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The Development of Online OSCE Prototype for OSCE in School of Nursing: Lesson Learned

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***Abstract*—Conventionally, paper is used for scoring Objectives Structured Clinical Examination (OSCE). This paper-based system is not only time consuming, but also high in possibility of error, subjective, and not effective. The objective of this paper was to discuss the development of Online OSCE (ON-OSCE) application prototype for scoring OSCE. The ON-OSCE was developed by using prototype model consisting of three phases: (1) analysis of the drawbacks of paper-based assessment and the need to develop online-based scoring system, (2) design the ON-OSCE system, and (3) implementation, evaluation and feedback of ON-OSCE. The second phase was the most challenging one because it must accommodate the weakness of paper-based system and cover the accuracy of score. Before the ON-OSCE was implemented, the subject coordinator ensured the checklist that was used for measuring the skill competency thatshould be valid, reliable, and integrated the additional values of institution. The fixed checklist was entered into the system by administrator. After the checklist was ready, the administrator inserted the list of students who would be assessed. During the OSCE, the examiner observed the students and used the tablets or PC to access the score directly. While the examiner finished the scoring process, the result of the observed student would directly appear in the tablet or PC. The result for all of students could be downloaded and stored that can be used to score the overall student achievement in nursing skill laboratory work. The ON-OSCE will enable to reduce the time to score, improve the accuracy and objectivity, reduce paper use, and improve the examiners and students' satisfaction. The ON-OSCE can be used in regular OSCE as long as the institutions have good internet connection, hardware (tablet or PC), valid skill checklists, and well-trained examiners.**

Keywords—online, Objective Structured Clinical Examination (OSCE), Nursing Skills

I. INTRODUCTION

The Objective Structured Clinical Examination (OSCE) is a method of assessing a student's clinical competency which is objective and in which the areas tested are carefully planned by the examiners [1]. OSCE fulfils the criteria of valid, reliable, and practical which are introduced by Harden and Gleeson in 1979 to assess medical student's competence. The clinical competency to be tested consists of several skills. During the OSCE, the students rotate round several stations, spending a specified time at each station. The time allowed is the same for all the stations, and the stations must be designed with this in mind. The examiner uses checklist to record the performance of the students as they pass through the station. Recently, OSCE has been implemented globally among students of health care providers [2], not only among medical students but also among dentistry [3], and nursing students [4].

School of Nursing, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (SON FMHS UMY) has implemented OSCE since 2001 to asses nursing student's competence in nursing skill laboratory because it is considered as the most appropriate way to assess student's ability to perform nursing skills and procedures. In SON FMHS UMY, the students must pass 4-6 stations in each OSCE with about 10-30 minutes in a station depending on the skill and procedure that is tested. The scenario is provided in each station, and the students perform the required skill(s) written on the scenario. In SON FMHS UMY, there are several preparation steps before conducting OSCE including the form of OSCE committee; train the examiner, train the students, construct the exam blueprint, write the cases and probes, construct the checklist to each case, recruit and train standardized/simulated or real patients, pilot the exam and revise as needed, conduct the full scale exam, analyze the results, and report the results [2].

Scoring the student's competence at OSCE station is conducted using checklist. The checklists are the marking or scoring guidelines containing information, points, items or tasks expected to be performed by the examinee when he/she is observed by the examiner [2]. In SON FMHS UMY, the checklist is divided into several stages and aspects including the pre-interaction stage, preparation stage, interaction stage, termination stage, documentation stage, and soft-skills. Each stage has several items/procedures that must be performed by the students. There are scores that need to be inputted in each item/procedure. The score consists of raw score, critically score, and difficulty score. Raw score is measured by the observation of detail procedure that has been completed by the students. Critically and difficulty score are constant that have been set by the team teaching. The student's final score is the multiplication of raw score, difficulty score, and critically score. This scoring system is designed to increase the objectivity of the scoring. Furthermore, the Islamic values procedures have been integrated in the checklist to achieve the vision and mission of SON FMHS UMY.

Previously, the OSCE scoring process used paper-based checklist. After the completion of OSCE, the examiner must calculate the score manually based on the checklist. The process required time and extra work for examiner. The checklist also did not provide comment about the student's performance that might important to review student's performance. With the paper-based checklist scoring, the

examination administrator had to copy a lot of checklist and form as the observation tools. Paper waste after the OSCE also became one problem that needs to be considered. The similar problems have been noticed from the previous study. The results of paper-based test were not available immediately after the test and cause delay in providing score and feedback. Moreover, with the higher number of students who take the test, paper-based test cause pressure on the academic staff time, ability to moderate and audit examination output, production cost, and the pressure on assessment administrative staff [5].

The advancement of technology influences the OSCE scoring process. Several studies showed that electronic-based scoring system has been developed. Electronic OSCE software has been designed in the management of a four OSCE stations assessment with a cohort of first year undergraduate nursing students delivered over two consecutive years in one higher education institution in Ireland [6]. They found that the electronic software enabled the storage and analysis of overall group and individual results that offer considerable time saving. The system that only allowed the completed marked form to be submitted electronically prevents the potential missing data. Additionally, the feedback facility allowed the student to receive evaluation on their performance in timely manner and use the feedback to benchmark and improve their performance.

More recent study designed eOSCE to assess the student's clinical competencies of Master of Nursing Primary Health Care Nurse Practitioner Program [7]. They found that the eOSCE has many advantages. The advantages includes the user friendly, easy to use, provided objective assessment, and allowed them to pay more attention to the student's performance because they did not need to write comment on a paper. All users reported the preference for eOSCE than the traditional paper-based checklist. The OSCE coordinator can tabulate and verify the final OSCE scores quickly and efficiently, provide timely feedback to students. Another advantage of the eOSCE management system is that assessment data were complete for all students. No check-list items were left unmarked because eOSCE prompted and required examiners to complete all marking areas to submit a student's score. This is an advantage that is more than the traditional paper-based OSCE marking, in which item numbers are frequently left unmarked, leaving uncertainty regarding students' performance on these items and inaccurate results.

Considering the positive aspects of electronic use of OSCE scoring, the researchers developed a prototype of online OSCE scoring system called ONLINE-OSCE (ON-OSCE). The focus of this paper is on the development of a prototype to provide a brief explanation of ON-OSCE and the related work.

II. METHODOLOGY

The ON-OSCE was developed by using prototype model. The prototype model is one of Software Development Life Cycle Model based on the idea of creating the entirely or part of a system in a pilot version. The goal is to build the various versions and constantly refine those versions until the final product is reached (Isaias & Issa, 2015). In this study, the development of ON-OSCE consists of three phases: (1) analysis of the drawbacks of paper-based assessment and the need to develop online-based scoring system, (2) design of the ON-OSCE system, and (3) implementation, evaluation and feedback of ON-OSCE (figure 1).

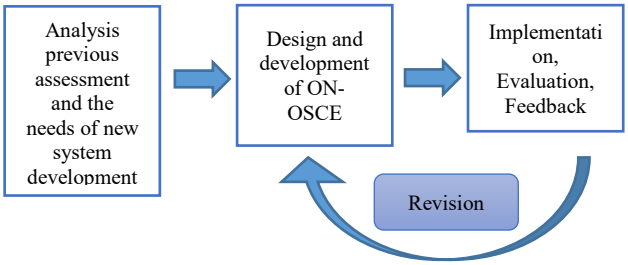

Fig 1. Development Phases of ON-OSCE

A. *Phase 1. Analysis of paper-based assessment and the needs of ON-OSCE*

The analysis process was conducted through observation in the skill laboratory of SON FMHS UMY during the first semester of academic year 2017/2018 and interview with the head of school, head of skill laboratory, OSCE examiners, and administrative staffs in SON FMHS UMY. The observation was done to analyze the problems of paper-based scoring system and the needs to develop computer-based scoring system.

SON FMHS UMY has used paper-based assessment for OSCE since 2001. Primarily, each student had one assessment form with several pages of sheets required to be marked by the examiner. When the student was tested four different skills, they had to have four different forms. With the increasing number of students, the required paper significantly increased. Consequently, there was a huge of paper waste after the OSCE. Several years after, in 2011, the form was modified to reduce the waste product. One form could be used to score up six-eight students. Some columns were merged, and the font size was reduced. This strategy was good to control the paper waste. However, the paper waste still becomes a severe problem that need to be considered.

The second problem related to the paper-based was the scoring process. During the test, the examiners must closely observe the student's performance. They could not calculate the score immediately during the observation process. Otherwise, they would miss some procedures performed by the students. In the end of the OSCE, the examiners had to calculate the score manually. When the examiner joined the next round of OSCE or another schedule, they could not calculate right after the OSCE was ended. Therefore, the OSCE result could not be tabulated by the administrative staff and announced to the students directly. As the consequences, the students often receive the results of their OSCE three up to a week after the OSCE.

The next identified problem was about the unmarked point. Often, but not always, unmarked point was found in certain procedure. This unmarked point caused uncertainty in scoring and less accurate score. Another problem related to inaccurate score was the examiner intention to upgrade the borderline score. In SON FMHS UMY, the minimum point to pass the OSCE is 75.00. The students who scored below 75.00 were considered fail and must conduct the remediation to improve his/her score. The remediation process is another thing that needs an extra effort. The greater number of the student that takes remediation, the more examiner has to do extra time and

effort to re-test the student. Therefore, sometimes, the examiner revised the score of the student who had score close to 75.00. This problem caused unaccountable and unobjective score to the students.

Finally, there was a growing attention to improve the OSCE scoring system in SON FMHS UMY. The required improvement should accommodate the need of scoring system that are paperless, easy to score, prevent unmarked point, accurate, objective, facilitate the feedback note, web-based or online system, the score could be downloaded and imported into excel system to facilitate the summative tabulation, the system can be integrated with the university academic system, safe, and provide analyzed data (pass rate percentage etc).

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B. Phase 2. Design and Development of ON-OSCE

In this stage, the researchers collaborated with the Information Technology (IT) staff at Informatic System Bureau of Universitas Muhammadiyah Yogyakarta. The researcher prepared the organization of OSCE including the checklist preparation, scoring standard and guideline, OSCE stations, schedule, ON-OSCE simulation and training, and collected the feedback from the examiners and students. Meanwhile, the IT staff developed the program and revised the program based on the feedback from the user.

The checklist format used in ON-OSCE program was not totally new checklist. The format used the same component as used in the paper based (figure 2). Then, the researcher collaborated with the coordinator, co-coordinator, and team teaching of the subject to validate the OSCE checklist. The subject coordinator is the person in charge who collects the checklist to be used to test the students. The checklist is developed by a person or teams that expert in that skill, therefore the role of coordinator is essential in ensuring the availability of the checklist. The co-coordinator is the person that responsible to manage the process of OSCE. He/she has to ensure that the scenarios for OSCE, checklists, simulated patients, instruments and examiners are ready on the OSCE day. The subject coordinator and co-coordinator were not involved directly on the ON-OSCE program development, but they support on the availability of the checklist installed on the ON-OSCE.

Each procedure in the checklist was carefully considered for its validity; raw score, critically score, and difficulty score. The team used the existing guideline and evidence based to validate the checklist of each procedure before it is used to test the students. The critically and difficulty score were fixed and decided by the team. While all the team agrees that the checklist is valid and all of the scores have been set, the checklist is ready to be used.

The procedure stages are the stages in implementing nursing procedure that consist of pre-interaction stage (self-evaluation and preparation before meeting the patient), preparation stage (self-introduction, validation of the patient, and procedure, explanation of the procedure, re-consent of the patient), interaction stage (the stage when the nurses conduct the main procedures based on the standardized operation procedure and guideline), termination stage (ending the procedure, reinforcing the patient, and educating the patient), documentation stage (recording the procedure or nursing skill and patient's responses), and soft-skills. Students are scored based on their performance in each item of the stages.

Fig 2. OSCE Checklist Template

The score consists of raw score, critically score, and difficulty score. Raw score is measured by the observation of detail procedure which has been completed by the students, ranged from zero (0) to five (5) depending on the procedure. The procedure that only requires one action has zero (0) and one (1) raw score. The more actions are required in a procedure, the higher raw scores it has. When a procedure has three raw scores, but the student only performed one action, the student got score one in raw score section. Critically and difficulty score are ranged from one to three. Score one (1) means least critical and difficult and score three (3) is very critical and difficult. This score is constant because it has been set by the team. The student's final score is the multiplication of raw score, difficulty score, and critically score. Maximum score (max score) is the possible maximum score that can be achieved by the students, while the actual score is the real score achieved by the students based on their performance. The valid checklist is integrated in the ON-OSCE system. After the checklist had been set, the researchers and the IT staff collaborated to develop program that can accommodate the required OSCE scoring system as mentioned in the phase one.

The simulation and socialization of the ON-OSCE was conducted after ON-OSCE prototype version one has been done. The simulation involved the OSCE examiners, students, nursing laboratory administrative staffs, simulated patients, and IT staff. The examiners scored four students from different grades with different skill based on their grade. This OSCE simulation was crucial to pilot the test program and gather feedback for further developing of the program.

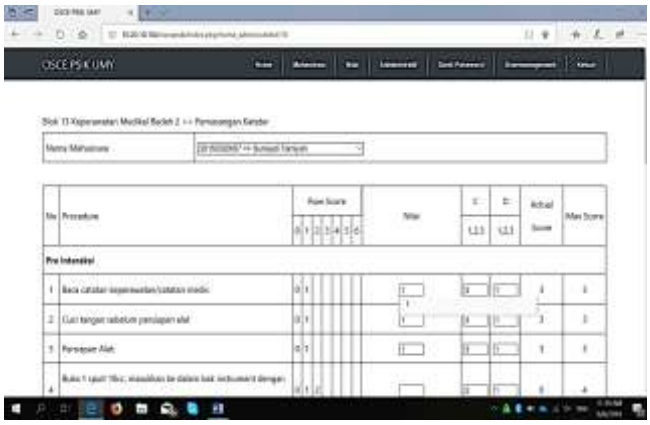

Fig 3. The Display of ON-OSCE Version 1

Before the simulation, the ON-OSCE program was ready to use. The ON-OSCE program and each menu of the program were presented to all OSCE examiners. The examiners were exposed with the program that can be accessed through their notebooks, laptops or mobile phones. They had chance to explore and clarify the way to operate the program. Any inquiries were discussed and any difficulties for running the program were resolved during the simulation. In this phase, the examiners were allowed to give suggestions and recommendations to further developing the program.

The results of the simulations provide a valuable input to further improvement of the program. These include the menu to add comments or feedbacks on each procedure, the way to input score should be easier, and the additional information related to the test including the number of stations, station line, and scenario code. All the inputs were used to revise the ON-OSCE version one to ON-OSCE version two.

C. Phase 3. Implementation, Evaluation, Feedback

The ON-OSCE version two has been settled following the OSCE simulation (figure 4). The ON-OSCE version two has been used in the regular and formal OSCE in the second semester in academic year 2018/2019. Prior to the implementation of the ON-OSCE, the related staffs (administrative staffs, examiners, and students) received clear explanation about the procedure of ON-OSCE application. The students and examiner's evaluation and feedback about ON-OSCE application were assessed through e-learning system.

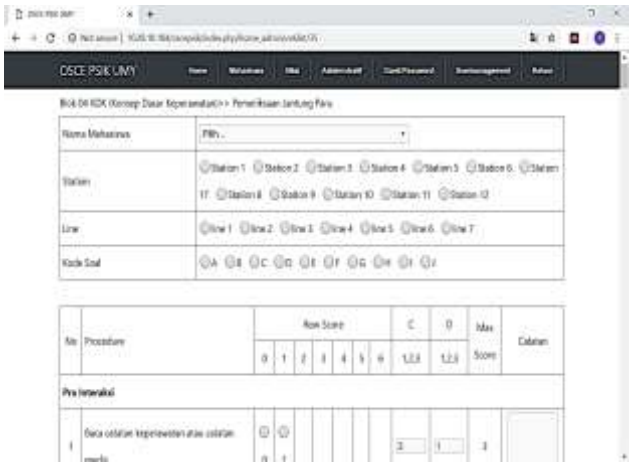

Fig 4. The Display of ON-OSCE Version 2

III. Results & Discussion

Online-OSCE (ON-OSCE) was developed to facilitate the process of OSCE through online system that allows the examiner to easily score the students' performance in OSCE. Subject coordinator and co-coordinator, administrative staff, students, examiners, and IT staff are people that involve in ON-OSCE system implementation. Each person has important responsibility to ensure that the system run very well. There are 3 stages for implementing ON-OSCE; pre-OSCE, OSCE, and post-OSCE.

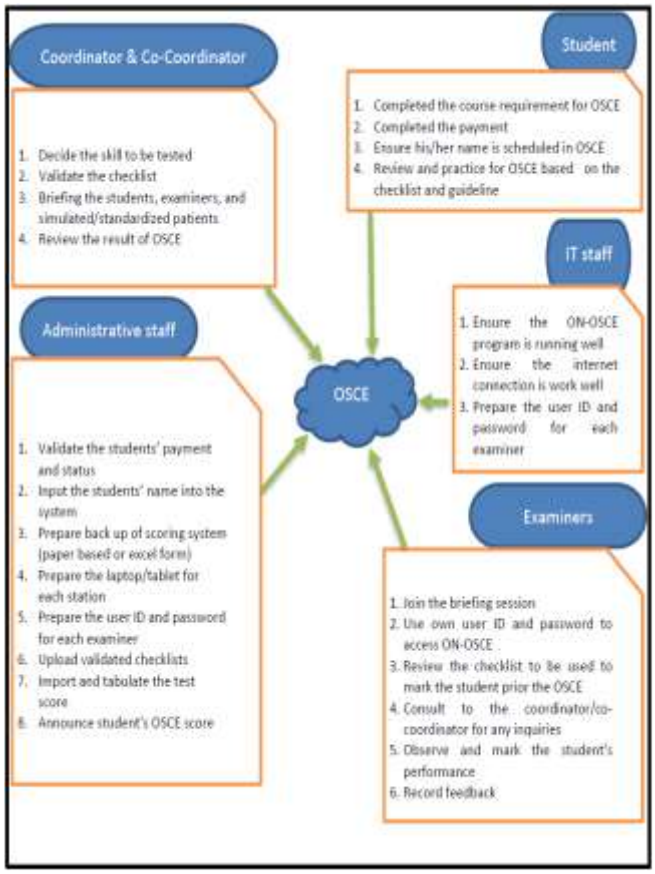

Fig 5. The Role of Personnel in ON-OSCE

Pre-OSCE was a preparation stage before OSCE. Ideally, pre-OSCE is done within 3 days of prior OSCE. During this stage, there are several things that have to be done. The coordinator and co-coordinator must decide the skills that will be tasted to the students and what stages of each skill that will be observed. Since the time for OSCE was limited in each station, some skills that required were quite long time such as abdominal physical examination can be divided into two or more station. The time, the availability of equipment, the number or required simulated or standardized patient, the number of the students should be considered for deciding the skills and stages of skills that will be tested. While the skills have been set, the validated checklist must be prepared. Along with the subject team teaching, the coordinator and co-coordinator carefully validated the checklist based on the station and skills that were tasted.

The validated checklists should be given to administrative staffs at least three days before the OSCE that allow the staffs to input the checklist into ON-OSCE system. The coordinator

and co-coordinator should give clear briefing to the students and examiner about the OSCE procedures, duration or time in each station, the skills and skill's stage that will be tested, student's and examiner's tasks, scoring system, passing grade to pass the OSCE, and schedule. During the briefing, the coordinator and co-coordinator distributed the user ID and password for every examiner, case or scenario for OSCE, and inform the examiner's station. The briefing session allows the examiners to ask any inquiries about their task, checklist and other related problems to warrant the clear understanding and same perception among examiners. Additionally, the coordinator also has to brief the simulated or standardized patients to guarantee they act as required in the scenario.

During the pre-OSCE stage, administrative staffs ensured the students would take OSCE have finished their payment and registered in the academic informatic system then the validated students list should be inputted in the ON-OSCE system. The staffs also received the validated checklist from the coordinator or co-coordinator, then upload the validated checklist into the ON-OSCE. In order to prevent any trouble during the OSCE such as the internet connection problem, electricity problems, and laptop or tablet problem, the backup scoring system (paper-based and the excel form) were prepared. The administrative staffs also had to prepare the laptop or tablet ensuring that the batterie was fully charged, and there were no troubles on the computer hardware. Ideally, like other computer-based test, the backup laptop should be available, about 10% of total laptop used in all station. In the case that several laptops have problems in the same time, the examiners are allowed to use their own laptop or tablet as long as it has internet connection.

The IT staff had to ensure that the ON-OSCE program and internet connection in the OSCE center run very well. The user ID and password for each examiner also had to be created by the IT staff. Those would be used by the examiner to assess the ON-OSCE, thus every examiner had their own user ID and password.

The students in the pre-OSCE had to complete the entire course requirement for OSCE, including 100% attendance in the skill practice. They also had to complete the payment and ensure that their were listed in the OSCE schedule. Moreover, they should have reviewed the skills to be performed during the OSCE.

The examiners had to attend the briefing session prior the OSCE because the briefing session was very important to confirm and warrant the examiners role. They had to review the checklist that would be used to mark the student. Any questions regarding the checklist and OSCE could be clarified during the briefing session. The examiners also received the user ID and password to use ON-OSCE.

During the OSCE, the examiners played significant role for marking the students through careful observation. They were required to write on the system when they noted some that might cause any doubt regarding to the student's performance. Critical aspects that were missed by the students and required feedbacks also need to be written in the ON-OSCE. Thus, the students could receive feedback that was beneficial to improve their performance. During the OSCE, the examiner had to give mark for every single procedure in the checklist. They could not continue the marking process when there was any unmarked procedure. Immediately, after they completed the mark, the student's result was available in the result menu. There was no extra work and manual calculation after the OSCE finished.

Post-OSCE stage is the time when all of the students completed the OSCE in all required stations. In this step, the role of administrative staffs is very important. The staffs imported the data from ON-OSCE in the excel form and tabulated the test score. Although it required additional process, the tabulating score could be finished in several hours after OSCE. The OSCE result could be announced less than 24 hours after OSCE. Therefore, the students could prepare themselves whether they had to join remediation OSCE or not.

In this last stage, the coordinator and co-coordinator review the result of OSCE. They can use the feedback to improve the student's performance and retrieve the data form the ON-OSCE to analyze what skills that most students passed or failed.

Pre-OSCE required quite complex preparation. However, the rest stages are simpler. The similar result can be found in the previous study. eOSCE required some time to input schedules and checklist into the program, less set-up time was required to input the data when the team gained experience using eOSCE [7]. Other previous study also found that eOSCE required pre-examination preparation and challenges for examiners especially for those who are not familiar and comfortable using technology [8].

During the OSCE, the concern about the possibility of device failure or connection problems exists. Therefore, the paper-based or excel form of checklist is still prepared as an anticipation strategy. The paper-based form as a backup is recommended in using electronic assessment as a safeguard [7], [9].

The most benefit of ON-OSCE is the time-saving. As other previous study found, the automaticity of the system greatly decrease the time for scoring [2], [6]–[9]. Additional benefit including the big data saving and analysis can be used to further improve the student's performance [6].

IV. Conclusion & Recommendation

Online-OSCE scoring system provides more efficient than traditional paper-based assessment. Although some preparations are required prior the OSCE, the advantages of information technology utilization in OSCE are more superior than its drawbacks. Therefore, it is strongly recommended to health care provider's education institution to develop and integrate technology in OSCE and other student's assessment process.

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