



Attitudes to and evaluation of Objective Structured Practical Examination by first-year Microbiology Students of a Tertiary Educational Institution in Nigeria.

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ABSTRACT

Challenges associated with examiner variability, standardization, and uniformity of assessment have been identified in traditional practical examination methods of assessment of practical skills. These concerns have been addressed by the Objective Structured Practical Examination (OSPE), which is objective, reliable, and efficient for assessing individual students' practical knowledge, skills, and abilities. This study evaluated the attitudes to and evaluation of OSPE by first-year Microbiology Students of the Bayelsa Medical University, Nigeria. The entire class comprising 41 first-year Microbiology students participated in this study. They were randomly divided into four groups of 12, 12, 12, and 5 students. A total of 12 stations were created, including 10 and 2 work and rest stations, respectively. The practical knowledge assessed covered the three domains of learning (cognitive, affective, and psychomotor). Each student spent 5 minutes at each station. The attitude to the use of OSPE for evaluation was determined using structured questionnaires designed with the Likert's scale (5-0). The results showed that the mean response was in the range of 3.56 – 4.22. The results also revealed that OSPE is an effective tool for assessing the students' knowledge and will give broader coverage of knowledge, opportunity to answer all questions, and make it easier to score high grades. It was therefore suggested to be adopted in the Department as a tool for assessing all practical examinations. The Cronbach's alpha of 0.754 showed that the items (had good internal consistency) are good (reliable) for making a decision. Based on the findings of this study, we conclude that OSPE can replace the existing conventional method of practical examination and we recommend that the Department of Microbiology and other non-clinical disciplines adopt OSPE as an assessment tool for all practical examinations.

1.0 INTRODUCTION

Assessment is one of the vital measures of learning in any discipline, and it is essential to determine students' competencies (Relwani et al., 2016). Assessment is done in all aspects of the educational sector. Still, in most educational sectors, assessment is done with the sole aim of determining the students and or the number of students that passed or failed a particular examination. However, assessment needs to be done holistically for evaluation and decision-making.

There are different types of assessments used in evaluating formative and summative examinations. The common ones include essays or theory (short and long), which is mainly used to assess the cognitive domain and the students writing abilities (composition) of students, multiple-choice questions (MCQ), Objective Structured Clinical Examination (OSCE), and Objective Structured Practical Examination (OSPE). The OSCE and OSPE are used to assess the three domains (cognitive, psychomotor, and affective) of learning. Of these, Essay and MCQ are commonly used in all disciplines. However, in the health profession, OSPE and OSCE are also common, where they are used to assess students' performance, clinical knowledge, and skills accurately needed to make an informed decision (Frantz et al., 2013).

The Objective Structured Clinical Examination developed in the mid-1970s was used to assess clinical proficiency in an objective and structured way (Harden and Gleeson, 1979; Frantz et al., 2013), and it entails students moving through several stations or benches where they are assessed separately following specific defined standards in the form of a worksheet (Frantz et al., 2013).

According to Harden and Cairncross (1980), Frantz et al. (2013), Mard and Ghafouri (2020), OSPE was modified for its use in practical examinations from OSCE in 1975. The main advantage of OSPE is that it is used to assess an individual's practical ability in both summative and formative assessments outside the clinical context, and students obtain feedback as an integral component of their learning processes (Frantz et al., 2013). OSPE creates objectivity (because all students are exposed to the same questions and time interval) (standardization) in assessment and covers a wide range of scope as compared to traditional assessments, which are unstructured and never reliable because different students are assessed by other examiners and sometimes with additional questions or same questions with different approaches (Frantz et al., 2013). OSPE is used to evaluate the individuals' practical skills (Sai et al., 2020) and used to identify students' strengths and weaknesses and focus on intervention (Faldessai et al., 2014). Feedback from students using OSPE has shown an increased

satisfaction in a course, validity, and reliability compared with the traditional approach (Rahman et al., 2007; Ananthkrishnan, 1993; Mard and Mard and Ghafouri, 2020).

The shortcomings of the traditional practical examination are characterized by subjectivity. To a large extent, these have been addressed by OSPE due to their objectivity, which has taken the assessment of practical skills to a different dimension. Like OSCE, OSPE is common in medical disciplines; it can also be applied in other related fields, especially Microbiology.

Microbes are found in diverse environments, where they play both beneficial and detrimental roles to living organisms and non-living things. Thus its study should be done holistically by incorporating practical exercises for all the sub-disciplines, topics, or courses under the microbiology curriculum. Conventional microbiological processes are time-consuming; hence, using traditional practical examinations may create broad subjectivity in its application. OSPE minimizes the challenges associated with the microbial processes during the examination and the subjectivity created using conventional techniques for assessment. To evaluate the effectiveness of a particular assessment tool, the student's attitude and perception towards the pattern and conduct of the examinations must be taken into consideration; that is why the present study is essential.

Information on students' attitudes towards OSPE as an assessment tool for first-year microbiology students is scarce in the literature, particularly in Bayelsa Medical University, Nigeria. Due to the numerous advantages of OSPE, it was adopted in the Department of Microbiology at the Bayelsa Medical University (BMU), Bayelsa State, Nigeria. For a formative end-of-semester examination, the practical examination was conducted for first-year microbiology students as part of their first semester practical examination (Introductory Microbiology). At the end of the examination, feedback was obtained from the students using a structured questionnaire to determine their attitude towards using OSPE as an assessment tool for the practical examinations. Therefore, this study focuses on the attitude of the first-year Microbiology major students on the use of OSPE for practical examinations. The findings of this study will be helpful in decision-making to the scientific community, especially the Microbiology discipline.

2.0 MATERIALS AND METHODS

2.1 Design, setting, and sample

This study's qualitative data was obtained from an open-ended questionnaire served to all forty-one (41) first-year microbiology major students immediately after

the first OSPE in the Department of Microbiology at the Bayelsa Medical University in December 2020. The students were briefed on the essence of OSPE before the examination by the course lecturers.

2.2. OSPE Organization

The OSPE was conducted for introductory microbiology, a core course for first-year students in the microbiology programme. Twelve (12) stations were set up, consisting of 10 workbenches and two rest stations. The stations were arranged to move quickly to the next station completing a practical technique and answering related theoretical questions (Frantz et al., 2013). Students spent 5 minutes at each of the stations. The time duration was regulated with the assistance of a laboratory technologist that served as the time-keeper. The students were divided into four groups of 12 students each except the last group, which had five students. Each group was supervised/invigorated by the course lecturers and laboratory technologists.

The exercise was carried out in two batches using three laboratories. Two laboratories were used simultaneously for the first 24 students, while the remaining 17 were quarantined in the third laboratory. At the end of the OSPE for the first batch, the answer scripts were retrieved, and the students moved to the third laboratory, while the last set consisting of 17 students was moved to the laboratory used for the first 24 students. The movement was done in a way that both groups did not meet. At the end of the OSPE, the students were given a structured questionnaire to test their attitude and perception towards OSPE for effective evaluation for all practical examinations. The examiners (course lecturers) reviewed the OSPE instructions before the assessment period.

2.3 Data collection and procedure

Two open-ended questionnaires used for data collection focused on the effectiveness, degree of difficulty,

adequacy of time, preference for practical examinations, suitable format for assessing knowledge, previous knowledge, opportunity to answer all questions, test for a broader scope, level of difficulty, and emotional stress associated with OSPE. The eleven items in the questionnaires were designed using the Likert scale (5 - 0) of different categories. Anonymity was ensured during responses by students.

2.4 Data analysis

The data were processed using Microsoft Excel files and cross-checked by two staff of the Department independently. The responses of the students were analyzed using SPSS version 20. The data were summarized into mean, mode, median and standard deviation, and simple percent. Pearson's correlation, analysis of variance, and reliability (Cronbach's alpha) were also carried out to show the statistical significance of the items. The result was summarized into bar charts and plotted using SPSS (Figures 1-11).

3.0 RESULTS AND DISCUSSIONS

The attitude of the first-year Microbiology major students to the OSPE is shown in Table 1 and Figures 1 - 11. Table 1 shows the descriptive statistics of the students' responses on attitudes to the use of OSPE as an assessment tool. Table 2 shows Pearson's correlation matrix of all the items on the students' responses to the attitude to OSPE for evaluation. Based on the items tested, the mean values ranged from 3.56 ± 1.23 – 4.22 ± 0.97 for the arithmetic mean, 4.00 – 5.00 for median mean, and 4.00 – 5.00 for mode except for items 6 and 7 that had a low mean value of 1.00 for both median and mode, and 1.54 ± 0.98 – 1.85 ± 1.24 for the arithmetic mean.

Table 1: Descriptive statistics of the students' responses on attitudes to the use of OSPE as an assessment tool

Statistics	Questions										
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
N	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00
Mean	3.88	4.20	3.56	4.05	4.00	1.54	1.85	3.83	4.22	3.98	4.10
Median	4.00	4.00	4.00	5.00	4.00	1.00	1.00	4.00	4.00	4.00	4.00
Mode	4.00	4.00	5.00	5.00	5.00	1.00	1.00	4.00	5.00	5.00	5.00
Std. Deviation	1.03	0.64	1.23	1.16	0.97	0.98	1.24	1.14	0.96	0.99	1.07

Table 2: Pearson's Correlation matrix of all the items on the students' responses on the effectiveness of OSPE as an assessment tool for first-year microbiology students

Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Q1	1.000										
Q2	-0.115	1.000									
Q3	0.392	-0.016	1.000								
Q4	0.612*	-0.147	0.314*	1.000							
Q5	0.199	0.040	0.000	0.464**	1.000						
Q6	-0.033	0.068	0.222	0.020	-0.052	1.000					
Q7	0.182	-0.121	0.287	0.075	0.083	0.688**	1.000				
Q8	0.366*	0.013	0.232	0.347**	0.406**	-0.005	0.195	1.000			
Q9	0.583**	0.010	.444**	0.662**	0.373*	0.058	-0.014	0.400**	1.000		
Q10	0.218	0.245	0.156	0.437**	0.546**	0.040	-0.044	0.330*	0.480**	1.000	
Q11	0.170	0.264	0.225	0.117	0.000	0.164	0.144	0.302	0.295	0.239	1.000

Source: Authors

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

N=41

The responses on the effectiveness of OSPE as an assessment tool by first-year Microbiology major students indicates that 29.27%, 41.46%, 21.95%, 2.44%, and 4.88% agree that it is an excellent, good, average, poor, and very poor tool for assessing practical in the microbiology programme, respectively (Figure 1). Approximately 92.86% of the students indicated that OSPE is effective in evaluating their knowledge. OSPE

as an effective tool for assessing students of microbiology on practical's correlates positively with time adequacy ($r=0.392$) and opportunity for all students to answer the same question ($r=0.366$) at $p<0.05$; and Department to adopt OSPE for all practical examination ($r=0.612$) and its performance compared to other traditional practical examination ($r=0.583$) at $p<0.01$ (Table 2).

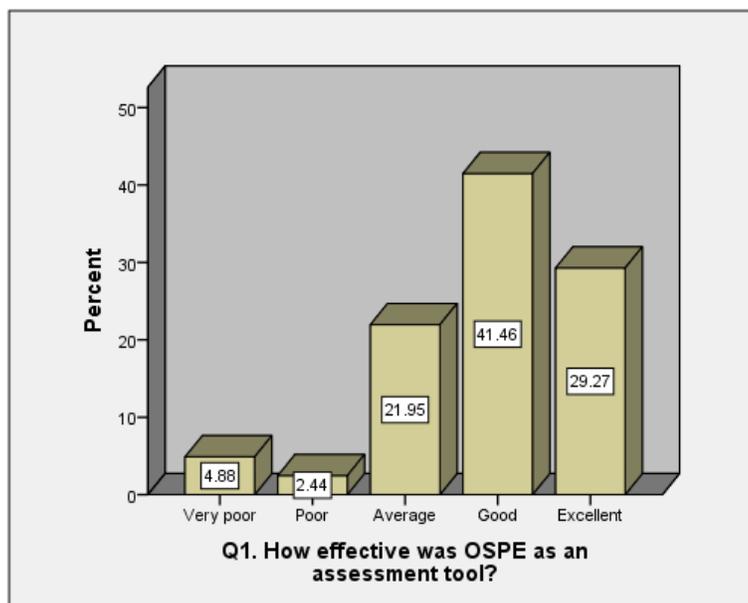


Figure 1: Responses on the effectiveness of OSPE as an assessment tool by first-year microbiology students (Source: Authors)

Based on the degree of difficulty, responses showed that 31.71%, 56.10%, 12.20%, 0.00%, and 0.00% opined that the OSPE was not difficult, fairly difficult, moderately difficult, very difficult, and extremely difficult, respectively (Figure 2). Overall, 31.70% indicated that it is not difficult, suggesting that they may score high if OSPE is

used as an assessment tool. At the same time, about 68.30% showed that it is slightly difficult, meaning they may score an average to good. Based on the responses to very difficult and extremely difficult, no student found it very difficult, and therefore, none of the students were hoping to fail the OSPE.

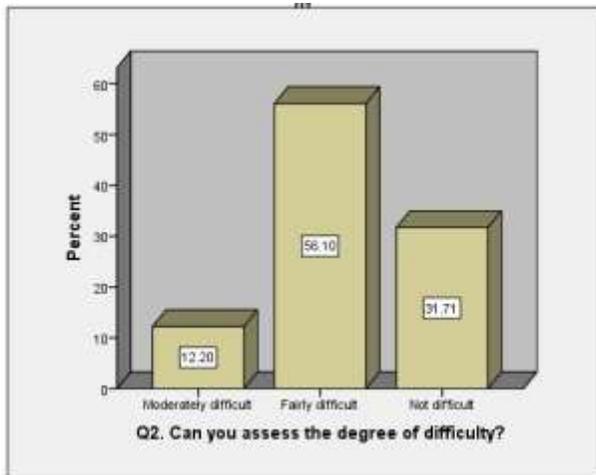


Figure 2: Responses on the degree of difficulty of OSPE as an assessment tool by first-year microbiology students (Source: Authors)

On the time adequacy, responses show that 29.27%, 24.39%, 24.39%, 17.07%, and 4.88% agreed that the time given was adequate, adequate, moderately adequate, average, and grossly inadequate, respectively (Figure 3). Only less than 5% of the students indicated that the time was not acceptable. Thus the remaining

95% agreed that there was sufficient time for the OSPE. The time adequacy correlates with performance compared to other traditional practical examinations ($r=0.314$) at $p<0.05$, and the notion that it is easier to pass and score high compared to conventional practical examination ($r=0.444$) at $p<0.01$ (Table 2).

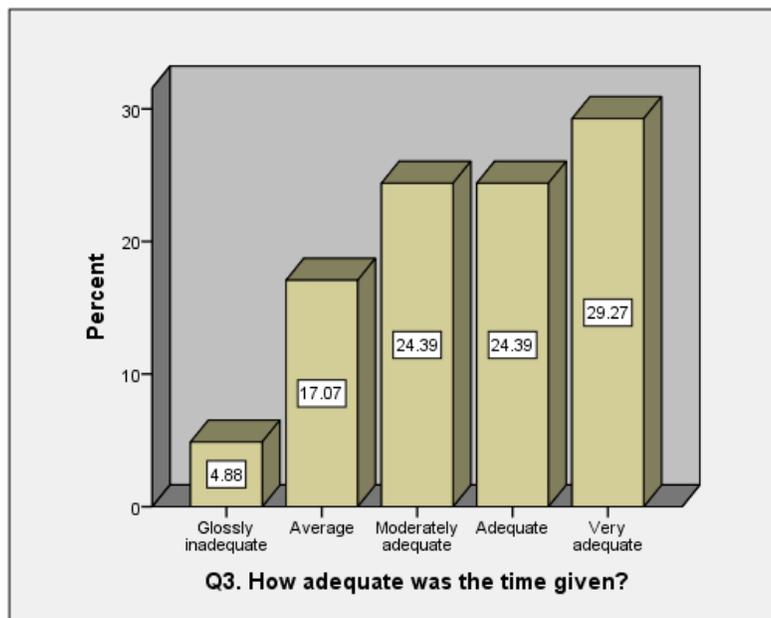


Figure 3: Responses on the adequacy of time in an OSPE by first-year microbiology students (Source: Authors).

On the preference of the Department to adopt OSPE for all practical examination, 51.22%, 17.07%, 19.51%, 9.76%, and 2.44% agree strongly, agree, moderately agree, fairly disagree, and strongly disagree, respectively (Figure 4). Again 87.74% opined that they prefer OSPE for all practical examinations in the Department. However, with varying degrees of acceptability, many of them representing over 50% of

the students accepted OSPE firmly. The choice of OSPE for assessing all practical examinations in the Department correlates with a better format for evaluating students' knowledge ($r=0.464$), easier to pass, and score high ($r=0.662$). It covers a wide range of scope or knowledge ($r=0.437$) at $p<.01$ and a better opportunity for students to answer some questions ($r=0.347$) at $p<0.05$ (Table 2).

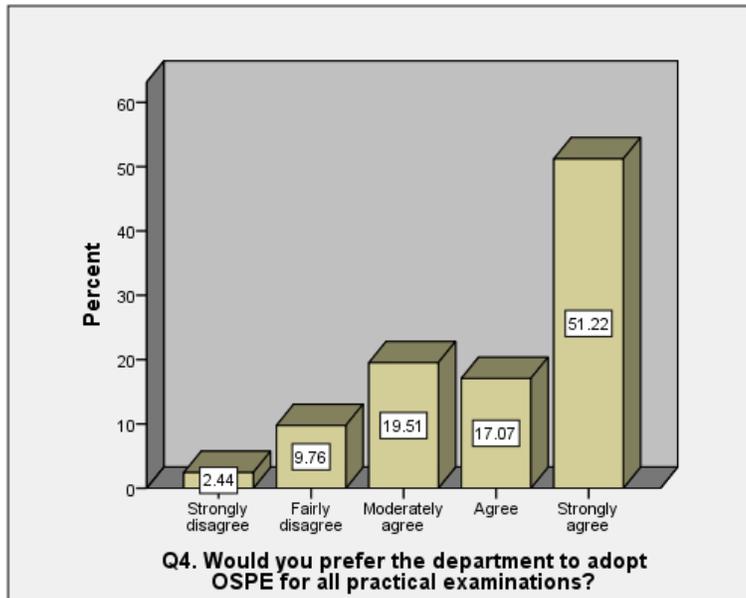


Figure 4: Responses on the preference of OSPE for all practical examinations in the Department of Microbiology (Source: Authors)

On the suitability of assessing knowledge using OSPE, 39.02%, 29.27%, 24.39%, 7.32%, and 0.00 % agree strongly, agree, moderately agree, fairly disagree, and strongly disagree, respectively (Figure 5). Again 92.68% opined that OSPE is suitable for their practical examination, though with varying degrees of acceptability, but a high number of them representing

over 39% of the students accepted OSPE firmly. OSPE as a better format of assessing students' knowledge correlates with opportunity for all students to answer the same questions ($r=0.406$) and cover a wide range of scope ($r=0.546$) at $p<.01$, and easier to pass and score better when compared to traditional practical examination ($r=0.373$) at $p<0.05$ (Table 2).

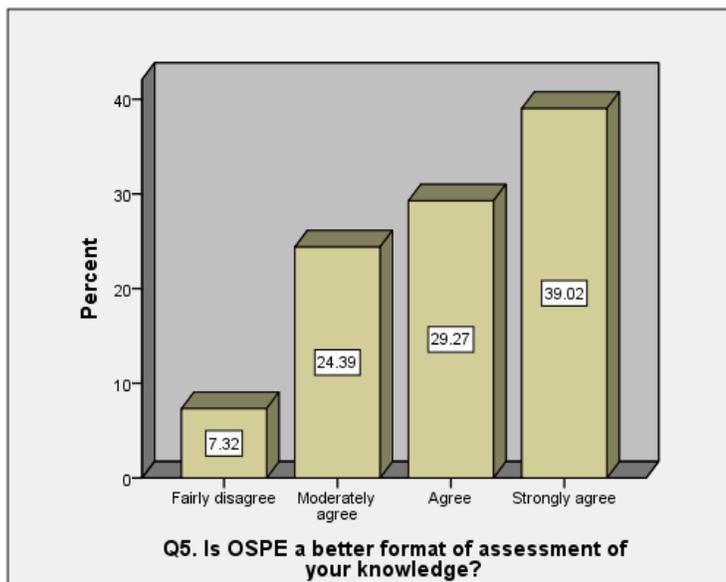


Figure 5: Responses on the suitability of OSPE for assessing first-year microbiology students in a practical examination (Source: Authors)

On the test of students' previous knowledge on OSPE, 68.29%, 19.51%, 4.88%, 4.88% and 2.44 % responded that they never, rarely, occasionally, frequently and very frequently taken part in an OSPE.

Again, this suggests that approximately 88% of the students had not used OSPE before the examinations (Figure 6). The test of students' previous knowledge on

OSPE correlates with knowledge about it ($r=0.688$) at $p<0.05$ (Table 2).

On the knowledge of OSPE as an assessment tool, 58.54%, 17.07%, 9.76%, 9.76%, and 4.88% responded that they never, rarely, occasionally,

frequently, and very often taken part in an OSPE. Again, this suggests that approximately 75.61% of the students had not heard about OSPE before (Figure 7).

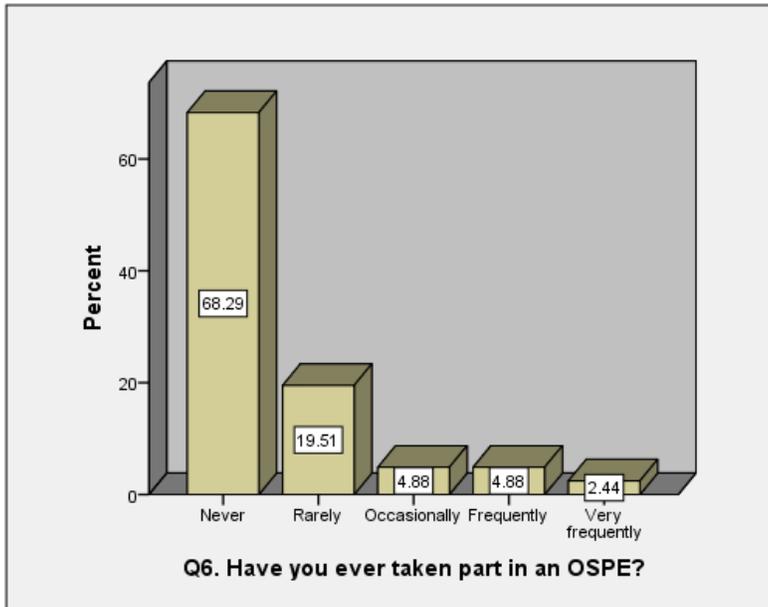


Figure 6: Responses on the use of OSPE before use in the assessment of introductory microbiology course for first-year microbiology students (Source: Authors)

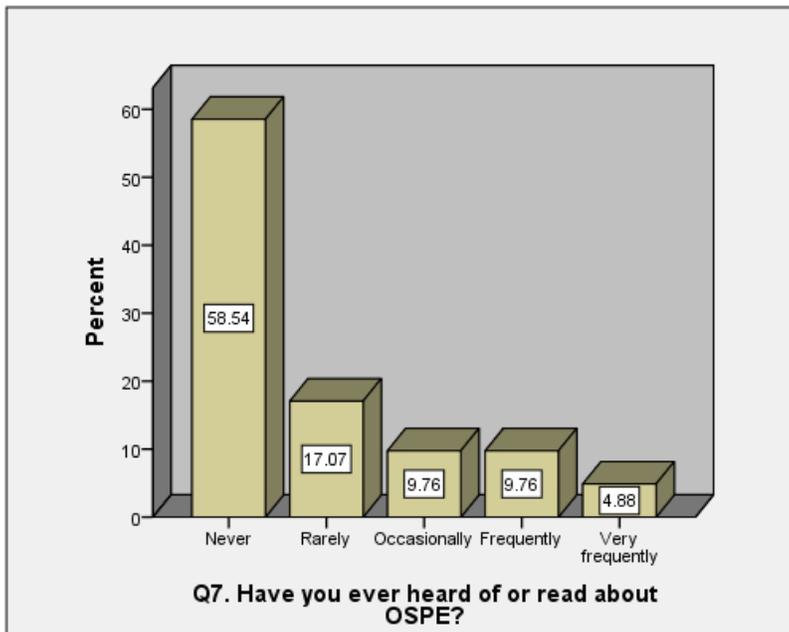


Figure 7: Responses on the knowledge of OSPE as an assessment tool by first-year microbiology students (Source: Authors)

On the perspective that OSPE allows students to answer some questions, 31.71%, 39.02%, 14.63%, 9.76%, and 4.88% agree strongly, agree, moderately agree, fairly disagree, and strongly disagree, respectively (Figure 8). OSPE gave all students equal opportunity to answer the

same questions correlates with easiness to score better when compared to traditional practical examination ($r=0.400$; $p<0.01$) and covers a wide range of knowledge ($r=0.330$; $p<0.05$) (Table 2).

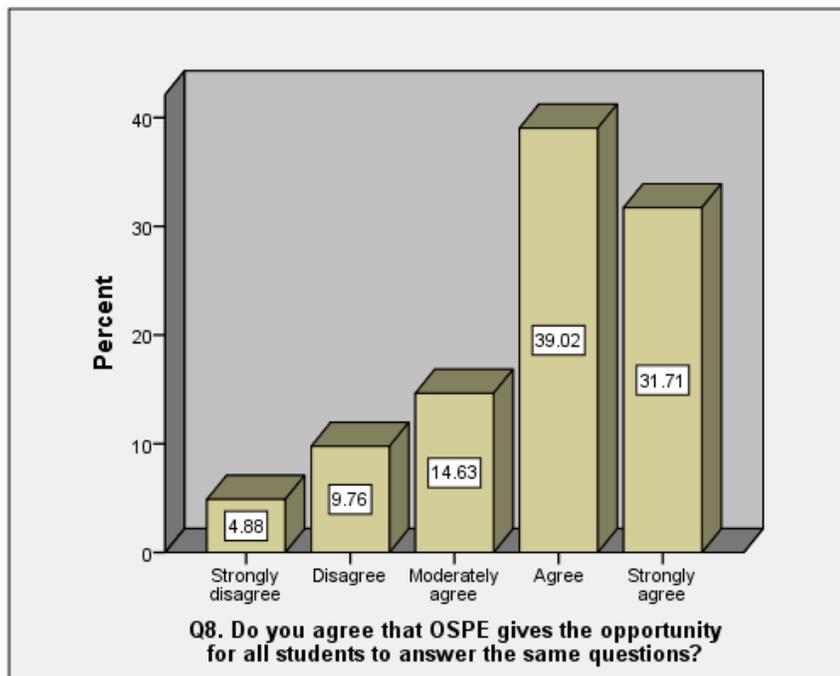
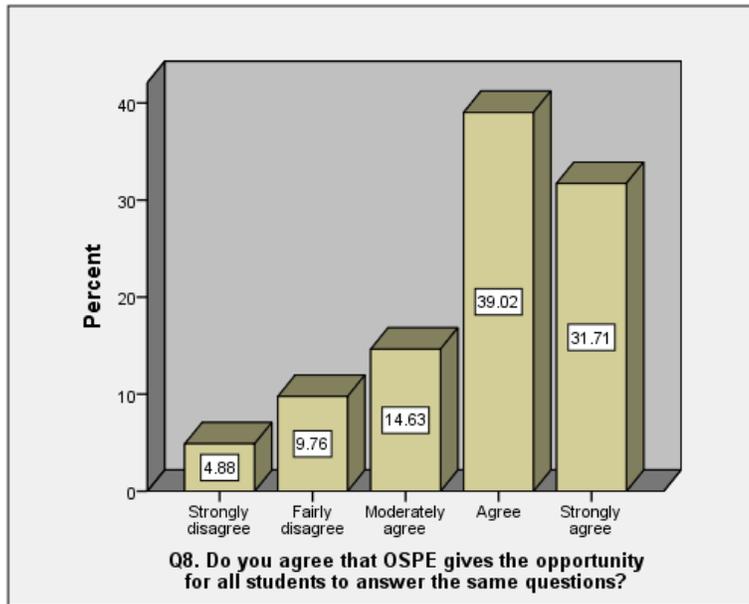


Figure 8: Responses on the merit (all students answering the same question) of OSPE as an assessment tool by first-year microbiology students (Source: Authors)

On the easiness to pass and score better, 48.78%, 31.71%, 14.63%, 2.44%, and 2.44% agree strongly, agree, moderately agree, fairly disagree, and strongly disagree, respectively (Figure 9). The easiness to pass and score a high grade in OSPE when compared to

other forms of practical examination showed a strong significant relationship with a wide range of knowledge covered compared with the traditional practical examination ($r=0.480$; $p<0.01$) (Table 2).

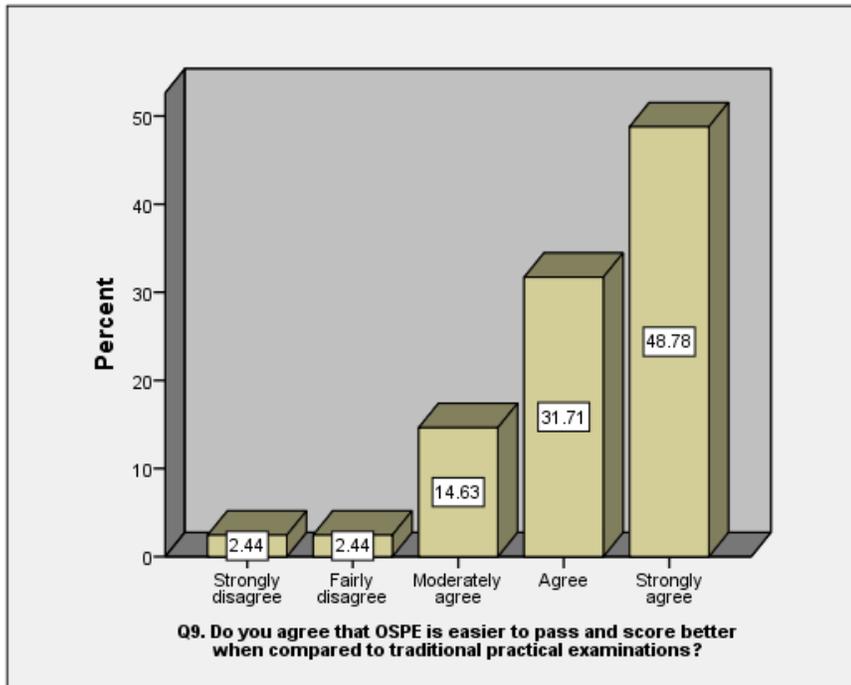


Figure 9: Responses on the easiness to score better and pass compared to the traditional methods by first-year microbiology students (Source: Authors)

On the perspective that OSPE covers a wide range of knowledge compared to the traditional practical examination, 35.59%, 34.15%, 19.51%, 9.76%, and 0.00% agree strongly, agree, moderately agree, fairly disagree, and strongly disagree, respectively (Figure 10).

On the degree of emotional stress (the feeling of psychological strain and uneasiness that one may fail the examination) experienced during OSPE practical examination compared to the traditional practical examination by first-year microbiology students, 46.34%, 29.27%, 14.63%, 7.32%, and 2.44% agree strongly, agree, moderately agree, fairly disagree and strongly disagree, respectively (Figure 11).

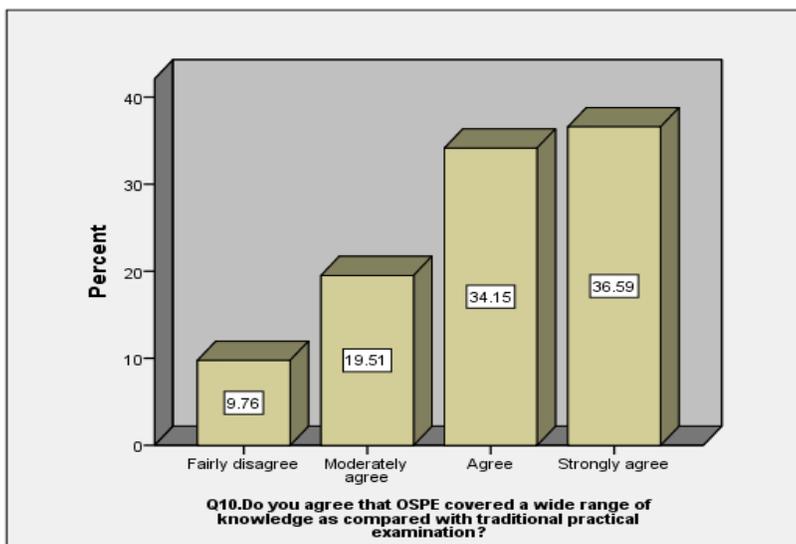


Figure 10: Responses on the merit (broader scope) of OSPE as an assessment tool by first-year microbiology students (Source: Authors)

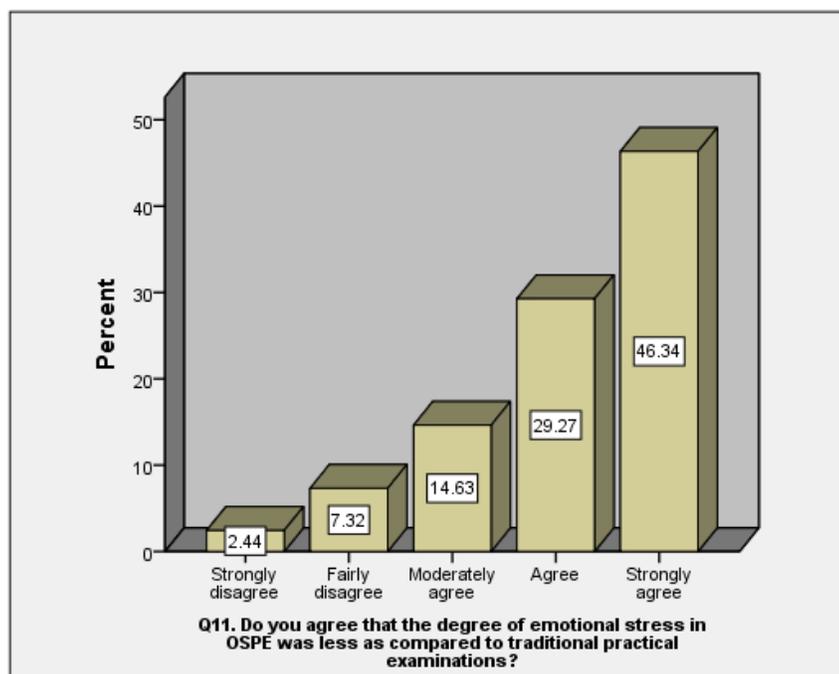


Figure 11: Responses on the degree of emotional stress during OSPE practical examination compared to the traditional practical examination by first-year microbiology students (Source: Authors)

The findings of this study had some similarities with previous works. For instance, Jena et al. (2015) reported that time given for OSPE was sufficient (78%); students score higher in OSPE than in conventional examination (66%), OSPE should be included in students' assessment (66%), and students were appraised of the OSPE pattern (83%) among undergraduate pathology students in a tertiary institution in India. Sai et al. (2020) reported that OSPE is relevant (88%), the time provided was adequate (90%), easier to pass compared to conventional practical examination (70%), be adopted as part of the assessment method in the Department (90%), provides better tendency to score high grade (87), less stressful (84%) and improve students practical skills (91%) among first-year allied health sciences students in basic medical sciences. Relwani et al. (2016) reported that a large number of students agreed that OSPE is fairer compared to the conventional practical examination (95.30%), covers a wide range of knowledge (100%), easier to pass, and score better (82.20%), should be adopted in the Department (95.70%), decline in emotional stress (85.60%) among MB, BS students Department of Community Medicine of MGM Medical College, India. Faldessai et al. (2014) reported that OSPE is an effective tool for examination and learning (90.60%), stressful (22.60%), less valuable compared to traditional practical examination (12.00%), time inadequacies (37.30%) among undergraduate students in Biochemistry. Mard and Ghafouri (2020) compared the traditional practical examination and OSPE. They reported that OSPE is preferable to question relevance (75.00%), time adequacy (64.00%), fairness (61.00%), easier to pass (57.00%), better method of assessment (59.00%), chance to score high grade (48.00%) and less

stressful (51.00%) among medical students in experimental physiology. The similarity in attitude suggests the objectivity and reliability of OSPE as an effective assessment tool.

The significant positive correlation among most of the items suggests that the items are influenced by each other. Therefore, since the effectiveness of OSPE as an assessment tool is influenced by the time given, there is a need for the Department to adopt it as an assessment tool because it allows students to answer some questions (thus eliminating variability and standardizing the examination) and easier to score high grade (thus eliminating high failure rate). The choice of the Department to adopt it suggests that it will be a better way of assessing the students' knowledge, enabling them to answer all questions and score very high. Again, the opportunity for all students to answer all questions also increased the scope of knowledge coverage, making it easier for the students to pass and score very high grades.

The reliability analysis (Cronbach's alpha) of the student's responses to items on the effectiveness of OSPE as an assessment tool for the first year microbiology programme was 0.754, which indicates that it is suitable for assessment and decision-making, a few items could be improved upon. The Cronbach alpha shows the validity of the responses of the students toward OSPE as an assessment tool. This reinforced that students' have indicated that OSPE is a suitable method of assessing a practical examination (Natu and Singh, 1994; Shenoy et al., 2017). The Cronbach alpha in the students' responses (questionnaire) is similar to the value of 0.790 reported in Pharmacology assessment using OSPE for second-year MB, BS students (Jain et al., 2021), 0.800 reported in the

reaction of carbohydrate (biochemistry) using OSPE for first-year MB,BS students (Krishna et al., 2011).

The Cronbach alpha recorded is in accordance with values recorded in the OSPE examination in different parts of the World. Hosseini et al. (2013) reported Cronbach alpha values of 0.907 in assessing Biochemistry laboratory skills (Hosseini et al., 2013), Shenoy et al. (2017) reported Cronbach alpha values of 0.724 - 0.845 in pharmacology for second-year MB,BS students. However, Cronbach's alpha value of ≥ 0.724 has been reported as high-internal consistency in assessment (Shenoy et al., 2017).

The deletion of any of the items will cause a change in Cronbach's alpha values. The range of 70 – 80 is suitable for classroom assessment as specified by Patel (2017). Apart from items 2, 6, and 7, deletion of

any of the items will cause a fall in the Cronbach's alpha values, which is an indication that items 1, 3, 4, 5, 8, 9, 10, and 11 play a significant role in the reliability of the effectiveness of OSPE as an assessment tool among first-year Microbiology Students (Table 3). Thus, the internal consistency is good, and it showed a higher correlation among the items. Again, it also showed that students' responses would likely reflect on their performance. Based on the internal consistency measure of the 41 first-year Microbiology major students, removing some problematic items will increase the overall reliability of the response. Overall, there was a significant difference ($p = 0.000$) between the items to which the students responded (Table 4). This further showed variability in the perceptions about the items on the evaluation score sheet.

Table 3: Reliability analysis (Cronbach's alpha) of the students' responses if an item is deleted on the effectiveness of OSPE as an assessment tool for first-year microbiology programme (Source: Authors)
Item-Total Statistics

Questions	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1	35.3171	31.472	.513	.549	.722
Q2	35.0000	37.800	.032	.229	.768
Q3	35.6341	31.038	.434	.341	.732
Q4	35.1463	29.978	.561	.603	.713
Q5	35.1951	33.261	.378	.510	.739
Q6	37.6585	34.830	.232	.605	.756
Q7	37.3415	32.930	.282	.662	.755
Q8	35.3659	30.938	.492	.354	.723
Q9	34.9756	30.674	.644	.649	.707
Q10	35.2195	32.176	.474	.473	.727
Q11	35.0976	33.140	.340	.271	.744

Table 4: Analysis of variance of items and students' responses
ANOVA

	Sum of Squares	df	Mean Square	F	Sig
Between People	139.858	40	3.496	42.524	.000
Between Items	365.388	10	36.539		
Within People	343.703	400	.859		
Residual	709.091	410	1.729		
Total	848.949	450	1.887		

Grand mean = 3.5632

4.0 CONCLUSIONS

This study showed the attitude of first-year microbiology major students to the use of OSPE for their practical examination. The findings showed that OSPE is an effective tool for assessing the students' knowledge, giving broader coverage to knowledge, the opportunity to answer all questions, and making it easier to score high grades. The study suggested its adoption in the Department of Microbiology as a tool for assessing all

practical examinations. This study also revealed that OSPE was well accepted by the students compared to traditional patterns of examination and indicated the importance of the role of the students in developing new examination assessment tools. No assessment tool is perfect, but this marks a considerable step towards having more objective and reliable examinations. Based on the findings of this study, there is a need for the Department of Microbiology to adopt this assessment tool for all practical examinations of the students. In

addition, other disciplines, particularly non-clinical fields, need to adopt OSPE as a reliable, objective, and standard tool for assessing practical skills. The Department also needs to carry out this exercise for the next four years and compare the results.

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Conflicts of interest/Competing interests

The authors declare no competing of interest.

Ethical considerations

Ethical approval was obtained from the Research and Ethics Committee of the Bayelsa Medical University, Nigeria with Ethical approval number REC/2021/0008.

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