

Evaluasi Keterampilan Mahasiswa dalam Meracik Pulveres

Evaluation of Students' Skills in Compounding of Divided Powders

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Submitted: 1-18-2019

Revised: 3-26-2019

Accepted: 3-27-2019

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ABSTRAK

Beberapa obat yang diperlukan pasien anak tidak tersedia secara komersial dalam bentuk sediaan yang sesuai. Bentuk sediaan pulveres yang dihasilkan melalui proses *compounding* dapat menjadi alternatif untuk mengatasi permasalahan tersebut, meskipun permasalahan akurasi dosis masih menjadi isu utama. Tujuan penelitian adalah membandingkan kemampuan mahasiswa sebelum dan setelah mengambil praktikum *compounding* sekaligus melihat akurasi bobot pulveres yang diracik oleh mahasiswa. Desain penelitian merupakan *pre-post study*. Mahasiswa yang mengambil praktikum *compounding* (selama 12 minggu) pada tahun 2017 diminta untuk meracik sebuah resep yang berisi racikan pulveres pada awal dan akhir semester, diberikan penambahan materi dengan video peracikan dan juga *feedback* terhadap hasil *pre-test* mereka sebagai bahan evaluasi. Data ditampilkan dalam bentuk persentase dan perbedaan antara *pre-test* dengan *post-test* diuji dengan uji Wilcoxon. Hasil penelitian menunjukkan bahwa terdapat peningkatan secara signifikan kemampuan mahasiswa dalam perhitungan kebutuhan bahan obat, pemilihan warna etiket, perhitungan *beyond-use date*, melipat pulveres, dan pembuatan salinan resep. Namun demikian, hanya sebagian kecil mahasiswa (15,3%) yang semua pulveres hasil racikannya masuk dalam rentang bobot yang diperbolehkan. Studi ini mendokumentasikan kebutuhan penilaian kualitas produk hasil racikan mahasiswa secara kuantitatif dan menjadikan penilaian tersebut sebagai salah satu parameter penilaian kinerja mahasiswa.

Kata kunci: *compounding*, penilaian mahasiswa, pulveres, keseragaman bobot

ABSTRACT

Several types of medicines for pediatric patients are not commercially available in appropriate dosage forms. While divided powder resulted from compounding process is an alternative to address this problem, the dosage accuracy is still profoundly a major issue. This research was aimed at comparing student's ability prior to and after taking compounding practical work and analyzing weight accuracy of divided powders compounded by students. This research was designed as a pre-post study. Students who were taking compounding practical work (for 12 weeks) in 2017 were asked to fill a prescription contained divided powders in the beginning and the end of the semester, given enriched learning material of compounding technique videos and feedback as evaluation of their pretest results. The data is presented in the form of a percentage, while differences between pretest and post-test are compared utilizing Wilcoxon test. This study suggests that there was a significant increase of students' ability in calculating the amount of each ingredient required to fill the prescription, choice of label color, approximating the beyond-use date, folding the divided powders, and making a copy of the prescription. However, there was a small number of students (15.3%) whose divided powders they have dispensed were in the allowed weight range. This study documents the need for quality assessment of medications prepared by students quantitatively and this assessment serves as a parameter of student performance.

Keywords: *compounding*, student assessment, divided powders, weight uniformity

INTRODUCTION

Compounding is one of the important elements in pharmaceutical practices¹ and is defined as both art and science in tailoring medicines for specific needs

of the patients². This is one of ten competencies that need to be mastered by Indonesian pharmacist candidates³. Therefore, many universities include it as part of their curriculum.

Compounding is addressed more for pediatric patients and is used to adjust to the availability of medications which are not supplied commercially⁴. There are many commercial medications, which are not available for pediatric patients due to its relatively small market. Thus, it gives quite little return on investment for pharmaceutical industry. Moreover, there will be more requirements for doing researches on children than on adults, so it leads to the potential delay in the marketing of certain products⁵. Therefore, compounding is needed to solve the availability of medications, especially for pediatric groups.

The patient-care paradigm requires pharmacists to be responsible for developing the outcome of the patients. According to this paradigm, even the modest compounding needs to have a quality assurance⁶. Considerable attention is given to the medication error that can influence the patients' outcome, and that compounding is one of the potential sources of these problems⁷. One of the most important problems in compounding is an issue of dosage accuracy⁴.

Several types of research have attempted to observe the dosage accuracy problem from compounded medications such as dosage accuracy in the compounding of potassium permanganate solution and caffeine citrated solution⁸, diphenhydramine hydrochloride solution⁹, and calcium carbonate capsule⁷. The quality assurance for calculating the amount of active substance in the compounded products is conducted by using several methods, ranging from a simple method such as scaling the weight of capsules, the use vapor pressure osmometer to the use of a spectrophotometer or expensive method such as using high-performance liquid chromatography (HPLC). Aside from the type of instrument used in quality assurance, a simple, less expensive, and fast analysis method is needed in the educational field. Thus, teachers can evaluate the students' compounding ability during their training⁸.

Dosage forms, mostly made through compounding in several countries, are a dermatological product, oral solution, and oral suspension⁴. In Indonesia, dosage forms that are mostly prepared by compounding are divided powders. There are some advantages of divided powders, some of which are that it can contain several ingredients in a single dosage form; it can be done to adjust the dosage; dosage adjustment can be made easily; it is more stable than the liquid availability; it has been packed for one time-giving; and it is easier to give. On the other hand, the drawback is that it is difficult to eliminate the unpleasant taste¹⁰.

There has not been any research conducted on the quality of the compounded medications in the form of divided powders that are produced by pharmacy students. Therefore, this research attempts to compare the students' ability prior to and after they have taken the compounding practical work as well as to observe the accuracy of the weight of the divided powder dispensed by them.

METHODS

The design of the research was a pre-post study where in the beginning and the end of the semester students were asked to compound the same prescription, which was then compared. Before the pre-test, the students were given information about the study (fully informed) and written informed consent was taken from those students. This informed consent included the information that students can freely to participate or not and information about their decision to participate or not would not affect on their final grade. This study was approved by the Dean and Head of Pharmacist Professional Program.

Student and Course Description

The population was 172 students of Pharmacist Professional Program at one of a state university in Indonesia, especially those in the first semester of 2017/2018 who were

R/ Paracetamol	300 mg
Chlorpheniramine maleate	1,6 mg
mf pulv dtd No V	
s t d d pulv I	

Figure 1. Prescription for Pre-Test and Post-Test (Written in Branded Names)

doing their compounding practical work. According to Raosoft online sample size calculator (<http://www.raosoft.com/samplesize.html>) the sample estimate was at least 120 by using 5% margin of error and 95% confidence interval.

The compounding practical work is the last practical course before students undergo their internship in pharmacies or hospitals and then attend the national examination to get a license as a pharmacist. These practical work course included 12 sessions with 4 hours duration in each session. The first session was to provide an explanation about the whole training activity as well as the rules of it, followed by 9 sessions of dispensing pharmaceutical products based on a prescription and 2 others with service simulation in a pharmacy setting. In this research, students are given additional materials of compounding technique videos in the 9th session. It contained the use of safety equipment, operating a prescription balance, scaling the substances (fluid, solid, semi-solid), compounding method, and packaging. Students were also given feedback on their pretest result as an evaluation object in the 9th week.

Prescription

The prescription given to students during pre-test and post-test was a prescription for 5-year-old children just like what (Figure 1). Students were asked to compound that prescription, starting from prescription screening (administrative, pharmaceutical, and clinical evaluations) including the calculation of each ingredient required to fill the prescription, compounding of 5 divided powders based on the

prescription, and copying the prescription for patients' reimbursement process. As for during pre-test and post-test, the source of ingredients was obtained by crushing commercial generic tablets. This was used to lessen the mistakes due to the scaling factor so it could also be used to see the students' ability to divide the divided powders based on the permitted weight range. Students' skill evaluation can be done by measuring the physical attribute from the compounded product they have made as an example of the parameter is the uniformity of divided powders' weight².

Data Analysis

The data observed from the students included skills in calculating each ingredient needed for the prescription, choosing the right label colors, deciding the beyond-use date (BUD), folding the divided powders, and making a copy of the prescription. The researchers evaluated and assessed the working paper and divided powders of each student using a specific list of assessment criteria.

The problems in the prescription that include the mark of *dtd* (*da tales doses* or give such doses) so the medicine's ingredients written in the prescription should be multiplied by the number of the divided powders supposed to be made (5 divided powders). Since the source of ingredients was obtained from commercial generic tablets, the calculation of the medicine's ingredients needed has to be converted into how many paracetamols and chlorpheniramine maleate tablets needed. This is determined by dividing the medicine's ingredients with the active substance on each tablet. The label color used

Table I. Comparison of Calculation of the Number of Ingredients to be Dispensed, Choice of the Right Label Color, Beyond-Use Date, and a Copy of the Prescription

		Pre-test (n=165)		Post-test (n=164)		Significance Value of Wilcoxon Test
		n	%	n	%	
Calculation of the quantity of each ingredient for the prescription						
Calculation of paracetamol	Correct	148	89.7	157	95.7	0.018*
	False	17	10.3	7	4.3	
Calculation of chlorpheniramine maleate	Correct	152	92.1	156	95.1	0.225
	False	13	7.9	8	4.9	
Choice of label color						
	Correct	160	97.0	164	100.0	0.025*
	False	5	3.0	0	0.0	
Determining BUD						
	Correct	39	23.6	153	93.3	0.000*
	False	126	76.4	11	6.7	
Folding the divided powders						
	Correct	76	46.1	161	98.2	0.000*
	False	89	53.9	3	1.8	
Making a copy of the prescription						
Written based on original prescription	Correct	77	46.7	158	96.3	0.000*
	False	88	53.3	6	3.7	
<i>Det</i> marking	Correct	105	63.6	161	98.2	0.000*
	False	60	36.4	3	1.8	
<i>Da generic</i> marking	Correct	9	5.5	56	34.1	0.000*
	False	156	94.5	108	65.9	

*Significant differences

was white because the divided powders should be given orally¹¹. Since there was not enough information about the stability of the compounded product, BUD of divided powders was decided 6 months at most¹². This BUD needs to be included in the label. The copy of prescription needs to be written according to the original prescription due to the statement of *the pro copie conform* (written based on the original prescription), and a marking *det* (*detur* or already given to the patient). Besides, medicine in its branded name was written in the prescription, while the ingredients of the medicine were available in generic. Therefore, the *da generic* marking should be provided inside the copy of the prescription. In Indonesia, pharmacists are allowed to make a change from branded medicines approved by physician permission and or the patients¹³.

Divided powders made by the student would be weighted by laboratory technician

using a digital scale to know whether its weight was already in accordance with the allowed weight range or 90-110% of the theoretically calculated weight for each unit¹². The data analysis was shown in the form of a percentage while the analysis of the comparison between the pre-test and post-test was done by using the Wilcoxon test. The p-values of 0.05 or less were considered to be statistically significant.

RESULT AND DISCUSSION

The result indicates that there was an increase in students' skill in calculating each medicine's ingredient needed to fill the prescription, choosing the right label color, deciding the beyond-use date (BUD), folding the divided powders, and making a copy of prescription (Table I). All of the increase was significant when compared to the pre-test result ($p < 0.05$), except in one point namely the calculation of chlorpheniramine maleate

Table II. Comparison of Divided Powders Weight During the Pre-Test and Post-Test

	Average					Average (grams)	Standard deviation
	Divided powders 1 (grams)	Divided powders 2 (grams)	Divided powders 3 (grams)	Divided powders 4 (grams)	Divided powders 5 (grams)		
Pre-test	0.427	0.435	0.430	0.423	0.414	0.426	0.008
Post-test	0.415	0.417	0.415	0.412	0.416	0.415	0.002

needed to be dispensed. When the pre-test and post-test were compared, there was a slight increase in the number of students calculating the right amount of chlorpheniramine maleate. However, the increase was still not significant because the baseline in the pre-test was already quite high reaching 95.1%.

There were 825 divided powders during pre-test and 820 divided powders during post-test dispensed by 165 and 164 students respectively. The desired weight of each divided powder that was dispensed by students should be 0.418 g or 418 mg. The comparison of divided powders weight between pre-test and post-test (Table II). The average weight of the divided powders during the pre-test (426 mg) was higher than the desired weight. This is because during the pre-test several students made mistakes in counting, so they took the tablet more than it should be. The average of divided powders during the post-test (415 mg) was closer to the expected divided powders' weight. The standard deviation of divided powders weight during the post-test (2 mg) was less than the deviation standard during the pre-test (8 mg).

The weight variation allowed is 10% of the desired concentration which was in the range of 90-110%^{9,12}. In the prescription, the weight of the divided powder included in the range was between 376 mg to 560 mg. From the whole divided powders made by the students, there was an increase of the number of divided powders which are in the permitted weight, rising from 47.6% during the pre-test to 55.7% during the post-test. In the weight of the divided powder less than 90%, there was a slight increase during the post-test compared to the pre-test. While the number of divided

powders that weight more than 110%, there was a decrease from 27.4% to 18.2% (Figure 2).

In this research, even though the divided powders' weight did not guarantee the uniformity of dosage, the probability of the uniformity of active substance was higher in the divided powders with a more homogenous weight. The research from the divided powders weight and active substance from the pharmacies' compounding shows that all of the divided powders which do not reach the weight uniformity is actually also do not reach the uniformity of medicine's dosage¹⁴. Therefore, weight uniformity can be an alternative to be an objective evaluation parameter of students' compounding skill. Coloring substance in the compounding process can be used as another parameter to reveal the homogeneity of the compounded product.

The analysis was also conducted to the number of students who succeeded in making divided powders within the allowed weight range. Figure 3 shows a decrease in the number of students in which all the five divided powders were not met in the range of allowed weight, falling from 11.6% to 9.8%. In addition, the number of students who were only able to make 1 or 2 divided powders in the allowed weight range was also decreasing. On the contrary, there was an increase in students who are able to make 3 or more divided powders in the allowed weight range. The number of students who were able to make all the five divided powders increased from 5.5% to 15.3%.

This research was carried out on pharmacy students or pharmacist' candidates, not to those of licensed pharmacists.

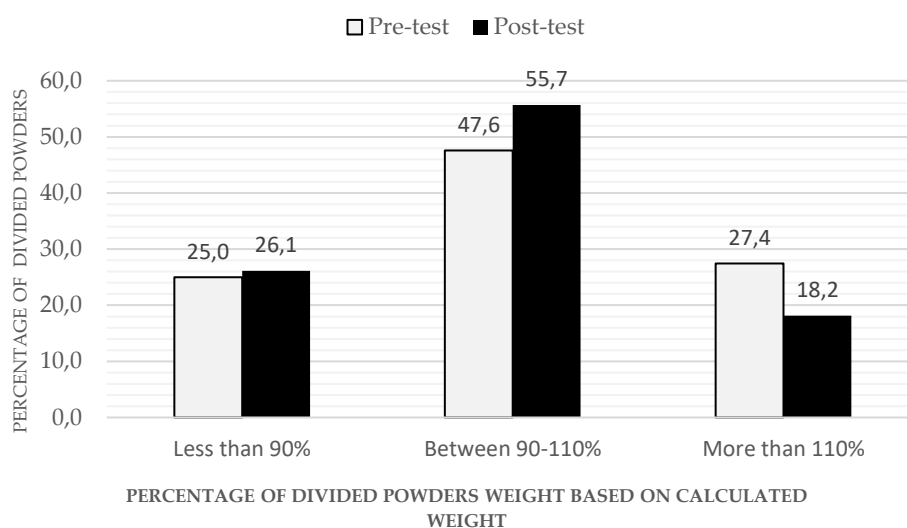


Figure 2. Comparison of the Number of Divided Powders in the Permitted Weight Range

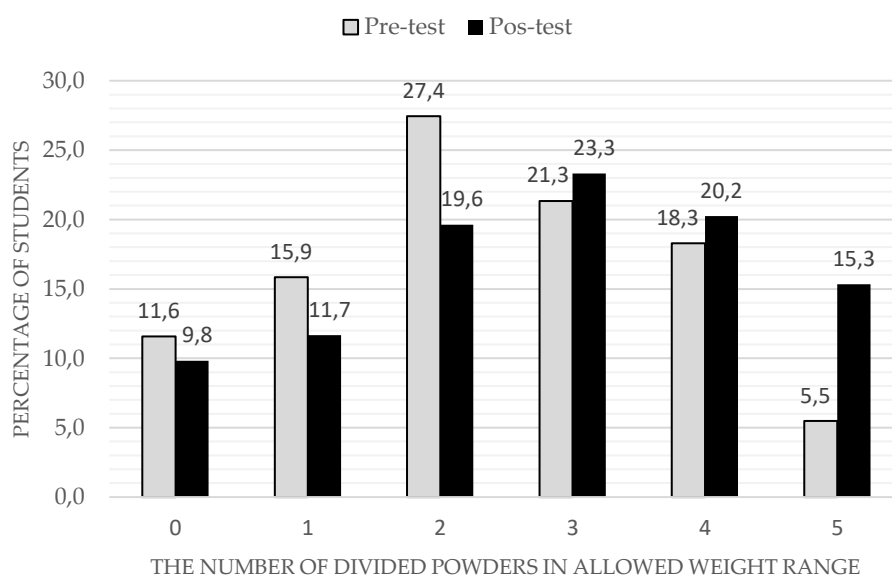


Figure 3. Comparison of the Number of Students Whose Divided Powders in the Permitted Weight Range

Even though students are a lack in experience compared to licensed pharmacists, they are working in a more controlled environment and repeatedly warned and observed for always using the right technique and procedure where it is always overlooked by licensed pharmacists in real practice. Continuous observation and attention have made students, during the training, view as a representative of pharmacists⁹. In this research, there was only 15.3% of students

whose divided powders were categorized in the allowed weight range. A study in Yogyakarta indicates that there was only 40% of pharmacies that made divided powders based on the allowed weight range. However, the number of pharmacies in this study was still limited to only 10 pharmacies¹⁴.

Objective evaluation of the students' skills in compounding needs to be used for calculating competencies. This kind of evaluation takes a long period of time, needs

experienced personnel in product analysis, and high amount of expense as well². A simple, less expensive, and quick analytical method should be developed to evaluate students' compounding skills during the compounding practical work⁸. As an example of cytotoxic drug admixtures scaling, even though the analytical measurement by weighing the IV solution did not verify medication dosage inside an IV solution. This quantitative method, however, could be used to document whether the right technique was used during the compounding process⁸. Scaling the weight is needed because even pharmacists that have already completed their education are still feeling worried due to little evaluation to medicines they made, especially about the dosage and the weight¹⁵.

Pharmacists should have knowledge and accurate skills in compounding. The result suggests that there was an increase in all aspects of evaluation after students undergo practical work. However, students' skills in dividing the divided powders with allowed weight were still lower compared to their skills in other aspects. However, students' skill in these other aspects such as calculating each medicine's ingredient, choosing the right label color, calculating the BUD, folding the divided powders, and making the copy of prescription got higher portion in the students' working evaluation. There were only a few evaluations related to the product quality of the compounded product. This could result in mistakes in the evaluation process because there were more than 90% students who appropriately calculated the medicine's ingredients to be dispensed, chose the label color, calculated the BUD, folded the divided powders, or made the prescription's copy. However, there was only 15.3% of them who were able to make divided powders in the allowed weight range. Integrating the quality decision during the compounding practical work can increase students' comprehension of products' quality from the compounded products. It can also give students a chance to think about the cause of their mistakes and

correct their compounding technique in the future¹⁶.

In this research, the feedback on the products' quality was only carried out for once, and the quality measurement of the divided powders was conducted by the laboratory technician. The feedback related to the products' accuracy from the compound product needs to be given to students in order to provide a view about the quality and how well the target had been reached¹⁷. It is suggested that the analysis of the compounded medication is carried out by the students themselves. Thus, they can get the estimation of active substance dosage while at the same time they would also get feedback for their compounded medication⁸. Evaluation of the products' quality should be done repeatedly, and the feedback given directly will increase the students' learning and make them more competent¹⁸. Students also need to be pushed and to be directed to do a review for the feedback obtained, namely the mistakes they did during the training (reflection) so that they will understand what they need to do to decrease those mistakes¹⁹. Therefore, the evaluation of the students' compound products should be carried out from time to time, and that quality assessment also includes students. Thus, the feedback can be obtained from them soon.

This study has some limitations. First, there is a possibility that some divided powders which reach the weight uniformity are actually do not reach the uniformity of medicine's dosage. Second, weight uniformity is not the only one of quality control of divided powders, there are other parameters such as uniformity of color or particle size that did not measure in this study.

CONCLUSION

This research indicates that there was a significant increase of students' ability in calculating the quantity of each ingredient to be dispensed, choices of label color, approximating the beyond-use date, folding divided powders, and making a copy of the

prescription. However, there was a small number of students (15.3%) whose divided powders they dispensed are in the allowed weight range. Therefore, it is necessary to make changes in the assessment of student ability, especially in practical work. Current assessment without assessing the uniformity of divided powders weight will lead to bias in assessing the students' competency. This study documents and highlights the need for quality assessment of products prepared by students quantitatively and this assessment serves as a parameter of student performance.

ACKNOWLEDGMENT

This research was funded by grants of Pharmacist Professional Program of the Faculty of Pharmacy, Universitas Gadjah Mada in 2017.

DAFTAR PUSTAKA

1. Park HL, Shrewsbury RP. Student Evaluation of Online Pharmaceutical Compounding Videos. *Am J Pharm Educ.* 2016;80(2):1-7.
2. Roark AM, Anksorus HN, Shrewsbury RP. Long-term Results of an Analytical Assessment of Student Compounded Preparations. *Am J Pharm Educ.* 2014;78(9):1-6.
3. Indonesian Pharmacist Association. *Indonesian Pharmacist Competency Standards.* Jakarta: IAI; 2016.
4. Kristina SA, Wiedyaningsih C, Widyakusuma NN, Aditama H. Extemporaneous Compounding Practice By Pharmacists: a Systematic Review. *Int J Pharm Pharm Sci.* 2017;9(2):42-46.
5. Nahata MC, Allen L V. Extemporaneous Drug Formulations. *Clin Ther.* 2008;30(11):2112-2119.
6. Kolling WM, Mcpherson TB. Assessment of the Accuracy of Pharmacy Students' Compounded Solutions Using Vapor Pressure Osmometry. *Am J Pharm Educ.* 2013;77(3):1-5.
7. Capehart KD. A Laboratory Exercise in Capsule Making. *Am J Pharm Educ.* 2008;72(5).
8. Kadi A, Francioni-Proffitt D, Hindle M, Soine W. Evaluation of Basic Compounding Skills of Pharmacy Students. *Am J Pharm Pharm Educ.* 2005;69(4):508-515.
9. Shrewsbury RP, Deloatch KH. Accuracy in Prescriptions Compounded by Pharmacy Students. *Int J Pharm Compd.* 1998;2(2):139-142.
10. Marriot JF, Wilson KA, Langley CA, Belcher D. *Pharmaceutical Compounding and Dispensing.* Second Edi. London: Pharmaceutical Press; 2010.
11. Ministry of Health Decree. *Ministry of Health Decree No 73 Year 2016 on Standards of Pharmaceutical Services in Pharmacy.* Jakarta; 2016.
12. U.S.Pharmacopeial Convention. *Pharmaceutical Compounding - Nonsterile Preparations. USPharmacopeia.* 2014:356-360. [http://www.usp.org/usp-nf/official-text/revision-bulletins/pharmaceutical-compounding-nonsterile-preparations.](http://www.usp.org/usp-nf/official-text/revision-bulletins/pharmaceutical-compounding-nonsterile-preparations)
13. Government Regulation. *Government Regulation No 51 Year 2009 on Pharmaceutical Works.* Jakarta: Pemerintah Republik Indonesia; 2009.
14. Sugianto L, Yetti O, Handayani S. Uji Keseragaman Bobot dan Keseragaman Kadar Sediaan Pulveres yang Dibuat Apotek. *J Heal Sci.* 2008;3(6):1-5.
15. Wiedyaningsih C, Kristina SA, Widyakusuma NN, Aditama H. Opinion and Expectation of Pharmacists on Providing Extemporaneous Compounding in Jogjakarta and Central Java Provinces, Indonesia. *Int J Pharm Pharm Sci.* 2017;9(7):79-82. doi:10.22159/ijpps.2017v9i7.18358
16. Pignato A, Candidate P, Birnie CR. Analysis of Compounded Pharmaceutical Products to Teach the Importance of Quality in an Applied Pharmaceutics Laboratory Course. *Am J Pharm Educ.* 2014;78(3):1-10.

17. McGill JE, Holly DR. Integration of Pharmacy Practice and Pharmaceutical Analysis: Quality Assessment of Laboratory Performance. *Am J Pharm Educ.* 1996;60:370-374.
18. Begley K, Monaghan MS, Qi Y. Repeated Testing to Improve Skills in a Pharmacy Practice Laboratory Course. *Am J Pharm Educ.* 2013;77(6).
19. Morecroft CW. Engaging in Reflection: Error Logs and The Developing Students' Skills. *Pharm Educ.* 2011;11(1):172-176.