Undergraduate Medical Students' Perceptions of an Online Audio-Visual-Based Module for Teaching Musculoskeletal Physical Examination Skills

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ABSTRACT

INTRODUCTION: Video-based learning has gained prominence in medical education and, more recently, in musculoskeletal teaching. This study investigated medical students' perceptions of the effectiveness of online video-based learning for musculoskeletal physical examination skills.

METHODS: For one academic year, undergraduate medical students were instructed online through video-based learning before bedside teaching about the physical examination of knee and shoulder joints. At the end of the course, the students participated in a survey to assess their perceptions of the online video-based learning module using a pre-validated questionnaire. The questionnaire consisted of closed-ended and open-ended questions. The closed-ended question responses were assessed using a Likert scale; the open-ended responses were analyzed qualitatively.

RESULTS: In total, 242 out of 310 students who participated in the online video-based learning responded to the survey. Most students found the teaching approach to be satisfactory and preferable to traditional teaching methods. However, they also felt that these modules could not replace hands-on practice. The most helpful aspects of the training modules were a better understanding of the specific tests, technique, and sequence of administering the physical examination. Perceived limitations included the inadequately addressed theoretical basis of the physical examination and the special tests, the need for more time to explain clinical anatomy, and the practical implications of the positive special tests.

CONCLUSION: Undergraduate medical students perceive VBL as helpful for MPES learning. The positive aspects of the VBL approach in teaching MPES are that it is comprehensive, easily accessible, offers standardized teaching, save times, and it includes demonstrations of special tests, examination techniques, and the sequence and organization of the clinical examination. The main perceived limitations were lack of content regarding clinical reasoning and the anatomical basis of the clinical tests.

KEYWORDS: video-based learning, musculoskeletal, physical examination, audiovisual learning

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Introduction

The concept of audiovisual supplementation in medical education is well known.[1] Traditional audiovisual aids in medical education consist of slide shows, illustrations, audiotapes, video recordings, and so on. Audiovisual material can be repeated based on the students' needs, and precise details in illustrations and videos make the subject more understandable.[2,3] Along with computer technology and the internet, audiovisual tools have also advanced. Nowadays, smartphones can match the power of computers and are popular among medical students.[4] Podcasts, educational videos, simulations, online programs, and app-based learning are becoming widely used as audiovisual aids on smartphones and computers.[5–7]

Clinical skills in medical education involve psychomotor domain-based learning and are difficult to teach through lectures or textbook-based learning alone.[8] Therefore, hands-on bedside teaching (BT) has been advocated for learning clinical skills. BT helps students learn to deal with real clinical scenarios, interact with patients, learn the steps of physical examination (PE), and practice the learned skills. However, students are often deprived of a good BT because sessions are poorly scheduled and insufficient for learning clinical skills.[9–11]

The causes of this shortcoming are multifactorial and include limited resources to handle large numbers of students and physicians' busy schedules. Time constraints and unavailability of appropriate patients are the most common obstacles in BT.[12] Thus, there is a need for a modified or blended approach to BT wherein the students are introduced to basic knowledge of clinical skills prior to the actual bedside session so students are more confident and involved in the hands-on practice and the time devoted to the bedside session can be better utilized. Thus, the innovations in teaching are mainly designed to accommodate sessions with large numbers of students and clinical examinations with limited numbers of patients, address apprehension among both patients and students, compensate for a lack sufficient background knowledge to understand the clinical findings, and allow for time constraints.[13] Therefore, revisions to BT were required for it to be the gold standard for teaching clinical competencies. The purpose of all the new, innovative

methods—video-based learning (VBL), peer-assisted learning (PAL), simulated patients, patient educators, simulation devices, workshops, and bootcamps—is to facilitate teaching so that the amount of actual BT required may be reduced and the BT sessions become more productive.

In orthopedic teaching, musculoskeletal physical examination skills (MPES) are complex clinical skills.[14] To involve medical students more fully in practice, the teaching strategy should focus on simplifying the steps to learn the complex skills matching the students' attention span.[15] Learning complex skills through step-by-step instructional videos is a possible solution, as students are given enough time to focus on the standardized steps shown in the videos.[16] In addition, technological resources are very popular with students, and so educational videos are useful for clinical learning.[17] Video demonstrations can effectively save the time of live demonstrations of clinical methods.[18] Therefore, educational videos can supplement BT sessions. However, it is unclear whether students are comfortable with such an approach to MPES instruction. To the best of our knowledge, undergraduate medical students' perceptions of video-based learning (VBL) for MPES have not been previously studied.

The main objective of this study was to investigate medical students' perceptions of online educational video modules for MPES teaching through a questionnaire.

Methods

This cross-sectional study was conducted at the Medical College of King Saud College, KSA, during the 2017–2018 academic session. In this institution, the undergraduate medical curriculum extends over seven years with a four-week orthopedics course in the fifth year. During these four weeks, the students are exclusively taught orthopedics. This course has an outcome-based curriculum that includes six sessions of PE for the shoulder, knee, hip, spine, peripheral nerves, and foot/ankle. The author created 8 to 11 min of online YouTube videos on shoulder and knee PEs for teaching purposes. The videos comprise demonstrations of gait evaluation, inspection, palpation, range of motion evaluation, and special tests. The content of the videos was validated by three experienced orthopedic surgeons.

Students were asked to watch the PE videos twice: one day prior to their BT session and again at the beginning of the session under the supervision of an orthopedic expert. Afterward, the orthopedic expert (AZA) demonstrated the clinical examination and addressed student queries. The students were then asked to perform the clinical examination on a simulated patient or their peers, and the orthopedic expert corrected any student errors in performing the examination at that time.

At the end of the four-week orthopedics course, we administered an objective structured clinical examination (OSCE) to each group as part of a summative assessment. OSCE examinations included knee and/or shoulder PEs. We asked students to complete a physical questionnaire form to assess their perceptions of the online video module augmented BT immediately after the exam. Students who had not participated in the shoulder and knee BT sessions BT or had not watched the videos prior to attending the teaching session were not included.

The questionnaire was developed and validated by the teaching faculty in the Department of Medical Education and was later approved by the institutional review board. The questionnaire was prepared based on a literature review of the deficiencies in the MPES teaching methods and evolution of video-based learning in MSK teaching. It was decided that the questionnaire would be a combination of closed-ended and open-ended questions in order to add the scope aspects that may not be highlighted in the closed-ended questions. To validate the survey items, the closed-ended questions segment was initially tested with a group of 30 undergraduate medical students; the internal consistency was considered to be high, as the Cronbach's alpha was 0.89. The open-ended questions were validated through the Delphi method after mutual consensus was achieved among the board members.

The questionnaire consisted of two parts: closed-ended questions and open-ended questions. The closed-ended questions were used to assess agreement on the Likert scale ratings (5 = strongly agree/ 4 = agree/ 3 = unsure/ 2 = disagree/ 1 = strongly disagree). These questions aimed at analyzing the perceptions of the online video modules in terms of comprehensiveness (questions 1 and 2), superiority over textbook learning (questions 3-5), effectiveness in terms of clinical learning (questions 6-8), complementary role to BT and exam preparation (questions 9-12), reliability as a teaching method (questions 13-15), and future prospects and recommendations (questions 16-18) (Table 1). The open-ended questions explored perceptions of the online video module for PE in terms of the benefits (questions 1 and 2), weaknesses (open-ended questions 3 and 4), and opportunities for improvement (question 5) (Table 2).

The Likert scale scores for each of the closed-ended questions were graphed in Microsoft Excel version 16.52, and the mean ratings (and standard deviations) were calculated for each question. We used the automation approach to qualitatively analyze the participants' responses to the open-ended questions in the surveys. The free text of the responses to the open-ended questions was qualitatively analyzed using an online free text analysis tool (Textalyser, https://seoscout.com). Responses were then categorized based on their similarity and the repetition of keywords. Two authors independently categorized the responses, and the categorical responses were finalized after subsequent discussions and mutual consensus. The frequencies of each categorical response were calculated. A single sample Z-test was used for the single-group analysis of the Likert-scale responses to all closed-ended questions to

Table 1. Responses of closed-ended questions concerning students' perception of online video modules supplemented bedside teaching.

NO	QUESTIONES	LIKERT SCALE RATING, MEAN (SD)	P-value*
1.	Video clips' contents cover all essential clinical skills	4.62 (0.88)	0.001
2.	Video clips meet my learning needs and improve the intended learning outcomes	4.45 (1.12)	0.001
3.	VBL is more effective than the traditional method of learning (reading textbook)	4.43 (0.85)	0.001
4.	I can retain more knowledge from video-based instructional methods when compared to other traditional teaching methods (textbook/lecture).	4.56 (0.75)	0.001
5.	Watching the Video clips help me to practice PE skills better than just reading it from the textbook.	4.65 (0.83)	0.001
6.	I learned as much from VBL as the clinical bedside method of teaching.	4.17 (1.34)	0.001
7.	Combining VBL with other formats of clinical teaching improves my learning	4.74 (0.66)	0.001
8.	VBL format can be a substitute for the hands-on practice of PE learning	1.83 (1.04)	0.953
9.	VBL before teaching session made my learning easier and faster during the teaching session	4.03 (0.76)	0.001
10.	Watching the video clips before the clinical BT prepares & helps more compared to only reading	4.72 (0.64)	0.001
11.	Watching the clips before the exam improves my performance during OSCE	4.76 (0.60)	0.001
12.	Video clips help me to prepare for my clinical exam	4.72 (1.34)	0.001
13.	Video clips are preferable to other formats of clinical teaching	3.37 (1.35)	0.091
14.	The video clips facilitated my learning	4.73 (0.67)	0.001
15.	Video clips are fair teaching tools	4.72 (0.58)	0.001
16.	Video clips should be used more often in the clinical years of the undergraduate program	4.63 (0.79)	0.001
17.	I would like to generalize the VBL methods to other joints' PE or courses containing clinical skills lessons	4.61 (0.65)	0.001
18.	I wish VBL was regularly used to teach all joints PE.	4.76 (0.46)	0.001

* P-value for single-sample Z-test within each survey question.
VBL: video-based learning.
BT: bedside teaching.
PE: physical examination.

compare them to the mean response, which was "3" (neutral), and identify those that were differed significantly from the mean. All analyzes were performed at a significance level of 0.05.

Results

A total of 310 undergraduate students who had completed the online video modules-based learning for the shoulder and knee joint PEs were invited to take part in the survey. A total of 242 (78%) students responded to the survey, 157 male and 85 female students.

Closed-Ended Questions

The responses to the closed-ended questions suggest a generally strong agreement with the comprehensive nature of online video modules, the superiority of these modules over the standard textbook or lecture-based instruction, and their role as adjuncts or supplements to the clinical instruction and exam preparation. Regarding the effectiveness of these modules in clinical learning, the students did find them helpful. There was a statistically insignificant disagreement that these modules can substitute hands-on clinical practice. Regarding their role as a teaching method, most students found them reliable; however, no consensus was reached regarding the preference over other teaching methods. Respondents strongly supported the wider use of online video modules. The detailed results can be found in Table 1.

Open-Ended Questions

The open-ended responses indicated that the online video modules were time-saving, easily accessible, comprehensive, concise, convenient, and allowed more time for hands-on practice during the clinical sessions. The specific tests, techniques, and steps of PE in a standardized manner were perceived as the unique advantages of online VBL. The lack of a theoretical section and less time spent explaining clinical anatomy were

perceived as weaknesses of the training modules. However, no aspect of the online video modules was perceived as less helpful or unsupportive. Among the aspects that could be improved, respondents suggested adding an explanation of clinical anatomy, background, and clinical implications of specific tests, and detailed elaboration of what positive clinical findings mean. The detailed results can be found in Table 2.

Qualitative Analysis

The closed-ended responses highlighted the comprehensiveness, superiority over textbook learning, role in clinical learning, and the future scope of wider application of VBL. However, some students thought that VBL might not be able to replace the BT completely, and some indicated they may prefer other learning methods. Thus, students would prefer VBL as one of the options rather than the sole option of clinical learning.

Table 2. Responses of open-ended questions concerning students' perception of online video modules supplemented bedside teaching.

Question 1: Mention the main advantages/benefits of the VBL
Responses (frequency): • Saves time for exam preparation (15) • Saves more time for study in general (14) • More standardized compared to the textbooks (12) • Easy access to go back and review any time (20) • Helpful before practicing (13) • No need to read from different sources (7) • Save time during BT (8) • More chance for hands-on practicing during bedside teaching (19) • Comprehensive and concise (14) • Excellent source for exam preparation (20)
Question 2: Mention the weak points/disadvantages the VBL
Responses (frequency): • Does not cover the theoretical aspect (3) • Need for more time to explain the clinical anatomy (3)
Question 3: Which aspects of the videos did you perceive as being helpful and supportive for your learning process?
Responses (frequency): • Special tests (17) • The technique of performing the exam (12) • Sequences of proper PE (8) • Organize and standardized (11)
Question: Which aspects of the videos did you perceive as being less helpful and less supportive for your learning process?
No responses
Question: How could the videos be further improved?
Responses (frequency): • Include some discussion on the surface and clinical anatomy (5) • More explanation of what positive test means (4) • Clinical background of special tests and their implications clinically (7)

VBL: video-based learning.
BT: bedside teaching.

Another important observation is that the students watched these videos to gain a better understanding of BT sessions; thus, the entire purpose of learning would be defeated if BT were to be eliminated. Also, due to the easy and quick access to the online modules, the students used them as aids for exam preparation; in particular, they find the stepwise demonstrations in the videos helpful in preparation for OSCE and other formats of clinical examination.

The open-ended responses yielded a wider picture and deeper insight into the specific pros and cons of VBL in MPES teaching. While all the observations of the closed-ended responses were replicated in the open-ended responses, the open-ended responses provide clarification and allow for deeper analysis and illuminate the reasons behind their responses to the closed-ended questions. It is likely that standardization of the instruction steps helped students feel more confident, as they all had the same understanding of the steps demonstrated in the videos. For example, one student said, "I don't need to care about what clinical testing method is written in the textbook when I have this learning video available on my phone."

The students also highlighted the benefit of better time management concerning exam preparation and BT sessions. One student said, " I don't need to go search the book, discuss with colleagues or confirm with the teacher, regarding the correctness of my method of clinical examination because I can easily cross-check with the videos provided to me, this saves me a lot of time." Hence, the content of videos and their comprehensiveness is likely related to better time management among students. Another student said, " without videos, I felt a bit hesitant to perform examinations in front of teachers and colleagues, but with video-based learning, I take less time to perform clinical tests as I practice them through video-based steps." Thus, videos are helpful prior to BT with more confident students, who also felt they spent more time practicing during BT. Among the aspects that needed attention to the limitations of the VBL, students pointed out the lack of background knowledge, especially theoretical aspects and clinical anatomy, and practical implications of the clinical findings in the instructional videos. One student said, " Although the steps were quite clear, I had to read about the surface markings before I could understand the video properly." Another said, " I can do the clinical examination, but for the mechanism of the test, I have read textbooks." Another student pointed out, "the management part after making a diagnosis needs to be read from the textbooks." The same finding may interlink with the closed-ended response suggesting that video clips are not always preferred over other formats of clinical teaching.

Discussion

The results of the current study highlight the general acceptance of instructional VBL as a supplement to the standard BT for MPES. Most students found the video modules to be

satisfactory and superior to traditional teaching methods in terms of effectiveness, knowledge retention, convenience, result orientation, and time management for both in-session practice and exam preparation. Although not statistically significant, there was concern that these modules could not replace hands-on practice, suggesting that they should only be used as a supplement to BT. Among the open-ended responses, the most helpful aspects of the instructional video modules were a better understanding of the specific tests and techniques and the sequence of administering PE in an organized and standardized manner. Perceived limitations included the inadequate presentation of the theoretical basis of the PE and of the special tests, the need for more time to explain clinical anatomy, and the practical implications of the positive special tests.

Instructional videos for clinical skills can serve as a long-term investment for clinical teaching without the need for the clinician to teach everything from scratch. A quick summarized in-person teaching session, explaining all aspects of clinical skills, may not be well received by every student despite the clinician's efforts.[15] Providing lecture notes/text-based learning is an alternative to providing students with prior learning that is not time-bound and is independent of the actual class session. However, textual learning for clinical skills may not spark students' interest.[19] At this point, it should be emphasized that the VBL, although beneficial, cannot replace textbooks because of the amount of knowledge and subject matter covered in them. However, due to their visual input, videos help to better visualize the concepts taught in textbooks, going beyond what can be understood through reading alone.[20] Therefore, in MPES, which usually involves complex skills and is difficult to be imagined by reading texts, VBL can help to make textbook reading easier and faster. VBL is on the rise in medical education.[21–25] Videos arouse interest through a variety of sensory impressions, as they can include text, moving images, and sound.[19] Multiple sensory stimulations lead to more cognitive connections, resulting in a better understanding of the concepts and the development of deep thinking.[26] Videos can help improve students' knowledge retention regarding procedural steps, such as in PE, because they can watch each step repeatedly until they can do it themselves.[6,27] In addition, videos can potentially contribute to a better interaction between students, as they can be prepared or have their questions ready during the actual session.

The online learning module is convenient for students because they can access the videos from computers or portable devices such as smartphones. Thus, students can choose a convenient location to participate in video modules. In addition, VBL is an effective form of microlearning because when the videos are short and structured in small steps, they promote the retention of knowledge and engagement in the learning process.[28] Therefore, online video-based instructional modules can be effectively integrated with BT for MPES instruction. The increased student interest noted in the current study can be explained by the benefits mentioned above. Among the specific benefits of the online video supplementing BT for MPE, students highlighted special tests and a better understanding of the PE steps. The special tests include complex maneuvers that involve the psychomotor domain and are different from the general PE, which primarily involves observations and interpretations.[29] A session of BT may not provide sufficient time for demonstration, understanding, and practice of complex skills. On the other hand, VBL can help repeat steps for a better understanding.[15] Therefore, students may also have a better understanding of concepts related to instructional videos if they read the textbooks after watching the videos.

The results of the current survey are consistent with previous studies that examined the effectiveness of online instructional videos in teaching clinical skills.[30–35] The researchers found that educational videos were effective in improving clinical skills in general and specific PE. Hull et al [36] supported the use of instructional videos prior to BT sessions for orthopedic knee PE. Prior VBL resulted in higher OSCE scores, compared to VBL after BT. Lenchus et al [32] found a significant improvement in invasive skills among internal medicine residents following a similar blended teaching approach that combined VBL prior to BT.

The responses to the open-ended questions also revealed some specific advantages of the video modules that were not captured via responses to the closed-ended questions; specifically, the open-ended responses clarified that the use of the videos helped students better understand special tests, examination techniques, and the sequence and organization of the clinical examination. This advantage may explain why students found the video modules helpful for practicing and reviewing material prior to exams. Notably, none of the students responded to the question asking them to identify the less helpful aspects of instruction videos. However, as the shortcomings were already discussed in prior questions, students might not have responded because they had not identified any less-helpful aspects of the VBL that had not already been addressed. Secondly, the students' awareness of the shortcomings of the methodology may have been limited given their limited exposure to the method (ie, they had only recently experienced the teaching strategy for the first time). A wider implementation could have resulted in specific answers to this question.

Few studies have investigated the efficacy of VBL in MPES. Mehrpour et al [37] found a positive association between video-based supplemented learning and clinical examination outcomes among students trained to splint injured limbs. Torres et al [38] analyzed the effectiveness of a mixed approach, combining VBL and face-to-face sessions for musculoskeletal clinical reasoning skills, and found improved outcomes compared to the baseline assessment. In addition, general satisfaction was

observed among the students using this approach. Tripodi et al [39] recorded first-year osteopathic students' perceptions of video-supplemented clinical teaching and found supportive feedback. Students felt that video supplementation improved comprehension; increased learning, exam performance, and exam confidence; reduced exam anxiety; and eliminated minor technical difficulties. However, undergraduate medical students' perceptions of such a teaching approach to musculoskeletal skills learning have not been evaluated previously.

Students in our study perceived the online videos before BT as effective for preparing them for the face-to-face session. This chronology is likely to have helped students better prepare and compile questions to be discussed in the in-person session. Better understanding during the session results from intentional engagement, as students are already familiar with the steps of the ongoing instructional session. Prior video-based training helps them to be motivated and confident during an actual BT session.[19] The instructional videos in this study were standardized because they were validated by experts and were the same for all students. The procedural steps were fixed and uniform for all students. This standardization potentially contributes to the development of a healthy interactive environment in which students can interact with each other and with the facilitator to achieve better understanding. In addition, the VBL is time-saving because of the standardized videos that can be repeated in different sessions. Students are likely to take less time to understand the steps shown in the videos compared to text-based learning. VBL is helpful for test preparation because, first, students have convenient access to video resources that they can access at any time, and second, students can watch the videos as many times as they want to retain the information.

While most responses in the survey found online VBL to be helpful as a supplement to BT, there were also a few shortcomings. The main limitations perceived by the students were that they must have knowledge of the clinical anatomy and the theoretical basis of the positive findings they will be collecting. A major concern about VBL is that it would be impractical to cover all concepts of medical education through videos. Textbooks are the traditional form of medical education to explain the theoretical basis of clinical findings. Although videos effectively simplify the steps of a complex clinical skill or maneuver, it is essential that students learn the background concepts and theoretical portions of the clinical skills from the textbooks or lecture handouts. This combination of teaching strategies will result in balanced learning that includes both text and audiovisual stimulation and contributes to the overall development of medical students as lifelong learners. In this way, students will not be completely dependent on videos, even for basic things. Meanwhile, it was emphasized that students' learning methods are very different. There are mainly reading/writing learners, auditory learners, and visual learners.[39] Therefore, a flexible approach is needed to allow for individualized learning. Students should be able to choose the learning method that is most appropriate for them among videos, text sources, and audiotapes.

The limitations of the instructional videos' inability to cover the theoretical, anatomical, and clinical reasoning aspects of MPES highlight the role of an instructional model designed to cover different aspects of medical teaching. The videos might fulfill the need for better instruction of the procedural parts to be learned. However, the knowledge and affective domains may require other alternative strategies to cover clinical competency comprehensively. An instructional design helps educators structure their teaching to make the best possible use of different teaching methods. There are several well-known instruction design models, including Gagne's theory of instruction,[40] Mayer's instruction based on cognitive load theory,[41] Peyton's 4 step approach to procedural instruction,[42] and Merrill's First Principles of Instruction.[43] Gagne suggested nine events of instruction that may enhance student learning: gain attention, inform learners of objectives, stimulate recall of prior learning, present stimulus, provide learner guidance, elicit performance, provide feedback, assess performance, and enhance retention and transfer [40]. Mayer et al [41] highlighted three important instructional goals are: to reduce extraneous processing (cognitive processing that does not serve an instructional objective) during learning; to manage essential processing (cognitive processing aimed at representing the essential material in working memory) during learning, and to foster generative processing (cognitive processing aimed at making sense of the material) during learning. Peyton's 4 step approach for clinical skills involves the following steps: Step 1—demonstration by the trainer; Step 2—stepwise description of the skill in detail, Step 3—trainer repeats steps as described by the trainee; and Step 4—the trainee performs the skill.[42] Merrill proposed that learning is better when instruction is problem-centered, activates existing knowledge, includes demonstrations, provides opportunities for application, supports integration into the real world.[43]

One common observation regarding the instructional models is that demonstrations that can be provided through instructional videos must be supplemented with the other teachings of basic knowledge and methods to strengthen the quality of instruction. For this reason, video modules cannot be used as the sole means of providing medical education. There is emerging evidence of the role of videos for different steps of learning, but it is still unclear, and further research is required. The survey in the present study examines students' perceptions of clinical examination demonstration through videos but does not reflect the role of other additional instruction teaching model designs.

The current study helps to shed light on students' perceptions of VBL as an auxiliary method to supplement BT for MPES. Learning MPES is a topic of great concern among medical educators worldwide. Published evidence suggests a

general lack of satisfactory MPES among undergraduate medical students.[9–11] Teaching methods for MPES instructions are far from standardized, and there is wide variation among medical institutions.[44] Innovations in teaching methodology that allow students to better understand MPES are desirable. VBL is one such alternative that has been introduced in medical education through various means, such as instructional videos, online modules, and computer-based learning. However, to strengthen VBL in MPES teaching, it is essential to know how satisfied students are with this approach and which educational videos they prefer as complementary tools to the standard BT. There is a major gap in the literature regarding such assessment. The current study explores this aspect of the implementation of VBL in MPES teaching and may be helpful in the future policy implementation of curricula and teaching methods. This study is important in the context of the innovations attempted to improve medical education. The improvement in the assessment scores shows the effectiveness of the modified teaching approach, even though it does not provide information concerning the weaknesses and strengths of the approach from the students' point of view. The current study highlights the need for an integrated teaching approach that combines VBL with traditional teaching methods.

The results of this study indicate that the VBL teaching method is worthy of further development and examination, as it has the potential to become a standard teaching approach for MPES. These initial findings highlight students' perceptions of the useful aspects, as well as some limitations, of the instruction via online video modules. The MPES involves step-by-step procedures for physical examination, interpretation, and diagnosis formulation that can be conveyed by well-structured videos. However, not all concepts in medical education involve procedural steps, and the effectiveness of video-based learning for such aspects may not be equivalent to its effectiveness for MPES. Another important concern with VBL is the need to incorporate an effective two-way feedback mechanism to assess students' continuous participation and ensure the teaching is not monotonous. In addition, students may lose interest in watching the VBL if it is available for a prolonged period.[45] Furthermore, an element of physical interaction is always necessary to understand and manage real-life scenarios.[15] Lastly, educational videos are sophisticated tools that require a precise strategy and execution to develop all of the educational competencies they are intended to cover. In the absence of such a comprehensive approach, the students may not understand the steps well or may interpret them incorrectly.[45] Thus, videos must convey to each student what the facilitator wants them to learn. Accommodating this need could be costly and laborious and involve multidimensional coordination from media and technology personnel, experts in the field, and pilot testing. Moreover, there are no guidelines for video quality assessment and credibility. Thus, although video-based learning appears to be an attractive educational alternative, it may face constraints in execution. More evidence is necessary to determine how video-based learning can be implemented on a larger scale.

This study has some limitations. First, the students' perceptions may not have touched all aspects of VBL that could be revealed by a broader implementation of VBL. Second, the survey analyzes students' perceptions of VBL for MPES and cannot objectively predict the improvement in clinical skills or their grades as a result of VBL. Students use several other learning methods mentioned above that may affect their clinical learning and act as confounding factors. Third, students' perceptions are based on training for the PE of two major joints. A larger, multidisciplinary application of video modules is required for providing clarity. Lastly, the study was conducted in the pre-COVID-19 era; therefore, the impacts of the pandemic on student learning have not been assessed. The students' perceptions of the teaching models may vary from those captured in this study due to their experiences during the pandemic; the potential differences warrant further investigation and analysis to determine differences in the context of (or after) the COVID-19 pandemic and the myriad effects of in-person and distance learning for students worldwide.

Conclusion

The current survey suggests that undergraduate medical students perceive VBL to be helpful in MPES learning. The are several positive aspects of the VBL approach in MPES teaching: they are comprehensive, easy to access, and efficient (time-wise), provide standardized teaching, demonstrate special tests and examination techniques, and they model the sequence and organization of the clinical examination. The main perceived limitations are that they lack clinical reasoning content and effective anatomical teaching in preparation for the clinical tests. Further, large-scale evidence and further studies are required to understand the perception patterns of VBL in MPES and other fields of medical education and to assess the feasibility and acceptance of such teaching methods.

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Ethical Approval and Consent to Participate

This study was approved by the institutional review board of King Saud Medical University, Kingdom of Saudi Arabia. (Approval No. 20/0002/IRB). The work was carried out in accordance with the Declaration of Helsinki (https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethicalprinciples-for-medical-research-involving-human-subjects/), including, but not limited to, there being no potential harm to participants, that the anonymity of participants was guaranteed, and that informed consent of participants was obtained.

Declaration of Interest

The authors declare no conflicts of interest.

Informed Consent

Not applicable, because this article does not contain any studies with human or animal subjects.

Trial Registration

Not applicable, because this article does not contain any clinical trials.

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