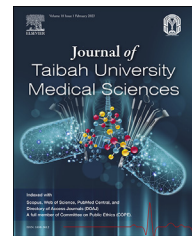




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Original Article

## Medical students' perception and academic performance after team-based and seminar-based learning in human anatomy



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### المخلص

**أهداف البحث:** تعمل الاستراتيجيات التعليمية المتمحورة حول الطالب مثل التعلم القائم على حل المشكلات والتعلم المستند إلى الحالة والتعلم القائم على الفريق والندوات على تعزيز التعلم الجماعي للطلاب والتعلم الذاتي. أجريت هذه الدراسة لتقييم تحصيل الطلاب في موضوعات علم التشريح التي تم تقديمها من خلال جلسات التعلم القائم على الفريق والندوات. بالإضافة إلى استبانة أولويات الطلاب فيما يتعلق بهاتين الطريقتين في تعلم التشريح.

**طرق البحث:** يتم إجراء جلسات التعلم القائم على الفريق من خلال اختبار ضمان الجاهزية الفردية، واختبار ضمان جاهزية المجموعة، والمحاضرة المصغرة، وتمارين التطبيق. بينما تتكون الندوة من الاختبار القبلي ومن ثم محاضرة من قبل الأقران ثم الاختبار البعدي. تمت مقارنة أداء 117 طالبا في ثلاث جلسات من التعلم القائم على الفريق وثلاث ندوات بعد معايرة الأسئلة. جميع الطلاب ملتحقين

بالسنة الثانية (عددهم 42) والثالثة (عددهم 40) والرابعة (عددهم 35) في كلية الطب بجامعة بيشة خلال العام الدراسي (2019-2020).

**النتائج:** لوحظت زيادة تدريجية في متوسط درجات جلسات التعلم القائم على الفريق بين السنوات المختلفة حيث كان المتوسط لطلاب السنة الثانية (68.6 ± 9.56) ولطلاب السنة الثالثة (82.8 ± 12.25) ولطلاب السنة الرابعة (92.7 ± 4.70). بينما كانت ثابتة تقريبا في درجات الندوات حيث كان المتوسط لطلاب السنة الثانية (80.0 ± 9.66) ولطلاب السنة الثالثة (85.11 ± 10.16) ولطلاب السنة الرابعة (85.9 ± 8.80). أسفرت نتائج استخدام اختبار "كوهينز دي" (للتحقق من قوة العلاقة بين النشاطين) لطلاب السنة الثانية عن 1.03 ولطلاب السنة الثالثة 0.16 ولطلاب السنة الرابعة 0.74. كما تم تحليل نتائج استبيان الإدراك والتفضيل المستلمة من 39 طالبا من طلاب السنة الثانية و 35 طالبا من طلاب السنة الثالثة و 28 طالبا من طلاب السنة الرابعة. اختار غالبية الطلاب التعلم القائم على الفريق كطريقة تعلم مفضلة لديهم بينما كان مستوى القبول ضعيفا جدا فيما يتعلق بالندوات.

**الاستنتاجات:** يمكن أن نستنتج أن التعلم القائم على الفريق أكثر إفادة للطلاب حتى في العلوم العملية الأساسية مثل علم التشريح وذلك في الغالب بسبب تعليم الأقران الجماعي الذي يعزز الشعور بالمنافسة الجماعية بدلا من طبيعة التعلم الذاتي للندوات التي قد تكبح الشعور بالمنافسة.

**الكلمات المفتاحية:** التعلم القائم على الفريق؛ الندوة؛ جامعة بيشة؛ تعليم التشريح

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## Abstract

**Objectives:** Student-centered educational strategies like problem-based learning (PBL), case-based learning (CBL), team-based learning (TBL), and seminars enhance group and self-learning. This study was carried out to evaluate students' achievements in anatomy topics delivered through TBL sessions and seminars and to survey student preferences regarding these two modalities in anatomy learning.

**Methods:** TBL was conducted through individual readiness assurance tests (IRATs), group readiness assurance tests (GRATs), mini-lectures, and application exercises. Seminars included pretests, peer lecturing, and posttests. The performance of 117 students in three TBL sessions and three seminars was compared after standardizing the questions. The students were second-year (42), third-year (40), and fourth-year (35) students at the College of Medicine, University of Bisha, KSA, during the 2019/2020 academic year.

**Results:** A gradual increase in the means of TBL grades was noticed among second-, third-, and four-year students (means  $\pm$  SD:  $68.6 \pm 9.56$ ,  $82.8 \pm 12.25$ , and  $92.7 \pm 4.70$ , respectively), but their seminar grades were nearly stationary (means  $\pm$  SD:  $80.0 \pm 9.66$ ,  $85.11 \pm 10.16$ , and  $85.9 \pm 8.80$ , respectively). Cohen's *d*-test to check the strength of the relationship between the two activities showed 1.03, 0.16, and 0.74 in the same order. We statistically analyzed perception and preference questionnaire results received from 39, 35, and 28 second-, third-, and four-year students, respectively. The majority of the students selected TBL as their preferred learning modality. However, their acceptance of the seminars was very poor

**Conclusions:** It can be concluded that TBL is more beneficial to the students, even in practical sciences like anatomy, most likely because group peer teaching enhances the sense of collegial competition, as opposed to the self-learning nature of seminars, which might suppress the sense of competition.

**Keywords:** Anatomy education; Seminar; TBL; University of Bisha

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## Introduction

Recently, all medical colleges are motivating their students to learn in an active environment to prepare for long-term learning.<sup>1</sup> Several active learning strategies dealing with higher intellectual functions were developed to increase student participation in learning. These strategies enable medical students to identify their learning needs and how to meet these needs, which is crucial for long-term learning.<sup>2</sup> Peer teaching has been used in many areas of

health education in the form of peer-assisted learning and reciprocal peer teaching.<sup>3</sup> Human anatomy is an important subject that is included in different courses at the pre-clerkship stage. Anatomy was considered the centerpiece of preclinical training in traditional curricula.<sup>4</sup> Both clinicians and anatomists endorsed the importance of appropriate and specific information regarding human anatomy for patient safety in clinical practice.<sup>5</sup> In addition, owing to the technological progression and the development of integrated curriculum bodies, human anatomy teaching is continually changing.<sup>6</sup> Hence, student-centered educational strategies were implemented in which students can share and apply valuable clinical anatomical knowledge.<sup>7</sup> Several medical institutions in the Middle East and worldwide have approved different student peer teaching strategies, such as team-based learning (TBL) and seminars, that match the educational needs in medical education.<sup>8</sup> TBL is a form of collaborative learning that consists of performing individual and group work with immediate feedback, to increase the role of students to prepare themselves before class and contribute to class events.<sup>3</sup> Communication and teamwork skills among students can be improved by implementing TBL in basic courses by combining independent out-of-class preparation with in-class discussion.<sup>9</sup> It has been reported that the implementation of TBL can improve student performance and perception.<sup>10</sup> Seminars are an instructional method whereby learners practice and interact with instructors, without involving extensive faculty time.<sup>11</sup> The educational goals of seminars are to enhance students' abilities and strengthen their communication skills.<sup>12</sup> Although TBL and seminars have different modes of student participation, in both modalities, the students need to prepare the required objectives included in the study guide by reading from textbooks and viewing the materials previously prepared by staff before conducting the activity as directed self-learning.<sup>13</sup> Since its establishment, the College of Medicine at the University of Bisha in KSA approved an integrated student-centered educational program formed of system-based modules and problem-based learning (PBL) as a primary method for teaching and learning medicine. This five-year integrated curriculum comes after a preparatory year (premedical year), in which students can enroll directly after high school to learn the principles of basic medical sciences. The curriculum is divided into three phases. The first phase lasts for three years and covers the basic medical sciences (gross anatomy, histology, embryology, physiology, biochemistry, pathology, pharmacology, health in the community, and clinical skills). The second phase takes place during years four and five and consists of pre-clerkship study. The third phase is the clerkship phase.<sup>14</sup> Active learning methods such as TBL and seminars were adopted because student motivation forms the core of the learning process in student-centered curricula.<sup>15</sup> They are conducted in the form of a two-hour session once per week to increase student participation and improve critical thinking and communication skills. Interactive lectures, self-directed learning, bed-side teaching, and practical and clinical skill sessions were also approved in the curriculum.<sup>16</sup> In addition to these active learning methods (PBL, TBL, and seminars)

in anatomy, hands-on practical sessions for cadaver dissection and demonstrations on plastic models, plastinated specimens, and the Anatomage virtual table are conducted to improve understanding and refine knowledge. In the first phase, multiple-choice questions (MCQs) and short-answer questions are the approved modalities for student assessment. Moreover, tutors in PBL and during seminar presentations evaluate the students' performance. An integrated, multidisciplinary theoretical and objectively structured practical examination is held after each course.<sup>17</sup> Indeed, the selection of suitable and acceptable methods of teaching and assessment in a student-centered manner improves the acquisition of knowledge and skills, as reflected in student performance.<sup>18</sup> The seminar, as an educational strategy for undergraduates, is not widely addressed in the literature, especially in anatomy teaching. As an ambitious institution striving for the development and fulfillment of accreditation criteria, continual evaluation of approved teaching methods, achievements, and student satisfaction is mandatory. This study aimed to evaluate student achievements in anatomy activities held in TBL sessions and seminars in different courses, and to explore student perceptions toward these two interactive educational modalities (TBL and seminar) in anatomy learning.

## Material and Methods

### *Participants and study design*

The study was performed in the College of Medicine of the University of Bisha, KSA. This is a newly established college, and the number of enrolled students is still limited. Furthermore, during the 2019/2020 academic year, only male students were enrolled at the college; a female section of the college was added subsequently. As such, male students registered in their second ( $n = 42$ ), third ( $n = 40$ ), and fourth ( $n = 35$ ) years for the 2019/2020 academic year participated in this study. These students were included in different integrated courses that contained a considerably heavy load of anatomy learning throughout the academic year. The gross anatomy load in the curriculum of the College of Medicine, University of Bisha forms about 10% of the whole contact hours distributed in 12 courses delivered over six semesters. The gross anatomy disciplines in these courses were integrated with other disciplines, such as histology, embryology, physiology, biochemistry, microbiology, pathology, and pharmacology. Student achievements in different courses were assessed through MCQs and short-answer questions for the theoretical parts. In addition, an objectively structured practical examination was held on cadaveric and plastic samples to assess the practical components. Second-year students were included in a course on structure and function for four weeks. The topics included an introduction to human anatomy and its roles in medical practice, levels of organization of the human body, the normal structure and functions of the tissues, organs, and systems of the body integrated with their malfunctions. The pure anatomy materials in the structure and function course contained six hours of TBL sessions and six hours of seminars. Third-year students took a musculoskeletal course for eight weeks, which involved incorporating data about different parts of

the skeleton, muscle groups, and joints. Fourth-year students had an eight-week course on the central nervous system that dealt with the development, structure, function, and disorders of the nervous system and special senses. The pure anatomy materials in the musculoskeletal and central nervous system courses contained eight hours of TBL sessions and eight hours of seminars. All the activities were conducted on site and in person before the COVID-19 lockdown.

### *Team-based learning and seminars*

At the beginning of each course, the medical students were supplied with a timetable, study guide, and the objectives for each activity, as well as references and study materials. The week before the activity (TBL or seminar), the assigned tutor communicated with students to specify the needed materials for the activity. TBL and seminars were conducted as two-hour sessions once per week for each activity at the College of Medicine of the University of Bisha, KSA. TBL started by an IRAT with seven MCQs for 14 min. Then, the students were divided into groups, with a maximum of ten students per group.<sup>3</sup> Each group conducted a discussion facilitated by the tutor about the seven MCQs in the GRAT, and then used a scratch card to give their answers within 10 min.<sup>6</sup> The assigned tutor carried out a mini-lecture to refine the knowledge and stress the required skills. The application exercise was the last event in the session, and it was conducted at a group level. The assessment was distributed among the different events as follows: 70% for IRAT, 20% for GRAT, and 10% for the application exercise. Pre-class preparation for the seminar included a PowerPoint presentation that covered the objectives of the topic. The presentation was prepared by two assigned students chosen in order. The presentation was revised and refined through communication between the assigned tutor and the students. Seminar sessions usually began with a pretest with seven MCQs for 14 min (worth 70% of the assessment). This quiz was followed by peer tutoring conducted by the two assigned students using their prepared and revised PowerPoint presentation and facilitated by the tutor. Assessment of the presenting students' performance was carried out by the tutor according to a checklist, and it was not considered in the final assessment. The seminar session ended with a posttest of seven MCQs within 10 min (worth 30% of the assessment mark). Anatomy activities were conducted by different tutors from the anatomy unit according to the scheduled timetable. Awareness sessions for the staff about the techniques of the activities were carried out within the schedule of the faculty development program and continuously monitored by the medical education training unit. Student-orientation sessions about different activities were done during their enrolment in the college, and a student guide was delivered in hard copies and is available in soft copy on the website of the University of Bisha.

### *Assessment of academic performance*

The continuous assessments in TBL and seminars of the previously defined medical students from years two, three, and four were considered (42, 40, and 35 students, respectively). All the participants were male, with a mean  $\pm$  SD age

of  $20.5 \pm 0.75$ ,  $21.2 \pm 1.1$ , and  $22.4 \pm 0.9$  for second-, third-, and fourth-year students, respectively. All the included students were registered as regular students and fulfilled all the prerequisites. Student marks were collected from the official records. Second-year students had three TBL sessions and three seminars in anatomy topics and were all included in the study. Third- and fourth-year students had four TBL sessions and four seminars in anatomy within their courses so that three activities were chosen randomly to include their marks in the study. To determine the accuracy of question sampling, the quizzes within the TBL sessions or seminars were constructed with a blueprint. The questions in the blueprint were classified according to Bloom's taxonomy, with 30% classified as memory and recall and 70% classified as understanding and application. The questions were constructed by different professors in the unit of anatomy and reviewed by all the unit staff members during a unit meeting to ensure the validity of the questions. They were then revised by the student assessment committee. Notably, seven MCQs were assigned in each assessment for each activity (IRAT and GRAT in TBL; and pretest and posttest in seminars). The difficulty of the questions was standardized through item analysis. The mean student marks in the three TBL sessions and the three seminars were calculated for each student in each year and compared using a paired-sample *t*-test. The strength of the relationship between the two activities (TBL and seminars) regarding student achievements was compared using Cohen's *d*-test, by calculating the mean difference between student achievements in both activities and then dividing by the pooled standard deviation ( $\pm$ SD) of the data for each year.<sup>7</sup> A *P*-value  $<0.05$  was considered statistically significant for all analyses. The Statistical Package for the Social Sciences (SPSS) software version 16 (SPSS Inc., Chicago, USA) was used for data analysis.

#### Assessment of perception

The second part of the study was performed by designing an online questionnaire through Google Docs to check students' perception regarding TBL and seminars in human anatomy learning. The questionnaire was designed by medical educators at the College of Medicine of the University of Bisha, and a link was sent to the official e-mails of students and labeled as anonymous with optional participation. It consisted of 12 questions in which the students were allowed to rank their perception using a five-point Likert scale: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). In addition, we included a question about whether they prefer TBL or seminars for anatomy learning. The optional participation of students in the questionnaire was considered as consent. Data collected from the first 12 items are presented as means  $\pm$  SD of the points from the Likert-scale responses for each item. The results for the last question item are presented as percentages based on the total participants in each year. The consistency and reliability of the items of the survey were considered using Cronbach's alpha test.<sup>19</sup> Kendall's Tau-b coefficient was used to assess the validity of the questionnaire.<sup>20</sup> The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was performed to reexamine the validity of the survey. Furthermore, Bartlett's test of sphericity was used as an

indicator of the relationship strength among variables.<sup>21</sup> Factor analysis was performed after determining the data appropriateness to assess the strength of the relationship among items of the surveys. SPSS software version 16 (SPSS Inc., Chicago, IL) was used to measure these parameters.

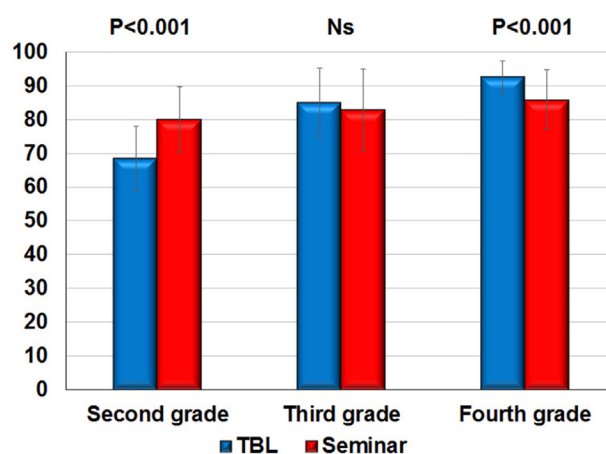
## Results

#### Analysis of academic performance

Item analysis showed a mean difficulty index of 60%. Between the three years, there was gradual improvement in the means of grades in TBL (means  $\pm$  SD:  $68.6 \pm 9.56$ ,  $82.8 \pm 12.25$ , and  $92.7 \pm 4.70$  for second-, third-, and fourth-year students, respectively). However, the means of seminar grades were nearly stationary (means  $\pm$  SD:  $80.0 \pm 9.66$ ,  $85.11 \pm 10.16$ , and  $85.9 \pm 8.80$  for second-, third-, and fourth-year students, respectively). Comparing the means of student grades in the two modalities (TBL and seminars) showed variable degrees of significance. Concerning the second year (the structure and function course), there was significant difference between TBL and seminars in favor of seminars, with  $P < 0.001$ . The mean difference in the results of the TBL and seminars in the third year (musculoskeletal course) was nonsignificant, with  $P = 0.306$ . The results of the fourth-year course (central nervous system course) indicated a significant difference between TBL and seminars in favor of TBL, with  $P < 0.001$  (Figure 1). Using Cohen's *d*-test, the mean differences in student achievements in TBL and seminars in the second, third, and fourth years were 1.03, 0.16, and 0.74, respectively.

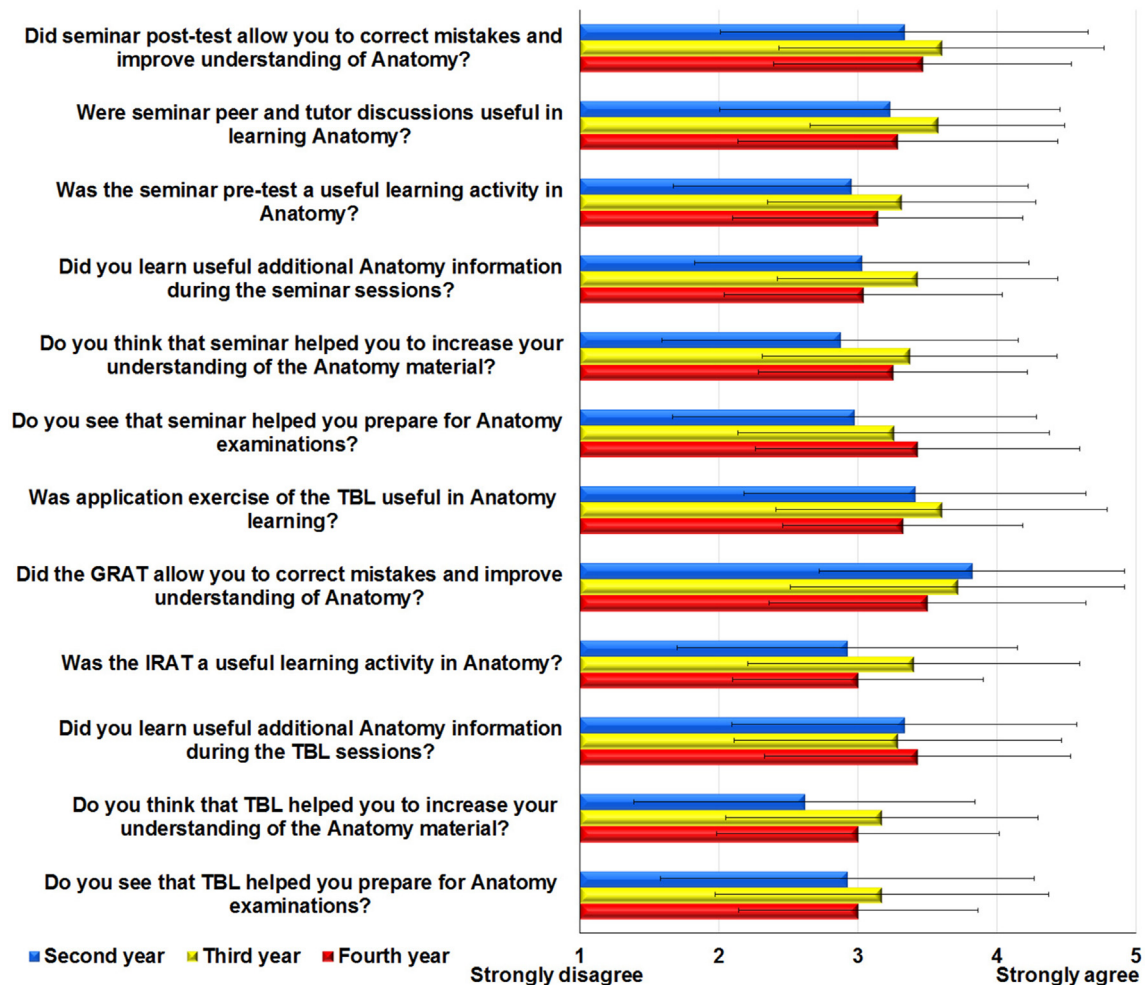
#### Analysis of perception

In the second year, the participation percentage was 93% (39 of 42 students). Further, 87.5% of third-year students



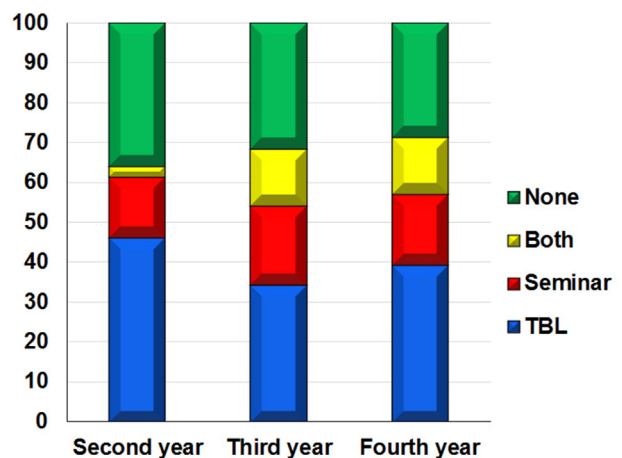
**Figure 1:** Representation of the students' mean scores in team-based learning and seminars in the second, third, and fourth years ( $n = 42$ , 40, and 35 students, respectively). The figure shows a gradual increase in mean team-based learning scores and constancy in mean seminar scores. The significance of the differences between both modalities is also provided. Values are means  $\pm$  SD.





**Figure 2:** Results of the survey of second-, third-, and fourth-year students ( $n = 39, 35,$  and  $28,$  respectively). The results show student perceptions about team-based learning and seminars in anatomy learning. Scores are based on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Values are means  $\pm$  SD.

shared in the questionnaire (35 of 40 students), and 80% (28 of 35 students) completed the survey in the fourth year (Figure 2). Cronbach's alpha tests for survey items indicated values of 0.94, 0.95, and 0.95 for the different years in ascending order. For the second year, the correlation coefficient ranged from 0.101 to 0.712, and it ranged from 0.124 to 0.667 and 0.182 to 0.747 for the third and fourth years, respectively. This indicated that the survey had a high degree of consistency and reliability, and the items were correlated well. Kaiser–Meyer–Olkin measures of sampling adequacy were 0.842, 0.835, and 0.726 for the second-, third-, and fourth-year student surveys, respectively. Bartlett's tests of sphericity were  $<0.001$  for the questionnaire for the three years. Notably, two factors were extracted from the survey of each year by factor analysis. In the second-year student survey, the factors covered the “importance of seminar in understanding” and “roles of TBL circumstances.” These two factors explained 71.79% of the cumulative variance: 61.17% and 10.62% for factors one and two, respectively. However, the extracted factors are related to the “role of TBL in understanding” and “peer discussion in



**Figure 3:** Summarization of student choices by second-, third-, and fourth-year students ( $n = 39, 35,$  and  $28,$  respectively) between team-based learning and seminars as their preferred method to learn anatomy. Values are presented as percentages (%).

seminars” in the year-three survey. They explained 66.78% of the cumulative variance, with 58.06% and 8.72% for the first and second factors, respectively. Regarding the fourth-year questionnaire, the factors outlined “peer discussion in seminars” and “role of TBL in understanding.” The factors explained 78.74% of the cumulative variance, with 67.42% and 11.32% for factors one and two, respectively. Concerning the last question in the questionnaire, to express their modality preference in learning anatomy, the students were allowed to choose TBL, seminars, both, or neither. All over the three years, TBL had the highest percentage of preference, especially among second-year students, followed by fourth- and then third-year students (46.2%, 39.3%, and 34.3%, respectively). In contrast, preference for seminars was much lower (20.0%, 17.9%, and 15.4% for third-, fourth-, and second-year students, respectively). A considerable percentage of students in all years preferred neither modality (35.9%, 31.4%, and 28.6% for second-, third-, and fourth-year students, respectively). The lowest percentages (2.6%, 14.3%, and 14.3% for years in ascending order) were for students who chose both modalities (Figure 3).

## Discussion

Moving away from teacher-centered forms to student-centered integrated models is a current trend in medical education.<sup>22</sup> In addition, increased representation of active learning strategies such as PBL strategies at the expense of passive learning approaches such as lectures is highly advocated.<sup>3,22</sup> Moreover, using different student-centered active learning methods with different objective assessment procedures is crucial for identifying and measuring student preparation abilities, engagement, and knowledge.<sup>23</sup> Anatomical courses provide a high degree of interactive teaching, which gives the anatomists the opportunity to modify and implement new approaches to learning.<sup>24</sup> Owing to the involvement in the integrated courses and the decreased curriculum time and teaching staff, methods of anatomy teaching have changed greatly to cope with accreditation requirements and technological progression.<sup>25</sup> In anatomy curricula, peer teaching has been widely recognized as a worthy approach to learning and has been effectively blended into healthcare curricula.<sup>26</sup> The style of peer teaching varies greatly among different curricula, including peer-developed learning materials, one-on-one teacher–student interactions, and group peer teaching.<sup>13</sup> In addition to lectures and practical sessions, since 1991, German medical schools applied a new approach to medical teaching in the form of seminars in anatomy and physiology.<sup>27</sup> As well, several medical schools in KSA, such as Al Qassim College of Medicine and Fakeeh College for Medical Sciences, have adopted TBL as an assessment strategy in different courses.<sup>7,28</sup> As a new and ambitious medical school, the College of Medicine of the University of Bisha in KSA adopted several new approaches, such as TBL, PBL, and seminars, for teaching integrated courses. Recent reports include the use of TBL in anatomy teaching.<sup>7</sup> Because it requires students to learn anatomical facts, from which they construct anatomical concepts for clinical problem solving, team-based learning is considered an attractive strategy for medical gross anatomy.<sup>13</sup> Student

performance after TBL in anatomy teaching has been evaluated in previous publications and showed acceptable improvement.<sup>29</sup> Moreover, it was reported that the weaker students perform better after using TBL regularly to learn anatomy.<sup>30</sup> In addition, Inuwa et al. (2012) compared student achievements in IRAT and in-course examinations and attributed significantly higher mean scores in IRAT, indicating that students better understood course content provided by a TBL teaching strategy.<sup>3</sup> In other studies, scores in final examinations were compared in two student cohorts, where the first was taught with traditional lecture-based methods, and the second with TBL in medicine,<sup>31</sup> physical therapy,<sup>32</sup> and nursing.<sup>33</sup> Taken together, the scores greatly support the use of the TBL approach in gross anatomy courses. Adding to this, the students in our study showed an acceptable level of achievement in TBL activities. Although the difficulty of the questions was standardized, there was significant improvement in TBL marks ( $P < 0.001$ ) from increased experience in learning. The younger the students, the less their experience in learning and the less their ability to benefit from the learning strategy. This was evident in the marks of the second-year students, who got the lowest marks in comparison with their older colleagues. Moreover, the highest marks were obtained by the oldest students. This is consistent with Mansoor et al. (2019), who found that student performance improved insignificantly in the first half of the course but showed significant improvement in the second half.<sup>34</sup> In other experiments, students did not achieve better scores after TBL when compared to traditional lectures.<sup>35</sup> However, the results of a study conducted in China revealed that TBL enhanced examination scores.<sup>36</sup> Based on the argument by Inuwa et al. (2012), lower student achievements in the in-course test were attributable to the wide content area covered in the test compared with the IRAT, which covered a small topic in the course.<sup>3</sup> The modified version of TBL conducted by Anwar et al. (2020) provided students with a pressure-free environment to consolidate knowledge obtained throughout the course and improved their performance.<sup>37</sup> To the best of our knowledge, there are no previous studies of undergraduate achievements in anatomy seminars. In our study, student achievements in TBL were compared with their achievements in seminars as two balanced modalities regarding their weight in the assessment, the conduction frequency, their weight in the curriculum, and covering topics of nearly the same size. Student marks in seminars over all three years were nearly average, showing a stationary character between means, with no significant improvement or regression through different years ( $P = 0.0511$ ). This might be because students benefit most from seminars from the first time they apply. According to the principles of small group learning, active learning promotion is the main objective of seminar learning, although the outcome is affected by the didactic approach and the facilitating methods used by the teachers.<sup>38</sup> Using a previously structured questionnaire, student perceptions regarding TBL and seminars were evaluated through different years. Variable satisfaction degrees were recorded among students in different years. Most of the students appreciated the value of GRAT in TBL, which is the characteristic cornerstone in peer teaching, learning, and brushing-up on knowledge of

anatomy. Moreover, the importance of the posttest during the seminar pertains to the correction and confirmation of knowledge. This coincides with Inuwa et al. (2012), who found that considerable teaching and learning occurred between peers during GRAT, and that TBL provides a valuable opportunity for the tutor to clarify misunderstandings about anatomical concepts.<sup>3</sup> In our study, team-based learning was preferred by students in all years and student marks progressed as the students got older and built more social relations between them. Furthermore, student enthusiasm, initiative, learning ability, communication skills, and team awareness were markedly enhanced after TBL.<sup>36</sup> Most students agreed that TBL is promising, as students interact more and show good acceptance, high motivation, and successful experiences.<sup>35</sup> Moreover, TBL can develop inter-professional learning and serve as a substitute for didactic lectures in anatomy education.<sup>9</sup> Interestingly, Vasan et al. (2009) observed that all students had positive perceptions of TBL, and that the perceptions among high-performing students were significantly greater than those among low achievers.<sup>39</sup> They proposed that high achievers can successfully use the interactive learning modalities or have previous experience in active learning and are able to adapt more easily to the benefits of this method in learning anatomy. In contrast, some students rated traditional strategies of teaching higher than other forms, including TBL. It was suggested that these students have encountered difficulty in assessing their perceived learning from TBL.<sup>40</sup> At the College of Medicine, Al Faisal University Riyadh in KSA, a study was conducted to evaluate the perception for different learning strategies according to different personality types. The results showed that some students who are sensitive and tend to avoid conflict and confrontation preferred nearly equally both traditional lectures and TBL.<sup>41</sup> In the current study, it was surprising to find that approximately twice as many students preferred TBL over seminars, although their achievements in seminars were acceptable. Seminars are subject-centered or leader-centered, rather than participant-centered. Seminar leaders explore a predetermined topic after an assessment and then ensure that it was adequately delivered.<sup>4</sup> Tutarel et al. (2000) concluded that effective and acceptable anatomy teaching in a seminar must contain a short introduction by the tutor, along with attractive, informative graphics that are descriptive and visual.<sup>27</sup> In addition, it was reported that group interaction during seminars was negatively related to learning.<sup>42</sup> However, in other recent studies, students believed that the interactive manner of seminars is highly interesting, aids in learning, and has a positive effect on student assessments.<sup>13</sup> In addition to studies conducted in multidisciplinary team seminars that delivered didactic and case-based instructions supplemented by cadaveric presentations in anatomy, the authors stated that the seminars were associated with improved knowledge scores and resident satisfaction.<sup>43</sup> Moreover, because seminars are considered more practical, interactive, dynamic, and interesting, they received uniform positive feedback in anatomy teaching among rheumatologists.<sup>44</sup> Going up through years in this study, the refusal of both learning modalities decreased in a gradual manner that goes well with the distribution of marks and student satisfaction, especially regarding TBL. In addition, the low preference for both modalities among

second-year students might be caused by less orientation and familiarity with the techniques and relatively little socialization among students that improved gradually. Taking into consideration the results of previous evaluations, some professionals revealed that the manner of teaching and learning is the main reason for the success. Seminars provide a good opportunity to combine preclinical subjects such as anatomy with their clinical applications.<sup>27</sup> In addition, TBL is an effective substitute for anatomy lectures when properly prepared and conducted.<sup>6</sup> This is consistent with the results of well-structured online TBL sessions conducted by Al-Neklawy and Ismail (2021) at Fakeeh College for Medical Sciences, Jeddah, KSA, on different medical programs, showing statistically significant positive satisfaction and success.<sup>28</sup> As well, student perception showed that modified TBL made the students feel restful and enhanced their knowledge consolidation, exam preparation, and performance.<sup>37</sup>

## Conclusion

By summation of the current results with the previous experiences in education, it can be concluded that TBL is more favorable to medical students at the University of Bisha, even in practical sciences like anatomy. This might be because group peer teaching activities reinforce student information, maintain student–student and student–tutor contact, and motivate the students to improve their performance.

## Study limitations

The first limitation is the small number of enrolled students. The college is newly established, and at the time of the study, only male students were enrolled. The second limitation is that the final achievements of the students could not be evaluated, as the final examinations were shifted online due to the COVID-19 pandemic. However all the included activities (TBL sessions and seminars) were conducted at the college before lockdown. The third limitation is that there were no available historical data regarding student achievements in anatomy without TBL and seminars that could be used as a gold standard, as these two modalities have been adopted since the establishment of the curriculum.

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## Conflict of interest

The authors have no conflict of interest to declare.

## Ethical approval

Approval from the local research and ethics committee of the College of Medicine at Bisha University was obtained with reference number UBCOM/H-06-BH-087(04/16), ethical date is March 10<sup>th</sup> 2020.

### Authors contributions

**AMA** conceived and designed the study, analyzed the data, and shared in validation, writing, reviewing, and editing the draft. **HMS** applied the methodology and shared in project administration. **ASM** supervised the work and shared in the investigation and methodology design. **AME** led the writing, reviewing, and editing of the draft, and shared in the investigation and data curation. **AAH** provided logistic support and shared in project administration. **OAM** led the investigations and shared in reviewing and editing the draft. **TAE** managed the resources and software issues, and shared in methodology design and validation. **AS** shared in data analysis and the validation of the study. **MA** managed project administration issues and shared in formal analysis. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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### References

- Elzainy A, El Sadik A. The impact of flipped classroom: evaluation of cognitive level and attitude of undergraduate medical students. *Ann Anat* 2022 May 5:151952.
- Lambert DR, Lurie SJ, Lyness JM, Ward DS. Standardizing and personalizing science in medical education. *Acad Med* 2010; 85: 356–362.
- Inuwa IM, Al-Rawahy M, Roychoudhry S, Taranikanti V. Implementing a modified team-based learning strategy in the first phase of an outcome-based curriculum—challenges and prospects. *Med Teach* 2012; 34: e492–e499.
- Shiozawa T, Griewatz J, Hirt B, Zipfel S, Lammerding-Koepfel M, Herrmann-Werner A. Development of a seminar on medical professionalism accompanying the dissection course. *Ann Anat* 2016; 208: 208–211.
- Fleagle TR, Borcharding NC, Harris J, Hoffmann DS. Application of flipped classroom pedagogy to the human gross anatomy laboratory: student preferences and learning outcomes. *Anat Sci Educ* 2018; 11: 385–396.
- Melovitz-Vasan C, Pinhal-Enfield G, DeFouw DO, Vasan NS. Team-based learning: an effective pedagogical strategy to teach anatomy. In: Chan LK, Pawlina W, editors. *Teaching anatomy: a practical guide*. 1st ed. New York, NY: Springer International Publishing; 2015. pp. 133–141.
- El Sadik A, Al Abdulmonem W. Improvement in student performance and perceptions through a flipped anatomy classroom: shifting from passive traditional to active blended learning. *Anat Sci Educ* 2021; 14: 482–490.
- Thistlethwaite JE, Davies D, Ekeocha S, Kidd JM, MacDougall C, Matthews P, et al. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME guide no. 23. *Med Teach* 2012; 34: e421–e444.
- Lochner L, Wieser H, Oberhöller G, Ausserhofer D. Interprofessional team-based learning in basic sciences: students' attitude and perception of communication and teamwork. *Int J Med Educ* 2020; 11: 214–221.
- Chen M, Ni C, Hu Y, Wang M, Liu L, Ji X, et al. Meta-analysis on the effectiveness of team-based learning on medical education in China. *BMC Med Educ* 2018; 18: 77.
- Bednar ED, Hannum WM, Firestone A, Silveira AM, Cox TD, Proffit WR. Application of distance learning to interactive seminar instruction in orthodontic residency programs. *Am J Orthod Dentofacial Orthop* 2007; 132: 586–594.
- Shedlock J, Sims RH, Kubilius RK. Promoting and teaching the history of medicine in a medical school curriculum. *J Med Libr Assoc* 2012; 100: 138–141.
- Patel JR, Patel DS, Desai R, Parmar J, Thaker R, Patel ND. Evaluation of student seminar in medical education: student perspectives. *Int J Curr Res Rev* 2015; 7: 6–9.
- Ibrahim ME, Al-Shahrani AM, Abdalla ME, Abubaker IM, Mohamed ME. The effectiveness of problem-based learning in acquisition of knowledge, soft skills during basic and preclinical sciences: medical students' points of view. *Acta Inform Med* 2018; 26: 119–124.
- Sattar K, Sethi A, Akram A, Ahmad T, John J, Yusoff MS. Flipped classroom teaching modality: key concepts and practice endorsements. *Educ Med J* 2019 Mar 1; 11(1).
- Ibrahim ME, Al-Shahrani AM. Implementing of a problem-based learning strategy in a Saudi medical school: requisites and challenges. *Int J Med Educ* 2018; 9: 83–85.
- Yaqinuddin A, Ikram MF, Zafar M, Eldin NS, Mazhar MA, Qazi S, et al. The integrated clinical anatomy program at Alfaisal University: an innovative model of teaching clinically applied functional anatomy in a hybrid curriculum. *Adv Physiol Educ* 2016; 40: 56–63.
- Day LJ. A gross anatomy flipped classroom effects performance, retention, and higher-level thinking in lower performing students. *Anat Sci Educ* 2018; 11: 565–574.
- Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. *Res Sci Educ* 2018; 48: 1273–1296.
- Couso I, Strauss O, Saulnier H. Kendall's rank correlation on quantized data: an interval-valued approach. *Fuzzy Set Syst* 2018; 343: 50–64.
- Chan LL, Idris N. Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha. *Int J Acad Res Bus Soc Sci* 2017; 7: 400–410.
- Wijnen-Meijer M, Ten Cate OT, Van Der Schaaf M, Borleffs JC. Vertical integration in medical school: effect on the transition to postgraduate training. *Med Educ* 2010; 44: 272–279.
- Carrasco GA, Behling KC, Lopez OJ. Evaluation of the role of incentive structure on student participation and performance in active learning strategies: a comparison of case-based and team-based learning. *Med Teach* 2018; 40: 379–386.
- Morton DA, Colbert-Getz JM. Measuring the impact of the flipped anatomy classroom: the importance of categorizing an assessment by Bloom's taxonomy. *Anat Sci Educ* 2017; 10: 170–175.
- Vasan NS, DeFouw D. Team-based learning: pedagogy for the 21st century-effective, efficient and economical. In: Gillies RM, editor. *Pedagogy: new developments in the learning sciences*. 1st ed. Hauppauge, NY: Nova Science Publishers, Inc.; 2012. pp. 271–295.
- Youdas JW, Hoffarth BL, Kohlwey SR, Kramer CM, Petro JL. Peer teaching among physical therapy students during human gross anatomy: perceptions of peer teachers and students. *Anat Sci Educ* 2008; 1: 199–206.
- Tutarel O, Luedemann W, Nautrup CP, Jahn K, Wilke M, von Rautenfeld DB. Introduction and evaluation of a modular



- seminar system in gross anatomy teaching at the Hannover Medical School. *Ann Anat* **2000**; 182: 393–396.
28. Al-Neklawy AF, Ismail AS. Online anatomy team-based learning using blackboard collaborate platform during COVID-19 pandemic. *Clin Anat* **2022**; 35: 87–93.
  29. Vasan NS, DeFouw DO, Holland BK. Modified use of team-based learning for effective delivery of medical gross anatomy and embryology. *Anat Sci Educ* **2008**; 1: 3–9.
  30. Koles PG, Stolfi A, Borges NJ, Nelson S, Parmelee DX. The impact of team-based learning on medical students' academic performance. *Acad Med* **2010**; 85: 1739–1745.
  31. McMullen I, Cartledge J, Levine R, Iversen A. Team-based learning for psychiatry residents: a mixed methods study. *BMC Med Educ* **2013**; 13: 124.
  32. Lein J, Donald H, Lowman JD, Eidson CA, Yuen HK. Evaluation of team-based learning in a doctor of physical therapy curriculum in the United States. *J Educ Eval Health Prof* **2017**; 14: 34.
  33. McRae ME, Chan A, Lee AJ, Hulett R, Coleman B. Team-based learning improves staff nurses' knowledge of open-and closed-chest cardiac surgical resuscitation. *Dimens Crit Care Nurs* **2017**; 36: 60–67.
  34. Mansoor M, Aly SM, Javaid A. Effect of team-based learning on second year students' academic performance. *J Coll Physicians Surg Pak* **2019**; 29: 860–864.
  35. Rezende AB, de Oliveira AG, Vale TC, Teixeira LA, Lima AR, Lucchetti AL, et al. Comparison of team-based learning versus traditional lectures in neuroanatomy: medical student knowledge and satisfaction. *Anat Sci Educ* **2020**; 13: 591–601.
  36. Yan J, Ding X, Xiong L, Liu E, Zhang Y, Luan Y, et al. Team-based learning: assessing the impact on anatomy teaching in People's Republic of China. *Adv Med Educ Pract* **2018**; 9: 589–594.
  37. Anwar K, Kashir J, Sajid MR, Rasool AJ, Shaikh AA, Ikram MF, et al. Implementation of structured team-based review enhances knowledge consolidation and academic performance of undergraduate medical students studying neuroscience. *Adv Physiol Educ* **2020**; 44: 232–238.
  38. Spruijt A, Jaarsma AD, Wolfhagen HA, van Beukelen P, Scherpbier AJ. Students' perceptions of aspects affecting seminar learning. *Med Teach* **2012**; 34: e129–e135.
  39. Estai M, Bunt S. Best teaching practices in anatomy education: a critical review. *Ann Anat* **2016**; 208: 151–157.
  40. Laksov KB, McGrath C, Josephson A. Let's talk about integration: a study of students' understandings of integration. *Adv Health Sci Educ Theory Pract* **2014**; 19: 709–720.
  41. Arain SA, Alhadid DA, Rasheed S, Alrefaai MM, Alsibai TMA, Meo SA. Perceived effectiveness of learning methods among preclinical medical students - role of personality and changes over time. *Pak J Med Sci* **2021**; 37: 1854–1859.
  42. Jaarsma AD, De Grave WS, Muijtjens AM, Scherpbier AJ, Van Beukelen P. Perceptions of learning as a function of seminar group factors. *Med Educ* **2008**; 42: 1178–1184.
  43. D'Souza L, Jaswal J, Chan F, Johnson M, Tay KY, Fung K, et al. Evaluating the impact of an integrated multidisciplinary head & neck competency-based anatomy & radiology teaching approach in radiation oncology: a prospective cohort study. *BMC Med Educ* **2014**; 14: 124.
  44. Torralba KD, Villaseñor-Ovies P, Evelyn CM, Koolae RM, Kalish RA. Teaching of clinical anatomy in rheumatology: a review of methodologies. *Clin Rheumatol* **2015**; 34: 1157–1163.

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