontic Residents |            |            |            | Whole       |
|--|------------------------|------------|------------|------------|----------------------|------------|------------|------------|-------------|
|  | Year 1                 | Year 2     | Year 3     | Total      | Year 1               | Year 2     | Year 3     | Total      | Cohort      |
| Accountability<br>(Max: 40, mean± s.d.)<br>Cronbach's alpha                  | 26.5 ± 0.7             | 28.0 ± 4.2 | 30.5 ± 2.1 | 28.3 ± 2.8 | 34.0 ± 4.4           | 29.7 ± 1.2 | 30.3 ± 1.5 | 31.3 ± 3.1 | 30.1 ± 2.1  |
|  |                        |            |            | 0.83       |                      |            |            | 0.75       | 0.81        |
| Preference for Lecture /<br>TBL<br>(Max: 80, mean± s.d.)<br>Cronbach's alpha | 50.0 ± 4.2             | 51.5 ± 6.4 | 50.5 ± 4.9 | 50.7 ± 4.1 | 44.7 ± 7.2           | 46.8 ± 2.9 | 53.3 ± 6.1 | 49.2 ± 6.2 | 49.8 ± 13.5 |
|  |                        |            |            | 0.69       |                      |            |            | 0.78       | 0.74        |
| Student Satisfaction<br>(Max: 40, mean± s.d.)<br>Cronbach's alpha            | 27.5 ± 0.7             | 27.5 ± 0.7 | 30.0 ± 2.8 | 28.3 ± 1.9 | 30.3 ± 2.1           | 30.3 ± 2.1 | 29.3 ± 0.0 | 29.6 ± 9.5 | 29.1 ± 1.9  |
|  |                        |            |            | 0.69       |                      |            |            | 0.68       | 0.66        |
| Programme Content<br>(Max:5, mean± s.d.)<br>Cronbach's alpha                 | 4.4 ± 0.5              | 4.1 ± 0.3  | 4.5 ± 0.5  | 4.3 ± 0.5  | 4.5 ± 0.5            | 4.3 ± 0.5  | 4.6 ± 0.6  | 4.6 ± 0.5  | 4.6 ± 0.5   |
|  |                        |            |            | 0.94       |                      |            |            | 0.98       | 0.96        |
| Programme Learning<br>(Max:5, mean± s.d.)<br>Cronbach's alpha                | 3.4 ± 0.5              | 3.3 ± 0.9  | 4.4 ± 0.5  | 3.6 ± 0.8  | 4.1 ± 0.9            | 3.7 ± 1.3  | 4.3 ± 0.5  | 4.0 ± 1.0  | 3.9 ± 0.9   |
|  |                        |            |            | 0.95       |                      |            |            | 0.99       | 0.98        |
| Faculty<br>(Max:5, mean± s.d.)<br>Cronbach's alpha                           | 4.4 ± 0.5              | 4.5 ± 0.5  | 4.4 ± 0.5  | 4.5 ± 0.5  | 4.3 ± 0.5            | 4.3 ± 0.5  | 4.6 ± 0.6  | 4.4 ± 0.5  | 4.4 ± 0.5   |
|  |                        |            |            | 0.98       |                      |            |            | 0.96       | 0.97        |