STUDENT'S PERCEPTION OF HYBRID TEAM-BASED AND CASE-BASED LEARNING IN UNDERGRADUATE ENDODONTICS EDUCATION

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LIST OF ABBREVIATIONS

BDS Bachelor of Dental Surgery

CBL Case Based Learning

DDS Doctor of Dental Surgery

ESE European Society of Endodontology

IRAT Individual Readiness Assurance Test

JEPeM Human Research Ethics Committee, USM

MDC Malaysia Dental Council

MQA Malaysian Qualifications Agency

MQF Malaysian Qualifications Framework

TBL Team Based Learning

TRAT Team Readiness Assurance Test

LIST OF APPENDICES

PERSEPSI PELAJAR TERHADAP PEMBELAJARAN HIBRID BERASASKAN PERBINCANGAN SECARA BERKUMPULAN DAN PEMBELAJARAN BERASASKAN FAKTA KES DALAM PENDIDIKAN ENDODONTIK SARJANA MUDA DOKTOR PERGIGIAN

ABSTRAK

Jumlah bilangan kajian yang meneroka penggunaan pendekatan hibrid yang menggabungkan TBL dan CBL dalam pendidikan pergigian adalah terhad. Kajian ini bertujuan untuk menilai persepsi pelajar terhadap pembelajaran endodontik secara hibrid TBL-CBL dan menentukan sama ada jantina dan etnik mempengaruhi persepsi pelajar. Pelajar tahun akhir sarjana muda pergigian dijemput untuk mengambil bahagian dalam sesi hibrid TBL-CBL. Pelajar dibahagikan secara rawak kepada enam kumpulan yang terdiri daripada enam hingga tujuh pelajar, dan sesi tersebut dikawal selia oleh seorang fasilitator, disokong oleh dua pensyarah. Pada sesi terakhir, soal selidik yang mengandungi 23 item yang merangkumi empat domain dari segi keberkesanan, guru, interaksi pasukan dan persekitaran pembelajaran serta soalan terbuka telah diedarkan kepada para pelajar. Kadar respons adalah 78% (n=39). Skor purata bagi item soal selidik adalah antara 4.44 hingga 4.90, menunjukkan persepsi positif dalam kalangan pelajar terhadap hibrid TBL-CBL untuk pembelajaran endodontik. Mengenai soalan terbuka, pelajar menekankan bahawa sesi hibrid TBL-CBL ini menghubungkan mereka kepada situasi klinikal secara berkesan, meningkatkan pemikiran kritikal dan memupuk komunikasi dua hala. Namun, pelajar menyatakan keinginan untuk sesi hibrid TBL-CBL yang lebih kerap dengan kes-kes yang lebih mencabar pada masa akan datang. Persepsi positif daripada pelajar pergigian menggalakkan potensi pengintegrasian pendekatan baharu ini ke dalam kurikulum pergigian, sekali gus mengalihkan fokus daripada kuliah didaktik. Kajian

masa depan boleh dipertimbangkan untuk melanjutkan tempoh penggunaan hibrid TBL-CBL dalam pengajaran dan pembelajaran endodontik, diikuti dengan penilaian pengekalan pengetahuan bagi sesi hibrid TBL-CBL berbanding kuliah formal.

STUDENT'S PERCEPTION OF HYBRID TEAM-BASED AND CASE-BASED LEARNING IN UNDERGRADUATE ENDODONTICS EDUCATION

ABSTRACT

Limited studies have explored the use of the hybrid approach combining Team-based Learning (TBL) and Case-based Learning (CBL) in dental education. This study evaluates how students perceive the hybrid TBL-CBL approach to learning endodontics and determines whether gender and ethnicity impact students' perceptions. A total of 50 final-year undergraduate Bachelor of Dental Surgery (BDS) students from Universiti Sains Malaysia (USM) were invited to participate in a hybrid TBL-CBL session. They were randomly divided into six groups of six to seven students, and the session was conducted by one facilitator, supported by two lecturers. At the end of the session, a 23-item questionnaire consisting of four domains (perception of effectiveness, teacher, team interaction and learning environment) and open-ended questions was distributed. The response rate was 78% (n=39). Mean scores for the questionnaire items ranged from 4.44 to 4.90, suggesting a positive perception among students towards this hybrid TBL-CBL approach to learning endodontics. Regarding the open-ended questions, students highlighted that this hybrid TBL-CBL session effectively linked them to clinical situations, enhancing critical thinking and fostering two-way communication. However, students expressed a desire for regular hybrid TBL-CBL session with more challenging cases incorporated in the future. The positive perception of dental students encourages the potential integration of this novel approach into the dental curriculum, moving away from didactic lectures. Future studies could consider extending the period of using hybrid TBL-CBL in teaching and

learning endodontics, followed by assessing the retention of knowledge for hybrid TBL-CBL sessions compared to formal lectures.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This thesis is organised into five chapters. Chapter one introduces the background of the study, problem statement, research objectives, research questions, the significance of the study, operational definition, scope of the study, as well as the summary of chapter one. Chapter two provides the literature review of the current dental education, followed by its evolution in Malaysia. It also addressed the teaching and learning in undergraduate endodontics, active learning strategies such as TBL and CBL, and the learning approach among genders and ethnicities. The theoretical and conceptual framework underpinning the present study is included in the chapter as well. Meanwhile, Chapter three presents the methodologies used for data collection and describes the steps to analyse the data. Chapter four presents the study results, which have been categorised into a few themes and discusses the findings compared to the existing literature. Lastly, Chapter five concludes the study's results, addresses the limitations, and offers recommendations for future research.

1.2 Background of the study

Dental education is a dynamic process that needs to be adjusted regularly. The fundamental goal of dental education is to prepare future dental professionals with strong psychomotor and critical thinking skills. The requirements for dentists are becoming more stringent, and they now include the ability to solve problems and engage in self-directed learning, critical thinking, communication, teamwork, and,

eventually, lifelong learning (Wang et al., 2021b, Burgess et al., 2017). In addition, the faculty aims to educate lifelong learners who will apply their expertise to improve and maintain their patient's dental and systemic health (Hammad et al., 2020). Therefore, educators should employ various teaching methods to engage students and foster their learning to deliver this multifaceted education.

However, the most typical and exemplary traditional teaching and learning technique has been the didactic lectures (Challa et al., 2021), which do not effectively teach the application of knowledge or the development of critical thinking (Oderinu et al., 2020). Dental students have been taught via a one-way, "spoon-feeding" approach, in which the students passively absorb the information by attending lecture classes, listening to and watching the lecturer's presentations, and reading handouts. Paulo Freire called this pedagogical method "banking education" and is often ineffective because students' attention is hardly maintained for more than 15 minutes (Vanka et al., 2019). Students may find it challenging to retain, remember, and interpret such a large amount of information (Challa et al., 2021) and eventually carry a risk of potential cognitive overload with a low level of cognitive work (Vanka et al., 2019). Unfortunately, the information might be lost because students cannot ascribe meaning to it as a deep and enduring understanding of students is not promoted (Tavares et al., 2019). Consequently, a "disconnection" might happen between memorising information and the ability to process and apply it to a real-world clinical situation (Horne and Rosdahl, 2017).

The undergraduate curricula in endodontics strongly emphasise theoretical knowledge and practical skills, with increasing attention paid to integrating innovative

learning resources (De Moor et al., 2013, Alraisi et al., 2019). In Malaysia, endodontics is taught mainly through formal lectures, complemented by seminars, problem-based learning (PBL), preclinical training, and clinical practices (De Moor et al., 2013, Baharin and Omar, 2021).

Imparting theoretical knowledge and gaining essential practical skills are critical components of dental education in endodontics (Haupt and Kanzow, 2023). The variety of root canal anatomies, the responsibility involved in patient care, and the lack of confidence among the students all contribute to the fact that many dental students find learning endodontics to be complex, challenging, and stressful. Also, they do not feel adequately prepared to take assessment examinations on complex procedures, such as endodontic molar treatments. This insecurity can reflect the insufficient clinical and didactic teaching methods in a dental curriculum (Seijo et al., 2013). It is hypothesised that the effectiveness of undergraduate instruction has some bearing on how well students perform and their capacity for high-calibre work. Having stated that, the educator's job is to ensure efficient preparation and exposure to clinical cases, which can occur through various pedagogical systems.

As a result, today's educational methodology is shifting away from traditional lecture-based teaching toward a more participatory learning style that incorporates group discussions, case-based learning, and self-assessment procedures. It has been reported that students who participated in clinical demonstrations were more confident than those who simply received theoretical teaching, and high-standard practitioners were seen when problem-based learning methods were applied (Hattar et al., 2021). Student preference has also shifted from lecture-based instruction toward active

learning practices (Hyun et al., 2017). Therefore, education has made significant strides away from traditional lecture-based approaches, recognising the importance of providing learners with a sense of relevance and active engagement in the subject matter (McLean, 2016).

Teaching strategies will not improve overnight. Understandably, no curriculum will satisfy every learner or faculty group, but incorporating learner preferences within a curricular framework holds a more significant promise to create a sustainable, accepted curriculum (Srinivasan et al., 2007). The perspectives of dental undergraduate's educational experiences are essential in developing teaching methodologies (Tavares et al., 2019). Continuous contribution is required from teachers and students to be fully involved and provide feedback so that positive amendments can be made (Wang et al., 2021b). Thus, the present study aims to evaluate students' experience of the hybrid TBL-CBL teaching method in learning endodontics.

1.3 Problem Statement

However, Hrynchak *et al.* (Hrynchak and Batty, 2012) discovered that PBL might not be the best candidate of active learning for endodontics teaching as it is time-consuming with minimal guidance and direction to complete a case discussion. Also, PBL is resource-intensive, with one tutor per group (Krzic et al., 2020) which might not be an ideal active learning method for dental schools in Malaysia with an imbalanced staff-to-student ratio. As we know, low staff-to-student ratios offer more

clinical interaction time, creating a better learning environment than high staff-to-student ratios (Alraisi et al., 2019).

A previous study has displayed that student felt insufficient time was devoted to endodontics, and the quality of endodontics education was poor. Thus, it is advisable to alter educational methods involving case-based learning and discussions, which have been demonstrated to encourage active learning and enhance student confidence in a subject (Davey et al., 2015).

According to Pileggi *et al.* (Pileggi and O'Neill, 2008), the TBL approach was introduced into the dental field in 2005 for the first time to refine students' learning and performance in diagnosing dental disease in the endodontics course. A previous study has displayed that the TBL approach accommodated large class sizes, but students may experience limited interaction with tutors (Krzic et al., 2020). Students felt that TBL left them teaching themselves with limited guidance, fewer in-depth discussions but too much time focus on quizzes. In this case, they preferred small group format of CBL over TBL, which is in line with a previous study by Haley *et al.* (Haley et al., 2020), which discovered that students preferred the small group format of CBL over TBL as it made them feel more comfortable participating and asking questions among their peers.

Active learning, along with curricular integration, early clinical exposure, and evidence-based teaching and assessment, are key reforms in dental education aimed at equipping students with necessary competencies to become entry-level general dentists in the 21st century (Perez et al., 2023). Our literature search found a lack of

studies combining TBL and CBL in teaching undergraduate endodontics. Hybrid TBL-CBL might be an intermediate solution as previous study showed students reported higher satisfaction and a better perceived understanding of the subject matter with CBL, while overall student performance was better in TBL (Haley et al., 2020). Students reported the implementation of TBL for learning endodontics increased knowledge retention and confidence in applying therapeutic concepts in clinical practice (Chen et al., 2022).

By performing this research, we will be able to identify how undergraduate dental students perceive this novel hybrid TBL-CBL approach in learning endodontics, as activating students' interest in learning is essential for the effective delivery of knowledge.

1.4 Research Objectives

General objective

To evaluate students' experience of the hybrid TBL-CBL teaching method in learning endodontics course.

Specific objectives

i. To evaluate undergraduate dental students' perception of the effectiveness, teacher, team interaction and learning environment of the hybrid TBL-CBL teaching method in endodontics based on their satisfaction with the learning process.
ii. To determine whether gender and ethnicity have an impact on students' perceptions of the hybrid TBL-CBL teaching method in endodontics.

1.5 Research Questions

i. What are the students' perceptions and learning experiences with this new hybrid TBL-CBL teaching method in undergraduate endodontics education?

ii. What areas worked well, and what changes would they propose to improve this hybrid TBL-CBL teaching method in undergraduate endodontics education?

1.6 Research Hypothesis

i. There is no significant difference on students' perceptions towards effectiveness, teacher, team interaction and learning environment of the hybrid TBL-CBL teaching method in undergraduate endodontics education.

ii. There is no significant difference of students' perception of the hybrid TBL-CBL teaching method in undergraduate endodontics education based on gender and ethnicity.

1.7 Operational Definitions

i. *Undergraduate dental student:* Student enrolled in the 5-year Bachelor of Dental Surgery program.

ii. *Didactic lecture:* A teacher-centred method of instruction in which teachers deliver and students receive lessons, best suited to brief delivery of factual information.

iii. *Problem-based Learning (PBL):* An instructional method in which students learn through the structured exploration and resolution of real-world or simulated problems.

iv. *Case-based Learning (CBL):* An instructional method in which students analyse and discuss real-life or simulated cases to apply theoretical knowledge in practical contexts.

v. *Team-based Learning (TBL):* A structured, collaborative learning and teaching strategy that uses permanent teams to enhance student engagement and accountability.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter highlights the current evidence in the literature that forms the foundation of the present study. It starts with an introduction to dental education, followed by its evolution in Malaysia. It also addressed the teaching and learning in undergraduate Endodontics, active learning strategies such as TBL and CBL, and the learning approach among genders and ethnicities.

2.2 Dental Education in Malaysia

Dental education in Malaysia encompasses cognitive (knowledge) and psychomotor (skills) components to equip dental students for proficient patient treatment (Halim et al., 2021). It seeks to educate dental professionals by imparting knowledge and training, instilling the philosophy of lifelong learning in all undergraduates (De Moor et al., 2013).

However, challenges such as large student numbers, diverse learners, and limited student engagement time can make it difficult for educators to help all students reach their full potential successfully. The utilization of effective teaching strategies is crucial for mastering fundamental concepts. Traditional dental education was centred around repeating information and procedures to enhance learning efficiently. Unfortunately, evidence suggests the existence of the learning curve, commonly known as the plateau effect, wherein continued repetition of procedures stops improving skills after a certain point (Godderidge et al., 2019). Moreover, clinical

exposure to patients in health professions education provides a unique environment that regular classrooms cannot reproduce, making it challenging to adequately address the transfer of essential problem-solving strategies (Qutieshat et al., 2020). Therefore, a more evidence-based approach to education has replaced the didactic technique. Numerous active learning strategies have arisen, including case studies, problem-based learning, case-based learning, flipped classrooms, team-based learning, virtual reality, and, more recently, blended learning concepts in diverse formats (Tavares et al., 2019).

Until 1997, the University of Malaya (UM) in Kuala Lumpur was the only dental school in Malaysia, which was established in May 1972. The Bachelor of Dental Surgery (BDS) degree was initially a four-year program and transitioned into a five-year program in July 1975. In Malaysia, there are 13 dental schools offering bachelor's degrees such as Bachelor of Dental Surgery (BDS) or Doctor of Dental Surgery (DDS). The dental curriculum in Malaysia consists of an initial two-year focus on preclinical didactic and laboratory work, followed by three years of intense clinical training under the guidance of faculty members. Dental students begin their journey of clinical dentistry in the third year, participating in lectures and rotations through medical hospital wards. Fourth-year students are involved in a blend of clinical and laboratory coursework. Conversely, the primary focus of fifth-year dental students is on patient care, emphasizing comprehensive treatment planning and management (University of Malaya, 2006) (Komabayashi et al., 2007).

Governed by the Malaysian Qualifications Framework, overseen by the Malaysia Dental Council (MDC) and the Malaysian Qualifications Agency (MQA), this framework sets the standards and prerequisites for prospective dentists. This

ensures that dental school graduates are both qualified and proficient in delivering safe dental care. The Dental Dean's Council approved a revised version of competencies for new dental graduates in 2021. The Program Learning Outcome (PLO) has been divided into nine primary categories to match the new Malaysian Qualifications Framework (MQF) version 2.0, where the learning outcomes must include cognitive, psychomotor, and affective domains ("Malaysian Qualifications Framework (MQF) 2nd Edition," 2017).

2.3 Teaching and Learning in Undergraduate Endodontics

Transferring both theoretical knowledge and skills training are crucial in undergraduate endodontics education (Haupt and Kanzow, 2023). In addition, all dental undergraduates should be taught the concept of lifelong learning and evidence-based practice (Baaij et al., 2024).

All dental schools in Malaysia are required to incorporate endodontics teaching into their undergraduate curriculum following the guidelines established by the Malaysian Dental Council (MDC) and educational authorities in Malaysia (Malaysian Qualifications Agency 2019, Malaysia Dental Council 2020). The curriculum emphasises endodontics through formal lectures supplemented by seminars, PBLs and preclinical training. The lectures focus on essential scientific principles relevant to endodontics, following the guidelines outlined by the European Society of Endodontology (ESE) (De Moor et al., 2013).

Dental graduates should be proficient in performing pulp management for single-rooted teeth and uncomplicated multirooted teeth (Malaysian Dental Council, 2020). However, endodontics teaching and training were incorporated into the

restorative course within its timetable, along with other restorative subjects. This, in turn, might compromise dental students' chances of practising endodontics at dental school. Thus, it is advisable to employ various teaching strategies, such as clinical case presentations and PBLs, as they help students link theory with clinical application. Additionally, collaboration with other disciplines in endodontics teaching, especially during seminars, PBLs and case presentations, offers students a comprehensive approach to patient management beyond solely concentrating on endodontics management (De Moor et al., 2013).

The ESE recommended that undergraduate endodontics education be taught by qualified and experienced staff in Endodontology (Baaij et al., 2024). Maintaining a high staff-to-student ratio is advised to promote safe practice, close engagement and supervision during the learning process (Baaij et al., 2024). Nonetheless, the scarcity of academic endodontists is one of the significant challenges for most dental schools in Malaysia, consequently impacting the staff-to-student ratio. A recent survey revealed that the staff-to-student ratio is between 1:3 to 1:8 (Baharin and Omar, 2021).

2.4 Team-Based Learning

Team-Based Learning (TBL) was originally designed by Professor Larry Michaelsen in the 1980s at Oklahoma University in the United States and was tailored for the context of business education (Burgess et al., 2020b). Subsequently, it rapidly gained traction and widespread adoption in numerous countries across the globe (Joshi et al., 2022), particularly in the realm of health sciences education for professionals such as dentists (Parmelee, 2010, Haidet et al., 2012). Integrating TBL into dental curricula has increased student satisfaction (Bouw et al., 2015), with studies showing higher satisfaction levels and better performance than conventional teaching methods

(Bhat et al., 2021). Therefore, various dental disciplines, including periodontics, oral medicine, oral radiology, fixed and removable prosthodontics, have adopted TBL into their educational approaches.

TBL represents a teaching pedagogy that maintains the benefits of a constructivist learning principle to teaching while requiring only a minimal number of expert facilitators. TBL is a well-structured small-group pedagogy that focuses on knowledge application rather than regurgitation (Macke et al., 2019), ensuring learners use the problems to build on existing knowledge and apply new knowledge (Burgess et al., 2018). One significant benefit is that each student receives consistent guidance, which might improve the levels of quality assurance (James Trill et al., 2024). Additionally, TBL achieved higher levels in both cognitive and psychomotor domains of Bloom's taxonomy. It not only boosts critical thinking skills but also fosters long-term retention of information, preparing students for effective group collaboration (Echeto et al., 2015, Haley et al., 2020). The advanced student preparation in both TBL and CBL allows students to achieve a higher level of learning as defined in Bloom's taxonomy. This is evident as the classroom focus shifts from mere recall and repetition of factual knowledge to applying and analysing the content within the context of case scenarios. This might be why students tend to perform better in end-of-term examinations for topics covered through TBL than those covered in traditional lecture sessions (Haley et al., 2020, Takeuchi et al., 2015).

Several studies found that students generally prefer the structure and format of TBL over PBL sessions, finding them more conducive to learning, engagement and participation (Burgess et al., 2017) (Burgess et al., 2020a). Unlike PBL, TBL does not require compartmentalized space for group tasks, as an open space encourages

productive interaction among team members for collaborative problem-solving (Halim et al., 2021) (Challa et al., 2021). Consequently, this setup reduces individual avoidance of planning and participating in group activities, leading to higher quality of both team and class discussions (Burgess et al., 2018).

2.4.1 Characteristic of TBL

The TBL process encompasses various stages, including advanced assignment, individual readiness assurance test (IRAT), team readiness assurance test (TRAT), feedback, team discussion, and decision defence (Burgess et al., 2020b). It highlights three key components for effective active learning: (i) individual and group accountability, (ii) necessity and chance for group interaction, and (iii) motivation to engage in interactive discussions (Echeto et al., 2015).

TBL involves breaking down large classes into smaller teams of five to seven students who collaboratively solve authentic problems facilitated by one tutor (Burgess et al., 2018). This student-centred approach enhances learning and provides educators more time to focus on advanced knowledge comprehension and understanding. TBL combines theoretical tactics to enhance the efficiency of small groups working independently in classes with high student-faculty ratios (up to 200:1) (Echeto et al., 2015). This differs from PBL, where similar small-group activities are involved but require independent tutors for each group to observe the progress of group discussions (Takeuchi et al., 2015).

Within TBL, the teacher assumes the role of a learning guide, establishing educational objectives, developing study materials, devising tests, and presenting challenges for groups to tackle. The instructor guides the discussion that the learners generate. Strategies providing passive learning, such as lecturing, are reduced in this

process. Student-centred principles and supportive scaffolding are important in constructivist learning theory and are consistently inherent.

Students are expected to actively participate with their peers and the content to address problems. The cultivation of critical thinking is exemplified and improved through exercises that simulate real-world problems commonly encountered in daily clinical practice (Hrynchak and Batty, 2012). The critical thinking framework consists of four major elements (Sweet and Michaelsen, 2023): (i) A critical thinking attitude; (ii) Ability to use specific critical thinking skills; (iii) Ability to apply those skills in new contexts; (iv) Habits of reflection upon one's own thinking

Furthermore, TBL's unique sequence of individual and team activities, as well as its feedback rhythm and incentive structures, promotes groups to evolve from collections of individuals into high-performance, self-managed learning teams (Michaelsen et al., 2011). This focused and immersive variant of small group-based learning is characterised by: (i) Class time is predominantly dedicated to students working in permanent, strategically assembled teams; (b) Concept coverage is attained through students' pre-class individual self-study, followed by an in-class Readiness Assurance Process encompassing individual and team tests; (c) Most class time is used for team assignments through which students help one another learn course material at an applied level; (d) Students are accountable to one another through peer assessment and feedback.

2.4.2 Phases of TBL

The TBL process consists of three phases. During the preparation phase, individual learning takes place before the class session, conducted beyond the confines of the classroom, be it at home or in the library. Learning resources may encompass

journal articles, videos, or voiceover PowerPoints. The subsequent phases unfold in the classroom, with students organised into teams. These teams generally consist of five to seven members, and team composition should remain fixed for an extended period (Parmelee et al., 2012).

The second phase is readiness assurance, designed to assess whether students have acquired a sufficient understanding of the subject and to address any uncertainties. It starts with an individual closed-book knowledge test, presented in a single best answer MCQ format known as the Individual Readiness Assurance Test (iRAT). Students then undergo the same closed-book test within their designated teams, called the Team Readiness Assurance Test (tRAT). During the tRAT, students engage in discussions and reach a consensus on their team answers. Once the team commits to an answer, the correct response is revealed, offering immediate feedback. This mode of peer learning clarifies misconceptions and bridges knowledge gaps. Frequently, the small group discussions spark additional questions about the subject matter. These queries can be expansively addressed class-wide or directed to the teacher for further clarification. Individual TBL grading motivates students to prepare sufficiently before the TBL session, whereas team grading provides an incentive to maximize teamwork (Haidet et al., 2012).

In the third and final phase of application exercises, students collaborate within their teams to address scenarios, typically clinical problems or cases, that prompt the application of knowledge acquired in the earlier stages of TBL. These application exercises occur under open-book conditions and adhere to the "4S" principle (Michaelsen et al., 2011). Each team engages with the "same" problem, which must be "significant". The response from each team must be a "specific" choice representing

the team's consensus. In the latter part of the application exercise phase, the team presented their choices "simultaneously", followed by a class-wide discussion facilitated by the teacher. The process of discussions and debate within teams and between teams guided students to develop a defensible rationale for clinical judgment, thereby stimulating critical thinking as they engage deeply with the content (Echeto et al., 2015).

Towards the conclusion of the discussion, the teacher may provide an expert solution if necessary. Single-best-answer MCQs or short-answer questions were often used as application exercises to facilitate simultaneous reporting.

2.4.3 Limitations of TBL

While TBL offers numerous benefits, challenges persist regarding its design, organisation, and implementation as a teaching approach. It was a time-consuming task requiring various experts' input (Burgess et al., 2017). Many students felt that they were self-taught with little guidance in TBL and fewer opportunities for in-depth discussions. Additionally, students expressed dissatisfaction with the rigid teaching approach in TBL, mentioning there was a shortage of time for questions and discussions but too much time spent on quizzes (Haley et al., 2020). Furthermore, some students may not value collaborative teamwork and perceive TBL as less effective and efficient when compared to didactic learning. They may thrive in the competitive environment of higher education, which discourages some students from engaging and exchanging ideas. Students who are not interested in this learning method and students may lack initiative, clinical and critical thinking due to reliance on teachers (Wang et al., 2021b). Inexperienced facilitators who lack of understanding and support of this learning strategy may influence student's perspective, where

students are likely to be less satisfied if they think they haven't gained desired knowledge (Challa et al., 2021).

2.5 Case-Based Learning

Case-Based Learning (CBL), also known as the case-teaching method, designs a typical case for teaching content and emphasises case discussion by applying comprehensive knowledge. Christopher Columbus Langdell first proposed it at the United States Harvard University. It provides a better sense of reality by linking theory to clinical practice by applying knowledge to the cases and transforming vague concepts in textbooks into evocative clinical knowledge, where clinical cases act as the subject of this teaching method (Wang et al., 2021a). This inspires students to think, solve problems and develop their reasoning ability (Zhang et al., 2012). The ability to think critically and reason based on knowledge is the cognitive skill a dentist needs (Ibrahim, 2010). This induces more in-depth and focused learning, which goes beyond recognizing correct answers and is more aligned with critical thinking, behavioural changes, and the ability to apply learning to new cases more broadly.

The impact of CBL can range from simple knowledge gains to changing patient care outcomes (McLean, 2016). Participation in case-based activities has notably increased student's comfort levels and the theory-practice gap between preclinical and clinical operative experiences might be overcome correspondingly.

2.5.1 Characteristic of CBL

The learning objectives of each case were determined by the facilitator in CBL (Carrasco et al., 2019). It differs from PBL, although it shares principles of PBL, by focusing more on learning objectives, practical application of learning in a clinical setting, which may enhance the learning by enhancing the knowledge and skills in

clinical topics (Deshpande et al., 2019). CBL requires the learners to possess prior knowledge of the subject – which is contrary to PBL, in which the learner is assumed to have zero knowledge of the delivered topic (Carrasco et al., 2019). CBL is most effective for students with strong foundational knowledge of a topic, whereas PBL encourages students to learn foundational knowledge while performing research on a clinical case (Haley et al., 2020).

2.5.2 Limitations of CBL

While CBL has proven to be an effective approach in medical education, yielding high satisfaction among both students and instructors, it is also a resource intensive way of learning that demands ample time, space, and funding for proper coordination. In addition to training, another challenge of involving more facilitators is the variable experience of tutors with difficulty in standardising experiences across different groups (Gold et al., 2020).

2.6 The combination of Team-Based and Case-Based Learning

In recent years, the combination of team-based and case-based teaching models has been incorporated as one of the teaching strategies (Bhat et al., 2021). TBL-CBL method designed to address logistical, educational, and resource-related issues. It has been suggested as an active learning method that maintain learning outcomes and student satisfaction, while also reducing institutional costs in comparison to small group active learning sessions (Maas et al., 2018). It is a case-based learning approach where a single facilitator leads the large group, with teaching and learning occurring both in small teams and large groups at the same time, using a peer-to-peer format. One of the downsides of CBL was the effectiveness and experience of the session were

largely depended on the abilities of individual facilitators. Relocating all students to the lecture hall able to eliminate this variability (Gold et al., 2020).

A traditional radiology lecture was redesigned using this approach. It was favourably received by students, who acknowledged that engaging in scenario discussions helped them develop critical thinking and problem-solving skills. Besides, the small group setting for team tasks and immediate feedback grabbed the class's attention and interest (Kumar and Gadbury-Amyot, 2012). Similarly, in a study by Ling *et al.,* most students felt the TBL-CBL blended learning mode had achieved high satisfaction compared with traditional theoretical learning, citing its effectiveness in enhancing thinking ability and making personalized diagnoses and treatment plans (Ling et al., 2023).

Moreover, dental students also enjoyed this hybrid learning method, and a study was carried out on them in the dental material science course. The results suggested that it is an effective teaching method to improve their knowledge, academic performance, clinical reasoning skills, understanding of the learning context and working in groups. The learning experience has also been enhanced by relaxed learning surroundings and increased chances of interaction with the facilitator (Lin et al., 2022).

Table 2.1: Comparison of problem-based learning, case-based learning, and team-based learning

Characteristic	Problem-Based Learning	Case-Based Learning	Team-Based Learning
Learning approach	1. Advanced preparation not required 2. Open inquiry	1. Advanced preparation required 2. Guided inquiry	1. Advanced preparation required 2. Guided inquiry
Facilitators	1 per small group	1 per small group	1 or 2 per large room (with many small groups)
Focus	1. Identify knowledge gaps 2. Research gaps 3. Report findings	Specific prompts or questions about case scenario	1. IRAT/TRAT 2. Application exercises

2.7 Learning approach among gender

Given the significant influx of women into dentistry, gender differences in the educational environment have become an important research focus (Haug et al., 2021). There have been suggestions that biological variables like hormones and brain organization cause gender differences in cognitive abilities, skills, and behaviour. These factors influence how each gender behaves and performs, thus affecting educational achievement (Hashem, 2022).

Gender differences can manifest in numerous ways, ranging from stereotypes about the kinds of procedures males and females are deemed capable of performing to evaluating and mentoring students. Such disparities can diminish learning opportunities for dental students in clinical practice, consequently impeding career

opportunities and limiting the potential of both male and female students. Raja *et al.* highlighted gender bias influences students' interactions with the interprofessional team. Some female students felt they were not taken seriously, while others experienced either leniency or stricter accountability based on gender. The need for unbiased support from colleagues and mentors was highlighted for motivation and learning. Females were believed to be more caring, emphatic, and concerned about relationships. Yet, it was common to assign patients to students according to gender preconceptions. (Raja et al., 2023)

A study found that compared to the male students, female students had lower interest and enthusiasm for the next CBL class, potentially due to male students dominating the group discussions. This caused female students to rate CBL as less effective in making learning engaging and enjoyable. To address this issue, facilitators should prevent any one student from monopolizing the group discussion since it can lead to resentment and discouragement among others. Gender equality should be a focus to prevent male students from suppressing female opinions during the case discussions. This highlights the importance of considering gender and program of the study when implementing CBL, requiring facilitators to devise specific adaptations and modifications (Osinubi et al., 2020).

Tiwana *et al.* (Tiwana et al., 2014) evaluated gender issues in clinical education and observed that female students expressed lower confidence than males in clinical settings. A cultural perception exists that males are more knowledgeable and capable than females, which may reduce female students' confidence levels. Female students reported that their male peers were more assertive in seeking faculty attention,

occasionally bypassing them in line to speak with their mentors. Hence, it is the responsibility of dental educators to make sure every student is treated fairly.

In addition, Haug *et al.* (Haug et al., 2021) investigated gender disparities related to undergraduate education in Endodontics. According to students' feedback, males felt significantly more secure and confident when performing root canal treatment than females. One potential explanation for this could be a lack of self-efficacy among female students. The results of this study suggest the necessity of addressing gender differences in undergraduate education in Endodontics.

On the other hand, a previous study revealed no difference in the way students perceived the gender of the faculty in terms of clinical knowledge, critical thinking, communication, approachability, motivation, trust, and feedback. This equal perception was seen regardless of the student's gender and ethnicity of the faculty. Students viewed both genders were as motivating, supportive, and encouraging when it came to critical thinking (Rashid and ElSalhy, 2022).

2.8 Learning approach among ethnicities

The multiracial nature of Malaysia, which hosts students from different ethnicities, necessitates educator awareness if it impacts dental education. Ethnicity influences both student learning and teaching strategies. Western culture prioritizes skill development and active involvement, aligning with social constructivist theory, where learning is based on an individual's capability to learn and interact. Conversely, Eastern culture focuses on memory and the interpretation of information.

Macke *et al.,* (Macke et al., 2019) did a study to compare the academic outcomes of black students with their white counterparts in TBL courses and discovered that

black students received lower scores on their peer evaluations, even though their overall course grades were comparable with white students. This implies that their peers are not seeing them positively during group work. The achievement and general academic experience of the black students were being adversely impacted by their group experience. Although TBL does not intend racial discrimination, such discrimination may occur because of racism and bias.

It was suggested that educators do not need to adapt educational strategies that fit every student perfectly, as students' learning styles are adaptable. Several studies showed that although eastern students may initially struggle with student-centered learning, they were able to adapt new learning environment after few months. In addition, students' engagement levels have progressively increased over time after familiarising themselves with a new learning strategy. Therefore, a combination of constructivist (active) and didactic (passive) learning may be beneficial, as both methods can complement each other (Chuenjitwongsa et al., 2018).

2.9 Conceptualisation of the study

The theoretical framework for the study is introduced in this subtopic, along with the learning theories that underlie it. Additionally, the conceptual framework demonstrates how the study's concept is conveyed.

2.9.1 Theoretical Framework

Clinical exposure in health professions education offers a unique learning environment that cannot be fully recreated in traditional classrooms, thereby restricting the teaching of crucial problem-solving skills. Dental graduates not only need to proficiently acquire the clinical skills necessary for their career but also demonstrate excellence in critically assessing their clinical reasoning and understanding the