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RESEARCH ARTICLE

BLENDED LEARNING APPROACH PROMOTES THE APPLICATIONIN ORTHOPEDICS, A MIXED PROSPECTIVE STUDY

Adel M. Aboregela[1], Zenat Khired[2], Mushabab Alghamdi[3], Ahmed Al Ameer[4], Sultan Al Amri[4], Mohammed Alqarny[4] and Zienab Alrefaie[5,6]

1. Basic Medical Sciences, College of Medicine, University of Bisha, Bisha, Saudi Arabia.
2. Orthopedics Department, College of Medicine, Jazan University, Jazan, Saudi Arabia.
3. Internal Medicine Department, College of Medicine, University of Bisha, Bisha, Saudi Arabia.
4. Surgery Department, College of Medicine, University of Bisha, Bisha, Saudi Arabia.
5. Physiology Department, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.
6. Physiology Department, Faculty of Medicine, Cairo University, Cairo, Egypt.

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Abstract

Objectives: Blended learning is a combination of online and face-to-face teaching. The current study aimed to assess the impact of a blended approach on perceptionsand achievements in orthopedics.

Methods: The online component of the developed blended course comprises lectures, discussion forums, demonstrative videos, scenarios, discussion panels, and illustrated atlases. In college, activities included hands-on and bedside teaching sessions. Hybrid activities such as team-based learning, case-based learning, and seminars were included. Case discussions and roleplays were conducted as assignments. Students' perceptions were identified through the survey and focus groups, while tutors' opinions were expressed through personal interviews. A comparison between students' achievements after the blending and that of the previous year taught in traditional form was carried out.

Results: A high degree of student satisfaction, enthusiasm, and interest in the blended course was identified; students recommended its use in other courses and showed appreciation for how the tutors conducted it. Tutors revealed acceptance towards blending and suggested some modifications. There was a significant improvement in students' achievements in the Objective-structured-practical and Objective-structured-clinical examinations (p= 0.0005 and 0.0011) compared to the previous year, with no difference in MCQ achievements.

Conclusion: It can be concluded that the blended approach enhanced students' skills and enthusiasm in orthopedics.

Introduction:-

E-learning has become an important part of medical education [1, 2]. Blended learning is a mode of instruction that combines online activities with face-to-face activities to incorporate technology within the instructional design [3]. Various authors have shown great benefits and student satisfaction when blending E-learning with face-to-face learning [4, 5]. Although we were forced to shift to online learning because of the COVID-19 pandemic, there is a

Corresponding Author:- Mohammed Alqarny
Address:- Surgery Department, College of Medicine, University of Bisha, Bisha, Saudi Arabia.

persistent need to consider flexibility in timetabling through sustainable blended courses [6]. A particular potential of blended learning can be seen in extending the means of teaching by supporting students' preparation and learning process beyond face-to-face seminars or classic textbooks with tools such as short videos [7], podcasts [8, 9], or virtual patients [10-13]. The introduction of E-learning content in medical and surgical teaching has undergone a vast expansion from conventional CDs or online texts to podcasts, wikis, and virtual patients [12, 13]. However, many aspects regarding the use of blended learning concepts are still deficient, especially in clinical courses [14]. Even though students' approval and their gains in knowledge are often evaluated [15-18], some of these studies depend on participants voluntarily using the new programs, which might be a selection bias [19, 20]. More studies are still needed to prove the impact of blended learning on the enhancement of students' knowledge and clinical skills [21]. As well, more data is still needed to fill the gap that describes the best practices that can be used to teach skills as well as to guide the design of blended learning curricula in such subjects [18, 22]. Since its establishment in 2014, the College of Medicine University of Bisha has continued to participate in the development of health by offering the integrated PBL curriculum adopted by many medical schools in Saudi Arabia [23]. This innovative, outcome-based curriculum has been developed according to the standards of the National Commission for Academic Accreditation and Assessment (NCAAA) that was established in accordance with the Saudi-MED domains to ensure quality within the Kingdom of Saudi Arabia universities [24]. This curriculum is composed of three phases, basic, clinical, and clerkship [25]. Orthopedics is delivered within the clinical phase as a three-credit hours course distributed as two hours theoretical (36 contact hours) and one hour practical (36 contact hours). It is divided into two main themes: traumatic disorders and bone metabolic and infectious disorders (approved program specifications 2014). According to the policy of the program, different interactive learning methods were approved. The theoretical component was delivered as twenty contact hours of interactive lectures and four contact hours for each team-based learning, seminar-based learning, directed self-learning, and mentoring [23]. In the same context, the practical component was offered as twenty contact hours of hospital visits, ten hours of practical training in skill laboratories, and six hours of case-based learning [26]. Throughout the course, the students were assessed through different learning strategies and the midcourse, which constitutes forty percent of the total score. At the end of the course, the students had a final theory exam formed of multiple-choice questions and short-answer questions [27, 28]. This exam forms twenty percent of the total score. The remaining forty percent were distributed between objective structured practical examination and objective structured clinical examination equally [29]. The main goal of the current project was to develop a sustainable blended learning orthopedics course, not only during the COVID-19 pandemic but also thereafter. In addition, to assess students' and faculties' perceptions regarding the newly designed course. As well as to assess the academic performance of the students by applying the blended learning approach in orthopedics. The answers can add to the core knowledge as the published literature on using the blended approach in teaching clinical courses; especially orthopedics was deficient. As well, there were no similar interventions in orthopedics courses in Saudi Arabia universities except the evaluation study performed at Qassim University [30]. Also, it can offer guidelines to develop other blended clinical courses at Bisha university or even other institutions in Saudi Arabia.

Methods:-

Development of Orthopedic blended course

Since 2014 -the foundation of the college- the orthopedics course has been delivered three times in its traditional form. Conduction of the course was carried out byhiring collaborators from other different institutions. Many problems in student training were faced due to staff shortages. With the eruption of the COVID-19 pandemic, it was mandatory to shift to online learning due to the lockdown. However, the pure online clinical course was not a practical solution as it lacked clinical skill acquisition, so the best-selected choice was the blended approach. The intended learning outcomes of the orthopedics course were revised independently and blindly by three orthopedic surgeons to ensure its scientific homogeneity. Each expert provided a detailed report with modifications and suggestions for improvement. The three reports were revised, refined, and aligned with the program outcomes by the curriculum committee in the college of medicine, University of Bisha. Upon consensus and structural adjustment, the learning outcomes were revisited again by the experts to confirm their validity and reliability and then approved at different administrative levels. The second step was to design a suitable teaching and learning strategy for each topic and outcome. This was offered by the medical education department in parallel with the curriculum committee and the cooperating orthopedic surgeons. Synchronous interactive lectures and live discussions through Blackboard formed most of the online component of the course, in addition to some assignments in the form of discussion forums. As well, free asynchronous demonstrative online videos, clinical scenarios for training, discussion panels, and illustrated atlases were provided. Regarding TBL, CBL, and seminar activities, they were conducted in the hybrid mode alternatively (some online and some in college). The students were divided into groups of four to attend the skill laboratory sessions and perform clinical procedures on models and some volunteers. As well they

were divided into groups with two students per group and distributed on scheduled hospital rotatory visits so that each student could attend and apply all the required skills. Throughout the course, the students were asked to perform some assigned group tasks in the form of case discussions and roleplays, videotape, and submit it. All the submitted activities were assessed by orthopedic experts, and feedback was given to students as a sort of formative assessment.

Students' Survey

After the final approvals and before the conduction of the course, orientation sessions for the students and the staff about the developed course were performed. The course was delivered to fifth-year students through the academic year 2020/2021 in its new design, and at the end of the course, a questionnaire was distributed among students to assess their perception. The questionnaire was designed and approved by the medical education unit in the college of medicine, University of Bisha, to evaluate the different aspects of the blended approach in orthopedics. The survey was launched through google Forms and distributed through the official emails and WhatsApp groups, and the optional participation was considered approval from the students. The questionnaire started with some questions describing the demographic distribution of the participants as well as their contact information. After that, closed-ended questions outlining the perception regarding the design of the orthopedics course. Finally, some closed-ended questions about the perception of the blended approach. The perception questions depended on a Likert satisfaction scale ranging from one to five, strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5).

Students' focus groups

The second part of the perception assessment was conducted by performing three rounds of focus groups to elicit specifically how the students perceived the course, the challenges they encountered, and suggestions for improvement. Each focus group was formed by nine volunteered students chosen randomly from the same studied patch. The focus group sessions were moderated by an investigator other than the orthopedics tutors and the course coordinator one week after the final exams to minimize bias. Each session lasted for 30 minutes and was audio-recorded for further verbal transcription and thematic analysis. The focus group guide was designed by the medical education department in the college of medicine, University of Bisha. The data were analyzed by two independent investigators who subsequently met to gather similarities to resolve discrepancies in the topics identified after confirmation of data accuracy. Descriptions were matched, and the major themes of student responses were identified by the same investigators in cooperation with the medical education department. The use of both quantitative and qualitative assessments helped the investigators to obtain a complete outline of the students' perspectives regarding the designed course and the whole blended approach.

Staff interviews

The blended course was delivered by three orthopedics surgery and one rheumatology staff. At the end of the course, personal interviews were conducted with the respected tutors to check their perceptions regarding the course. Each interview lasted about twenty minutes, discussing their perception towards the cornerstones of the course as a whole and the blended approach especially. Interviews were conducted by an investigator other than the course coordinator to decrease bias as well; they were recorded for further transcription and analysis. A guide for the interview and the proposed questions were designed by the medical education unit in the college of medicine, University of Bisha.

Assessment of Academic Performance

To the policy, student assessment in the college of medicine, University of Bisha, is conducted at two levels. The first one is the continuous assessment which includes the mid-course exam and the assessment activities throughout the course. Continuous assessment shares by forty percent and the final assessments form the remaining sixty percent of the total assessment of the course. As a clinical course, the final assessment of orthopedics is divided between theory exam, OSPE, and OSCE, with twenty percent for each. Evaluations of students' achievements were conducted on two levels, selective and total. All the questions were designed by the tutor themselves following the designed blueprint, revised in a departmental meeting, and rechecked structurally by the student assessment committee to ensure validity and radiality. During final exam preparation, randomly selected six multiple choice questions (MCQs) and four OSCE stations were the same as the final exam of the previous academic year, 2019/2020, in which the course was conducted traditionally. A selective comparison between the achievements in the repeated questions was carried out, as well as a comparison between the total achievements in the theory exam, OSPE, and OSCE. Standardization of the two sets of questions was confirmed by the student assessment committee through the calculated difficulty indices.

Statistical analysis:
All data were analyzed by SPSS software version 16 (SPSS Inc., Chicago, USA). The demographic distribution of the participants in the questionnaire was presented as percentages. However, data collected from the perception questions were analyzed and presented as means ± SD of the scores for each question. Also, the degree of satisfaction was summarized by the percentages of the participants that showed agreement (strongly agree and agree) to different survey questions. Cronbach's alpha [31], Kendall's tau B coefficient [32], and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were considered to assess the consistency, reliability, and validity of the questionnaire. The strength of the relationship between variables was measured through Bartlett's test of sphericity [33]. Unpaired sample t-test was used to compare the means of student achievements either in selected questions or in the final total. Also, Cohen's d test was used to compare the strength of the relationship between the achievements of the two cohorts [34]. Significance was considered at $P < 0.05$

Results:-

Students' Survey (Figure 1)
The perception of 30 students (93.75%) of the fifth year (2020/2021) in the College of Medicine, University of Bisha, was evaluated by analyzing the questionnaire results. The whole patch of students were males with mean ± SD for age 23.29 ± 0.78. Students' cumulative grades were distributed as 1 A+, 6 A, 4 B+, 8 B, 7 C+, and 4 C grades. Moreover, their achievements in orthopedics were distributed along the whole scale of grades A+, A, B+, B, C+, C, D+, and D with 2, 6, 7, 4, 3, 6, 1, and 1, respectively. Approximately all the students have previously attended many distance learning courses, with mean ± SD = 5.40 ± 2.931 for the number of attended online courses. Also, they spend an acceptable number of hours per day on their personal computer for medical studies (mean ± SD = 4.87 ± 2.609). Ninety percent of the participating students regularly use the internet in their study, and 83.3% appreciated learning through the web. To evaluate students' perception regarding the newly designed orthopedic course and the blended approach, a Likert scale with five degrees of satisfaction scored from one to five (strongly disagree, disagree, neutral, agree, and strongly agree) was used. Internal consistency was ensured by calculating Cronbach's alpha = 0.915; also, the KMO measure of sampling adequacy was 0.685, and Bartlett's tests of sphericity were highly significant <0.001. Survey items were correlated together by Kendall's tau_b test showing coefficients ranging between 0.113 and 0.775. By factor analysis, three factors were extracted that describe 46.92%, 68.15%, and 74.67% of the cumulative loadings. The first factor touched on the feedback mechanisms in the blended course and the future use of the blended approach. The second factor expressed the different aspects of face-to-face sessions given through the blended orthopedic course. The third factor discussed the impact of formative assessment in different interactive activities conducted within the course. As shown in figure (1), the highest mean score was in favor of the item asking about the satisfaction, interest, and enthusiasm for learning orthopedics by the blended approach (mean ± SD = 3.97 ± 1.245).

Students' focus group
Three rounds of focus groups were moderated one week after the final exam. The data were validated by two experts from the medical education department who gathered similarities and resolved discrepancies after confirmation of data accuracy. Responses from the students were assembled in four main themes; the first theme was that 80% declared that the blended orthopedic course met their expectations "Yes it did, now my knowledge in orthopedic is more than that I expected to have," "It improved my vision about Orthopedic not only reading x-rays but also how to deal with patient and advise them," "It was fun and got new experiences in different aspects." The second theme was the appreciation of the organization, conduction, and the use of new techniques of learning "I liked the course coordinator organization and different ideas that were applied like: Quizzes, the videos for examination," "I liked the arrangement and how it was handled as well as the methods of teaching like case discussion and assignment videos," "The blackboard was so useful and organized with no need to go anywhere else to get studying resources, all were provided in a professional way." The third theme touched on the value of tutors' efficiency in dealing with the blended approach "It is fascinating to learn from the major consultants in the country," and "The best tutor is that who summarizes the topics and teaches us what we need to know related to our level," "I did not like the teaching of some tutors as they didn't succeed in delivering the content to the students." The fourth theme emphasized the difficulties encountered during course conduction, like the squeeze in the timetable and the decreased number of hospital visits. "I liked the course, but I didn't like the time isn't enough for a course like this," "Tight time was the major obstacle," "I wanted to go more to the hospital to see some orthopedic cases or to see some of the instruments."

Faculty interviews

Considering the satisfaction of the staff, personal interviews with the respected tutors that were involved in teaching the blended course were moderated and validated by medical education experts. All the tutors appreciated the learning materials that were used as they were suitable for each topic and encouraged student participation tutors also praised the course organization and acknowledged candidates' attendance, participation, and enthusiasm. Interestingly, two tutors were so passionate about the course that they suggested a change in the time allocated for each topic to make students more acquainted with important orthopedic topics and proposed some interesting textbooks as learning resources.

Analysis of Academic performance (Figures 2 and 3)

Students' academic achievement included their scores in; final MCQs, OSPE, and OSCE. Thirty MCQs that were prepared according to the blueprint and checked for validity by the assessment committee were included in the final exam (30% remembering and 70% understanding & application). Six MCQs were randomly selected (each out of 0.8 mark) from the final exam of the 2019/2020 patch (traditional) to be repeated in the final exam for the patch of 2020/2021(blended). Also, four OSCE stations (each out of 5 marks) were repeated from the previous academic year with no repetition in the OSPE questions. Regarding the ages of the students, the mean and ± SD in the traditional patch was 23.75 ± 0.31 and in the blended patch was 23.29 ± 0.78 with a nonsignificant difference (P = 0.634). Also, the mean difference in the results of the final orthopedics course examinations was nonsignificant between the two patches (P = 0.809), with mean ± SD of 83.04 ± 5.30 and 82.56 ± 9.07 for the traditional and the blended patches, respectively. Students' achievements in three out of four repeated OSCE stations showed a significant difference between the traditional and the blended course in favor of blending by using an independent sample t-test. Means ± SD were 4.5 ± 0.35, 4.7 ± 0.42, and 3.9 ± 0.48 in the blended course and 3.9 ± 0.67, 4.17 ± 0.5,8 and 3.63 ± 0.40 for the traditional learning. These three OSCE stations included the topics of the shoulder, knee, and spinal examination with p values 0.004, 0.001, and 0.0153, respectively. Moreover, achievements in one out of six repeated MCQs showed significant improvement in the blended approach when compared to the traditional ones with p=0.0054 (figure 2). By comparing students' achievements in the whole MCQs, OSPE, and OSCE exams, there were significant improvements in students' performance in the OSPE and OSCE stations with p= 0.0005 and 0.0011, respectively (figure 3). Cohen's d test revealed a good effect size for students' achievements in OSPE and OSCE (0.96 and 0.83, respectively) and a weak effect size regarding students' grades in MCQs (0.09). These results suggest the positive impact of blending the course on improving students' performance.

Discussion:-

Recently, the use of electronic learning has been widely increased, especially in medical education, taking the advantage that students can learn anywhere and anytime. Although it lacks peer support and the physical visibility of the instructor, electronic learning was found to satisfy students' needs [35, 36]. Clinical skills form a crucial part of the education of medical students. which cannot be efficiently taught online alone, so blending is important in medical education, although the effectiveness of online teaching is still controversial [37]. This study was conducted to evaluate students' perception and academic performance after passing through the new experience of a blended approach in the faculty of Medicine at the University of Bisha. Also, the study aimed to assess faculties' perceptions regarding the newly designed blended orthopedics course to emphasize the sustainability of the course. The current results obtained from both the survey and the focus group revealed the students' positive attitude towards the blended approach. The highest mean score in the questionnaire was granted to satisfaction, interest, and enthusiasm for the blending of orthopedics. Moreover, in the focus groups, most of the students acknowledged the organization and the new online learning techniques that were involved and recommended using the blended approach in other clinical disciplines. Although some previously published works investigated blending in orthopedics, the current study is the first to assess the impact of blending in orthopedics in local institutions. Amin and Saqr published their students' declaration that they got a better chance of contact with their tutors and colleagues, as well as flexible learning and faster retrieval of information after blending the orthopedics course. Also, they had a better possibility of self-assessment and gaining feedback and recommended generalization of the concept in all courses [30]. Similarly, a pilot study was conducted by Back et al. to assess students' perception of the blended learning approach in orthopedics and showed positive feedback from the participating students [18]. It was also reported that E-learning in orthopedics was considered an effective alternative or at least a supplement to the traditional teaching methods for both undergraduates and postgraduates [38]. In addition, Chornyi and Vakulych revealed a very good positive perception among their students towards the blended approach in orthopedics, and they emphasized the importance of promoting critical thinking and problem-solving skills in orthopedics through collaborative learning by implementing online case-based education sessions [39]. The blended learning approach is highly context-sensitive,

and interdisciplinary differences should be considered [17]. Many studies demonstrated that blended learning is feasible, effective, and well-evaluated by students in training for oral radiology, spine surgery, and pediatric deformities [17, 40]. On the other hand, the blended learning concept in otolaryngology revealed a low satisfaction level among medical students [41]. Moreover, some studies indicated that medical students were satisfied with e-learning in clinical courses but did not see it as a strategy to replace traditional teacher-centered education [10, 42]. The cornerstone of blended learning is the involvement of the three independent elements of the theoretical framework, the teacher, student, and environment, to gain a successful student educational experience [22]. Through the performed focus groups in this study, the students raised this very important topic with multiple quotes and stressed on the importance of the tutors' qualifications and skills in delivering the blended content. This is in accordance with the conclusion that the enthusiastic educator is the first component in enthusiastic education, and training the educators is a crucial preliminary step in the blended approach [43]. Like all medical specialties, the orthopedic curriculum continues to expand, correlated with an increase in the objectives, and the traditional teaching methods seem to have become insufficient to deliver these complex topics to undergraduate students [44]. The tutors who shared in designing and delivering the blended orthopedics course in this study highly appreciated the teaching methods that were used and declared that they were suitable for each topic and encouraged student participation. Also, they acknowledged the suitability of organization and the learning materials for both topics and different students, which was reflected in the attendance, participation, and enthusiasm of them and the students. A very important note was added by Hickmann et al. that blending the clinical courses can enhance compliance with theoretical learning among students through customized sessions, supporting different learning styles that are accessible anywhere and anytime [45]. However, some educators denied the changes that accompany blended learning claiming that the interpersonal interactions with the students are affected by "the learners are not supervised during their studies away from the classroom, the ability of the teachers to assess learning and to provide guidance and support to the learners is a very week at this stage" [17, 43]. Both students and tutors in the current study stressed the importance of extending the duration of the course and the number of hospital visits. This is a great point for further evaluation as there is a great debate in the literature about the inadequacy of orthopedics training for undergraduates. Some authors related this inadequacy to the increasing complexity of the medical curriculum, teaching methodologies and approaches either practicing on real or simulation patients, insufficient teaching from the senior clinicians due to overload or duty-hour restrictions with potentially few opportunities for trainees to provide patient care, and the tight duration of the training [43, 44, 46, 47]. The effectiveness of combined online and face-to-face teaching regarding the acquisition of knowledge and skills is still controversial [14, 37]. What's unique about the current work is the significant improvement in students' performance in OSPE and OSCE compared to the previous traditional non-blended batch, although it was not reflected in the final score. Some previous results showed significantly higher theoretical and OSCE grades in the blended learning group compared to the traditional teaching group [15, 48, 49]. while others showed only improvement in theoretical scores with blending [18]. This highlights the importance of the current findings, which point to the impact of blending on clinical skills obtained by students. As previously reported, orthopedics surgical psychomotor skills are difficult to teach and master due to the challenges of the extensive knowledge required and working with new equipment, which can be improved through online learning modalities [38]. A combination of learning tools should be used to gain better efficiency, as each form of learning approach has its benefits and drawbacks [39]. The development of a blended course consisting of adaptive online learning, simulator training, and hands-on training has a positive effect on the surgical skills of trainees in orthopedics [17], obstetrics and gynecology [50], neurosurgery [45] and even in family planning education [51]. Many theories explain this concept, of which the students could manage their time in a way that was effective and convenient for them to achieve their goals [52]. Also, a well-designed online learning curriculum is based on a framework that focuses on effective pedagogical principles and is supplemented by understanding of what makes online learning suitable for students [53]. In addition, using interactive teaching provide intuitive interaction and social connections with educators and peers to ensure that the time spent in learning is as valuable as possible [15, 44]. The current results, together with previous ones, indicate that the interactive blended learning approach seems to be superior compared to traditional teaching due to its feasibility and effectiveness in training for the orthopedics domain. It gained wide acceptability among students and teachers and improved the performance of the students in clinical examinations. However, it was as effective to teach medical students the theoretical component as traditional learning. Consequently, further investigations are needed with broader samples and different modalities to prove the effectiveness of blending the orthopedics Course.

Limitations of the study:

As the university is a newly founded institution, some limitations were recorded in the study. The first limitation was the small number of the sample, although all the registered students were included. The study depended on the

blackboard facilities, free online demonstrative videos, and simulations in the skill laboratory, while the paid virtual platforms for orthopedics learning were not available.

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Conflict of interest:
All the authors declare no conflict of interest.

Ethical approval:
Approved by Research Ethics Local Committee, College of Medicine, University of Bisha (UBCOM-RELOC) with the registration number (H-06-BH-087)

Figure legends:

Figure 1:-Results of students' survey showing their perceptions regarding the blended approach in orthopedics learning. Scores are based on a five-point Likert scale (1: strongly disagree, 5: strongly agree). Values are presented as Means ± SD.

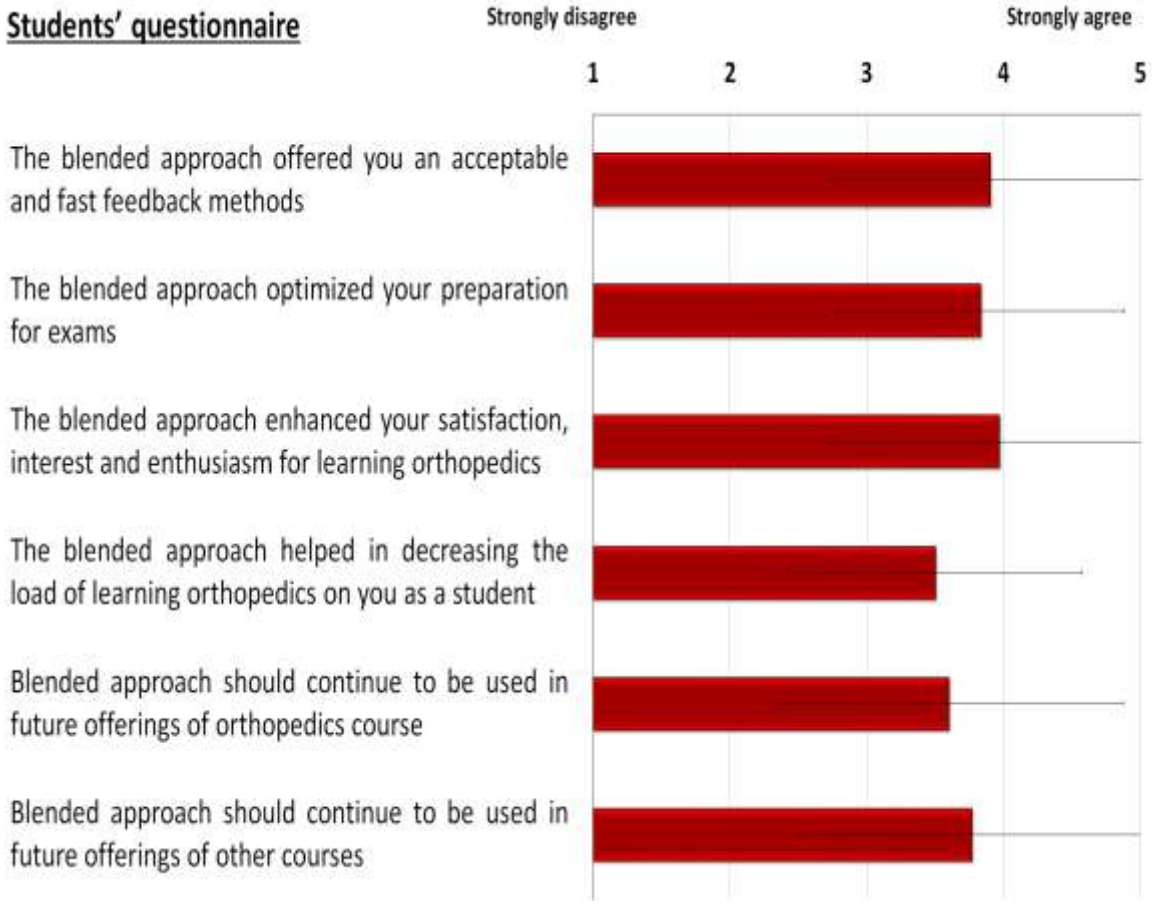


Figure 2:- Students' achievements in the selected questions of the final examination in orthopedics for both patches (traditional: 2019/2020 and blended: 2020/2021). MCQ/ 0.8 mark and OSCE/ 5 marks. Values are presented as Means ± SD.

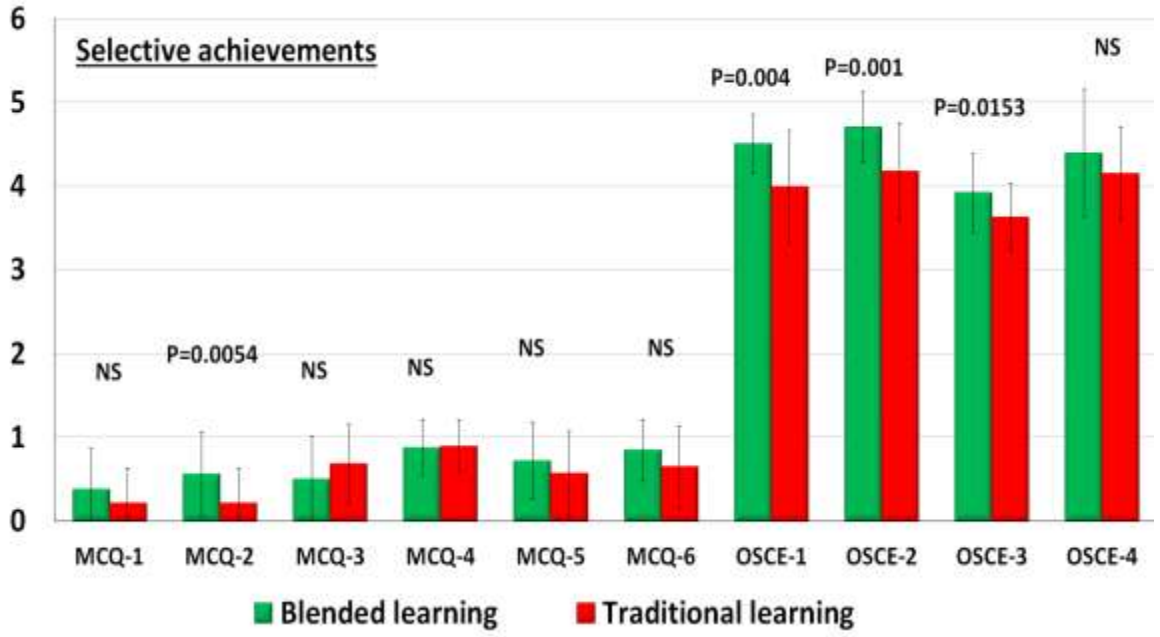
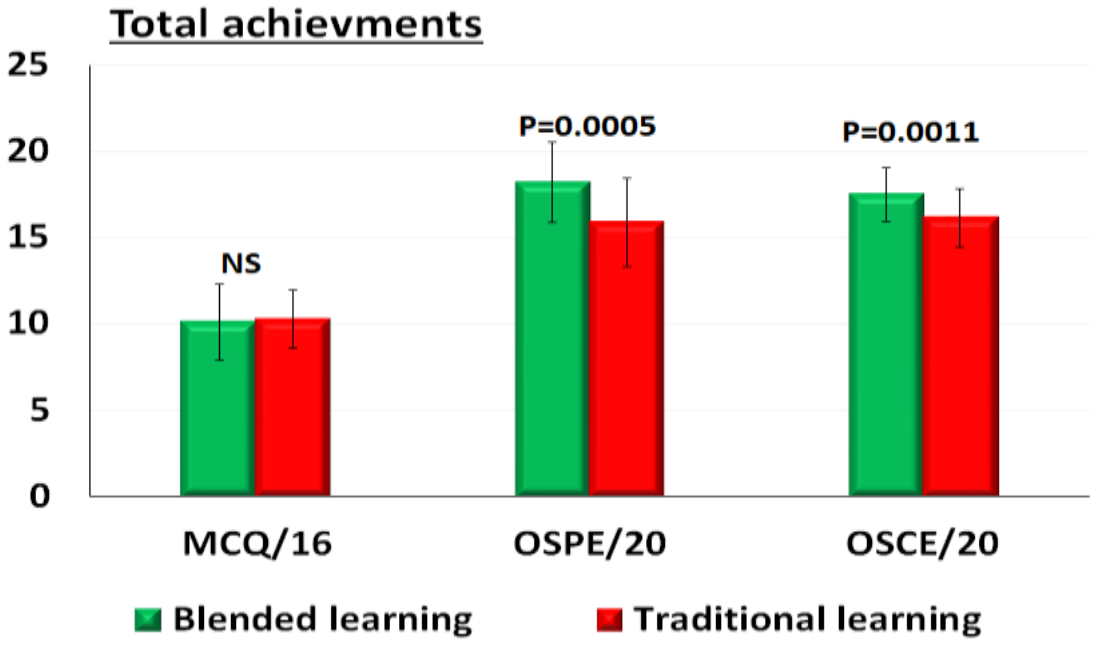
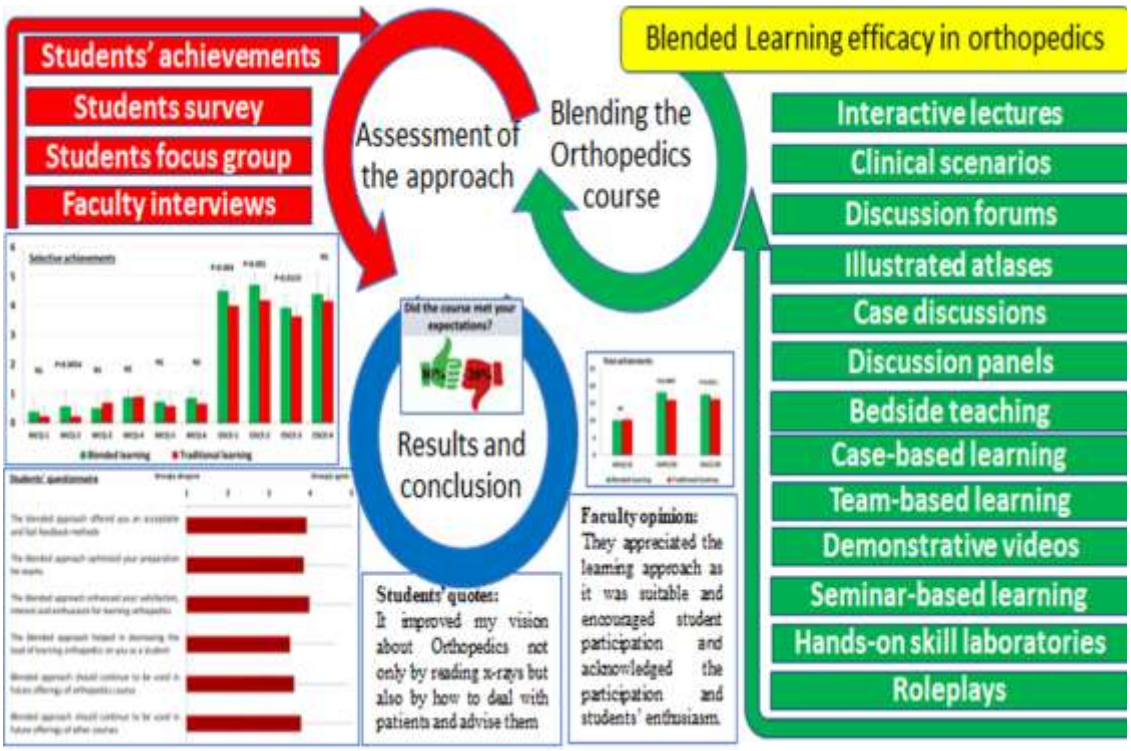


Figure 3:-Total achievements in the final orthopedics examination of both patches (traditional: 2019/2020 and blended: 2020/2021) (MCQs/ 16 marks, OSPE/ 20 marks, and OSCE/ 20 marks). Values are presented as Means ± SD.





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Author contributions:

Conceptualisation: **AMA.** Data acquisition : **ZK, MA, AA, and SA.** Data analysis and interpretation : **AMA.** Drafting of the manuscript : **MA.** Critical revision of the manuscript : **ZA.** Approval of the final version of the manuscript : **all authors.**

References:-

1. Alshibly H. An empirical investigation into factors influencing the intention to use e-learning system: An extended technology acceptance model. British Journal of Applied Science & Technology. 2014;4(17):2440.
2. Gray K, Tobin J. Introducing an online community into a clinical education setting: a pilot study of student and staff engagement and outcomes using blended learning. BMC medical education. 2010;10(1):1-9.
3. Lazinski MJ. Psychomotor Skills, Physical Therapy, and a Hybrid Course. Quarterly Review of Distance Education: Volume 18# 4. 2017;18(4):57-69.
4. Cooper D, Higgins S. The effectiveness of online instructional videos in the acquisition and demonstration of cognitive, affective and psychomotor rehabilitation skills. British journal of educational technology. 2015;46(4):768-779.
5. van Duijn AJ, Swanick K, Donald EK. Student learning of cervical psychomotor skills via online video instruction versus traditional face-to-face instruction. Journal of Physical Therapy Education. 2014;28(1):94-102.
6. Shaw SCK, Hennessy LR, Anderson JL. The learning experiences of dyslexic medical students during the COVID-19 pandemic: a phenomenological study. Adv Health Sci Educ Theory Pract. 2021. doi: 10.1007/s10459-021-10074-7.
7. Cooper D, Higgins S, Beckmann N. Online instructional videos as a complimentary method of teaching practical rehabilitation skills for groups and individuals. Journal of Educational Technology Systems. 2017;45(4):546-560.

8. Greenberger HB, Dispensa M. Usage and perceived value of video podcasts by professional physical therapist students in learning orthopedic special tests. Journal of Physical Therapy Education. 2015;29(3):46-57.
9. Bhatti I, Jones K, Richardson L, Foreman D, Lund J, Tierney G. E-learning vs lecture: which is the best approach to surgical teaching? Colorectal Disease. 2011;13(4):459-462.
10. Rowe M, Frantz J, Bozalek V. The role of blended learning in the clinical education of healthcare students: a systematic review. Medical teacher. 2012;34(4):e216-e221.
11. Fink MC, Heitzmann N, Siebeck M, Fischer F, Fischer MR. Learning to diagnose accurately through virtual patients: do reflection phases have an added benefit? BMC medical education. 2021;21(1):1-11.
12. Isaza-Restrepo A, Gómez MT, Cifuentes G, Argüello A. The virtual patient as a learning tool: a mixed quantitative qualitative study. BMC Medical Education. 2018;18(1):1-10.
13. Monton O, Smith A, Nakajima A. Lessons Learned from Building a Virtual Patient Platform. Recent Advances in Technologies for Inclusive Well-Being. 2021;196:211.
14. Agha R, Abdall-Razak A, Crossley E, Dowlut N, Iosifidis C, Mathew G, et al. STROCSS 2019 Guideline: strengthening the reporting of cohort studies in surgery. International journal of surgery. 2019;72:156-165.
15. Suwannaphisit S, Anusitviwat C, Tuntarattanapong P, Chuaychoosakoon C. Comparing the effectiveness of blended learning and traditional learning in an orthopedics course. Annals of Medicine and Surgery. 2021;72:103037.
16. Ackermann O, Siemann H, Schwarting T, Ruchholtz S. Effective skill training by means of E-learning in orthopaedic surgery. Zeitschrift fur Orthopadie und Unfallchirurgie. 2010;148(3):348-352.
17. Senkoylu A, Senkoylu B, Budakoglu I, Coskun Ö, Acaroglu E. Blended learning is a feasible and effective tool for basic pediatric spinal deformity training. Global Spine Journal. 2021;11(2):219-223.
18. Back DA, Haberstroh N, Antolic A, Sostmann K, Schmidmaier G, Hoff E. Blended learning approach improves teaching in a problem-based learning environment in orthopedics-a pilot study. BMC Medical Education. 2014;14(1):1-8.
19. Bloomfield JG, Jones A. Using e-learning to support clinical skills acquisition: Exploring the experiences and perceptions of graduate first-year pre-registration nursing students—A mixed method study. Nurse education today. 2013;33(12):1605-1611.
20. Ravindra P, Fitzgerald JEF, Bhangu A, Maxwell-Armstrong CA. Quantifying factors influencing operating theater teaching, participation, and learning opportunities for medical students in surgery. Journal of surgical education. 2013;70(4):495-501.
21. Ziegler R. MEC. O-Entwicklungeines e-Learning Tools für die unfallchirurgischeStudentenausbildung an der Universität des Saarlandes. 2019.
22. Volansky KJ. What are best practices to teach “hands-on” skills in a blended environment? Journal of Applied Learning and Teaching. 2020;3(1):80-89.
23. Ibrahim ME, Al-Shahrani AM. Implementing of a problem-based learning strategy in a Saudi medical school: requisites and challenges. International journal of medical education. 2018;9:83.
24. AL-Shahrani AM. Assessment of community empowerment in a new curriculum at college of medicine, University of Bisha, Saudi Arabia. Zagazig University Medical Journals. 2018;24(7):46-50. doi: 10.21608/zumj.2018.31550.
25. 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 Informatica Medica. 2018;26(2):119.
26. Owolabi LF, Adamu B, Taura MG, Isa AI, Jibo AM, Abdul-Razek R, et al. Impact of a longitudinal faculty development program on the quality of multiple-choice question item writing in medical education. Annals of African Medicine. 2021;20(1):46.
27. Rezigalla AA, Eleragi AME, Ishag M. Comparison between Students’ Perception toward an examination and item analysis, reliability and validity of the examination. Sudan Journal of Medical Sciences. 2020;15(2).
28. Salih KEM, Jibo A, Ishaq M, Khan S, Mohammed OA, Al-Shahrani AM, et al. Psychometric analysis of multiple-choice questions in an innovative curriculum in Kingdom of Saudi Arabia. Journal of Family Medicine and Primary Care. 2020;9(7):3663.
29. Salih K, Elamin BK, Al-Faifi JA, Khalid TBA, Miskeen E, Abbas M. Application of different standard settings in an innovative curriculum of College of Medicine, University of Bisha, Saudi Arabia. OnkologiaiRadioterapia. 2021;15(7):1-5.
30. Amin OA, Saqr M. Blended learning in orthopedics course: An evaluation study. International journal of health sciences. 2011;5(2 Suppl 1):40.

31. Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. Res Sci Edu. 2018;48(6):1273-1296.
32. Abdi H. The Kendall rank correlation coefficient. In Salkin NJ (Editor). Encyclopedia of Measurement and Statistics. 1st ed. Thousands Okas, CA: SAGE publication, Inc.; 2007. p. 508-510.
33. 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(10):400-410.
34. Cohen J. A power primer. Psycho Bull. 1992;1(1):155-159.
35. Vaona A, Banzi R, Kwag KH, Rigon G, Cereda D, Pecoraro V, et al. E-learning for health professionals. Cochrane Database of Systematic Reviews. 2018(1).
36. Hrastinski S. What do we mean by blended learning? TechTrends. 2019;63(5):564-569.
37. Pei L, Wu H. Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis. Medical education online. 2019;24(1):1666538.
38. Tarpada SP, Morris MT, Burton DA. E-learning in orthopedic surgery training: A systematic review. J Orthop. 2016;13(4):425-430. doi: 10.1016/j.jor.2016.09.004.
39. Chornyi V, Vakulych M. Specificities of remote teaching of traumatology and orthopedics course to medical students. RevistaRomaneascaPentruEducatieMultidimensionala. 2020;12(2Sup1):34-40.
40. Kavadella A, Tsiklakis K, Vougiouklakis G, Lionarakis A. Evaluation of a blended learning course for teaching oral radiology to undergraduate dental students. European Journal of Dental Education. 2012;16(1):e88-e95.
41. Grasl MC, Pokieser P, Gleiss A, Brandstaetter J, Sigmund T, Erovic BM, et al. A new blended learning concept for medical students in otolaryngology. Archives of Otolaryngology–Head & Neck Surgery. 2012;138(4):358-366.
42. Kassab SE, Al-Shafei AI, Salem AH, Otoom S. Relationships between the quality of blended learning experience, self-regulated learning, and academic achievement of medical students: a path analysis. Advances in medical education and practice. 2015;6:27.
43. Miller K, Kelly DM, Sheffer BW. Building a Clinical Skills Program for Orthopaedic Trainees. JPOSNA®. 2022;4(S1).
44. Poacher AT, Bhachoo H, Weston J, Shergill K, Poacher G, Froud J. Undergraduate education of trauma and orthopaedic surgery in the UK: a systematic review. Bone & Joint Open. 2022;3(7):549-556.
45. Hickmann A-K, Ferrari A, Bozinov O, Stienen MN, Ostendorp C. Neurosurgery resident training using blended learning concepts: course development and participant evaluation. Neurosurgical Focus. 2022;53(2):E13.
46. Buja LM. Medical education today: all that glitters is not gold. BMC medical education. 2019;19(1):1-11.
47. Kopelman P. The future of UK medical education curriculum–what type of medical graduates do we need? Future Hospital Journal. 2014;1(1):41.
48. George PP, Papachristou N, Belisario JM, Wang W, Wark PA, Cotic Z, et al. Online eLearning for undergraduates in health professions: a systematic review of the impact on knowledge, skills, attitudes and satisfaction. Journal of global health. 2014;4(1).
49. Jarrett-Thelwell FD, Burke JR, Poirier J-N, Petrocco-Napuli K. A comparison of student performance and satisfaction between a traditional and integrative approach to teaching an introductory radiology course on the extremities. Journal of Chiropractic Education. 2019;33(1):21-29.
50. Munro V, Morello A, Oster C, Redmond C, Vnuk A, Lennon S, et al. E-learning for self-management support: introducing blended learning for graduate students–a cohort study. BMC medical education. 2018;18(1):1-8.
51. Gunzburg R, Szpalski M, Lamartina C. Postgraduate education in spine surgery: the blended online learning concept. Springer; 2018. p. 2059-2061.
52. Khalil R, Mansour AE, Fadda WA, Almisnid K, Aldamegh M, Al-Nafeesah A, et al. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives. BMC medical education. 2020;20(1):1-10.
53. Martin F, Bolliger DU. Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. Online Learning. 2018;22(1):205-222.