

## TO EVALUATE THE RELATIONSHIP BETWEEN FORMATIVE AND SUMMATIVE ASSESSMENT OUTCOMES VIA POST-VALIDATION IN MEDICAL UNDERGRADUATE STUDENTS

Mohan Murugesan<sup>1</sup>, P. Leo David<sup>2</sup>, V. Brijin Mary<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Pathology, Kanyakumari Government Medical College, Tamil Nadu, India

<sup>2</sup>Professor, Department of Pathology, Kanyakumari Government Medical College, Tamil Nadu, India

<sup>3</sup>Assistant Professor, Department of Pathology, Kanyakumari Government Medical College, Tamil Nadu, India

Received : 10/10/2023  
Received in revised form : 25/11/2023  
Accepted : 16/01/2024

**Keywords:**

Formative, Summative, Post-validation, Medical undergraduate.

Corresponding Author:

**Dr. Leo David.P,**

Email: drmohanmurugesan@gmail.com

DOI: 10.47009/jamp.2024.6.1.110

Source of Support: Nil,

Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2024; 6 (1); 554-560

### Abstract

**Background:** Assessments are conducted to aid students in their learning process and to appraise their knowledge and understanding at a certain moment in time. They serve as the foundation for both formative and summative evaluation. Formative assessment facilitates the process of learning and is hence referred to as 'Assessment for Learning'. It encompasses actions aimed at evaluating the current state of students' learning and using the available knowledge to decide the necessary steps for improvement, both for students and their instructors. Summative assessment is used to assess the knowledge acquired at a certain point in time, therefore referred to as 'Assessment of Learning'. The aim is to evaluate the relationship between formative and summative assessment outcomes via post-validation in Indian Medical Graduates (IMG) after Competency Based Medical Education (CBME) Curriculum implementation by National Medical Commission (NMC). **Materials and Methods:** This research was conducted at the Department of Pathology, Kanyakumari Government Medical College, Tamilnadu. The study had a total of 350 students. The study population consisted of second-year medical undergraduates admitted after implementation of CBME Curriculum with 2020 Batch students, referred to as the A batch, and students admitted in 2019, referred to as the B batch. The study period of one year in the second year of the MBBS course for both A and B batches included various activities like their previous batches such as symposiums, home assignments, gross assignments, histopathology/cytology projects, day-to-day assessments, routine record work and internal assessment exams, both theoretical and practical. In addition extra interventions like Small Group Discussions (SGD), Self Determined Learning (SDL), Attitude Ethics and Communication (AETCOM) Learning, Case Based Learning (CBL) and Integrated Sessions were also conducted. The effectiveness of formative assessment, together with extra intervention, in altering the outcomes of summative assessment was evaluated. The summative evaluation marks of A batch and B batch were compared to those of the previous year students, referred to as C batch, who took the University test in 2021, the 2018 Batch admitted before CBME Curriculum implementation without any extra interventions. **Result:** The mean marks for the internal evaluation of A batch and B batch, with extra intervention, were  $75.09 \pm 1.22$  and  $71.17 \pm 1.34$  (out of 100) respectively. In contrast, the mean values for C batch, without extra intervention, were  $66.11 \pm 1.05$  (calculated to 100 marks). The mean university exam scores (out of 300) for batch A ( $212.11 \pm 5.28$ ) and batch B ( $204.11 \pm 5.25$ ) were higher compared to the scores of the previous year students ( $190.08 \pm 4.98$  calculated to 300 marks), and this difference was statistically significant ( $p < 0.001$ ). **Conclusion:** Formative and summative examinations are essential components of any educational system since they inform administrative choices about ability grouping, selection, and certification. The significance of formative assessment resides in the empirical evidence of its efficacy in enhancing the outcomes of summative assessment, as perceived by students, which varies across different cohorts.



## INTRODUCTION

Medical education has achieved significant advancements in teaching and learning activities. Curricula, instructors, and assessment methods are always evolving and being enhanced to address forthcoming difficulties. These modifications are implemented to enhance the proficiency of all medical practitioners in order to provide excellent healthcare services.<sup>[1]</sup> The process of assessment is a key factor in driving and influencing the learning process. This concise and well recognised phrase clearly asserts the existence of a correlation between evaluation and learning.<sup>[2]</sup> Evaluation may impact both the quantity and the quality of the study, as well as the distribution of students' endeavours. While there may be debates about the timing and mechanisms via which assessment impacts occur, there is no doubt about the presence of this link. The educational influence of tests on students' learning, also known as the testing effect, consequential validity, test-enhanced learning, backwash, washback, and testing phenomena, is a crucial aspect of the effectiveness of an assessment system. The impact of the testing effect on learning, while intended to be beneficial, is not always guaranteed. For instance, receiving a poor result on a test might demotivate a student.<sup>[3,4]</sup>

Examinations have historically been used only for evaluating students' knowledge and abilities, despite their longstanding role in education. The primary objective of this evaluation was often justified by the Colleges' social responsibility to guarantee the competence of its graduates. Furthermore, exams have been proposed as a potential driving force for students' motivation to study. Empirical investigations have shown evidence supporting this claim.<sup>[5-8]</sup> Many experts argue that in recent decades, the primary objective of evaluation should be to optimise students' proficiency and provide guidance for their future learning.<sup>[6-9]</sup> The transition from the traditional approach of evaluating learning outcomes to the contemporary approach of evaluating learning processes, known as the paradigm shift from 'assessment of learning' to 'assessment for learning', is increasingly gaining favour. Multiple research have shown that the impact of examinations on students' performance is more significant compared to instructional techniques. One such example is the study conducted by Raupach et al.<sup>[7]</sup> This change in paradigm highlights the need for a more profound understanding of the interaction between evaluation and learning. Without a profound understanding of these connections, it is impossible to create an effective evaluation system that really promotes learning.

A preliminary investigation of the available literature uncovered several research and review articles that examine the impact of evaluation on learning. Several research have focused on investigating the impact of formative assessment

and feedback on learning, while others have assessed the influence of summative assessments on learning.<sup>[10,11]</sup> Several research have investigated the correlation between overall evaluation variables and students' learning approaches.<sup>[12]</sup> Formative assessment is a non-formal evaluation conducted periodically over the course of education, serving as an essential component of the learning process. Summative evaluation is used to appraise the knowledge acquired at a certain moment, so referred to as 'evaluation of Learning'. It encompasses tasks such as assessing long-term learning progress and determining it via testing at a certain moment. It is a formal procedure that assesses the effectiveness, comprehension, and overall achievement of the learners upon completion of a course. The data obtained from assessments may be used to compare the aggregated outcomes of various groups or populations. This research aimed to analyse the effectiveness of formative assessment, along with supplementary assessment techniques as instructed in CBME Curriculum by NMC, in influencing the outcomes of summative assessment. The results of the study population were compared to those of the previous year's cohort of students before implementation of CBME Curriculum in 2019. Subsequently, the qualitative evaluation of students' perception of formative assessment was conducted.<sup>[13,14]</sup>

## MATERIALS AND METHODS

This research was conducted at the Department of Pathology, Kanyakumari Government Medical College. The study had a total of 350 students. The study population consisted of second-year medical undergraduates admitted in 2020, referred to as the A batch, and students admitted in 2019, referred to as the B batch. The study period of one year in the second year of the MBBS course for both A and B batches included various activities such as symposiums, home assignments, gross assignments, histopathology/cytology projects, day-to-day assessments, routine record work and internal assessment exams, both theoretical and practical. Additionally Small Group Discussions, Self Determined Learning, Attitude Ethics and Communication Learning, Case Based Learning and Integrated Sessions were also conducted. The effectiveness of formative assessment together with extra intervention, in altering the outcomes of summative assessment was evaluated. The summative evaluation marks of A batch and B batch were compared to those of the previous year students, referred to as C batch, who took the University test in 2021, without any further interventions before CBME Curriculum implementation.

**Statistical Analysis:** The data were analysed using SPSS software, specifically version 25.0, developed by SPSS Inc. in Chicago, USA. The descriptive

statistics were presented in terms of frequency and percentages. The Pearson correlation coefficient and its statistical significance were computed to determine the relationship between formative assessment marks and summative assessment marks. The significance of the study population assessment result was compared to that of C batch utilising Unpaired t-tests. The investigators created a well-organized questionnaire to gather students' opinions on an additional formative assessment method. The questionnaire was administered to students at the end of the course, before the university exam, after the university exam, and after the release of exam results. The data collected from both batches was then qualitatively validated.

## RESULTS

The research had a total of 350 students, including 150 students from batch A, 100 students from batch B, and 100 students from batch C. The Pearson's correlation coefficient between the marks of formative assessment with further interventions, and the university grades for Batch A and Batch B were 0.71 and 0.67 respectively. The p-value for both batches was less than 0.001.

The mean marks for the internal evaluation of A batch and B batch, with extra intervention, were  $75.09 \pm 1.22$  and  $71.17 \pm 1.34$  (out of 100 points) respectively. In contrast, the mean values for C batch, without intervention, were  $66.11 \pm 1.05$  (calculated to 100 marks). The mean university exam scores (out of 300) for batch A ( $212.11 \pm 5.28$ ) and batch B ( $204.11 \pm 5.25$ ) were higher compared to the scores of the previous year students ( $190.08 \pm 4.98$  calculated to 300), and this difference was statistically significant ( $p < 0.001$ ), as seen in [Table 1, 2].

Formative assessment feedback was collected from students in both A batch and B batch. The feedback was then verified, as shown in Table 3 and Table 4 correspondingly. This validation process took place at the conclusion of the course, before the university test, after the university exam, and after the release of the university exam results. The completion percentage of the feedback questionnaire among students varied, with response rates ranging from 84% to 100%. [Table 3]

The majority of respondents from Batch A, expressed that the small group discussions facilitated their critical thinking and academic studies (60%), while a significant number said that it helped them overcome their fear of public speaking (30%) based on the feedback received for the pre-university exams. Several individuals found it beneficial for test preparation and enhancing confidence in viva voce during post-university exam feedback. Approximately 20% to 24% of students expressed uncertainty regarding the efficacy of SGD in feedback provided after post-university exams and test outcomes. This hesitation may stem from

their belief that small group discussions primarily serve to alleviate social anxiety. According to post-exam results comments, 80% of respondents said that it facilitated a deeper comprehension of the subject matter for the university exams. A majority of the students (74%) admitted to engaging in the act of duplicating self determined learning topics during the study session. Among them, 40% resorted to copying from textbooks, while 34% copied from their peers. Only 24% of the respondents said that they used literature and gained information based on the comments received during the pre-university test. During the post-university examination feedback, over half of the batch (50%) expressed that SDL topics were beneficial. This may be attributed to the fact that some students who had copied from textbooks realised that it actually facilitated their learning. Additionally, a majority of students believed that self determined learning topics aided in revision and recall during exams. However, 20% of the students were uncertain about the value of SDL. Approximately 30% of individuals expressed the belief that it was not beneficial, a figure that aligns with the proportion of pupils who engaged in the act of copying from their peers (34%). Even in the comments received after the test results, 26% of the respondents had the same viewpoint.

In relation to Attitude Ethics and Communication Learning, 48% of the students said that they completed them just to get internal marks, while 40% believed that it aided in their personal grooming with regard to responsibilities and work ethics as stated in the feedback for the pre-university exams. According to post-university examination feedback, 76% of respondents found it beneficial and useful. This may be attributed to the fact that some students approached the task genuinely, using clarity, logical reasoning, scientific methods, and originality, even if it was primarily for the sake of obtaining internal scores. 30% of students were unaware of the significance of AETCOM Learning in feedback provided after post-exam results, perhaps because to a lack of understanding of its value and a tendency to regard it only as a task to be completed. Approximately 62% of the students in the pre-university test provided comments stating that case based learning aided in their comprehension and correlation of lab test results with clinical symptoms to come up with final diagnosis among the list of differential diagnosis. On the other hand, 32% of the students said that they completed these projects just to get internal marks. Merely doing the project work with the sole intention of earning marks, without understanding the practical application of case-based studies, has resulted in 34% and 20% of individuals lacking knowledge of its relevance in post-university examinations and post test results comments, respectively. This might be attributed, at least in part, to the lack of active engagement from the students throughout the offered exercises, as well as

the insufficient emphasis placed by the faculties on the practical aspects of the case-based studies for all students. A significant proportion of students, around 60% - 70%, said that they highly appreciated integrated sessions as it motivated them to actively engage in the learning process and comprehend the subject matter consolidated and unified. Between 20% and 34% of pupils shown apathy and lacked awareness of its significance, perhaps attributable to both student attitudes and instructors' failure to cultivate interest among all students. [Table 4]

Only 50% of the class of Batch B, said that the small group discussions aided their thinking and studying, while 22% specifically mentioned that it helped them overcome social anxiety in their feedback for the pre-university exams. The majority (66%) of respondents said that using this tool was beneficial for test preparation and increased their confidence during viva voce exams, as shown by post-university examination comments. This may be attributed to the fact that some students who first believed it just helped them overcome anxiety eventually discovered that it also aided in the learning process. 10% of students expressed uncertainty over the efficacy of SGD in relation to their examinations, maybe due to their view that it primarily addresses social anxiety. According to post-exam results comments, 60% of respondents said that these sessions helped them get a deeper grasp of the topic. Approximately 26% of students maintained their belief that the SGD was not beneficial for test preparation. This may be attributed, in part, to students who were not adequately preparing for examinations on daily basis. A majority of the cohort (56%) admitted to plagiarising self determined learning tasks assigned to them throughout the study time, with 26% of pupils copying from textbooks and 30% copying from their peers. Only 30% of the respondents said that they used recommended books and gained knowledge based on the feedback received from the pre-university test. According to the post-university examination response, 52% of the batch found the SDL to be beneficial. This might be attributed to the fact that some students who copied from textbooks realised that it really helped them study. Additionally, the majority of students said that the self determined learning process aided in revision and recollection during tests. However, 12% of the students were uncertain about the worth of the SDL exercises. Approximately 34% of individuals said

that they found it to be of little value, which aligns with the proportion of pupils who engaged in the act of copying from their peers (30%). Even in the comments received after the test results, 34% of them had the same perspective. In relation to Attitude Ethics and Communication Learning, 64% of the students said that they completed them just to get internal marks, while only 30% believed that they aided in comprehending and personal grooming with regard to responsibilities and work ethics, as per the comments received for the pre-university test. Majority of students (78%) commented in post-university test feedback that AETCOM Learning to be beneficial and valuable. This may be attributed to the fact that some students approached the learning sessions with sincerity, clarity, logical reasoning, and a scientific mindset, including creativity. It is possible that even those who first saw it as a means to get internal marks subsequently recognised its worth. 14% of students were unaware of the significance of AETCOM Learning in feedback provided after post-exam results, maybe because to a lack of understanding of its value and strategy, only doing it for the purpose of finishing it. In the pre-university test comments, 70% of the students said that case based learning aided their comprehension and correlation of lab test results with clinical symptoms to come up with final diagnosis among the list of differential diagnosis. Additionally, 26% of the students stated that they pursued these projects only to get internal marks. Merely focusing on achieving good grades when completing the project work, without understanding the practical application of case-based studies, has resulted in 26% and 22% of students being unaware of its relevance in post-university examinations and the comments received after exam results, respectively. This might be attributed, at least in part, to the students' lack of active engagement in the supplied exercise, as well as the faculties' insufficient emphasis on the practical aspects of the case-based studies for all students. A significant proportion of students, from 60% to 68%, expressed a preference for integrated sessions, stating that it helped them engage with lectures and comprehend the subject matter. A significant portion of 30%, of students shown a lack of interest and awareness about the relevance of the sessions. This might be attributed, in part, to the students' attitudes and, in part, to the instructors' failure to stimulate curiosity among all students.

**Table 1: Overall average marks of internal assessment**

Batch	Out of 100 marks		P value
	Mean	SD	
A	75.09	1.22	(A vs C)<0.001
B	71.17	1.34	(B vs C)<0.001
C	66.11	1.05	

**Table 2: University exam pathology marks out of 300**

Batch	Mean	SD	P value
A	212.11	5.28	(A vs C)<0.001

B	204.11	5.25	(B vs C)<0.001
C	190.08	4.98	

**Table 3: A batch student's feedback on formative assessment**

Do you think the following formative assessment will help/helped you in University examination to score marks	Yes	Not sure	No	
Small Group Discussions	60%	30%	10%	Pre-university exam
	62%	24%	14%	Post university exam
	80%	20%	0%	Post exam results
Self Determined Learning	66%	4%	30%	Pre-university exam
	50%	20%	30%	Post university exam
	62%	12%	26%	Post exam results
Attitude Ethics and Communication Learning	40%	48%	12%	Pre-university exam
	76%	18%	6%	Post university exam
	56%	30%	14%	Post exam results
Case Based Learning	62%	32%	6%	Pre-university exam
	56%	34%	10%	Post university exam
	72%	20%	8%	Post exam results
Integrated Sessions	70%	20%	10%	Pre-university exam
	60%	34%	6%	Post university exam
	62%	30%	8%	Post exam results

**Table 4: B batch student's feedback on formative assessment**

Do you think the following formative assessment will help/helped you in University examination to score marks	Yes	Not sure	No	
Small Group Discussions	50%	22%	28%	Pre-university exam
	66%	10%	24%	Post university exam
	60%	14%	26%	Post exam results
Self Determined Learning	56%	12%	32%	Pre university exam
	52%	14%	34%	Post university exam
	54%	12%	34%	Post exam results
Attitude Ethics and Communication Learning	30%	64%	6%	Pre-university exam
	78%	14%	8%	Post university exam
	76%	12%	12%	Post exam results
Case Based Learning	70%	26%	4%	Pre-university exam
	68%	22%	10%	Post university exam
	72%	22%	6%	Post exam results
Integrated Sessions	60%	30%	10%	Pre-university exam
	68%	30%	2%	Post university exam
	64%	30%	6%	Post exam results

## DISCUSSION

Formative assessment aims to directly influence learning in real-time. It enables instructors to monitor the learning progress of pupils, both individually and as a group. The systematic gathering of data pertaining to performance in connection to all pertinent knowledge and skills is undeniably the crucial aspect of the process. Without it, the ultimate report on accomplishment is unlikely to provide reliable information about students' attainment of the learning objectives. The importance of formative assessment resides in its proven effectiveness in enhancing the outcomes of summative assessment, and its influence may be measured. The use of formative evaluation in the learning process leads to significant improvement. The final outcomes may be anticipated by active participation in formative evaluation.<sup>[15]</sup> Formative evaluation may be used to evaluate the development of students, leading to improvements in the learning process and the production of competent doctors.<sup>[16]</sup> The most often used kind of formative evaluation in medical students is internal assessment exams and record work, which are provided at regular intervals during the study time. The evaluation of quality has

emerged as a significant obstacle in the field of medical education.<sup>[17]</sup> The integration of symposiums, home assignments, gross assignments, histopathology/cytology projects, and day-to-day assessment of individual performance by using various strategies such as including question sessions during lectures and administering quizzes on a regular basis has helped a lot in evaluation of the quality of learning.<sup>[2,18]</sup> As part of our research, we incorporated additional interventions such as Small Group Discussions, Self Determined Learning, Attitude Ethics and Communication Learning, Case Based Learning and Integrated Sessions in the formative evaluation of the study population as instructed by the National Medical Commission in Competency Based Medical Education Curriculum guidelines which was implemented from 2019 MBBS Batch. A direct relationship was seen between formative and summative assessment, and the study population achieved higher average scores compared to the previous year's main group, without such extra intervention. This difference was statistically significant. In their research, Kala Parvathy Kesavan et al. discovered a statistically significant positive association between formative and summative

evaluation. They also confirmed that the mean scores of the intervention group (monthly tests) were higher than those of the non-intervention group.<sup>[19]</sup> The influence of feedback on students' learning and achievement is significant.<sup>[20,21]</sup> The majority of the study population said that they found formative evaluation to be valuable for university examinations. Many participants also recognised its significance following the test and the subsequent results. Approximately 22% to 26% of students in B batch maintained their belief that the small group discussions was not beneficial for test preparation. This may be attributed, in part, to students who were not preparing on daily basis for examinations beforehand. According to Palmer E et al., formative assessment poses a problem to assessors due to the potential lack of sincerity among learners, since it does not immediately impact the final grade.<sup>[22]</sup> Disruption of autonomous study habits might impede students from abstaining from preparing for formative assessments.<sup>[19]</sup> Concerning Self Determined Learning, a range of 26% to 34% of the study population said that it did not contribute to their test performance. This finding aligns with the proportion of students who admitted to copying from their peers in both groups. Therefore, it can be said that duplicating tasks just for the sake of finishing them will not be beneficial in university examinations. Initially, it was believed that Attitude Ethics and Communication learning sessions before exams was not very beneficial. However, the significance of these learning sessions became apparent after the university exams. This realisation may have occurred because some students approached the tasks diligently, employing clarity, logic, scientific methods, and creativity. Even if their motivation was solely to earn internal marks, they ultimately recognised the value of the knowledge acquired through this process during the exams. In their research, Alsalthanie KM et al. found that self-regulated deep learning led to improved performance in summative assessment for 80% of the participants.<sup>[23]</sup> The lack of understanding of the AETCOM topics has resulted in 12% to 30% of students being unaware of its practical use, even after receiving their test results. Between 20% and 34% of students demonstrated a lack of understanding of the significance of Case Based Learning in university examinations, even after the completion of the exams and the release of the results. This might be attributed, at least partially, to the students' lack of active engagement in the supplied exercises and the faculties' insufficient emphasis on the practical aspects of case-based studies for all students. Labarca et al. observed that 90% of students who actively engaged in formative evaluation had enhanced academic performance.<sup>[24]</sup> Therefore, the active engagement of students, along with appropriate coaching, may enable them to see the significance of case-based discussions in their future endeavours. Between 20% and 34% of students

shown a lack of interest and awareness of the significance of Integrated Sessions. This might be attributed partially to the students' attitudes and partially to the instructors' failure to stimulate curiosity among all pupils. Students tend to choose assessment methodologies that are interesting, motivating, and amusing.<sup>[25,26]</sup> Therefore, in the future, it would be beneficial to use more innovative techniques along with word puzzles, picture-based questions and multiple-choice questions to actively engage students during integrated sessions. A formative evaluation may be considered effective only if it prompts both students and teachers to take action, thereby improving the learning process.<sup>[27]</sup>

## CONCLUSION

Formative and summative examinations are essential components of any educational system since they inform administrative choices about ability grouping, selection, and certification. The significance of formative assessment resides in the empirical evidence of its efficacy in enhancing the outcomes of summative assessment, as perceived by students, which varies across different cohorts. An appropriately organised formative assessment is necessary to enhance learning. The use of a more recent and supplementary formative assessment approach has been seen to have a substantial positive impact on the academic performance of two successive cohorts after Competency Based Medical Education Curriculum implementation by NMC.

## REFERENCES

1. Kordestani Moghaddam A, Khankeh HR, Shariati M, Norcini J, Jalili M. Educational impact of assessment on medical students' learning at Tehran University of Medical Sciences: a qualitative study. *BMJ Open*. 2019 July 29;9(7):e031014. doi: 10.1136/bmjopen-2019-031014, PMID 31362972, PMCID PMC6677973.
2. Murugesan M, Leo David P, Dr.Beyaril Chitra C. Correlation between formative and summative assessment results by post validation in medical undergraduates. *IOSR J Dent Med Sci (IOSR-JDMS)*;20(9) Ser.5:51-7 (September. 2021).
3. Anziani H, Durham J, Moore U. The relationship between formative and summative assessment of undergraduates in oral surgery. *Eur J Dent Educ*. 2008 November;12(4):233-8. doi: 10.1111/j.1600-0579.2008.00524.x, PMID 19021730.
4. Cilliers FJ, Schuwirth LW, Adendorff HJ, Herman N, van der Vleuten CP. The mechanism of impact of summative assessment on medical students' learning. *Adv Health Sci Educ Theory Pract*. 2010;15(5):695-715. doi: 10.1007/s10459-010-9232-9, PMID 20455078.
5. van der Vleuten CPM, Schuwirth LWT. Assessing professional competence: from methods to programmes. *Med Educ*. 2005;39(3):309-17. doi: 10.1111/j.1365-2929.2005.02094.x, PMID 15733167.
6. Schuwirth LWT, Van der Vleuten CPM. Programmatic assessment: from assessment of learning to assessment for learning. *Med Teach*. 2011;33(6):478-85. doi: 10.3109/0142159X.2011.565828, PMID 21609177.
7. Raupach T, Brown J, Anders S, Hasenfuss G, Harendza S. Summative assessments are more powerful drivers of student learning than resource intensive teaching formats. *BMC Med*. 2013;11:61. doi: 10.1186/1741-7015-11-61, PMID 23497243.

8. Heeneman S, Oudkerk Pool A, Schuwirth LWT, van der Vleuten CP, Driessen EW. The impact of programmatic assessment on student learning: theory versus practice. *Med Educ.* 2015;49(5):487-98. doi: 10.1111/medu.12645, PMID 25924124.
9. Cilliers FJ, Schuwirth LWT, Herman N, Adendorff HJ, van der Vleuten CP. A model of the pre-assessment learning effects of summative assessment in medical education. *Adv Health Sci Educ Theory Pract.* 2012;17(1):39-53. doi: 10.1007/s10459-011-9292-5, PMID 21461880.
10. Epstein RM. Assessment in medical education. *N Engl J Med.* 2007;356(4):387-96. doi: 10.1056/NEJMra054784, PMID 17251535.
11. Broekkamp H, Van Hout-Wolters BHAM. Students' adaptation of study strategies when preparing for classroom tests. *Educ Psychol Rev.* 2007;19(4):401-28. doi: 10.1007/s10648-006-9025-0.
12. Al-Kadri HM, Al-Moamary MS, Roberts C, Van der Vleuten CP, et al.. Exploring assessment factors contributing to students' study strategies: literature review. *Med Teach.* 2012;34;Suppl 1:S42-50. doi: 10.3109/0142159X.2012.656756, PMID 22409191.
13. Olupeliyawa A, Balasooriya C, Hughes C, O'Sullivan A. Educational impact of an assessment of medical students' collaboration in health care teams. *Med Educ.* 2014;48(2):146-56. doi: 10.1111/medu.12318, PMID 24528397.
14. Al-Kadri HM, Al-Kadi MT, Van Der Vleuten CPM. Workplace-based assessment and students' approaches to learning: a qualitative inquiry. *Med Teach.* 2013;35;Suppl 1:S31-8. doi: 10.3109/0142159X.2013.765547, PMID 23581894.
15. Carrillo-de-la-Peña MT, Baillès E, Caseras X, Martínez A, Ortet G, Pérez J. Formative assessment and academic achievement in pre-graduate students of health sciences. *Adv Health Sci Educ Theory Pract.* 2009;14(1):61-7. doi: 10.1007/s10459-007-9086-y, PMID 17972153.
16. Cauley KM, McMillan JH. *Formative Assessment Techniques to Support Student Motivation and Achievement.* Clearing House. 2010;83(1):1-6. doi: 10.1080/00098650903267784.
17. Reinert A. *Assessment in Medical Education: A primer methodology.* Perspective. 2017;2013:25-34.
18. Office of Health Sciences Education. *Improve learning through Formative assessment.* The Teach Doct Illum Evid Based Ideas Effect Teach. 2008:1-8.
19. Kesavan KP, Palappallil DS. Effectiveness of Formative assessment in Motivating and Improving the Outcome of summative Assessment in Pharmacology for Medical Undergraduates. *J Clin Diagn Res;*12(5):FC08-11. doi: 10.7860/JCDR/2018/34533.11527.
20. Rushton A. Formative assessment: a key to deep learning? *Med Teach.* 2005;27(6):509-13. doi: 10.1080/01421590500129159, PMID 16199357.
21. Palappallil DS. Attitude of interns and students on teaching and learning methodologies in pharmacology. *Int J Pharmacol Ther.* 2015;1:1-7 [Cited 2017 June].
22. Palmer EJ, Devitt PG. Limitations of student-driven formative assessment in a clinical clerkship. A randomised controlled trial. *BMC Med Educ.* 2008;8:29. doi: 10.1186/1472-6920-8-29, PMID 18471324.
23. Alsalhanie KM, Das S, Abdus-Samad S. Formative evaluation impacting the results of summative evaluation-a feedback based cross sectional study carried out among instructors of an international medical school. *Int J Res Med Sci;*5(7). doi: 10.18203/2320-6012.ijrms20172571.
24. Labarca J, Figueroa C, Huidobro B, Wright AC, Riquelme A, Moreno R. Perception of medical students about formative assessments during clinical courses. *Rev Med Chil.* 2014;142(9):1193-99. doi: 10.4067/S0034-98872014000900014, PMID 25517060.
25. Harlen W, James M. Assessment and learning: differences and relationships between formative and summative assessment. *Assess Educ Princ Policy Pract.* 1997;4(3):365-79. doi: 10.1080/0969594970040304.
26. Hudson JN, Bristow DR. Formative assessment can be fun as well as educational. *Adv Physiol Educ.* 2006;30(1):33-7. doi: 10.1152/advan.00040.2005, PMID 16481607.
27. Bell B, Cowie B. The characteristics of formative assessment in science education. *Sci Educ.* 2001;85(5):536-53. doi: 10.1002/sce.1022.