SCOPE OF EARLY FORMATIVE ASSESSMENT IN PROMOTING ACADEMIC SUCCESS IN MEDICAL STUDENTS

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ABSTRACT

Background: Formative assessment has an important role in higher education. This study aimed at evaluating multiple aspects of early formative assessment to determine its scope in promoting academic success in first-year medical students. **Methods:** A formative assessment with a physiology structured essay question was conducted for all first-year medical students at University of Colombo, Sri Lanka. The model answer and marking scheme were discussed and students self-marked their answers. The answer scripts were also marked by tutors and returned with feedback. Student and tutors marks were compared and correlated with physiology summative assessment marks using t-test, Pearson's correlation coefficient and Chi-square test. **Results:** Of 204 students 163 participated, but only 117 (57%) were used for analysis. The mean +/- standard deviation of student self-marks and tutor-marks were 24.53+/-20.66 and 34.53+/-22.35 respectively. The mean tutor-mark was significantly higher than (p<0.0001) and showed significant positive correlation with (r=0.801, p<0.01) the mean student self-mark. The student self-marks and tutor-marks had significant positive correlation (p<0.01) with marks of all first-year physiology summative assessments and their written components. In all summative assessments, the percentage of students who obtained ≥50% marks was greater in study participants than non-participants. Participants, compared to non-participants had a significantly higher (p<0.01) pass rate at all physiology summative assessments and multiple choice question component. **Conclusions:** The academic performance in physiology throughout first year positively correlated with performance at an early formative assessment and was significantly better in study participants than in non-participants. Students' had good self-assessment accuracy at the formative assessment.

Key Words: formative assessment, summative assessment, medical undergraduate, academic performance, basic sciences

INTRODUCTION

Formative assessment is assuming a significant role in higher education, with the paradigm shift in assessment culture highlighting its importance in student-centred adult learning **(1)**. It has many uses; such as providing feedback to students, guiding student learning and curriculum evaluation **(1, 2)**. Feedback is the central component of formative assessment that is useful for intervening with the intent to improve **(1-3)**. Feedback during formative assessment provides

the students a basis for correcting their mistakes, offers guidance for learning, serves as a reference point for end of course or module summative evaluation, reduces student anxiety by clarifying goals, and diminishes reliance on self while lessening the insecurity about performance in summative assessments **(4).** The role of the formative assessment as an integral component of the teaching programme has been accepted not only by educators, but also by students **(5)**. However, one study revealed that less than 50% of year 3 medical students were interested in accessing the formative feedback provided by tutors **(6)**.

The MBBS curriculum of the Faculty of Medicine University of Colombo (FMUC) introduces formative assessment early in the curriculum. From the first term onwards in the Basic Sciences Stream (BScS), all basic science disciplines (i.e. anatomy, physiology and biochemistry) conduct formative assessments. Two formative assessments are conducted in physiology during each of the 3 terms of the BScS, in the first year. Summative assessments in physiology comprise a continuous assessment at the end of each term (CA1, CA2 and CA3) followed by the BScS final examination at the end of the first year. During the formative assessments, students are given the opportunity to answer structured essay questions (SEQ) and several multiple choice questions (MCQ). The format and the standard of questions and the time allocated to answer them are similar to those at the summative assessments. At the end of the allocated time, the tutors display and discuss the expected model answer and the objective marking schemes. Students are requested to self-mark their answers and seek any clarifications. Individual feedback by tutors is not provided due to time constraints and having a large number of students in a batch.

At the FMUC, formative assessments have been conducted over the past 15 years, but their benefits for the students have not been formally evaluated. Though students state in their curriculum feedback that formative assessments are helpful, in later years of study it has been noted that student attendance at formative assessments is suboptimal. It is also uncertain if students are able to satisfactorily comprehend the model answer and marking scheme discussed by the tutor and if they are able to self-assess their answers with reasonable accuracy.

The aim of this study was to evaluate multiple aspects of formative assessment to determine the scope of early formative assessment in promoting academic success in medical undergraduates during the first year of study.

MATERIALS AND METHODS

This study was conducted at the first formative assessment in physiology in the first term of undergraduate study. A week before the study, students were briefed about the format of the formative assessment, the content area to be assessed and the procedure for self and tutor marking. They were also informed regarding the purpose of study, and all students in the batch were invited to participate. Students who wished to participate in the study were requested to submit the answer scripts to the tutors after self-marking at the end of the formative assessment, so that tutors could mark the answer scripts and use the information for the study. This ensured that any student who did not wish to participate in the study could still participate in the formative assessment, self-mark the formative assessment according to the model answer and marking scheme and join in any ensuing discussion without tutor bias or any negative effect. The model answer and the objective marking scheme were subject to prior expert validation by 2 senior lecturers in physiology

who had designed and carried out formative assessments over a decade. Students were ensured that their marks will be recorded only for the purpose of this study.

The study was conducted in the students' lecture hall. A question paper consisting of one SEQ with space for the structured answers was given to all first year students. The question paper was similar in format to the summative assessment examination paper, and would serve as the answer script after the question was answered. Students were asked to write their index number on the specific space provided. They were requested to answer by themselves within 30 minutes, without seeking any assistance from other sources. At the end of the formative assessment, the model answer with its marking scheme was projected on a screen, and students were requested to read and agree with the model answer and marking scheme. The tutor discussed the model answer and the marking scheme, and emphasized on the important aspects of the answer. The marks were allocated out of 100. The students were then asked to mark their answer according to the marking scheme given and 20 minutes were allocated for self-marking and entering the marks on the answer script. Afterwards, the students who wished to participate in the study submitted the answer scripts. The senior academic staff member who designed the question marked all answer scripts using the same marking scheme discussed with the students. The answer scripts were returned to students under confidential cover with the tutor mark and constructive feedback.

This particular method was used as it mimicked the actual formative assessment, except for the tutor marking which was done for the study purposes. Thus by adding tutor marking to a currently practiced activity, accuracy of student marking could be evaluated.

The marks of the summative assessment in physiology (CA 1, CA 2, CA 3 and BScS final) for this batch of students were obtained at the end of the year from the examinations unit of the medical faculty.

Ethical Considerations

Ethics approval was obtained from the Ethics review committee of FMUC, Sri Lanka (No. EC-10-102) after obtaining the permission of the FMUC to conduct the study. The work was carried out in accordance with the Declaration of Helsinki, including, but not limited to the anonymity of participants being guaranteed, and the informed consent of participants being obtained.

Statistics

Data were analysed using SPSS 18 statistical package. Descriptive data were analysed using the mean, standard deviation and percentages. Data were compared using the student t-test. Associations were analysed using, Pearson's correlation coefficient and Chi-square test. $p< 0.05$ was used for statistical significance.

RESULTS

The formative assessment question paper was distributed to all 204 first-year students. One hundred and sixty three students handed over the answer scripts at the end of the formative assessment, consenting to participate in the study. Only marks of 117 students (57%) of the batch were included in the final analysis as 46 students had not either stated the self-mark or completed the summative assessments.

Association of student self-marks and tutor marks of the formative assessment

The mean +/- standard deviation of self-marks and tutor marks were 24.53 +/- 20.66 and 34.53 +/- 22.35 respectively. The mean tutor mark was significantly higher than the mean student mark (p<0.0001) when compared using the paired

Table I: Correlation of student and tutor marks of the formative assessment with marks of summative assessments

Summative assessments	Pearson's correlation coefficient of student self-mark at the formative assessment versus summative assessment marks	Pearson's correlation coefficient of tutor-mark at the formative assessment versus summative assessment marks
CA 1	0.443*	0.402*
CA 2	0.414*	0.409*
CA 3	0.316*	0.325*
BScS final examination	0.393*	0.399*
BScS final examination MCQ	0.35*	0.35*
BScS final examination SEQ	0.318*	0.322*

* Significant at $p<0.01$, CA 1: First continuous assessment, CA 2: Second continuous assessment, CA 3: Third continuous assessment, BScS: Basic Sciences Stream, MCQ: Multiple choice questions, SEQ: Structured essay questions

Table II: Comparison of study participants and non-participants, obtaining ≥50% of total marks at physiology summative assessments

Summative assessments	Number of study participants	Number of non-participants	$x^2(1, N = 204)$
CA 1	148	28	14.01 †
CA 2	106	17	7.6*
CA 3	144	20	35.53 †
BScS final examination-total	124	20	11.75 †
BScS final examination MCQ	125	23	6.97*
BScS final examination SEQ	57	8	3.64

*$p<0.01$, †$p<0.001$, CA 1: First continuous assessment, CA 2: Second continuous assessment, CA 3: Third continuous assessment, BScS: Basic Sciences Stream, MCQ: Multiple choice questions, SEQ: Structured essay questions, x^2: Chi square

ABBREVIATIONS: BScS: Basic Sciences Stream, CA 1: First continuous assessment, CA 2: Second continuous assessment, CA 3: Third continuous assessment, FMUC: Faculty of Medicine University of Colombo, MCQ: Multiple choice questions, SEQ: Structured essay questions, x^2: Chi square

sample t-test, but there was a significant positive correlation between tutor marks and student self-marks (r=0.801, p<0.01).

Association of marks of the formative assessment with academic performance at summative assessments in physiology in the first year

Physiology marks at all first year summative assessments (CA1, CA2, CA3 and BScS final examination) were correlated with the student self-marks and tutor marks using Pearson's correlation coefficient (Table I). The content area tested in this formative assessment was assessed at only CA1 and the BScS main examination.

Both the student self-marks and tutor marks had significant positive correlation (p<0.01) with the marks of CA1, CA2, CA3, BScS final examination physiology total, and individual written physiology examination components (MCQ and SEQ) of the BScS final examination.

Academic performance in study participants and non-participants

In all the summative assessments, the percentage of students who obtained 50% or more (≥50%) marks was greater in study participants compared to non-participants. In the BScS final examination 76% of the 163 study participants and 48% of the 41 non-participants passed physiology obtaining ≥50% of the total marks. At the BScS final examination, 76% and 35% study participants and 56% and 19% non-participants, obtained ≥50% for MCQ and SEQ components in physiology respectively. In the three continuous assessments in physiology, the percentage of students obtaining ≥50% of the total marks was higher among the study participants (CA1 - 90%, CA2 - 65%, CA3 - 88.3%) than non-participants (CA1 - 68%, CA2 - 41%, CA3- 51.2%) respectively (Table II).

The number of study participants obtaining ≥50% of the total marks at the physiology summative assessments, compared to non-

participants, was statistically significant in BScS final examination (p<0.001), CA 1 (p<0.001), CA 2 (p<0.01), CA 3 (p<0.001) and MCQ component in physiology at the BScS final examination (p<0.01). However no significant difference was observed between the two groups of students in the SEQ component at the BScS final examination (p=0.057) (Table II).

DISCUSSION

The formative assessmentin this study was a single SEQ for 30 minutes, and the entire activity for students including the time for answering the SEQ, discussing the model answer and self-marking according to the marking scheme required only one hour. It is interesting to know that an activity requiring such a short time and minimum resources could be used to envisage students' academic achievements over the year. It is likely that the same pattern performance would be seen in other basic science subjects as well.

This study revealed important findings in three key areas related to formative assessment in physiology, i.e.

1. self-assessment accuracy of first year medical students
2. the association of the marks obtained at an early formative assessment with academic performance in first year summative assessments
3. the impact of participation in the formative assessment study per se, on the academic performance in the first year summative assessments

Self-assessment accuracy of medical students

The study revealed that the self-assessment accuracy of medical students is high, even early in the undergraduate period, with the students' self-marks having a highly significant correlation with the tutor marks. However, students tended to underrate themselves even when both tutor

and students were using the same structured marking scheme. Previous studies on medical students evaluating the self assessment ability have also revealed that students tend to underrate themselves **(7)**. It could be because students may hesitate to allocate marks for uncertain facts, for which the experienced tutor may award marks. It could also mean that the model answer and the marking scheme did not state all possible correct facts, which students would not have allocated marks for. A study on 3rd year medical students, which had a methodology very similar to the present study found that high achieving students tended to underrate themselves whereas low achieving students tended to overrate themselves **(8)**.

The association of the marks obtained at an early formative assessment with academic performance in first year summative assessments

Performance at an early formative assessment in physiology had a positive correlation with academic performance throughout first year (CA1, CA2, CA3, BScS final examination and its MCQ and SEQ components). This could be attributed to many factors: the formative assessment was conducted early in the undergraduate course, i.e. within the first 6 weeks, and high marks at formative assessments may be obtained by students with better facilities for learning such as text books, IT support, family support or higher English proficiency. The same factors that affected the higher performance at the initial undergraduate period may remain more or less to the same extent throughout the first year and even till later. It is also possible that high achievers may have performed better in both formative and summative assessments. However, the fact that poor performers could be identified early has a bearing on the ability to implement early measures to promote learning in such students. Other studies also have revealed that success in

formative assessments was associated with better results in the summative assessments among first year medical students for both open and closed book formative assessment **(9)**, in pre-graduate health science students **(10)** and first-year chemistry students **(11)**.Clinical formative assessments however have not shown a correlation with the overall grades among undergraduates in oral surgery **(12)**.

The impact of participation in the formative assessment study per se, on the academic performance in the first year summative assessments

In this study, the students who participated had a significant increase in obtaining marks ≥50% in summative assessments. The higher achievement was noted in CA1, CA2, CA3, BScS final examination and its MCQ component. The students who opted to participate in the study may be those who wish to receive tutor feedback and check their self assessment ability and attempt to improve their outcome. The students who were either unprepared or did not feel confident regarding their knowledge may not have either participated in the formative assessment or submitted the answer scripts to be included in the study. Thus insufficient knowledge or poor attitude could have contributed to the poor outcome in summative assessments in students who did not participate in the study. Somewhat similar findings have been reported in different contexts in other studies which compare students who participated in formative assessmentversus students who did not participate. Buchanan (2000) found that students participating in voluntary web-based formative assessments significantly outperformed students who did not participate **(13)**.Studies have shown that participating in formative assessments, regardless of the performance at the formative assessments, improved the academic performance in students.

In a study among pre-graduate students of health sciences, participation in formative assessment was a better predictor of final outcome than the success in formative assessment **(10)**. Participation in OSCE-type formative assessment among pharmacy students has shown a significant improvement in all OSCE performance measures **(14)**. It is likely that feedback received during the formative assessment contributed to the academic success.

The study revealed several important aspects which could be made use of in actual practice. Poor performers could be identified early in the undergraduate period using formative assessments, by providing opportunity for students with low marks at formative assessments to seek assistance, so that timely interventions could be made. The high self-assessment accuracy of medical students early in undergraduate learning should be developed, as it contributes to self-regulation, which is known to enhance academic success **(15)**. The high ability to self-assess could be utilized in devising learning activities for especially poor performers, in the form of tutorials, mock examinations, formative assessments, formative interactive lectures **(16)** etc., where structured and objective answers could be provided by tutors allowing students to self-assess their performance, saving tutor time while promoting student learning. Medical students should be explained regarding formative assessments at the time of entering the university, emphasizing their potential impact on learning and success at summative assessments, encouraging students to participate in formative assessments. Further studies should be conducted to explore if the performance at early formative assessments is associated with academic performance throughout the undergraduate and postgraduate period, and identify the best types of formative assessments to enhance deep learning in medical students. Studies should also evaluate how the self-assessment ability of students could be improved.

CONCLUSIONS

The academic performance in physiology throughout the first year had a significant positive correlation with performance at an early formative assessment and was significantly better in students participating in the study than in non-participants. Medical students' had good self-assessment accuracy, even early in the undergraduate period, which could be used in future formative assessments.

ACKNOWLEDGEMENTS

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