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RESEARCH

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Team-based learning (TBL) curriculum combined with video vignettes improves performance of undergraduate medical students on OSCE compared with TBL alone

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Abstract

Background Clinical practitioners think of frequent causes of diseases first rather than expending resources searching for rare conditions. However, it is important to continue investigating when all common illnesses have been discarded. Undergraduate medical students must acquire skills to listen and ask relevant questions when seeking a potential diagnosis.

Methodology Our objective was to determine whether team-based learning (TBL) focused on clinical reasoning in the context of rare diseases combined with video vignettes (intervention) improved the clinical and generic skills of students compared with TBL alone (comparator). We followed a single-center quasi-experimental posttest-only design involving fifth-year medical students.

Results The intervention group ($n=178$) had a significantly higher mean overall score on the objective structured clinical examination (OSCE) (12.04 ± 2.54 vs. 11.27 ± 3.16; $P=0.021$) and a higher mean percentage score in clinical skills (47.63% vs. 44.63%; $P=0.025$) and generic skills (42.99% vs. 40.33%; $P=0.027$) than the comparator group ($n=118$). Success on the OSCE examination was significantly associated with the intervention ($P=0.002$).

Conclusions The TBL with video vignettes curriculum was associated with better performance of medical students on the OSCE. The concept presented here may be beneficial to other teaching institutions.

Keywords Team-based learning, Video vignettes, Rare diseases, Undergraduate medical education, OSCE

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Introduction

Medical students must acquire not only skills in clinical reasoning but also skills to listen and ask relevant questions when seeking a potential diagnosis [49]. They usually learn to evoke the most frequent causes of diseases first. The phrase, *"When you hear hoofbeats, think of horses, not zebras,"* pronounced by Dr. Woodward in the 1940s, suggests that clinicians should think first of common diseases rather than spending time searching for rare conditions [13]. However, it is important for clinical practice to continue investigating when all common diseases have been discarded [31]. There are two important elements for students and, consequently, for medical educators: i the most easily memorized concepts are considered the most likely; ii an unconventional presentation of a frequent illness is more likely than the usual presentation of a rare health condition. According to Croskerry [12], thinking of clinicians can be divided into a rapid process based on pattern recognition and a slow approach of thinking to search for pathophysiological mechanisms. To use a rapid thinking process, students have to build repertoires of exemplary situations to organize their knowledge. Medical teachers should use the representation of contextual clinical problems to engage students in critical thinking [5, 11, 22, 45, 46].

Rare diseases concern more than 250 million people [38]. In most cases, they are severe and progressive, affecting the quality of life of patients. The objectives of World Health Organization are to decrease misdiagnosis, shorten time to diagnosis and to provide multidisciplinary accessible care [59]. The need to train medical students was stated by several health education authorities [10, 24, 54].

Literature data show that the long road to correct diagnosis and misdiagnosis are related to the physicians' lack of knowledge and inadequate training during medical studies [57, 58]. Among key components of medical decision making are the abilities of clinicians to identify essential information in a given clinical situation, recognize and interprete patterns in the collected information, summarize and hierarchize information to arrive to working hypotheses and conclusions (Mandin et al. [34]). Observation skills are essential elements in medical decision making and have to be specifically developed in medical students during their training [8]. Our pedagogical approach was focused on rare conditions, because clinical reasoning in this context is based on the recognition of specific patterns and capacity to synthetize and hierarchize patients' data. To our knowledge, there are no data regarding the potential benefits of teaching modules focused on clinical reasoning in the context of rare diseases on the clinical skills of undergraduate medical students.

According to the literature, rare diseases are insufficiently addressed during undergraduate medical education [62]. Only several medical schools offer elective modules focused on rare diseases to their undergraduate students [2, 3, 37, 47], such as the RARE Compassion program [37] or RAREDIG program (Medic 4 Rare Diseases). Some studies evaluated student perceptions [3, 47], however, the potential benefits of these programs on the clinical performance of students have not been reported.

In the Medical School of the University of Lorraine, we have initiated a pilot module aspiring to enhance understanding of rare diseases among the fifth-year undergraduate medical students. In our pilot study [20], the use of video vignettes [26, 56] with exemplary clinical situations was favorably accepted by medical students as it engaged them in self-reflection and clinical reasoning. However, the effective integration of clinical reasoning teaching modules into the medical curriculum is challenging because it represents an increased demand on faculty staff [5]. In the context of an increase in the number of medical students in medical schools, a team-based learning (TBL) method has been implemented in curricula that is less demanding in terms of human resources [7, 40]. Previously, a small pilot study including 26 medical students showed that the TBL class improved clinical reasoning skills of medical students in neurology [29]. In our approach, we focused on the differences in teaching methods (TBL with video-vignettes vs TBL alone). We hypothesize that TBL with a video vignette curriculum focused on clinical reasoning for rare diseases will improve the clinical skills of medical students compared with TBL alone. Our objective is to determine whether TBL combined with video vignettes (intervention group) improves the overall score of medical students on the objective structured clinical examination (OSCE) compared with TBL alone (comparator group).

Methods

Settings and study participants

We followed a single-center quasi-experimental posttest-only design [23] with an intervention group (TBL with scripted video vignettes) and comparator group (TBL only) (Fig. 1). For ethical reasons, we could not randomize students. We selected a method based on a posttest-only strategy to avoid the drawbacks of acquaintance with test questions [9]. Participation in the study was proposed to all fifth-year medical students of the University of Lorraine in the context of the compulsory TBL module focused on transversal clinical situations as starting points [55]. As illustrated in Supplementary Fig. 1, TBL module was composed of three components: i introduction session; ii distance preparation; and iii

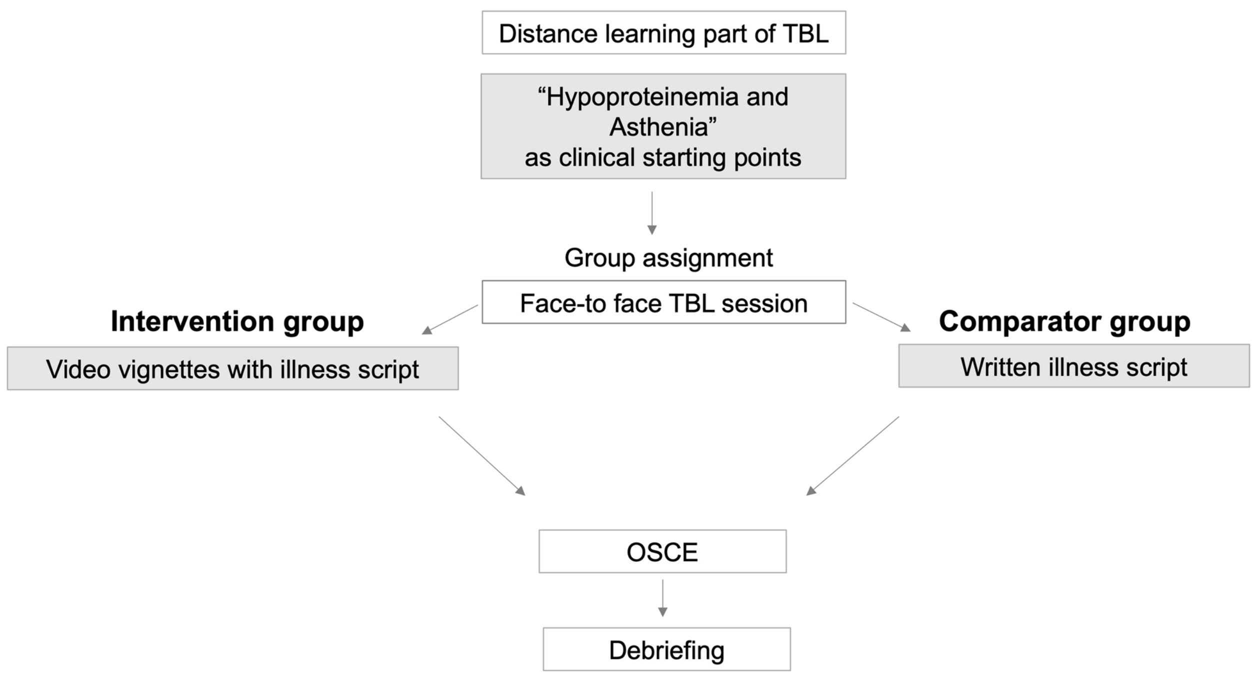

Fig. 1 Study design

face-to-face session. The course contained clinical situations and questions to solve. Feedback activities were incorporated into the distance learning part of TBL and face-to-face TBL session. Learning content is detailed in Supplementary Table 1.

There was no disadvantage due to withdrawal or nonparticipation. Students who were not willing to participate followed their regular fifth-year medical curriculum. At the beginning of the study, students were assigned to 41 teams composed of 7 to 9 students. Before the face-to-face TBL session, the students were unknowingly separated into intervention and comparator groups [14]. One medical instructor was responsible for the group of 67 to 98 students. The face-to-face session of TBL was organized in parallel in four amphitheaters (2 amphitheaters in the comparator group and 2 amphitheaters in the intervention group). All four medical instructors (CB, EF, II and EP) were members of the medical faculty OSCE pedagogical team and were actively involved in formative and evaluative teaching activities of undergraduate medical students, including the preparation of assessment tests. All of them used standardized teaching material for educational sessions in the form of PowerPoint presentations, video vignettes, quiz questions and guides on how to deliver effective feedback [55]. Pedagogical material is available on the university teaching platform (https://arche.univ-lorraine.fr/course/view.php?id=60441) and was aligned with the intended learning outcomes (Supplementary Table 1). All educational interventions were delivered as scheduled. No adaptation was needed.

After the initial experimentation and measurements of attainments, the educational material for both groups was freely available to all students on the Moodle platform of the University of Lorraine. The study was conducted according to the Guideline for Reporting Evidence-based Practice Educational Interventions and Teaching (GREET) Tool [44] (Supplementary Table 2).

Description of intervention

We used team-based learning (TBL) as an instructional strategy [40] (Supplementary Fig. 1) with slight modifications. An introduction session was organized in-class with the aim to present TBL approach and learning outcomes. A distance (online) part of the module was focused on both individual and group preparation using a didactic material on the Moodle platform to encourage collaboration and provide identical theoretical framework to all students. A face-to-face session consisted of the knowledge test (individual readiness assurance test, team readiness assurance test) with instructors' clarification, collective action (team application) and closing remarks by the instructors. In the construction of our program, we followed a social learning theory: 1) observed behavior must be noteworthy to get the attention of students and to be memorized; 2) behavior should be facile to reproduce; and 3) the subject must motivate students [4].

Pedagogical content corresponded to the curriculum requirements for the 2nd cycle of undergraduate medical education (Journal officiel de la République française – N° 204 du 3 Septembre 2023)[33] detailed in the Learning Assessment Booklet (LiSA) [55]. Students worked in teams on the same scenario with "hypoproteinemia and asthenia" as clinical starting points [55]. Learning outcomes were derived from Bloom's taxonomy [1] and used the words "apply", "use", "perform/interpret," and "participate" (Supplementary Table 1). The aim was to foster the development of transversal competencies [16]. Sequential key elements and uncertain items were integrated into illness scripts to foster clinical reasoning in the context of rare health conditions [20].

During a distance learning part of TBL, students worked in teams and were asked to submit their work assignments via the Moodle platform of the University of Lorraine (https://arche.univ-lorraine.fr/course/view.php?id=60441). We created date ranges for the students to view and submit their team assignments and to receive feedback from the instructors.

During a face-to-face session of TBL, students completed an individual readiness assurance test and a team readiness assurance test with immediate feedback from the instructor [40]. Then they actively participated (collective action) to solve clinical situations of a complex patient case covering the following domains: history taking, diagnostic strategy, data synthesis, physical examination, patient information and management (Supplementary Table 3). Illness scripts were presented to students by the instructors successively as the teams progressed through the scenario. Students in the intervention group received illness scripts in the format of video vignettes (3 video vignettes, each lasting between 5 and 7 min) and watched the vignettes on a central screen in the presence of the instructors. Students in the comparator group received 3 illness scripts in a written format. Written scripts were projected on a central screen and red aloud by the instructors. The cumulative amount of time students spent reviewing the video vignettes and the time spent on reading the written illness scripts was identical for both study groups. Students in the comparator group were challenged in the similar way as the intervention group to make interpretations, analyses and specific action and, if asked, to explain or defend their attitude to the class. A detailed description of the learning content is provided in Supplementary Table 1.

The video vignettes comported illness scripts realized with the help of standardized patients and short videos with patients' testimonials from online sources [17,36,41,51]. An example of the scripted video vignette is provided in Supplementary Table 4. The script illustrates a clinical situation of an adrenal crisis revealing primary adrenal insufficiency. Construction of the illness script was based on the standardized patient's script template described in the previous work [18]. Written illness scripts followed the same format as that for a video vignette (video being replaced by a written text).

The face-to-face session included peer and instructor feedback activities and a final summary from the instructor (Supplementary Fig. 1).

One month after the session, students completed a bloc OSCE as part of their 5th year of undergraduate medical studies. Two weeks after the OSCE session, students were invited to a final debriefing with the instructors.

Objective structured examination (OSCE)

All OSCE stations were developed by the pedagogical team according to the Learning Assessment Booklet (LiSA) for the 2nd cycle of medical studies [6]. The blueprint and test specifications (Table 1) were based on the

Table 1 OSCE stations with competency areas assessed

OSCE station: Competency areas	Clinical situation as starting point	Content
1: Patient information/ Management plan; Generic skills	Fall of an elderly person	Explain a postfall syndrome to the patient's daughter/ Suggest an appropriate management plan Ability to listen, questioning skills, ability to provide information to patients/carers
2: Physical examination/Diagnostic strategy; Generic skills	Urinary retention	Carry out a symptom-focused examination, ability to structure and conduct clinical examination/Ability to summarize data and justify the reasoning Explain the findings to the patient
3: Iconography/ Diagnostic strategy; Generic skills	Respiratory distress	Describe pulmonary radiography/Suggest a metastatic lung tumor as the most likely diagnosis; suggest 3 additional exams and justify. Ability to summarize data; ability to communicate with peers (clarity of communication)
4: History taking/Diagnostic strategy; Generic skills	Asthenia	Carry out a focused history/suggest steroid induced adrenal insufficiency as the most likely diagnosis Questioning skills, ability to structure/conduct the interview, ability to provide information to patients/carers

BPH Benign prostatic hyperplasia

curriculum standards for the fifth year of medical studies. In France, OSCEs represent a component of continuing assessment at medical faculties from the fourth year onward as preparation for the high-stakes national OSCE examination (Journal officiel de la République française – N° 204 du 3 Septembre [33]). The fifth-year bloc OSCE is generally composed of five stations. Given logistical difficulties that were encountered with the station evaluating skin laceration repair, the bloc OSCE circuit was composed of four stations, each dedicated to one situation, malaise, urinary retention or acute respiratory distress, to evaluate the following domains of clinical competency: 1) patient information/management plan; 2) physical examination/diagnostic strategy; 3) iconography/diagnostic strategy; and 4) history taking/diagnostic strategy (Table 1). Each OSCE station examined both clinical skills and generic skills (such as physician–patient relationship, care planning skills, summary of paraclinical test results…). The OSCE circuit was scheduled as two half-day sessions for all 5th-year students. All students were invited to participate in a briefing session two weeks before the OSCE that outlined the purpose of the exam and gave generic guidance on how to approach the stations. We recruited and trained standardized participants (SPs) according to national recommendations to ensure the accuracy of the role portrayal [19]. Before the OSCE, all examiners received specific training on the expected levels of students' performance and on the use of checklists and rating scales. The OSCE examiners were blinded to the two study groups. On the day of the OSCE, a calibration session was organized for all examiners to standardize the grading process, and a specific briefing session was provided for the SPs. Each station lasted 8 min, and 1 min was reserved for the change between two stations. Given the size of the student cohort, we ran 7 identical parallel circuits. Each student was evaluated by a single trained examiner. For each OSCE station, the examiners ascribed two scores to the student: a) according to the list of tasks using standardized dichotomous observation grids and b) a global performance grade using a 5-point rating scale: insufficient performance, borderline performance, satisfactory performance, very satisfactory performance, and outstanding performance.

Members of the pedagogical team organized debriefing sessions and provided students with feedback on their performance two weeks after taking the OSCE and before the day the exam results were released. The feedback was composed of two parts: i) feedback for the whole cohort of students according to station type and ii) individual feedback for interested students based on the examiners' notes written in the interval between stations on the evaluation sheets to provide indices of performance and propositions for amelioration. Specific debriefing sessions were also organized for the examiners and the standardized patients.

Ethics

The study was registered at the French National Commission for Data Protection and Liberties (Commission Nationale de l'Informatique et des Libertés; CNIL) (n° 2023–239). The present research was of an educational nature. It was not a clinical trial and did not fulfill specific criteria for registration according to the Checklist for Evaluating Whether a Clinical Trial or Study is an Applicable Clinical Trial (ACT) Under 42 CFR 11.22(b) for Clinical Trials Initiated on or After January 18, 2017. Ethics approval and informed consent were not necessary according to the French national regulations defined by article L 1123–7 of the Public Health Code (CSP)—Loi Jardé (n°2012–300 of March 5, 2012, in application in November 2016—Article R1121-1). Participants had the right to access, rectify, delete and limit the use of their personal data and could contact the educational institution's data protection officer and the CNIL (http://www.cnil.fr). All data were anonymized before the start of the analysis.

Statistical analysis

Variables are reported by their mean (± standard deviation; SD), median (interquartile range; IQR) or as percentages with 95% confidence intervals (95% CI). After assessing normal distribution, statistical analysis was performed with the use of parametric tests. We used Student's t test to analyze whether the intervention group and the comparator group were different in terms of quantitative variables. The Z test was used to compare two proportions between the two groups. Pearson's chi-squared test was used to determine whether there was a difference between the expected frequencies and the observed frequencies in OSCE success between the two study groups. A simple linear regression was used to determine the relationship between the overall OSCE score and success on the knowledge tests (Bloom's taxonomy levels 1 to 4) [1], defined as a mean score greater than or equal to 12/20 on the 5th-year undergraduate medical studies written progression tests.

The OSCE pass mark was calculated using a borderline regression method [32, 42] with the station score as a dependent variable and the overall performance level as an independent variable. We used R-squared as a main metric of the quality of a station [43]. R-squared values above 0.4 were considered satisfactory [27, 43]. For each station, a visual analysis of scatter diagrams was performed to evaluate the degree of spread in scores [27, 43]. The reliability of the stations was measured by Cronbach's alpha. We calculated a pass mark for each station within the circuit allowing for adjustments of difficulty (Khan [30]). We did not take into account missing items to avoid penalizing the students. The total number of items represented 100% of the overall score. The overall OSCE score was the average value of the cutoffs for each of the stations within the circuit [25, 27, 35]. The overall OSCE score was then expressed on a scale from 0 to 20 points in accordance with the French OSCE guidelines [6]. Subscores in generic and clinical skills were expressed as a mean percentage score indicating the percentage of achieved points out of total raw scores. Intercircuit variability was assessed using a one-way ANOVA. All statistical analyses were performed using XLSTAT software (Lumivero®) on the basis of a 2-sided type I error with an alpha level of 0.05.

Results

Baseline characteristics of the study participants

A total of 330 fifth-year students were invited to participate in the study. The flowchart of the study is presented in Fig. 2. There were no refusals to participate. Data were incomplete for 34 subjects. Finally, data from 296 participants were included in the analysis: 178 students in the intervention group (62% females) and 118 students in the comparator group (60% females). Students in the intervention group had a significantly lower success rate on the knowledge tests (Bloom's taxonomy levels 1 to 4) taken as part of their 5th-year undergraduate medical studies (84.2%) than students in the comparator group (93.2%) ($P=0.021$) (Table 2).

OSCE results

As detailed in Table 2, students assigned to the TBL with video vignettes curriculum (intervention group) had a significantly higher pass rate on the OSCE (80% vs. 64%; $P=0.006$) and a significantly higher mean overall OSCE score (12.04 ± 2.54 vs. 11.27 ± 3.16; $P=0.021$) compared with the students in the comparator group. Additionally, students in the intervention group performed significantly better in clinical tasks, with a mean percentage score of 47.63% compared to 44.63% ($P=0.025$) for students in the comparator group. Students who received TBL with the video vignette curriculum attained a significantly higher mean percentage score in generic skills (42.99%) than students in the comparator group (40.33%) ($P=0.027$) (Table 2). The reliability of the OSCE stations measured by Cronbach's alpha was 0.59, 0.84, 0.72 and 0.67, respectively (Table 3). A relationship strength between global grades and checklist scores (R-squared) was 0.56, 0.74, 0.65 and 0.39, respectively.

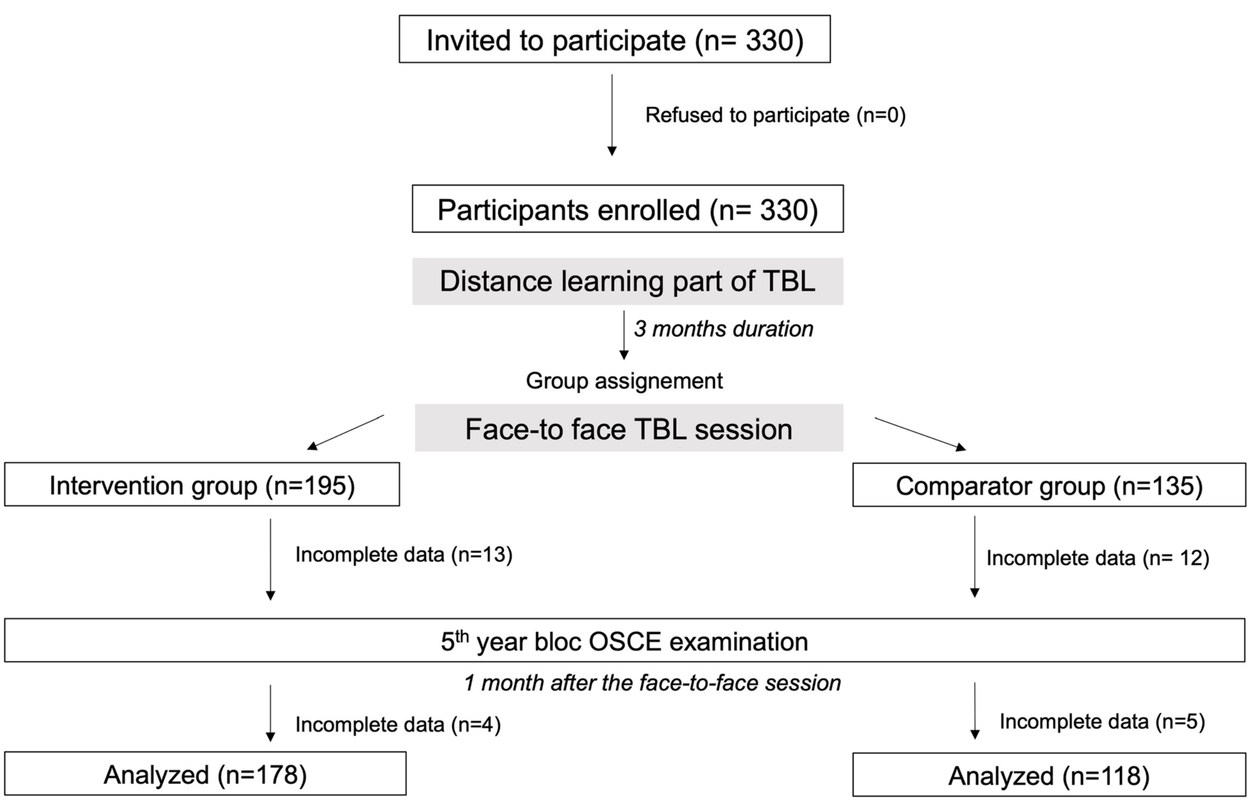

Fig. 2 Study flowchart

Table 2 Characteristics of the study participants and OSCE results for the intervention group and the comparator group

	Intervention group n = 178	Comparator group n = 118	P
Basic characteristics			
Females %	62	60	*ns*
Written knowledge tests success %	84.2	93.2	***0.021***†
OSCE results			
Overall OSCE pass rate %	80	64	***0.006***†
Overall OSCE score	12.04 ± 2.54	11.27 ± 3.16	***0.021***††
Clinical skills * (95% CI)	47.63 (46.13–49.14)	44.63 (42.33–46.94)	***0.025*** ††
Generic skills * (95% CI)	42.99 (41.63–44.35)	40.33 (38.32–42.33)	***0.027***††

Values are expressed as the mean (± SD), percentage (%) or mean percentage score (*)

† Z test to compare two proportions; †† Student's t test (two-tailed), *ns* – not significant

CI Confidence interval, *SD* Standard deviation

Table 3 Psychometric analysis of the OSCE stations

OSCE station	Pass mark (BRM)	Mean score (SD)	R-squared	Cronbach alpha	Intercircuit variability	Pass rate
Station 1	6.6	13.7 (4.1)	0.56	0.59	12%	78%
Station 2	7	11.8 (6.3)	0.74	0.84	3.5%	61%
Station 3	9.3	11.1 (4.1)	0.65	0.72	6.0%	64%
Station 4	8	10.2 (4.5)	0.39	0.67	9.7%	55%

BRM Borderline regression method [32, 42], *SD* Standard deviation

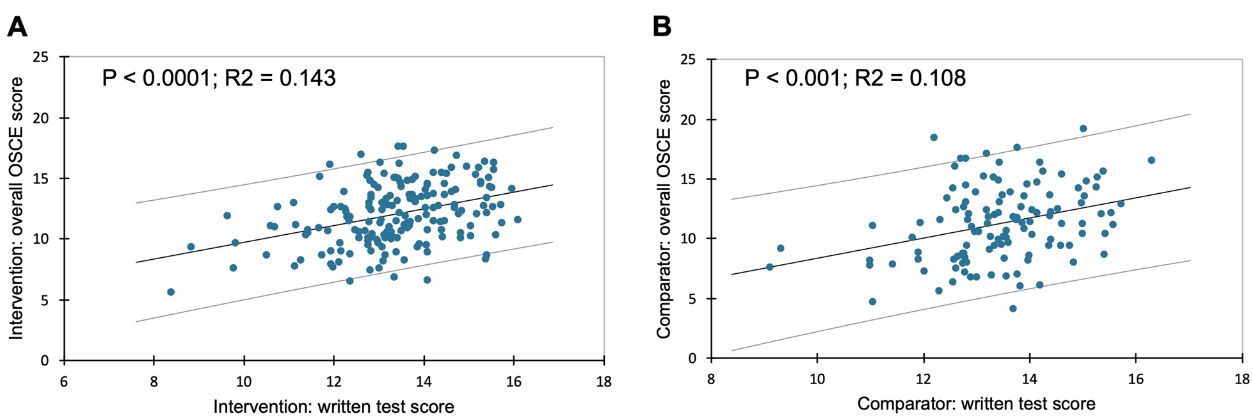

Fig. 3 Relationships between overall OSCE score and written test score in the intervention group (**A**) and in the comparator group **B**. Gray lines—95% confidence interval

Interestingly, the distribution of overall OSCE scores was comparable in both study groups (Supplementary Fig. 2). There was a significant relationship between the overall OSCE score and the written test score for the students in both study groups (Fig. 3). In the comparator group, given the R2, 11% of the variability of the overall OSCE score was explained by the written test score. In the intervention group, given the R2, 14% of the variability of the overall OSCE score was explained by the written test score. Success on the OSCE was significantly associated with the intervention ($P = 0.002$) (Table 4).

Discussion

The main findings of this study indicate that the TBL with a video vignette curriculum focused on clinical reasoning in the context of rare diseases was associated with better performance of medical students on the OSCE. To our knowledge, these observations are

Table 4 Details of the analysis comparing the OSCE examination success of the intervention group and the comparator group

	Intervention group n = 178	Comparator group n = 118
OSCE Pass	142 (130.49)	75 (86.51)
OSCE Fail	36 (47.51)	43 (31.49)
Pass rate	0.80	0.64
Significance level[a]	*P = 0.002*	

Sample raw data presented first, sample expected values in parentheses

[a] Pearson's Chi-squared test

new findings and have not previously been reported. Note that a positive association between TBL and OSCE scores was already observed; however, learning outcomes were not provided by the authors [39]. On the other side the use of video-vignettes has also been associated to a better outcome at OSCE [52, 60]. Hence, it seems that the two approaches have an additive effect. Moreover, students in the TBL with video vignettes group achieved higher scores in clinical and generic skills. Interestingly, literature data indicate that students who participated in educational sessions focused on generic skills in domains with a direct impact on patients' outcomes, such as providing information, patient education, or patient assessment and decision-making, improved their performance on the OSCE [61].

The results of this study further show that the instructional strategy is more beneficial for lower-achieving students because the students in the intervention group had a lower baseline success rate on the 5th-year progress knowledge tests. The most likely explanation for our observations is that the video vignettes were linked to a specific clinical context, which helped the students organize their knowledge [5, 22, 46]. Another explanation could be related to the teaching methods themselves: for example, in the written scripts setting, students did not interact as much as in the video sessions therefore their learning was not as good as the intervention group. Or clinical patterns presented to students during the video sessions had a more direct correspondence with actual clinical settings, while written scripts could not be transferred so easily to clinical situations. In addition, our strategy was supported by social learning theory, emphasizing the interplay between the cognitive work of the student and environmental factors, such as collaborative activities with peers and tutors [50].

The methodology of the present work was founded on a quantitative methodology [53] where the independence of the researcher's opinion and objective observation play important roles. Therefore, we were able to study our hypothesis through deductive reasoning. Our approach can be successfully proposed to a large cohort of students while engaging a minimal number of medical teachers. In addition, the use of video vignettes engages students in learning activities [15]. The incorporation of patients' voices and testimonials into the video vignettes was valuable because they brought live experiences and increased the authenticity of the scenarios. Indeed, patients are best placed to describe their values, needs and expectations [21, 48].

The overall OSCE score is part of the continuous educational assessment tools in our institution to monitor students' progress. In addition, psychometric analysis of individual stations enabled us to identify areas for improvement [27, 28, 43]. Note that station number 4 had a relatively poor R squared value, suggesting some misalignment of the global grade and checklist. We reviewed the standardization procedure, including the OSCE examiners' training, to control decision-making and evaluation variability [27, 43].

The fact that the videos can be implemented by large cohorts is a major strength of this research. Several limitations must be acknowledged here. This was a single institution experience, although it can easily be generalized. Elaborated pedagogical material (video vignettes) will help to standardize teaching modalities and can be beneficial to other institutions. Without true random assignment of the students to conditions, there remains the possibility of other important confounding variables that we were not able to control. We could not include any other personal demographic information due to ethical considerations. Participation in the study was proposed to all fifth-year medical students in the context of the compulsory TBL module. There was no refusal to participate. In addition, there was no disadvantage due to withdrawal or nonparticipation. These elements enabled to control a potential selection bias. We cannot eliminate a possible effect of any potential additional tutoring, such as private courses, that students might take. However, pedagogical content of TBL corresponded to the curriculum requirements for the 5th year of the 2nd cycle of undergraduate medical studies, so no additional knowledge was needed. We also compared the results with success rates on the knowledge progression tests taken as part of the 5th-year undergraduate medical studies. In our institution, written knowledge tests constitute a main component of students' assessment and reflect knowledge acquired during a whole academic year. Finally, there was no barrier in language as all students in our institution follow their studies in French. We plan to confirm the findings in a prospective randomized controlled study. From these perspectives, we aim to evaluate the benefits of this approach on the performance of students on the national OSCE, which is required for entry into residency training, and on patient outcomes.

Conclusion

The results of this study indicate that TBL with a video vignette curriculum focused on clinical reasoning for rare diseases was associated with better performance of medical students on the OSCE while enhancing both the clinical and generic skills of the students. The concept presented in this work may be beneficial not only locally but also to a more widespread audience, including medical students and medical teachers from other teaching institutions.

Abbreviations

OSCE Objective structured clinical examination
TBL Team based learning

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-024-05861-w.

Supplementary Material 1: Supplementary Figure 1. Education strategy.

Supplementary Material 2: Supplementary Figure 2. Distribution of the overall OSCE scores for the students in the intervention group and the comparator group.

Supplementary Material 3: Supplementary Table 1. Learning content.

Supplementary Material 4: Supplementary Table 2. Guideline for Reporting Evidence-based Practice Educational Interventions and Teaching (GREET) checklist.

Supplementary Material 5: Supplementary Table 3. Specification table based on intended learning outcomes.

Supplementary Material 6: Supplementary Table 4. Example of scripted clinical vignette.

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Authors' contributions

E.F. played a leading role in the design and the realization of the study, data collection and analyses, drafting and revising the manuscript; I.I., C.B., E.P. contributed collection and interpretation of the data and reviewing the manuscript; M.Be., H.H., M.Br. contributed to interpretation of the data and reviewing the manuscript.

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Availability of data and materials

Data are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was registered at the French National Commission for Data Protection and Liberties (Commission Nationale de l'Informatique et des Libertés; CNIL) (n° 2023–239). The present research was of an educational nature. Ethics approval and informed consent were not necessary according to the French national regulations defined by article L 1123–7 of the Public Health Code (CSP)—Loi Jardé (n°2012–300 of March 5, 2012, in application in November 2016—Article R1121-1). Participants had the right to access, rectify, delete and limit the use of their personal data and could contact the educational institution's data protection officer and the CNIL (http://www.cnil.fr). All data were anonymized before the start of the analysis.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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