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| RESEARCH ARTICLE

Pedagogy of Petroleum English Course, Part A: Comparing the Performance, Perception, and Satisfaction Between MOOC-Based Blended and In-Person Modalities Among Chinese Students

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| ABSTRACT

As Chinese and foreign oil and gas companies are expanding their activities internationally, the exigency for professionals with strong knowledge in English is of utmost importance. While a massive open online course MOOC-based blended learning modality has received widespread academic recognition across different fields. Its application in a Petroleum English course is unexplored, and its educational merits among Chinese undergraduate engineering students remain unclear. This study assesses the effectiveness of face-to-face learning modality and MOOC-based blended learning modality based on academic performance, students' perceptions, and learning satisfaction among Chinese sophomore year engineering students in the petroleum English course. A group of students of similar ages, gender, and academic background, and taught using distinctive lecturing modalities [ca., face-to-face learning modality (IM, n = 218), and blended learning modality (BM, n = 216)], was compared. It was revealed that the final mean grade of BM was higher than that of IM (75 ± 6.99 for IM versus 78.85 ± 7.76 for BM, with P <.05). The spatial distribution pattern revealed that students taught via BM achieved a higher mean grade in comparison to those of IM, regardless of the subcategories (ca. top 10%, upper middle 20%, lower middle 60%, and bottom 10%) based on the Wilcoxon Rank Sum test. Moreover, the Spearman test best describes the relationship between the face-to-face quiz grades and final examination grades (R2 = 0.532, P<.01) than the Pearson test (R2 = 0.207, P<.01). It was obvious from these results that the majority of students did not only agree or strongly agreed that the BM improved their learning competencies in various aspects, but also that the learning format was the most preferred (60.5%) in comparison to face-to-face learning alone (28.9%) and online learning alone (10.9%). According to these results, BM clearly contributed to fostering students' performance, perception, and satisfaction compared to purely IM in petroleum English course.

| KEYWORDS

Academic performance – blended learning – face-to-face learning – petroleum English

| ARTICLE INFORMATION

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1. Introduction

Talent development must be tailored to the societal exigencies and personal ambitions. Taking, for instance, domestic and foreign oil and gas companies, including Sinopec Corp. (China Petroleum & Chemical Corporation), CNOOC (China National Offshore Oil Corporation), Chevron Corporation, Shell Company, just to name a few, require professionals having a strong English knowledge profile in oil and gas and related industries. These ignite the essential requirements for training of professionals in English to align with the specific needs of the oil and gas and related industries. It is therefore highly capital to explore the teaching models that enable optimal training of professionals. Petroleum English is a specialized course designed to develop students' ability to communicate and interact effectively in English within the petroleum and related industries. The key content of the course covers fundamental knowledge related to petrochemicals, industry terminology, oil and gas development, and related areas. Its

ultimate objective is to provide students with the ability to master English vocabulary and expressions as well as grammatical structures used in petroleum and related sectors, to enhance their listening, speaking, reading, and writing skills. As a result, on the one hand, these would be actively strengthening students' intercultural communication abilities, which is relevant for smooth adaptation into multicultural ecosystems involving multinational companies. On the other hand, it serves as a support by helping students to better understand and address issues related to cross-cultural communication. Formerly, petroleum English was typically based on rigid face-to-face training in Chinese universities (Guerra et al., 2019). This model of training mainly involves trainers conveying theoretical knowledge to students with respect to the academic syllabus (Falk et al., 2016). However, not only is the traditional grammar-translation method used, but also in combination with the fact that shyness and anxiety predominated among students who spend prolonged time on note-taking tasks, these demerits lower their self-confidence and adversely restrain the way knowledges are acquired, shared, and propagated (Ebrahimi, 2025). Therefore, alternative teaching strategies are investigated to empower students' willingness, classroom interactions, collaboration, and accessibility in professional English.

Thanks to the boom of technological advancements, the traditional learning (face-to-face) method is gradually shifting to a digital one. More specifically, the massive open online courses (MOOCs), which are assimilated to online learning, provide an alternative learning avenue for learners (Goldberg et al., 2017; Reich, 2015; Yilmaz et al., 2021). MOOCs have been gaining predominance in various fields and serve as a foundation for digital education since their establishment in 2008 (Bozkurt et al., 2015; Du et al., 2022). So far, MOOCs have permitted a learner-centered training avenue that, in turn, empowers self-directed and free learning (Yuan et al., 2024). Its establishment promoted new experiences not only for students but also for instructors and academic institutions, which favorably and innovatively reformed the way knowledge is acquired in higher educational sectors (Yuan et al., 2024). However, as low completion rates of the assigned tasks as well as a lack of personal interactions have been consistently reported as the demerits, MOOCs alone cannot yield the expected experience for an optimal outcome for students and instructors (Fitton et al., 2020; Hoy, 2014).

In order to tackle these deficiencies, MOOCs can be combined with face-to-face learning as a blended education to offer an optimal teaching approach. Blended learning systems are gaining popularity in the educational field (Lee et al., 2023; Nashir et al., 2021; Palmer et al., 2022; Zhang et al., 2025). As illustrated in Fig. 1, a blended learning ecosystem encompasses both face-to-face learning and online learning or computer-mediated learning, affording more effective and flexible education academically (Ironsi, 2023).

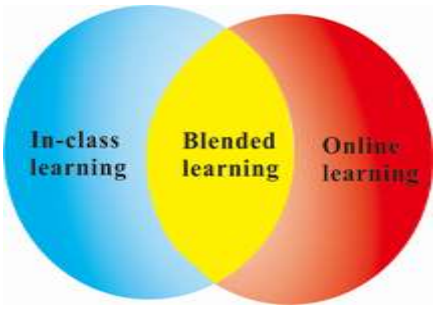

Fig. 1 Schematic illustration of blended learning ecosystem

More specifically, face-to-face learning favours the execution of student-centered learning tasks, which actively promote inter-personal communication with both instructors and other peers. This learning modality is consistent with instructional communication theory, which assesses the communication between human beings across teaching and learning scenarios as a result of emphasizing the influencing factors with respect to understanding and learning outcomes (Gourari et al., 2023). Whereas the online modality of blended education is based on multiple smart theories, permitting a customized learning avenue where learners can study at their own pace according to their own schedule (Díaz-Posada et al., 2017). The blended learning modality results in pedagogical reforms where advanced technologies are integrated into pedagogies, particularly those that facilitate the exposure to knowledge as a consequence of reduced physical barriers for learners who are inclined to the flexibility of online education (Klimova et al., 2015). Hence, a more adjustable and optimal learning ecosystem that can fit the students' preferences and needs for optimal student performance (Xiao et al., 2020).

Although MOOC-based blended learning modality has been widely reported across disciplines, including medical, pharmacotherapy, computer science, biology, social, and environmental (Bedebayeva et al., 2022; Berga et al., 2021; Hamdan et al., 2022; Nair & Bindu, 2016; Shang et al., 2018), its application in petroleum English learning is still in its nascent stage, and related studies remain scanty in the published literature. This gap not only restrains the progression of petroleum English learning but also limits the throughout transformation of petroleum English curricula. As per the previous report of Andrew et al., who emphasized the relevance of examining instructional design components that influence learners' performances, which should be

of great importance in future research related to petroleum English (Wang et al., 2025), this study seeks to overcome this gap by assessing the efficiency of blended learning in the petroleum English course.

The main goal of this research is to compare the impact of MOOC-based blended modality with face-to-face learning on not only the performance but also the perceptions, as well as satisfaction among Chinese students in the petroleum English course. The component of the blended course was speculated to improve the distinctive learning aspects compared to purely in-class (ca. face-to-face) learning.

2. Research methodology

2.1 Lecturing objects

Petroleum English, which is a course delivered to engineering students in their sophomore year, was offered by the College of Petroleum Engineering of Shandong Institute of Petroleum and Chemical Technology, China. The subjects were selected based on a presentation provided a week ahead before the commencement of the petroleum English course, which extends over 16 weeks in the 2024 Fall and Autumn semester. All students in both face-to-face and blended modality were informed and provided a written consent. Students repeating the course were not considered in the analysis. The relevant approval related to this study was sought from the College of Petroleum Engineering Ethics Review Committee.

2.2 Face-to-face learning modality

Students of the face-to-face learning modality were taught with lecture-based teaching, as detailed below: a week ahead of the class, the instructor shared learning materials, including a petroleum English textbook along with related exercises (ca., reading, speaking, listening, and writing). Cautions were taken by the instructor to upload the same PowerPoint slides that were used in the face-to-face lecturing modality into the online platform. The students completed the assigned exercises after class.

2.3 Blended learning modality

The blended learning group was assigned a distinct set of learning tasks, as listed in Table 1.

Table 1: Learning tasks organized in a blended learning model of petroleum English

Chapter	Pre-class tasks	Class tasks	Post-class tasks
Chapter 1 Introduction of the petroleum industry	Microteaching videos 1. Overview 2. Oil and natural gas 3. Oil and gas industry	Lecture on Chapter 1 Three main components of the industry* The origin of fossil fuels and the distribution of oil and gas production* Exercise Face-to-face discussion: What are the utilizations of petroleum resources?	Quiz based on Chapter 1
Chapter 2 Petroleum geology	Microteaching videos Fundamental geology 1. Origin of oil and gas 2. Reservoir traps 3. Well exploration	Lecture on Chapter 2 The formation process of the Earth's lithosphere Types of rocks, Formation of sedimentary basin* Exercise	Quiz based on Chapter 2
Chapter 3 Petrophysics	Microteaching videos 1. Porosity 2. Permeability 3. Development plan	Lecture on Chapter 3 Rock properties such as pore microstructure, porosity, permeability, and wettability* Comparison of the characteristics of connected pores, dead-end pores, and dead pores* Exercise Face-to-face discussion: Explain the various functions of porosity and permeability.	Quiz based on Chapter 3

Chapter 4 Drilling and completion	Microteaching videos 1. Well drilling 2. Rotating drilling 3. Mud system 4. Well control 5. Basic drilling process 6. Well completion	Lecture on Chapter 4 Equipment used in the drilling process and drilling rig components* Basic drilling process* Type of systems* Exercise Face-to-face discussion: What are the various functions of drilling mud during the drilling process?	Quiz based on Chapter 4
Chapter 5 Oil and gas production	Microteaching videos 1. Oil and gas recovery methods 2. Fracturing 3. Offshore oil production	Lecture on Chapter 5 Definition, principles, and equipment used for oil and gas production* Principles, functions, and structure of in rod pump* Characteristics and application of Rodless pump* Exercise Face-to-face discussion: What are the characteristics of the different oil recovery processes?	Quiz based on Chapter 5

Note: *stands as the key contents of the corresponding chapter.

2.3.1 Pre-course tasks

Students were required to watch about three (3) online videos, each continuously for at least 25 minutes and twice per week, available online on https://www.zhihuishu.com/, for their pre-course learning tasks. The MOOCs platform established an interactive learning ecosystem, where the teachers could not only address students' concerns regarding the teaching lessons, but also the students could freely share their thoughts.

The tasks related to the face-to-face learning modality were mainly composed of lecturing, exercises, quizzes, and classroom discussions. The study plan for each chapter consisted of objectives, key points, and contents, while basic knowledge was assimilated by the students by watching MOOC videos beforehand. The petroleum English exercises included single, multiple-choice, fill-in-the-blanks, true or false questionnaires, conducted on Xuexi Tong classroom application, which was developed by Beijing Century Super Star Information Technology Development Co., Ltd (Liu et al., 2021). The Chaoxing learning platform is a mobile software that allows PowerPoint slides to be uploaded, enabling students to complete tasks assigned by instructors. In each class section, the subjects were given relevant exercises prepared by the instructors for classroom discussions.

2.3.2 Post-course tasks

The instructors invited the students to complete the evaluation questions after class. These MOOC questionnaires serve as a versatile and potent tool for reviewing the teaching content and monitoring the density of knowledge acquired.

2.4 Students' assessment

The final grade for the students consisted of formative and summative assessments. Students in the blended learning modality were assessed via MOOC quizzes [ca. single, multiple, and true or false questions (30%)], homework (10%), face-to-face exercises (20%), and a final examination (40%). Comparatively, students related to the face-to-face modality were evaluated via homework (10%), face-to-face exercise (40%), and final examination (50%), as they are not involved in the MOOC learning session. It is worth noting that the final examination was conducted based on a closed-book test. Moreover, the number and type of questionnaires given to the students of both modalities were similar, though the contents were slightly distinct in the summative assessment for the final examination. Nevertheless, the questionnaires chosen from our questionnaire repository had a similar level of difficulty for both modalities. The same instructor was in charge of delivering the course to both learning modalities using an identical textbook and syllabus.

2.5 Student perception of blended learning modality

In order to examine the student perception regarding the blended modality, a survey questionnaire was designed. In detail, the questionnaires were composed of 11 closed-ended items using a 5-point Likert scale = strongly disagree, 2 = disagree, 3 = neutral,

4 = agree, and 5 = strongly agree. The obtained responses were analyzed and reported as frequencies using the percentage method.

2.6 Assessment of student satisfaction

The satisfaction of the students with respect to learning modalities was evaluated based on the previous study conducted by Lozano-Lozano et al. (Lozano-Lozano et al., 2020). The content related to learning satisfaction encompassed the six distinctive domains such as (1) general satisfaction; (2) comprehensibility of teaching contents; (3) whether the final examination reflected the course syllabus; (4) comprehensibility with the utilization of the learning modality; (5) whether the allocated time was enough to complete the exercises; and (6) enhancement in the ability to master the taught contents, and a 5-point Likert scale as aforementioned was employed. For this purpose, the total grades were evaluated for each zone statistically.

2.7 Statistical assessment

The Pearson's chi-square test and Spearman test were carried out to assess the categorical dataset represented as percentages. The dissimilarity in student examination grade and student satisfaction between the face-to-face learning modality and blended learning modality was analysed using the Wilcoxon Rank Sum test. The data related to the students' perception with respect to the teaching modalities was indicated. The internal consistency of each item was evaluated using the Cronbach's alpha value, confined between .70 and .95, which was suitable in this study (Tavakol et al., 2011). The means and standard deviation (SD) were used to indicate the continuous trend of the data. The GraphPad Prism software version 8.0.2 and Microsoft Excel (Microsoft 365) were used for statistical analyses. The $P < .05$ was used as the significance level in this research.

3. Results and Discussion

3.1 Results

3.1.1 Population characteristics

In this study, the students were split into two groups. The face-to-face modality (IM), which serves as a control, was composed of 218 subjects enrolled in Autumn 2024, whereas the experimental group (ca. blended modality, BM) group enrolled in Fall 2024 was constituted of 216 subjects. As listed in Table 2, the characteristics of the population in both groups were compared in order to overcome the non-randomization.

Table 2: Characteristics of the population of both groups

Characteristics	IM (n=218)	BM (n=216)	Chi square	P value
Age	19.50±0.87	19.80±0.36	890.20	0.35
Gender				
Female	88 (40.37%)	92 (42.60%)	0.51	0.67
Male	130 (59.63%)	124 (57.40%)		
Average grade for the national-level university entrance examination	623.32±39.51	631.32±31.65	855.35	0.27

As indicated in Table 2, the age of the students in IM and BM were obtained as 19.5 ± .87 and 19.8 ± .36, respectively based on Wilcoxon Rank Sum-test with $P > .05$. From the same table, it could be clearly seen that the gender ratio was statistically comparable (Chi square: .30, $P > .05$). Furthermore, the average grade for the national university entrance examination of IM and BM were calculated as 623.32 ± 39.51 and 631.32 ± 31.65, respectively (based on Wilcoxon Rank Sum-test with $P > .05$). Based on the aforementioned findings, the difference in students' age, gender, and average grade for national-level university entrance examination between the IM and BM were statistically insignificant, inferring that the population in both groups were comparable.

3.1.2 Evaluating the student's performance

After completing the course and writing a final examination, the performance of the students in both modalities was evaluated, and it was found that the mean grades of IM and BM were 75 ± 6.99 and 78.85 ± 7.76 out of 100, respectively ($P < .05$). The spatial distribution pattern of grades of students is displayed in Figs. 1. It was noticed that the students' grades ranged from A to D [ca. between 4.0 and 1.0 grade point average (GPA)], with a higher grade for the students in BM throughout the distinctive subcategories. As indicated in Fig. 1, the mean grades of the top 10% performers in both IM and BM were 94.23 ± 1.25 (see Fig. 1a) and 91 ± .81(see Fig. 1b), respectively ($P > .05$), indicating the predominance of the former. The mean grade of the subjects in BM and IM was obtained as 86.45 ± 2.50, as indicated in Fig. 1a, and 83.70 ± 2.21 for IM ($P < .001$), shown in Fig. 1b for the upper middle 20%. The performance of the subjects in BM overscored that in IM as the mean grade of 77.31 ± 1.58 (see Fig. 1a) versus 74.41 ± 1.76 represented in Fig. 1b ($P < .001$). The subjects in the bottom 10% in BM statistically also outperformed those in IM based on the results of the mean grades [(66.50 ± 2.26 (see Fig. 1a) and 64.56 ± 1.08 (see Fig. 1b) with $P < .001$]. As indicated in Fig. 1(b), the final examination grade versus face-to-face quiz grade was plotted to examine the relationship. For this purpose, the

Pearson and Spearman correlation tests, which are among the most commonly used, were adopted (Tyagi et al., 2023). As indicated in Fig. 1(b), there was a positive correlation between the final examination grades and face-to-face quiz grades. The Pearson test yielded an R2 of .207 (with P<.01), implying that 20.7% of the final examination grade is explainable by its association with face-to-face quiz grades. In comparison, the Spearman correlation produced an R2 of .532 (with P<.01), indicating a stronger correlation as 53.2% of the final examination grades are describable by their relation with face-to-face quiz grades.

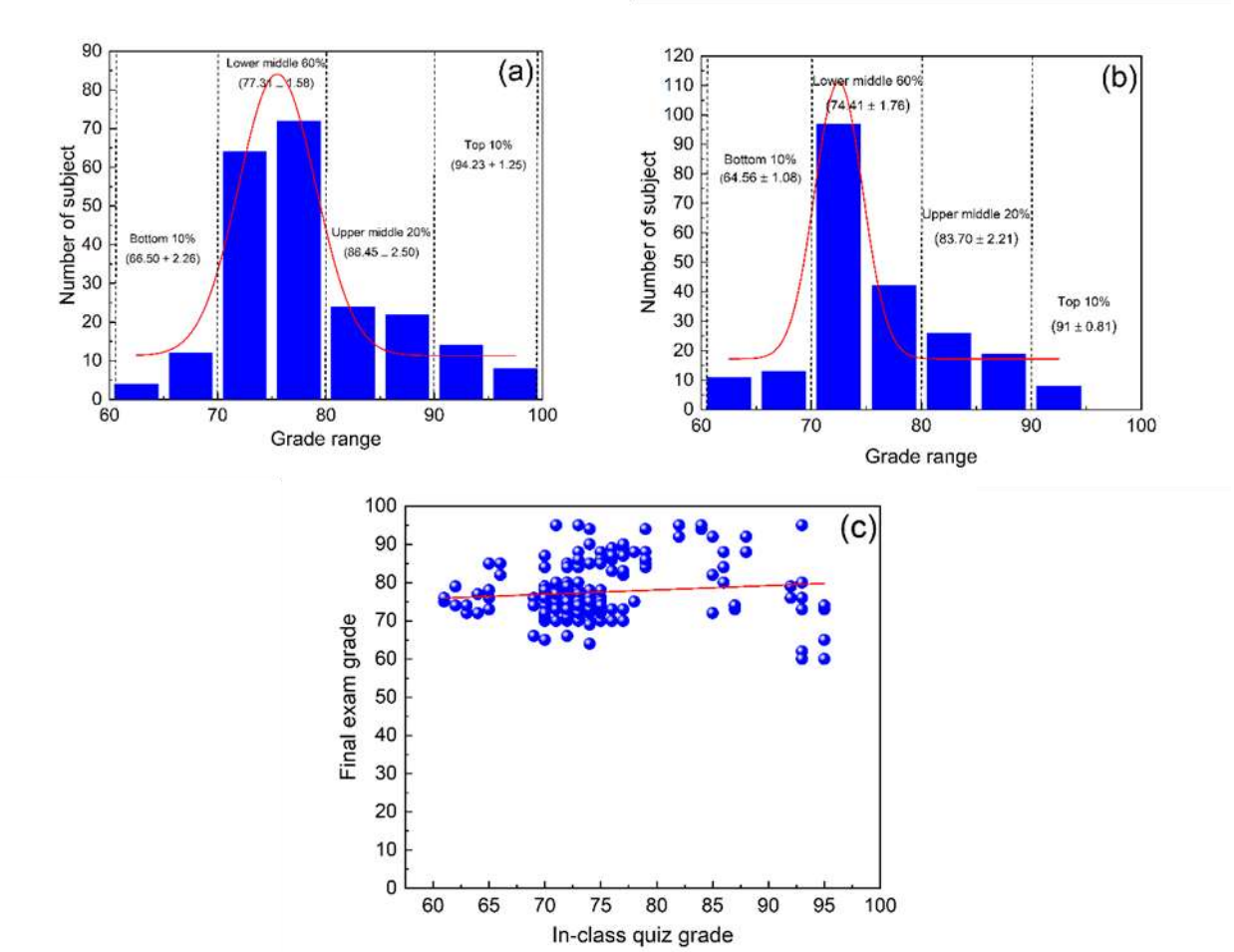

Fig. 1 Performance of the students in BM and IM. Note: (a) spatial grade distribution in BM; (b) spatial grade distribution in IM ; (c) correlation between final examination grade and face-to-face quiz grade for BM

3.1.3 Students' perceptions of blended learning modality

The students' perceptions regarding the blended learning modality are listed in Table 2. In general, the feedback from the students presaged a positive perception. Based on the students' feedback, Cronbach's Alpha was obtained as .906, indicating the reliability of the survey (Creswell, 2024). Based on the questionnaires listed in the appendix, majority of the students agreed or strongly agreed that the learning format improved their learning competencies in various aspects including their self-confidence in writing the final examination (4.02 ± 1.10), acquisition of theoretical and technical knowledges (3.22 ±.91), speaking skills (3.15 ±.81), listening skills (3.72 ± .51), writing skills (3.86 ± 0.85), reading skills (3.90 ±.75), response to MOOC questionnaires (3.67 ± 1.09), and feedback on quizzes and exercises given by the instructors (4.22 ± 1.32). Additionally, most of the students in the modality witnessed an improvement in in-person interactions with both their peers (3.78 ± 1.18) and instructors (3.85 ± .88). Furthermore, the majority of the students were more inclined to use the blended learning modality (4.35 ± 1.10).

Table 2 Results of the subjects' perception on blended learning modality based on a Five-Point Likert-Style Scale

List of questionnaires	Mean ± SD
BM boosts my self-confidence in writing the examination	4.02± 1.10
BM follows a satisfactory format in gaining theoretical and technical knowledge	3.22± .91
BM follows a satisfactory format in improving speaking skills	3.15± .81
BM follows a satisfactory format in improving the listening skills	3.72± .51

BM follows a satisfactory format in improving writing skills	3.86± 0.85
BM follows a satisfactory format in improving the reading skills	3.90± .75
Instructor's response to questions is prompted on the MOOC	3.67± 1.09
Feedback on quizzes as well as exercises is provided by the instructor	4.22 ± 1.32
BM enables improved in-person interactions with their peers	3.78 ± 1.18
BM enables improved in-person interactions with its instructors	3.85 ± .88
I am more inclined to BM	4.35 ± 1.10

BM: Blended model; MOOC: Massive open online course; SD: Standard deviation

3.1.4 Evaluation of students' satisfaction

Table 3 compares the satisfaction of the students with respect to various learning aspects in both modalities. The reliability of the study was checked using Cronbach's Alpha, which was obtained as .823 and .337, respectively, for IM and BM, implying the reliability of the survey. The study was conducted by considering seven key learning aspects, and each aspect was scored on the basis of a 5-point Likert scale (ca. 1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). As shown in Table 3, it was noticed that BM overscored those of IM regardless of the learning aspects. This implies that the students in BM were more satisfied compared to those in IM and even online learning (ca MOOC) alone, contributing to the highest learning rate as depicted in Fig. 2, which is consistent with a previous study (Zhang et al., 2025).

Table 3: Students' satisfaction with respect to learning modalities and aspects

Learning modalities	Learning aspects	Mean ± SD	P value	95% Confidence interval for mean
IM (n=218)	Format	2.85 ± .73	< .01	2.55-3.07
	Improve speaking skills	2.68 ± .91	< .01	2.45-2.90
	Improve listening skills	2.95 ± .85	< .001	2.73-3.16
	Improve writing skills	3.09 ± 1.03	< .001	2.91-3.24
	Improve reading skills	2.96 ± .93	< .01	2.78-3.20
	Interactions with peers	2.75 ± .63	< .01	2.50-3.01
	Interactions with instructors	2.81 ± .69	< .001	2.51-3.02
BM (n=216)	Format	3.43 ± 1.21	< .001	3.19-3.87
	Improve speaking skills	3.18 ± 1.01	< .01	3.01-3.70
	Improve listening skills	3.26 ± 1.09	< .01	2.98-3.78
	Improve writing skills	3.49 ± 1.25	< .01	3.10-3.89
	Improve reading skills	3.96 ± 1.34	< .01	3.58-4.12
	Interactions with peers	3.55 ± 1.32	< .001	3.13-3.91
	Interactions with instructors	3.93 ± 1.25	< .01	3.52-4.08

IG: Face-to-face group; BG: Blended group; SD: Standard deviation

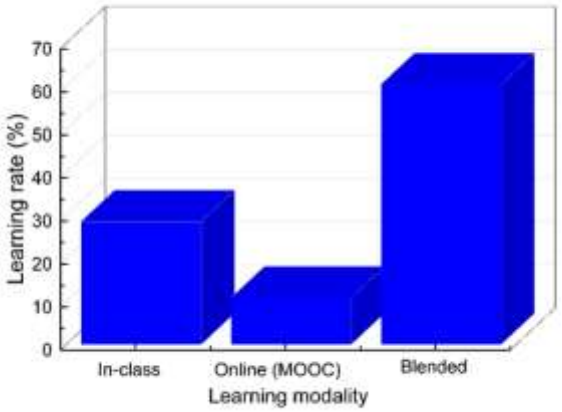

Fig. 2 Proportion of students' learning rate with respect to learning modality

3.2 Discussion

In this research, with respect to the findings mentioned above, it was revealed that, in general, the performance of students of BM overscored that of IM. Among the two teaching models, students were satisfied with BM and felt that the model improved their comprehension of the key concepts, and was mostly preferred. Therefore, the performance of students taught in petroleum English using BM overscored those tutored by IM.

The performance of students in BM overscored that of the IM across the spatial grade distribution. In detail, in top 10% (94.23 ± 1.25 versus 91 ± 0.81 with $P > .05$), upper middle 20% (86.45 ± 2.50 versus 83.70 ± 2.21 with $P < .001$), lower middle 60% (77.31 ± 1.58 versus 74.41 ± 1.76 with $P < .001$), and bottom 10% (66.50 ± 2.26 versus 63.08 ± 1.08 with $P < .001$). These results were expected as most of the students expressed their satisfaction regarding their learning experience, as the organization of the distinctive chapters and materials, along with the exercise and supporting instructional design online, was adequate, resulting in improved learning of theoretical and technical knowledge. This enhancement in learning performance of the students was consistent with previous research stating that tutoring with BM favourably influences the reading, writing, listening, and speaking skills of language learners (Al et al., 2024; Hakimi Asl, 2024; Mohammad et al., 2018). The fact that students were not only well-acquainted with the MOOC pre-course learning section but also the classroom interactions section, fostering their engagement in class. As a matter of fact, the MOOC pre-course learning affords the possibility for students to watch videos at their own pace ahead of face-to-face teaching, which is beneficial to students as they can appropriately practise their listening, writing, and reading competencies related to technical words and expressions, particularly for a course that mostly are unfamiliar with (Chen, 2023). Thus, the exposure of the students to MOOC pre-class learning may be considered as a cognitive organizer tool enabling the establishment of the necessary fundamental knowledge ahead of the face-to-face session. Another undeniable advantage of MOOC pre-class learning sessions is that they actively allow students to be engaged in quality discussion as the lecturing contents consist of relatively complex knowledge aspects, which have already been taught through the MOOC ahead of the face-to-face section. Interrogative questionnaires, which are one of the key activities during face-to-face learning sessions, stimulate interactions that afford the development of the students' key competencies as well as critical language abilities, including grammar, pronunciation, facial expression, eye to eye contact (Shih, 2010). As BM learning motivates autonomous education, enhances classroom interactions, eradicates communication anxiety, and strengthens the learners' cognitive abilities, the majority of the students reported that BM boosted the interactions not only with peers but also with instructors, which is beneficial for the transfer from teacher-centered learning to student-centered learning. In line with our findings, classroom interactions contribute to a number of merits, including developing students' autonomy, affording more personalized language support, favouring collaborative learning, fostering students' interaction and determination, and enhancing the language competencies of the students (Albiladi et al., 2019). The relationship between the final grade examination and face-to-face quiz grade of the students was positively correlated, and Spearman correlation produced the strongest relationship between the variables compared to that of Pearson. Our results are consistent with a previous study, which also observed a positive correlation between the face-to-face quiz grade and final grade (Dalfen et al., 2018). Prompt responses to questions and ready accessibility of the teaching materials on the MOOC platform, in combination with the feedback on quizzes, presumably fostered the students' conviction, especially reducing the pressure related to lecturing loads ascribed to the innovative concept adopted in the petroleum engineering course. In this regard, most of the students agreed that BM expedited the consolidation of theoretical and technical knowledge, which smoothed the preparation for the summative assessment. According to these findings, BM undoubtedly contributed to a higher level of educational standard with respect to academic performance and satisfaction among the students in BM.

Comparative the spatial grade distribution (ca. top 10%, upper middle 20%, lower middle 60%, and bottom 10%) revealed an improvement of the learning performance of the students when taught via BM, suggesting that BM may be particularly interesting in boosting cognitive competencies compared to IM for various qualities of students. Based on these, we could reasonably wonder what could be the learning motivations and autodidacticism capabilities that contributed to the enhanced achievements of the students? A suitable answer to this problematic would be given full attention in our forthcoming manuscript.

The research disclosed that 60.5% of the subjects perceived the BM as an efficient pathway to acquire cognitive competencies. Contrarily, only 28.6% and 10.9% of the subjects were inclined to MOOC lecturing alone and face-to-face lecturing alone, respectively. These findings validated why the face-to-face learning sessions should be combined with online learning sessions (ca. BM) rather than considering face-to-face learning or online learning alone, which is consistent with the previous report of Chen et al., who stated that Chinese students highly preferred to be taught using BM, ascribed to its numerous merits (Chen, 2023). The various reasons for these preference rates are as follows: on the one hand, as the students have been used to traditional teaching and feeling pleased to belong to a group, in combination with the limited option for online classes, are some of the reasons that justified the low rate of students in favour of MOOC learning alone; on the other hand, the lowest rate for face-to-face teaching preference might be connected to the shyness and anxiety of students regarding reading and speaking skills which drive low self-confidence. In this regard, the instructor should focus on strategies to not only captivate the attention but also encourage the students to foster their commitments with respect to the learning strategies.

4. Conclusions

These results herein disclose the performance, perception, and satisfaction among engineering students taught via IM and BM in the Petroleum English course. It was revealed that the BM relatively enhanced the performance of the students. As a result, a positive perception was presaged among the majority of the students who expressed their satisfaction regarding the teaching format and content. With reference to these findings, this research not only vivified the literature related the petroleum engineering and associated disciplines but also afforded a pragmatic guidance for incorporating BM into the undergraduate engineering syllabus to meet the exigencies of a realistic industrial ecosystem.

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Appendix

Pedagogy of Petroleum English Course, Part A: Comparing the Performance, Perception, and Satisfaction Between MOOC-Based Blended and In-Person Modalities Among Chinese Students

To improve upon the teaching performance via the use of MOOC-based blended learning modality, you are kindly invited to participate in the teaching and learning survey. Only a few minutes of your time are needed to complete this survey. It is worth mentioning that your participation is voluntary and will be kept anonymous, and your constructive feedback is of utmost value in improving the teaching and learning experience.

1. BM boosts my self-confidence in writing the examination.
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

2. BM follows a satisfactory format in gaining theoretical and technical knowledge.
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

3. BM follows a satisfactory format in improving speaking skills.
○strongly disagree
○disagree
○neither agree nor disagree (neutral)
○agree
○strongly agree

4. BM follows a satisfactory format in improving the listening skills.
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

5. BM follows a satisfactory format in improving writing skills.
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

6. BM follows a satisfactory format in improving the reading skills.
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

7. The instructor's response to questions is prompted on the MOOC
○strongly disagree

○disagree
○neutral
○agree
○strongly agree

8. Feedback on quizzes as well as exercises is provided by the instructor
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

9. BM enables improved in-person interactions with their peers
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

10. BM enables improved in-person interactions with its instructors
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

11. I am more inclined to BM
○strongly disagree
○disagree
○neutral
○agree
○strongly agree

12. Among the following lecturing modalities, which one is the best contributing to consolidating your cognitive competencies
○In-class lecturing modality
○ Online (MOOC) online modality
○Blended modality