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Are workplace-based assessment methods (DOPS and Mini-CEX) effective in nursing students' clinical skills? A single-blind randomized, parallel group, controlled trial

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Background: Evaluation of clinical skills is critically important for nursing students. However, the quality of evaluation tools is poor.

Objectives: To evaluate the effectiveness of Direct Observation of Procedural Skills (DOPS) and Mini-Clinical Evaluation Exercise (Mini-CEX) on clinical skills of nursing students.

Methods: This study was conducted among 108 senior nursing students. Mini-CEX and DOPS were utilized to evaluate clinical skills in the intervention group.

Results: The mean of students' scores in all of the five procedures was significantly higher in the intervention group compared to control group. Students' scores for the procedures significantly raised through the first stage of DOPS and Mini-CEX to the third stage.

Conclusions: Utilization of DOPS and Mini-CEX for evaluation of clinical skills in nursing students effectively enhance their learning ability. Implementing of such assessment methods lead to promoting clinical skills of students which eventually help them to provide high quality care for their patients.

Keywords: clinical competence; clinical skills; nursing students; educational measurement/methods; randomized controlled trial; Iran

Impact statement

This study can give us instructions to make our nursing students be competent to take high-quality care of patients.

Introduction

Nursing education is an issue of critical importance in the professional preparation (Hirsh et al., 2007). Education in the nursing profession includes two domains of theoretical knowledge and clinical skills (Christensen, 2011; Günay & Kılınc, 2018; Rafiee et al., 2014). Clinical education is a pivotal element in the performance-based profession of nursing (Atash Sokhan et al., 2011). It is also called the heart of professional education and accounts for 50% of the nursing curriculum (Günay & Kılınc, 2018; Karimi Moonaghi et al., 2010). Clinical education is a great opportunity

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to translate theoretical knowledge into clinical psychomotor skills (Günay & Kılınc, 2018; Mollahmadi, 2010). The coordination of knowledge and skills in caring for patients is obtained via the process of clinical educations (Mollahmadi, 2010) in which there are performance-based learning activities (Astin et al., 2005).

Students' evaluation is one of the key elements and challenging issues in the process of clinical education (Rafiee et al., 2014; Saarikoski et al., 2013). An appropriate evaluation method is capable of highlighting strengths and limitations in the clinical education which make it easier to promote positive aspects and resolve weaknesses (Smith-Strom & Nortvedt, 2008). An effective evaluation not only encourages students to learn more but also help teachers to assess their own activities. Furthermore, evaluating performance and providing feedback to students enhance individuals' learning skills (Bari, 2010; Franko et al., 2008). Nevertheless, there is evidence showing a weakness in the evaluation of clinical skills, students' performance and lack of compatibility with educational purposes (Rushforth, 2007). The two main impediments in clinical evaluation are subjective-based assessment and lack of attention to clinical competencies of nursing students (Rafiee et al., 2014). However, due to improved approaches in clinical education, it is necessary to use new assessment methods. Several assessment methods, including portfolio, Objective Structured Clinical Examination (OSCE) and logbooks are used to evaluate clinical skills. Portfolio is a reflection of key events in professional life that can be used for both learning and evaluation (Habibi et al., 2013), logbooks contain educational goals and guide instructors and students in clinical education (Heidari & Akbari, 2017), and OSCE is a structured and objective way to evaluate clinical skills (Rushforth, 2007). Despite all advantages, they may have several disadvantages (Habibi et al., 2013; Pugh et al., 2015).

Nowadays, education experts are seeking new evaluation methods that not only evaluate students' performance but also to assess competency, provide a feedback and promote their learning process (Karimi Moonaghi et al., 2010; Noohi et al., 2008). DOPS and Mini-CEX are the two common evaluation methods involve direct observation in real clinical settings to assess students' competency and supply appropriate verbal feedback (Habibi et al., 2013).

Given that clinical evaluation is one of the most important elements of clinical education that could motivate students and help teachers to identify the strengths and weaknesses of education. Also, considering challenges in clinical evaluation like, using not so desirable traditional methods by some instructors that leads to students learning difficulties and dissatisfaction (Habibi et al., 2013; Liu et al., 2019). On the other hand, despite the positive report regarding the educational impact of DOPS and Mini-CEX on students, there is still little evidence that indicates these work-based evaluation tools lead to improvement in students' clinical skills (Miller & Archer, 2010). Therefore, this study aimed to evaluate the effectiveness of Mini-CEX and DOPS on clinical skills of nursing students. Our hypothesis was that the work-based evaluation tools might have an impact on nursing students' clinical skills.

Methods

Design and participants

This single-blind randomized, parallel group, controlled quasi-experimental study with comparison group was conducted in Imam Khomeini hospital in Urmia, Iran in 2016. Our population was senior nursing students. Inclusion criteria were students in their final year of bachelor's study (seventh and eighth semester) and willing to participate in the current study. Students holding

a certificate in “evaluation methods” were not included in the study. Based on the previous study (Hengameh et al., 2015), by considering $\alpha = 0.05$ and power of 0.80%, the sample size was calculated to be 90 participants by using G*Power 3.1.2. However, a total of 108 participants was recruited due to 20% attrition rate (54 participants for each group). The participants were selected using convenience sampling method and randomly allocated to intervention and control groups (Figure 1). Lead researcher used the table of random number generator to randomly recruit groups. The CONSORT 2010 checklist was used to ensure quality reporting in this study (Schulz et al., 2010) (see Supplementary File).

Data collection and procedures

Clinical skills include both procedural and non-procedural skills. DOPS is an effective way to evaluate the procedural skills such as intravenous catheterization, dressing changes and suctioning based on the direct observation and the feedback given. Each test takes about 20 min in which the first 15 min, students take the test and another 5 min are spent in providing developmental feedback to students (Habibi et al., 2013). However, despite the benefits of the DOPS for evaluating procedural skills, it is not a suitable method for evaluating non-procedural skills. Mini-CEX is considered to be an appropriate method to evaluate and give feedback on non-procedural clinical skills such as communicating with patients, patient education and nursing reporting (Liu et al., 2019).

In this study, we used two checklists for evaluating the students. The first checklist included the students’ and assessors’ profile, and the second one included workplace-based assessment criteria (Mini-CEX and DOPS). Mini-CEX was used to assess skills on preparing a nursing report and patient education. There is a checklist with 30 items for evaluating nursing report. Items such as “recording the reason for failure to comply with the doctor’s orders” emphasize writing the key information about nursing report. The checklist was used to evaluate patient education comprises 13 items such as “answering client or family members questions”. Whereas DOPS was employed to assess skills related to intravenous catheterization, dressing change and suctioning. The form was used to evaluate intravenous catheter insertion include 26 items such as “selecting the right vein”. The checklist was used to evaluate dressing change comprise of 20 items such as “washing hands before and after procedures”. The checklist was used to evaluate suctioning skill of students contains 13 items such as “placing patient in right position”. In order to avoid dissemination of information, control group was assessed prior to the intervention group. Binary answers (0 = No and 1 = Yes) were utilized to evaluate students’ performance. The validity and reliability of these checklists were confirmed by Habibi et al. (2013). Lawshe’s Content Validity Ratio showed a CVI = 0.79 and CVR = 0.62 for the questions in the checklists and questions were below this amount were deleted or revised. Reliability was assessed using inter-rater reliability and three assessors observed at least five students at the same time for each procedure. Then, the intracluster correlation coefficient (ICC = 0.5) and Cohen Kappa coefficient (CKC = 0.6) were used to determine the inter-rater agreement for each item (Habibi et al., 2013). Coefficient of agreement among observers was used to measure inter-rater reliability in this study. For this purpose, six experienced researchers observed and evaluated a skill at the same time. Ultimately, the coefficient of agreement was calculated for each clinical skills of writing nursing report ($r = 95\%$), patient education ($r = 89\%$), intravenous catheterization ($r = 94\%$), dressing change ($r = 82\%$) and suctioning ($r = 86\%$). The results were acceptable and indicated the reliability of the study.

This study performed in two phases: In the first step, six clinical instructors (assessors) who had a master’s degree in nursing and willing to participate in the study were recruited. In this

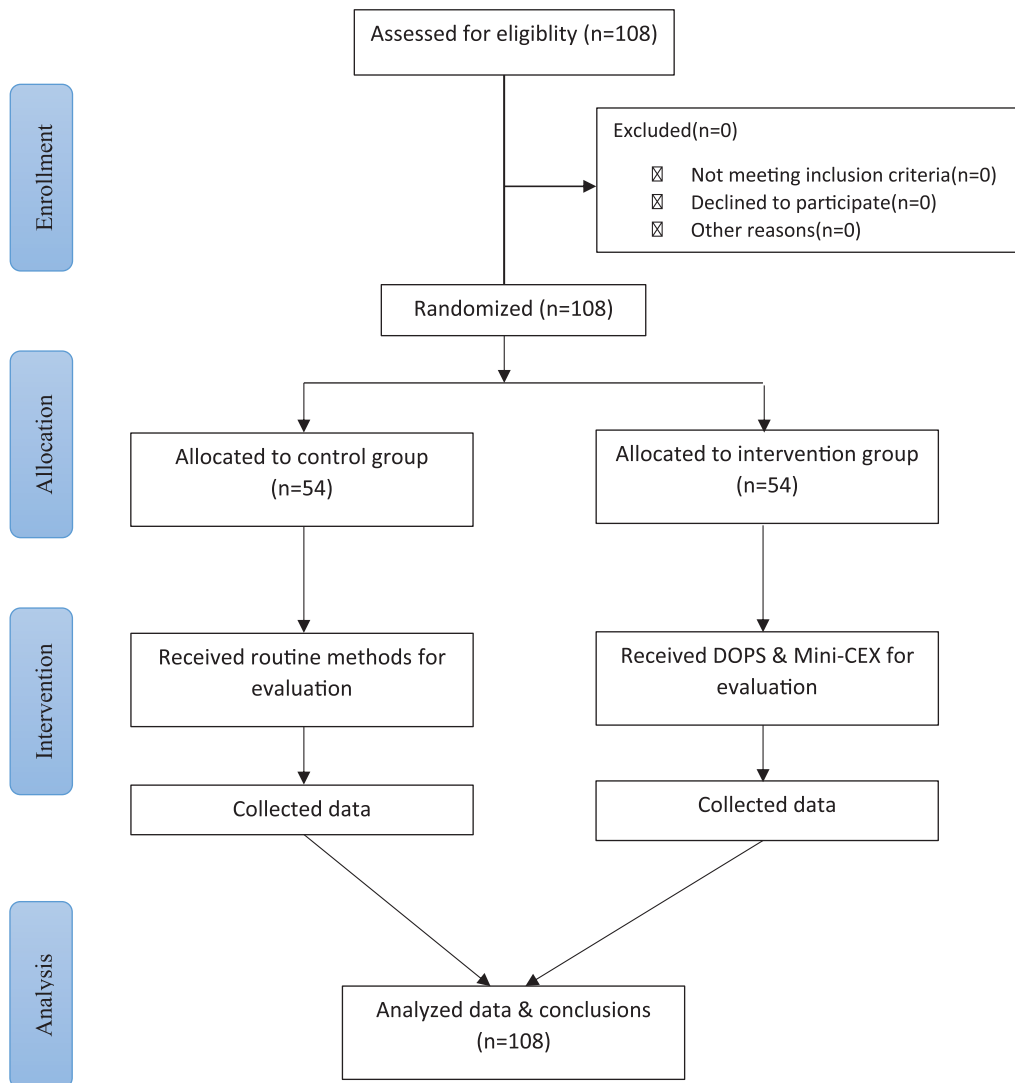


Figure 1. The flow diagram of the study based on Consort statement 2012.

phase, all six assessors were oriented to the purpose of the study and they participated in the orientation class regarding DOPS and Mini-CEX for 6 h and how to fill out the checklists.

In the second step, the control group was evaluated based on routine evaluation methods (combination of logbooks and summative scoring without verbal feedback) of nursing school and the intervention group was evaluated using DOPS and Mini-CEX based on the checklists with verbal feedback. Nursing students were evaluated while they were on their clinical course in medical-surgical unit, emergency department and ICU. The observation performed whilst the student carried out the activity. The procedure being observed should last no more than 15 min before the evaluation took place. The assessor then spent 5 min, providing immediate verbal feedback and filling out the evaluation form with the student present.

The primary outcome measures

Each of the five clinical skills (suctioning, intravenous catheterization, dressing change, nursing report and patient education) was evaluated in three stages with one-week interval between each stage. Finally, evaluation checklists were presented to students and the score obtained from the third stage was considered as the final mark of students. At the end, scores of procedures were compared between two groups.

Data analysis

Data were analyzed by the researcher who was blinded to the data using IBM SPSS software (version 20.0 SPSS Inc., Chicago, IL, USA). We used the Shapiro–Wilk test to determine the normal distribution of the data. It showed that our data are normally distributed. Thereby, parametric statistical tests such as independent sample *t*-test, repeated measure analysis of variance (ANOVA), chi-square and Pearson correlation were used to analyze data.

Ethics

The Review Board of Urmia University of Medical Sciences approved this research (IR.um-su.rec.1395.185). Participation was voluntary in this study and written informed consent was obtained prior to data collection. Participants were informed about the purpose and benefits of this study. They were also assured that the information collected during this course of study is anonymous and confidential.

Results

The majority of our participants (53.4%) were male and 87.44% were single. The students' average GPA (out of 20) was 16.12 (SD = 1.19) and mean age of participants was 22.3 (SD = 1.27) years old. Our findings showed that there are no significant differences between intervention and control groups in terms of age, gender, marital status and GPA. Independent sample *t*-tests showed no significant differences regarding the age and GPA in the intervention and control groups ($p > .05$). A chi-square test was conducted to compare gender and marital status among the intervention and control groups. Similarly, there was no significant difference between the two groups regarding the gender and marital status. These findings indicate homogeneity of our samples (Table 1).

An independent sample *t*-test showed that the mean of students' scores in all of the five procedures was significantly higher in the intervention group compared to control group ($p < .001$) (Primary outcome). The highest difference was attributed to the score of dressing change in the intervention group (mean = 89.34, SD = 9.25) rather than control group (mean = 63.12, SD = 9.86) (Table 2).

Repeated measure (within subject) ANOVA was conducted to compare students' scores within three different measures of DOPS and Mini-CEX. The results showed that there was a significant improvement in the students' scores on the three DOPS tests assessing the skill of suctioning ($F_{(2,110)} = 1.23, p = .000, = .9$). Bonferroni *post hoc* test showed that students obtained a significantly higher score at the third stage (mean = 88.6, SD = 4.6) compared to the second (mean = 67.4, SD = 5.4) and the first stage (mean = 42.5, SD = 4.4). Likewise, repeated measures (within subject) ANOVA analysis indicated similar result for dressing change ($F_{(2,108)} = 2.5, p = .000, = .97$), intravenous catheterization ($F_{(2,104)} = 1.3, p = .000, = .96$), patient education ($F_{(2,110)} = 1.2, p = .000, = .96$) and writing a report ($F_{(2,110)} = 2.6, p = .000, = .98$). Students'

Table 1. Demographic characteristics of participants.

Variable	Intervention Mean \pm SD	Control Mean \pm SD	Tests	<i>p</i>
Age (year)	22.93 \pm 0.48	23.52 \pm 0.36	$T = -1.13$	$p = .27$
CGPA	16.19 \pm 1.12	16.32 \pm 1.09	$T = -0.53$	$p = .34$
	<i>N</i> (%)	<i>N</i> (%)		
Marital status				
Married	13 (%23.9)	14 (%26.2)	$\chi^2 = 0.32$	$p = .81$
Single	41 (%76.1)	40 (%73.8)		
Gender				
Female	30 (%55.5)	35 (%64.8)	$\chi^2 = 1.5$	$p = .22$
Male	24 (%44.5)	19 (%35.2)		
Wards				
ICU	24 (%54.3)	23 (%42.5)	$\chi^2 = 0.93$	$p = .72$
Med-Surg	16 (%29.6)	17 (%31.4)		
ED	15 (%26.1)	15 (%26.1)		

Table 2. Independent sample *t*-test.

Procedures	Intervention Mean \pm SD	Control Mean \pm SD	<i>T</i>	<i>p</i>
IV catheterization	109.27 \pm 8.14	84.22 \pm 9.17	-0.16279	<.001
Dressing change	89.34 \pm 9.25	63.12 \pm 9.86	-0.17241	<.001
Suctioning	72.96 \pm 10.11	56.08 \pm 10.92	-0.10811	<.001
Writing a report	129.97 \pm 10.92	100.11 \pm 11.42	-0.37037	<.001
Patients Education	63.27 \pm 6.65	48.17 \pm 8.14	-0.02752	<.001

scores significantly raised through the first stage of DOPS and Mini-CEX to the third stage in the procedures ($p < .001$) (Table 3).

This evidence supports the hypothesis that repeated DOPS and Mini-CEX test affects students' performance. Specifically, the findings suggest that students' performance improved significantly after the third test compared to the first test.

Discussion

The current study investigated the effect of the two workplace-based assessment methods (Mini-CEX and DOPS) on clinical skills of nursing students. Our findings showed that these new assessment methods are more effective in the enhancement of nursing students' clinical skills compared to routine assessment methods. DOPS and Mini-CEX unlike other methods such as OSCE needs an authentic environment and can be conducted in wards or outpatient clinics with no further equipment, infrastructure and resources (Eardley et al., 2013; McGaghie, 2013).

Our results are consistent with previous studies and showed DOPS and Mini-CEX enhance clinical skills and learning strategies of nursing students (Bindal et al., 2011; Hengameh et al., 2015; Profanter & Perathoner, 2015). The meta-analyses by Lörwald et al. (2018) confirmed the positive educational impacts of the Mini-CEX and DOPS on the student performance. Another study showed that using DOPS as an assessment tool improved students' clinical skills and learning (Bagheri et al., 2014). Therefore, it is important to evaluate students' skills

Table 3. Repeated measure (within subject) ANOVA for students' scores on the three stages of DOPS and Mini-CEX.

	Mean	SD	<i>F</i>	sig	Mauchly's sphericity test
DOPS					
Suctioning			1.23	<.001	0.37
1	42.46	4.398			
2	67.36	5.45			
3	88.61	4.65			
Dressing change			2.5	<.001	0.65
1	52.69	3.38			
2	72.49	2.94			
3	93.55	2.46			
IV catheterization			1.3	<.001	0.45
1	67.53	5.15			
2	91.58	4.96			
3	113.36	4.19			
Mini-CEX					
Patient Education			1.2	<.001	0.24
1	40.34	2.36			
2	51.39	2.33			
3	63.57	2.85			
Writing a report			2.6	<.001	0.07
1	83.57	3.06			
2	111.43	3.65			
3	132.64	3.56			

for improving the quality of nursing practices. Despite confirming the positive effects of DOPS and Mini-CEX on students' clinical skills, some recent studies reported increased stress level of the students by using these modern evaluation methods (Amini et al., 2015; Cobb et al., 2013). This stress likely caused by a change in the routine evaluation methods and fear of unknown situations (Pulido-Martos et al., 2012).

Providing feedback to students is another usefulness of the Mini-CEX and DOPS in this study. The comments provided for students are considered as the key instrument in the clinical evaluation. In line with our result, Pernar et al. (2011) believed that valuable and critical comments provided after the Mini-CEX are enriched instruments. Another study showed that verbal feedback facilitates students' performance (Lörwald et al., 2018). Comments provided in the Mini-CEX are more useful when is written, interactive and consider students' reaction (Malik et al., 2011). Nevertheless, there are plenty of barriers for assessors to give a good feedback on students' performance including negative attitude toward reporting, lack of knowledge in documentation, inadequate confidence to judge students' ability, ambiguous remediation process and absence of the culture on giving feedback (Bush et al., 2013; Guerrasio et al., 2014; Pratt et al., 2013). These barriers may overcome using promoting culture of feedback on students' performance during work-based assessment methods (Saedon et al., 2012), designing faculty development interventions to educate assessors how to voice their worries in evaluation practices (Dudek et al., 2013; Dudek & Dojeiji, 2014), seeking support systems to address the mental exhaustion experienced when failing a student (Pratt et al., 2013), educating of assessor in ethical competence to support the standards and ethics of their profession (Black et al., 2014). Our assessors had an orientation class before the study began. They were oriented regarding two evaluation methods and their questions had been answered.

This study showed that repeated DOPS and Mini-CEX led to total improvement of students' skills and performance. Similar to our results, previous studies showed that repeating the new assessment methods effectively facilitate students' skills and enhance their performance (Bari, 2010; Pernar et al., 2011). A study by Weijs et al. (2015) showed that repeated DOPS on performing a procedure gave students the opportunity to track their clinical skill improvement and concentrate on their clinical performance. It is even reported that clinical competence of students can be better evaluated after repeating DOPS for the second time and students' performance was improved in the second stage (Amini et al., 2015).

Conclusions

The results showed that students' scores were significantly different between new assessment methods and the traditional methods. DOPS and Mini-CEX effectively enhanced learning ability in nursing students. Implementation of such assessment methods leads to promoting clinical skills of nursing students which eventually help nurses to provide high quality, fundamental care. Therefore, it is recommended to use workplace-based assessment methods such as DOPS and Mini-CEX for courses that may have a gap between theoretical knowledge and clinical competence. The feedback provided for students in DOPS and Mini-CEX is considered as the key strength of the new assessment methods.

Limitations

One of the limitations of this study was the use of checklists to directly observe and assess students which may adversely affect their performance. In order to control such a limitation, both groups were evaluated using the same checklist.

Impact statement

We reported the result of the study that showed effectiveness of workplace-based assessment methods (DOPS and Mini-CEX) in enhancement of nursing students' clinical skills. Valuable and critical feedback provided after DOPS and Mini-CEX plays an important role in learning clinical skills.

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