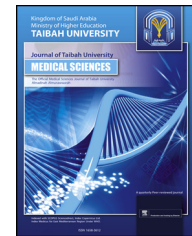




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Original Article

Comparing students' performance in self-directed and directed self-learning in College of Medicine, University of Bisha



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المخلص

أهداف البحث: تزيد استراتيجية التعلم المرتكز على الطالب من احتمالية تخريج أطباء أكفاء ومعتمدين على أنفسهم وقادرين على حل المشكلات. اعتمدت كلية الطب بجامعة بيشة التعلم الموجه ذاتيا ممثلا بالتعلم القائم على حل المشكلات، والتعلم الذاتي الموجه ممثلا بالتعلم القائم على الفريق.

طريقة البحث: تم جمع ما مجموعه 502 سوالا من أسئلة متعددة الخيارات من اختبارات منتصف المقرر والامتحانات النهائية من قبل خبراء المواد ذات الصلة من تسع دورات خلال الفترة من سبتمبر 2020 حتى يونيو 2023 والتي اعتمدت التعلم القائم على حل المشكلات والتعلم القائم على الفريق؛ 247 سوالا متعدد الأسئلة تتعلق بالتعلم القائم على حل المشكلات و255 سوالا يتعلق بالتعلم القائم على الفريق. تم استخدام التحليل السيكومتري لتحديد الأسئلة الصعبة والسهلة والأفضل. نقطة ثنائية حيث تشير إلى نقطة ثنائية ضعيفة وهامشية وجيدة وممتازة على التوالي. وأخيرا، تمت محاولة عدد المشتتات الوظيفية بنسبة تزيد عن 5% من المرشحين.

النتائج: لا توجد فروق ذات دلالة إحصائية في أداء الطلاب في الأسئلة متعددة الاختيارات المتعلقة بالتعلم المبني على المشكلات (يمثل أداة التعلم الموجه ذاتيا للمجموعات الصغيرة)، والتعلم المبني على الفريق (يمثل أداة التعلم الموجه ذاتيا للمجموعات الكبيرة) فيما يتعلق بمؤشر الصعوبة، ووظائف تشتت الانتباه.

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الاستنتاجات: لوحظ أنه لا يوجد فرق في أداء الطلاب سواء تم استخدام التعلم القائم على حل المشكلات أو التعلم القائم على الفريق لتعلم مقررات العلوم الطبية الأساسية. يحتاج التعلم في مجموعات صغيرة مثل التعلم القائم على حل المشكلات إلى موارد أكثر مقارنة بالتعلم في مجموعات كبيرة كما هو الحال في التعلم القائم على الفريق، وبالتالي يمكن لأي كلية أن تقرر استراتيجية التعلم المعتمدة على مواردها وعدد طلابها.

الكلمات المفتاحية: التعلم القائم على حل المشكلات؛ التعلم القائم على الفريق؛ التعلم الذاتي؛ التعلم الذاتي الموجه؛ مؤشر الصعوبة؛ نقطة ثنائية

Abstract

Background: Student-centered learning strategy increases the likelihood of graduation of competent, self-dependent, and problem-solving physicians. The University of Bisha, College of Medicine (UBCOM) adopted self-directed learning (SDL) represented by problem-based learning (PBL), and directed self-learning (DSL) represented by team-based learning (TBL).

Aim: To compare the students' performance in SDL and DSL among UBCOM students.

Methodology: A total of 502 multiple choice questions (MCQs) from the mid-course and final exams were collected by the relevant subject experts from nine courses during the period from September 2020 till June 2023 that adopted PBL and TBL; 247 MCQs related to PBL and 255 related to TBL. Psychometric analysis was used to determine difficult, easy, and optimum questions ($\leq 25\%$, $\geq 90\%$, and 26–89%, respectively). Point biserial as < 0.19 , 0.20–0.29, 0.30–0.39, and > 0.40 which indicate poor, marginal, good, and excellent point biserial, respectively. Finally, the number of functional distractors was attempted by $> 5\%$ of the candidates.

Results: No significant differences were noted for the students' performance in MCQs related to PBL (representing self-directed, small group learning tool), and TBL (representing directed-self, large group learning tool) regarding difficulty index (DI), point biserial, and distractors functionality.

Conclusion: It has been observed that there is no difference in students' performance whether PBL or TBL is used for learning Basic Medical Science courses. Small group learning such as PBL needs more resources in comparison to large group learning as in TBL, therefore any institute can decide on the adopted learning strategy depending on its resources and the number of students.

Keywords: Difficulty index; Directed self-learning; Point biserial; Problem-based learning; Self-directed learning; Team-based learning

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Introduction

Traditional teaching methods provide effective tools for knowledge transmission but consider students as passive recipients of knowledge with limited ability to reach and engage all students.¹ On the other hand, converting the students into active learners greatly reduces the learning time.² This can be achieved via student-centered learning activities, which are highly recommended nowadays by most medical schools worldwide. This approach converts the students into active learners, ensures students' engagement, and in turn enhances their satisfaction. Moreover, the student-centered learning approach proved to be more effective than the passive traditional teacher-centered approach in stimulating students' motivation, confidence, and enthusiasm and enhancing problem-solving and critical thinking skills.^{3–8} According to Bloom's taxonomy, students get lower-order cognitive skills, such as knowledge (information gathering) and understanding, through SDL and DSL before classroom time and later achieve advanced cognition (application, analysis, evaluation, and synthesis) in the classroom phase, where the teacher acts as a discussion organizer.⁹ Flipped classroom (FC) is a student-centered approach that reverses the traditional classroom and homework system in which DSL was done at home.¹⁰ In the FC approach, class time is used to integrate and apply the knowledge through problem-solving, team-based, and case-based learning.^{11–13}

Team-based learning is considered a successful way to apply a flipped classroom.¹⁴ Team-based learning is a method in which students learn the primary course content outside of class and spend class time working in teams to apply that content.¹⁵ Although TBL may be somewhat daunting in its implementation, it promotes problem-solving, cooperation, communication, and collegial competition and enhances life-long learning.^{16–19} In TBL, the Readiness Assurance Process (RAP) involves the students' accountability for completing the pre-class reading and acquiring the foundational knowledge before class, then completing it inside the classroom individually and through teamwork.¹⁵ Briefly, the TBL methodology involves firstly, the tutor sending the learning objectives and materials to the students. Secondly, the students will do their preparatory reading outside of class via individual learning, then attend the class for the MCQ assessment test on an individual basis called the individual readiness assurance test (iRAT). Thirdly, students answer the MCQs provided individually through different groups, the so-called team readiness assurance test (tRAT), by using an Immediate Feedback Assessment Technique (IF-AT) scratch-off card. For any missed questions on the tRAT, the team can generate a written appeal and revisit the preparatory work to engage with the material again. Fourthly, a facilitated discussion led by the tutor, through which time students ask questions about unclear concepts for further clarification. At the end of the RAP, the students should be sufficiently prepared to attempt application exercises.^{16,20–22}

The problem-based learning (PBL) is also an innovative student-centered strategy that encourages students to learn in

small groups through engagement in a real problem. They use “triggers” from a problem-case scenario to formulate their learning outcomes. Subsequently, they do independent, self-directed study before returning to the group to discuss and refine their acquired knowledge.²³ The PBL tutorial consists of a group of students (usually eight to 10) and a tutor who facilitates the session. Within each group, the students elect a leader (chair) and a “scribe” to record the discussion for each PBL tutorial. The students are then provided with a relevant, authentic, ill-structured problem scenario for discussion.^{16,24} The most widely used PBL methodology is the Maastricht “seven jump model”²⁵ that is implemented through two sessions separated by an independent study: *Step 1*: Clarifying terms and concepts; *Step 2*: Defining the problem, *Step 3*: brainstorming to discuss the problem, and suggest possible explanations; *Step 4*: Analyzing the problem; *Step 5*: Formulating learning objectives, *Step 6*: Collecting additional information outside the group through a self-directed study, *Step 7*: Reporting, synthesizing, and refining information. PBL is considered an efficient student-centered instructional method owing to its ability to foster active deep learning and knowledge retention, allow students to develop generic skills and attitudes needed for their future practice, enhance students’ motivation and engagement, and facilitate core curriculum integration.²³

Both PBL (representing self-directed, small group learning tool) and TBL (representing directed-self, large group learning tool) are well supported by the constructivist learning theory.^{26,27}

Since the PBL is considered an instructional method that depends on the learners’ efforts to design their learning needs and formulate their learning goals (SDL), learners are provided with learning objectives in advance in TBL (DSL). This research aimed to investigate if there is a significant difference in medical students’ performance on MCQs for topics learned through self-directed learning (represented by PBL) and directed structured learning (represented by TBL) in terms of difficulty index, point biserial, and distractor functionality.

Materials and Methods

This analytical cross-sectional study was conducted in UBCOM during the period from September 2020 to June 2023.

Study design

A quantitative cross-sectional study was carried out to evaluate the efficiencies of PBL and TBL approaches. Multiple choice questions (MCQs) from the mid-course and final exams were collected by subject experts and the course coordinators from nine courses conducted from grade II-IV that adopted PBL and TBL. MCQs were of the “one best answer from the 4 options” type. The courses were conducted in 3 successive academic years (2020–2021, 2021–2022, and 2022–2023). The courses were “Introduction to Medicine and Medical Education”, “Structure and Function of Human Body”, “Growth and Development”, “Biochemical and Genetic Basis of Human Body”, “Hematopoietic System and Host Defense”, “Gastrointestinal System”, “Cardiovascular system”, “Central nervous system”, and

“Behavioral science and Doctoring”. Students’ marks and item analysis reports were anonymously provided by the college exam office after the automatic machine correction of the MCQ questions.

Inclusion criteria

Exam results for the previously mentioned nine courses conducted in UBCOM in the academic years (2020–2021, 2021–2022, and 2022–2023).

Exclusion criteria

Exam results for any course other than the targeted courses in the assigned timeline, and any exam results for courses conducted outside UBCOM.

Sample size determination and calculation

$$\text{Sample size formula : } N = \frac{Z^2 \times P(1 - P)}{e^2}$$

By using a population proportion of 50%, 95% confidence interval, and a margin of error of 0.5%, the total population size is considered unlimited.... The sample size calculated by the online sample size calculator tool (www.raosoft.com), the estimated sample size is equal to 385 MCQs.

UBCOM is a new institute with three batches of full enrollment in hospital services and the Saudi residency program. The MBBS program has an innovative integrated curriculum with student-centered teaching and assessment methodology consisting of continuous assessment (40%) and final exam (60%) covering theory exam, OSPE, and OSCE.

Students’ orientation about PBL and TBL

Orientation of students about PBL and TBL activities was performed in the 1st course conducted in the 2nd year (Introduction to Medicine and Medical Education). The students received comprehensive illustrations regarding TBL, PBL, seminars, case-based learning (CBL), skill labs and simulators, medical professionalism, E-learning, mentoring, and communication skills.

The PBL activity in UBCOM

PBL is a complex task that requires teamwork between facilitators, subject experts, and the medical education department. It’s conducted once a week by a process or content expert.^{28,29} UBCOM generates its own PBL cases for the various courses in Phase I and II. The case scenario follows the seven principles for efficient problem design in PBL as described in the literature.³⁰ The facilitators write the case scenarios with guidance from the medical education department and subject experts from each discipline. There are 2 types of assessments: tutor assessment and peer assessment. Student assessment is split 35% for session 1 (attitude and punctuality 5%, group skills 10%, participation 10%, and critical thinking 10%) and 65% for session 2 (preparedness 5%, attitude and punctuality 5%, knowledge 20%, group skills 10%, participation 10%, relevance of resources 5%, and critical thinking 10%).

The TBL activity in UBCOM

TBL is conducted weekly by a subject expert. Students are divided into teams based on their academic achievements.

Pre-class materials are sent three days before the session. The subject expert prepares iRAT and tRAT questions and gives a mini-lecture. IFAT cards are used for instant feedback. A mini-lecture is conducted to clarify challenging learning objectives. A problem-solving exercise is given to assess students' application skills. The score split is 70% iRAT, 20% tRAT, and 10% application tasks.

Achievement assessment

A total of 502 MCQs were collected from courses that adopted TBL and PBL. All MCQs were approved by the Basic Medical Science Department and revised by the course and student assessment committees. The questions were classified according to Bloom's taxonomy into 30% knowledge and 70% skills and application. Item analysis was performed for difficulty and discrimination. 247 MCQs were related to PBL, 255 were related to TBL, and the courses covered basic science and different systems. The theory exams for these courses include MCQs to cover activities prepared through PBL, TBL, seminars, interactive lectures, and skill lab activities. Psychometric analysis was used to determine the difficult, easy, and optimum questions (<25%, >90%, and 26–89% respectively) according to UBCOM guidelines with little modification for the difficulty index used in many studies in which the difficulty index between 30 and 70% was considered as acceptable. Those items with values between 50% and 60% were ideal while items with less than 30% (too difficult) and more than 70% (too easy) are not acceptable or need revision,^{31,32} point biserial as <0.19, 0.20–0.29, 0.30–0.39 and >0.40 which indicate poor, marginal, good and excellent point biserial respectively^{33–35} and finally number of functional distractors (a functional distractor is that attempted by more than 5% of the candidates).^{36–38}

Statistical analysis

It was performed through the Chi-square test to compare PBL and TBL questions of the midcourse and final course exams regarding the difficulty index, point biserial, and functional distractors. The *P*-value is considered significant when it is <0.05.

Results

The total number of MCQs for the topics learned through PBL and TBL in the 3 successive academic years (2020–2021, 2021–2022, and 2022–2023) was 502 (247 for PBL) and (255 for TBL).

Regarding the difficulty index for MCQs about PBL topics, 8% (19/247) were difficult, 14% (34/247) were easy, and 78% (195/247) were optimum. For MCQs about TBL topics, 9% (23/255) were difficult, 13% (33/255) were easy, and 78% (198/255) were optimum (Table 1). There was no significant difference (*P* = 0.8407) between the difficulty index of MCQs touching PBL and TBL topics.

Regarding the discrimination index for PBL and TBL MCQs, poor discrimination was recorded in 22.3% (55/247), and 26.3% (67/255) respectively, marginal discrimination in 21.5% (53/247), and 25.1% (64/255) respectively,

Table 1: Estimation of the difficulty index for the midcourse and final theory exam questions of three successive academic years touching the topics learned through PBL and TBL in the selected medical courses.

Course name	No of PBL MCQS	No of TBL MCQS	Total	DI for PBL MCQs			DI for TBL MCQs			<i>P</i> -value
				No. of Difficult < 25%	No. of Easy > 90%	No. of Optimum 26%–89%	No. of Difficult < 25%	No. of Easy > 90%	No. of Optimum 26%–89%	
Introduction to Medicine and Medical Education	14	15	29	2	2	10	3	4	8	0.8407
Growth and Development	2	3	5	1	1	1	0	0	2	
Biochemical and Genetic Basis of Human Body	35	52	87	1	5	29	5	9	38	
Hematopoietic System and Host Defense	43	51	94	2	6	35	3	7	41	
Gastrointestinal	44	40	84	3	6	35	2	5	33	
Cardiovascular	40	35	75	3	3	34	4	2	29	
Behavioral Science and Doctoring	10	9	19	1	4	5	2	2	5	
Structure and Function of Human Body	10	16	26	2	1	7	0	1	15	
Central nervous system	49	34	83	4	6	39	4	3	27	

Significant *P*-value <0.05.

Table 2: Estimation of the point biserial for the midcourse and final theory exam questions of three successive academic years touching the topics learned through PBL and TBL in selected medical courses.

Course name	No of PBL MCQs	No of TBL MCQs	Total	Point biserial for PBL MCQs				Point biserial for TBL MCQs				<i>P</i> -value
				No. of <0.19 (poor)	No. of 0.20–0.29 (marginal)	No. of 0.30–0.39 (good)	No. of >0.40 (excellent)	No. of <0.19 (poor)	No. of 0.20–0.29 (marginal)	No. of 0.30–0.39 (good)	No. of >0.40 (excellent)	
Introduction to Medicine and Medical Education	14	15	29	1	3	3	7	2	4	8	1	0.1997
Growth and Development	2	3	5	0	0	2	0	1	2	0	0	
Biochemical and Genetic Basis of Human Body	35	52	87	0	4	22	9	1	15	24	12	
Hematopoietic system and Host Defense	43	51	94	10	12	9	12	18	11	8	14	
Gastrointestinal	44	40	84	11	10	17	6	9	13	10	8	
Cardiovascular	40	35	75	11	6	10	13	12	9	8	6	
Behavioral science and Doctoring	10	9	19	3	1	3	3	5	2	2	0	
Structure and Function of Human Body	10	16	26	4	2	1	3	4	4	4	4	
Central nervous system	49	34	83	15	15	10	19	15	4	3	12	
Total	247	255	502	55	53	77	72	67	64	67	57	

Significant *P*-value <0.05.**Table 3: Estimation of the distractor functionality for the midcourse and final exam questions of three successive academic years touching the topics learned through PBL and TBL in the selected medical courses.**

Exam no	No of PBL MCQs	No of TBL MCQs	Total	No. of functional distractors				No. of functional distractors				<i>P</i> -value
				None	One	Two	Three	None	One	Two	Three	
Introduction to Medicine and Medical Education	14	15	29	0	0	2	12	0	0	6	9	0.2272
Growth and Development	2	3	5	0	2	0	0	0	0	1	2	
Biochemical and Genetic Basis of Human Body	35	52	87	0	1	9	25	0	2	14	36	
Hematopoietic system and Host Defense	43	51	94	5	8	20	10	8	9	18	16	
Gastrointestinal	44	40	84	4	6	18	16	5	10	16	9	
Cardiovascular	40	35	75	2	6	14	18	2	8	10	15	
Behavioral science and Doctoring	10	9	19	3	2	5	0	2	1	1	5	
Structure and Function of Human Body	10	16	26	1	2	4	3	1	2	4	9	
Central nervous system	49	34	83	4	9	18	18	1	8	8	17	
Total	247	255	502	19	26	90	102	19	40	78	118	

Significant *P*-value <0.05.

Distractor is functional when attempted by >5% of the candidate, and nonfunctional when attempted by <5% of candidates.

good discrimination in 31.2% (77/247), and 26.3% (67/255) respectively, and excellent discrimination in 29.1% (72/247), and 22.4% (57/255) respectively (Table 2). There was no statistically significant difference ($P = 0.1997$) between the discrimination index of MCQs touching PBL and TBL topics.

Regarding functionality of the distractors for MCQs about PBL and TBL topics, none of the distractors were functional in 7.7% (19/247), and 7.5% (19/255), respectively. One distractor was functional in 10.5% (26/247), and 15.7% (40/255) respectively. Two distractors were functional in 36.4% (90/247), and 30.6% (78/255), respectively. Three distractors were functional in 41.3% (102/247), and 46.3% (118/255), respectively (Table 3). There was no statistically significant difference ($P = 0.2272$) between the distractor functionality of MCQs touching PBL and TBL topics.

Discussion

Medical schools worldwide are making continuous efforts to incorporate learner-centered educational activities in the undergraduate medical curricula, aiming at improving not only knowledge but also other important aspects of life-long learning, including collaborative learning, self-directed learning (SDL), directed self-learning (DSL), communication and information retrieving skills in students.^{39–42}

SDL, as defined by Knowles, is a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing, and implementing appropriate learning strategies, and evaluating learning outcomes.⁴³ On the other hand, DSL is an active learning process where the learners are provided in advance with pre-class specific learning objectives and some facilitation (guidance and supervision) through the learning process, which, in turn, can help establish a strong foundation for autonomous and deep learning.⁴⁴

To the best of our knowledge, this study is the first of its kind to make a comparison between SDL and DSL regarding psychometric analysis of the difficulty, and discrimination indices as well as the functionality of distractors of MCQs for midcourse and final theory exams of nine courses conducted in UBCOM along 3 successive academic years. In the present study, there was no statistically significant difference between MCQs touching the topics learned through SDL (PBL as an example) and the DSL (TBL as an example) with $P = 0.8407$, 0.1997 , and 0.2272 for the difficulty index, discrimination index, and the functionality of the distractors, respectively. PBL and TBL are considered two kinds of student-centered activities in which the students are active learners. It seems that both have an extremely similar effect on the students' performance in MCQs of the theory exams. This could be explained by adopting the student-centered approach of learning in UBCOM through the whole academic year "from year 2 to year 6" which makes the students master these instructional methods. Besides, the college adopts a weekly Faculty Development Program "FDP" in which training sessions and workshops enable the faculty to become experts in creating the one best answer MCQs. Moreover, the Student

Assessment Committee "SAC" precisely revises the exam questions with each course coordinator to reach the best question standardized formulation. This agrees with a study that concluded that conceptual clarity of what SDL entails and guidance for both teachers and students can help PBL bring forth self-directed learners.⁴⁵ These findings are consistent with Doo et al., who reported no significant differences in affective, cognitive, and behavioral learning domains in terms of the influence of SDL on learning outcomes. However, there was a significant difference in the effect size of SDL on learning outcomes among adult learners, undergraduates, and middle and high school students. The influence of self-management on learning outcomes was significantly smaller than on motivation and self-monitoring.⁴⁶

Nation and Rutter compared pharmacy student attainment (examination performance), progression (examination pass rate), and perception (sought via a questionnaire and focus group) of TBL (as a DSL representative) and PBL (as SDL representative) in pharmacy education at the University of Wolverhampton, School of Pharmacy.⁴⁷ The study reported that students' attainment was significantly higher with TBL compared with PBL (grade score: 11.19 vs. 8.73; $P \leq 0.001$). Additionally, the student perceptions favored TBL compared with PBL. They explained the TBL's superiority by its more structured nature, more proper students' pre-class preparedness, and the transparency of scores. The students liked having a score for their MCQs (iRAT); and the immediate feedback in their tRAT, which was engaging and motivating for them, and allowed students to benchmark themselves against each other, which in turn seemed to drive and motivate students to perform better. On the other hand, the students unpreferred PBL as it is a more self-driven teaching method, less structured, rely on peers and other PBL groups to gather, present, and analyze information. These findings were explained from the students' perspectives by their under-preparedness to present assigned topics. The difference between the outcomes of this study and our present study may be owing to the different programs and student natures at UBCOM. PBL and TBL are implemented more frequently in UBCOM (once weekly in every course) in parallel to the regularly conducted Faculty Developing Program sessions and workshops that are aimed at improving faculty attitudes, gaining knowledge and skills needed for upgrading teaching performances, and facilitating faculty's ability to recognize teaching deficiencies regarding these instructional methods. These factors may have a positive impact on mastering PBL and TBL regarding UBCOM students and tutors.

Additionally, undergraduate Pharmacy students are less interested in problem-solving as they have limited exposure to the workplace, in contrast with our UBCOM medical students. This can be understood in the context of self-determination theory, which highlighted two types of motivating conditions: controlled and autonomous, and reported that in autonomous motivators, subject interest drives learning.⁴⁸

It was reported that students showed equal perspectives, satisfaction, and learning objectives with SDL in undergraduate ophthalmic education during the COVID-19

pandemic in China.⁴⁹ Likewise, a study proved that DSL helps health profession trainees capable of effectively regulating their cognition, motivation, and/or behavior to achieve their learning goals.⁵⁰ On the other hand, SDL seems to be extremely beneficial for learners in choosing the time to learn, prioritizing the learned material, and identifying their own resources.⁵¹ Besides, another study revealed the ability of SDL to provide students with the necessary competencies to become lifelong learners, via students' exposure to SDL competencies to obtain the knowledge, skills, and attributes unique to their personal and professional growth.⁵²

Limitations of the study

As UBCOM is a new medical college, it enrolls only a few numbers of students; 90 per year (50 males and 40 females) which may affect the accuracy of the analyzed data. The English language of studying different courses seems to be difficult for the students which may affect their answers to the MCQ questions.

Conclusion

Both self-directed learning and directed self-learning have their merits and are applicable in different educational contexts. The choice between the two depends on factors such as the learner's level of self-regulation, the learning environment, and the desired learning outcomes. Both can lead to similar effects on MCQ questions regarding the difficulty index, discrimination index, and distractor functionality of Basic Medical Science courses as analyzed in this study but not the clinical courses. Medical colleges can adopt PBL, TBL, or both, as learning strategies, depending on their resources, the number of students, and with proper orientation of students and faculty.

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Conflict of interest

The authors have no competing interests to disclose.

Ethical approval

Ethical approval was taken from the Research Ethics Local Committee of the University of Bisha, KSA with the number "UB-RELOC H-06-BH-087/(0901.23)" on 1 November 2023.

Consent

The need for consent was waived by the Research Ethics Local Committee of the University of Bisha, KSA as all the data used in this study was anonymous.

Authors contributions

KS, JAF, MMA, OAM: Methodology, Investigation, Visualization, Writing-Original draft, Writing-Reviewing & Editing. ASM, AYA, WIE: Formal Analysis. TBAK, NAM, VM, and SMK: Conceptualization, Supervision, Methodology. HMAS, and AAH, SEM: Methodology, Writing-Original draft. MGT, AMA, MEI, AIOY: Methodology, Writing-Reviewing & Editing. All authors agree to be accountable for all aspects of work ensuring integrity and accuracy. 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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Appendix A. Supplementary data

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