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ORIGINAL ARTICLE

COMPARING SPACED AND MASSED PRACTICES AT DIFFERENT STAGES OF LEARNING ASSESSMENT

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ABSTRACT

Background: In spaced practice, learning is assisted by several time intervals between short learning sessions. In massed practice, the process of learning is assisted by using a few intervals between longer sessions. This study aims to explore two opposite learning strategies that are spaced and massed practice in regard of effectiveness and satisfaction levels.

Materials & Methods: A quantitative research methodology was utilized to compare two faculty development programs that used spaced and massed learning methodologies at different phases of learning. Sixteen faculty members were enlisted from King Abdul-Aziz University's (KAU) Faculty of Medicine in Jeddah. The assessment of spaced and massed practices among faculty members was determined through primary and secondary outcome evaluation. Statistical Package for the Social Sciences (SPSS) (version 23.0) was used to analyze the numerical data. A comparison of the satisfaction levels of students involved in the modules supervised by the faculty members of both groups, along with their success rate (based on the annual course reports) was tested using a paired samples t-test. A chi-squared test was employed to identify relationships between other categorical variables in the report.

Results: Massed practices and spaced practices were applied on two groups to compare their learning effectiveness. Most faculty members from both groups were judged to be able to use their skills in real-world situations. However, student satisfaction was better in massed practices than in spaced practices, despite the higher success rate for students taught utilizing the spaced type technique. Although differences in other areas were not statistically significant, the massed group exhibited a statistically significant increased use of assessment blueprint and constructed the blueprint according to evidence-based recommendations than the spacing group. However, in terms of successful course results, massed practices were more beneficial than spaced practices.

Conclusion: As both learning strategies can provide positive outcomes in particular learning environments, Therefore, suitable learning strategy selection is based on the developed scenarios and context.

KEY WORDS: Spaced Learning; Satisfaction; Learning assessment; Massed Learning.

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INTRODUCTION

To achieve the highest learning outcomes, an institutional faculty must integrate different programs, facilities, and equipment.[1] The development of these programs is especially important for medical practitioners, owing to the stable influx of junior faculty members and increasing the number of academic institutions around the world.[2] However, the faculty members' ability to transfer theoretical knowledge realistic teaching is the measuring criteria of the effectiveness of the faculty development programs. For instance, two significant indicators of the competence of a faculty development program are the scheduling of practice sessions and efficient use of session time. These indicators require to building a balance between productivity and efficiency for optimum outcomes.[3] The attainment of

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technical skills, reduce error rate, and enhancement in thinking patterns are some of the main factors in the selection of suitable learning strategy and are frequently assessed in several evaluations.[4]

The two learning strategies spaced and massed practices are commonly compared. Where in spaced practice learning is aided by various time intervals between short sessions whereas, in massed practice, the learning is aided by less or no time intervals in between longer learning sessions. Spaced learning entails a number of educational encounters committed to the same subject, separated by an inter-study interval, with a learning outcome after a retention interval.[5] Several learning benefits can be achieved through these different instructional techniques as noted by Dunlosky et al.[6] The potential for the massed strategy to provide better results in delayed retention assessments has been frequently emphasized.[7] Grote proposed that spaced practices promote better results when applied in educational contexts; the use of spaced practices in the classroom could enable program managers to design more effective curricula and policies.[8] Spaced practices are particularly helpful in memorization tests, although their efficacy for complex learning activities is questionable.[3] Spaced practices are sometimes considered successful in optimizing students' learning outcomes and skills for various problem-solving activities.[9]

For Seabrooket al. spaced learning enables maximum retention abilities.[10] Moreover, the number of intervals and repetition of concepts in space practices can promote good retention of ideas. Spaced learning has been found to be effective for learners of all ages when introduced to complex information in a realistic educational context.[11] Indeed, spaced learning shows generally favorable results in the long-term retention and acquisition of new skills. However, Hopkins et al. found that short-time lags improved massed learning knowledge acquisition in children, which deviates from adult learning where maximum benefits are obtained following longer intervals.[12]

The use of sophisticated equipment and resources in a medical educational institution is required in order to be consistent with medical practice. Therefore, teaching and assessment require substantial economic resources. It looked that massed distribution of information is important at several levels of educational development, particularly where complex and detailed high-level knowledge is necessary for a particular area. There is a paucity of research providing an important appraisal and a balanced assessment of massed and spaced practices to help to learn, and accordingly few in-depth studies that viewed the disadvantages and advantages of the strategies applied by medical teaching faculty. Therefore, the present study explores both mass and space practices use at various stages of learning, and two faculty development programs are compared that use these to enhance the assessment skills of the faculty members.

MATERIALS AND METHODS

A descriptive cross sectional study was conducted at the Medical Education Department at the Faculty of Medicine, in King Abdul-Aziz University (KAU), in Jeddah Saudi Arabia, to evaluate the output of the two programs, comprising spaced or massed learning strategies, at two different levels of appraisal. For the first level, predictions were made by faculty members to determine the best learning strategy for either faculty development program. The second level measured the outcome of the programs and their impact on student performance using various parameters incorporated into the programs. The duration of the study was up to one year.

The study sample constituted faculty members that used both spaced and massed strategies in their respective groups. A total of 35 faculty members were selected through probability sampling that is based on the principle of random selection or chance. The sample size was determined using the "Rao Soft" calculator, with confidence interval of 95%. All members who fulfilled the inclusion criteria were enrolled into the study. Faculty members that had previously attended any form of medical education workshops or activities were excluded.

The assessment of the proper implementation of spaced and massed practices among faculty members was determined through primary and secondary outcome evaluation. The primary outcome included an assessment of the "global rating scale - GRS" score to evaluate the participant's procedural skills and the secondary outcome included observation of Cardiopulmonary Resuscitation (CPR) quantitative metrics in form of multiple-choice questions and visual analogs. Statistical Package for the Social Sciences (SPSS) (version 23.0) was used to analyze the numerical data. A comparison of the satisfaction levels of students involved in the modules supervised by the faculty members of both groups along with their success rate (based on the annual course reports) was tested using a paired samples *t*-test. A chi-squared test was employed to identify possible relationships between other different categorical variables in the report.

RESULTS

There were total 35 participants in this study, majority were from 39 to 43 years of age. Table 1 presents the demographic information of the faculty member participants.

Table 2 presents a statistical analysis of the compari-

son between spaced and massed groups regarding the performance on different parts of the assessment cycle taught in the workshops. Most of the faculty members of the spaced group (62.5%) did not use assessment blueprints, whereas 87.5% of the faculty members in the massed group used assessment blueprints.

Around 62.5% of the faculty members in the spaced group and 87.5% of faculty members in the massed group performed a structured planned formative assessment. However, constructive feedback was given by 75% of faculty members in the spaced group and 62.5% of faculty members in the massed group. The item analysis was utilized by all faculty

Table 1: Participant demographics

Variables		Frequency	Spaced group (n=17)	Massed group (n=18)
Gender	Male	17	10	7
	Female	18	7	11
Age	30 to 34 years	3	2	1
	35 to 39 years	8	4	4
	39 to 43 years	15	8	7
	Above 43 years	9	3	6
Year of Experience	Less than two years	7	4	3
	Between two to six years	12	6	6
	Six to ten years	12	5	7
	Above 10 years	4	2	2
Students Taught in the modules	Less than 150 students	2	1	1
	150 to 250 students	9	3	6
	260 to 360 students	17	8	9
	More than 360 students	7	2	5

Table 2: Chi-squared test on a comparison between the spaced and massed groups in different parts of the assessment cycle in their modules

		Spaced group		Massed group		*P* value
Measure	Items	Number of modules	Percentage	Frequency	Percentage	
Used assessment blueprint	Yes	3	37.5	7	87.5	0.059
	No	5	62.5	1	12.5	
Blueprint was structured according to evidence-based recommendation	Yes	2	25	6	75	0.066
	No	6	75	2	25	
Presence of flaws in the sample of exam items	No flaws	3	37.5	3	37.5	0.435
	Few flaws	2	25	4	50	
	Lots of flaws	3	37.5	1	12.5	
Structured planned formative assessment was performed	Not done	3	37.5	1	12.5	0.285
	Done	5	62.5	7	87.5	
Constructive feedback was given	Not done	2	25	3	37.5	0.500
	Done	6	75	5	62.5	
Item analysis was performed	Yes	5	62.5	8	100	.100
	No	3	37.5	0	0	
Appropriate responses to the item analysis were done	Yes	3	37.5	6	75	0.157
	No	5	62.5	2	25	

Table 3: Comparison of student success rate and satisfaction levels in the modules that were supervised by faculty members of (1) spaced group; (2) massed group

Module No.	Success Rates(%)		Level of Satisfaction	
	Spaced group (n=17)	Massed group (n=18)	Spaced group (n=17)	Massed group (n=18)
1	99	96	4.3	4.5
2	99	91	4.2	4.2
3	96	99	3.6	3.9
4	97	94	4.1	4.3
5	94	98	4	4.0
6	99	97	3.5	3.8
7	99	95	3.4	4.0
8	95	99	3	3.7

Table 4: Paired samples t-test comparing the students success rate of the modules that were supervised using spaced and massed strategies

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% CI of the Difference				
				Lower	Upper			
Spaced group Success Rate/Massed group Success Rate	97.25%/96.12%	4.357	1.540	-2.517	4.767	.730	7	.489

Table 5: Paired samples *t*-test on the level of student satisfaction of the modules supervised by the spaced and massed groups

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% CI of the Difference				
				Lower	Upper			
Spaced group Level of Satisfaction /Massed group Level of Satisfaction	3.76/4.05	.4307386	.1522891	-.5226065	.1976065	-1.067	7	.321

members in the massed group, whereas it was used by 62.5% of faculty members in the spaced group. Table 2 shows appropriate responses to the item analysis were performed by 75% of the faculty members of the massed group and by only 37.5% of the spaced group. The massed group utilized statistically insignificantly more measuring tools than the spaced group, according to a chi-squared test, however, the criteria 'used assessment blueprint' and 'blueprint was constructed according to evidence-based advice' nearly reached statistical significance.

Table 3 provides a comparison of student success rate and student satisfaction in the modules supervised by faculty members of the spaced and massed group. The student success rate for the spaced group was marginally higher than in the massed group; the mean success rate of the spaced and massed groups was 97.25% and 96.12%, respectively, as shown in Table 4. However, the level of student satisfaction in the modules supervised by faculty members of the massed group was moderately higher than that of students supervised by faculty members in the spaced group. Tables 4 and 5 show the results of a *t*-test analyzing the mean difference between the paired observations. The results show an insignificant difference in success rates ($P = 0.489$) and levels of satisfaction ($P = 0.321$) between both groups. However, the mean levels of satisfaction in the spaced and massed groups were 3.76 and 4.05, respectively.

DISCUSSION

Both massed and spaced learning practices have been found to be significant for creating positive outcomes, reflecting the findings of several medical education studies. Spaced learning has been observed to be particularly useful to enhance a learner's ability

to retain and recall useful knowledge as required.[13] Patac and Patac found that spaced practices enhance motor skills, while having a greater impact on simple skills.[14] However, mass practices are perhaps more effective in addressing complex concepts for classroom discussion and learning.[15] The present study has highlighted the importance of massed and spaced practices at various stages of the acquisition of evaluation skills by faculty staff. However, the mass group in this study demonstrated greater coherence with most parts of the assessment cycle. For instance, the results show that the assessment blueprint was commonly used in massed learning practice (87.5%) and uncommonly used in spaced learning practice (37.5%), although these and other assessment skills were not found to be statistically significant.

An important discovery was the number of flaws found in writing exam items. For example, flaws were observed in exam sets created by both groups, but were particularly common in the spaced group: 12.5% of flaws were found in the massed group and 37.5% of flaws were found in the spaced group. The existence of flaws in exam items indicates a failure of faculty members to develop well-structured exam questions that incorporated knowledge learned in the workshops and with hands-on training. However, these findings contradict the results of Metcalfe and Xu,[16] where the spaced practice was more beneficial in increasing student focus on their studies and reducing the possibility of flaws.

Metcalfe and Xu also studied the idea of lack of attention and mind wandering in spaced and massed practices.[16] They found that massed practices are effective when constant learning is required, i.e., an uninterrupted study leads to the development of complex concepts.[17] However, some studies find that students cease to acquire useful information once they realize that they have sufficient knowledge about a subject at a certain time.[18] This suggests the idea that mass practice can reduce the learner's ability to acquire useful information when they are saturated with a particular knowledge or skill. Moreover, the learning ceases most clearly once the learner engages in mind wandering.[11] This may not have occurred in the current study, however, because each session was created to fulfill the objectives of the designed modules, and broadly succeeded in not reaching levels of saturation. In massed learning, particularly, people can switch their interests towards internal learning rather than learning from the external environment,[15] which can lead to greater concentration on the given educational media. McIntyre and Munson[19] suggest that massed practices use skillful resource planning, which may explain the effectiveness of the massed workshops compared to spaced workshops in the present study.

Students taught by the faculty of the massed group demonstrated better satisfaction levels, perhaps owing to the maintenance of a full assessment cycle. Also, a higher quality of exams in the massed group may explain the decrease in the success rate, because these exams were more effective and may reflect the true level of students since many validity and reliability measurements were used in the massed learning program.

The study has shown a limited use of structured formative assessment (which allowed teachers to evaluate the student's level of understanding through regular feedback) in massed practice compared to spaced practice. This difference could be explained by the lack of time to introduce this tool because of the tight schedules of modules in the mass group, where workshops were conducted in close proximity near the end of the academic year. These findings follow Kang et al.[3] and Yeh and Park,[20] which demonstrate the effectiveness of constructive feedback in spaced practices. In contrast with the findings of the current study, Pugh and Regehr[21] indicated that the efficacy of spaced practice was higher than massed practice. The effectiveness of spaced practices is also emphasized in Dunn et al.[22] and Grohmann and Kauffeld,[23] and Toppino and Cohen[24] reveal that spaced practice results in higher retention levels in comparison with massed practice.

The findings of the present study have indicated that massed group was better than the spaced group that was offered with spaced practices. On the contrary, still spaced technique has its superiority even if there had a better result for massed strategy. A study conducted by Karpicke and Roediger indicated that the efficacy of spaced techniques elevates progressively and encourages lasting retention. In addition, the dominance of this technique is considered to be widespread.[25] However, the findings of the present study have explained that massed strategy can be utilized in particular conditions as the students were taught the holistic approach of the assessment cycle that facilitates the faculty member for applying all aspects of the assessment cycle mutually. The skills retention taught was effective among the faculty members of the massed group as they exit the workshops with complete knowledge that facilitates them for applying the teachings in real-life practice rapidly.

RECOMMENDATIONS AND SUGGESTIONS

While this study recommends massed practices more frequently, this must be according to the learner's needs. We suggest that massed practices can be more commonly used because of their time efficiency.

This study was limited because of the presence of other faculty members who with experience in medical education and the small sample size. The participant's flow through the treatment program at all stages was not recorded. The study design is

based on retrospective aspects; therefore, additional prospective studies must be conducted in this regard. The study used a random sampling technique for selecting the faculty members. In-depth analysis can be obtained with the adoption of a purposive sampling technique when planning to perform semi-structured interviews.

CONCLUSION

The results of the current study show better outcomes using the massed strategy compared to the spaced strategy. This indicates that it is mainly the complexity of the subject, along with the capabilities of the learners that are the important factors in choosing the learning strategy required, along with other factors such as being economically beneficial and time efficient.

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CONFLICT OF INTEREST
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	RA, OH
Acquisition, Analysis or Interpretation of Data:	RA, OH, RJ, YSP, AT
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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.