



FORMATIVE ASSESSMENT TOOL FOR ACTIVE LEARNING

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ABSTRACT

Introduction: Formative assessments are considered as means of ensuring deeper learning and understanding. They provide feedback that moves learners' forward, activating students as instructional resources for one another.

Objectives: This study was done to evaluate the feedback instrument for validity and reliability, and seek student opinion about formative assessment used in the course so that further batches can be benefitted with a better teaching learning exercise. **Methods:** For evaluation of formative assessment, Likert scale with 11 items was constructed and administered to the students taking the course of Epidemiology in MD program of College of Medicine. Factor analysis was used to see similar pattern of responses in the Likert scale items. Scree plot was used to see 'leveling off' of Eigen values. Cronbach's alpha was used to see the internal consistency of the items in the scale. **Results:** Eleven questions relating to formative assessment in Epidemiology course were factor analyzed using principal component analysis with oblimin rotation. Kaiser-Meyer-Olkin test and Bartlett's test of sphericity both indicated that the set of variables are at least adequately related for factor analysis. Substantively, two factors were identified for formative assessment, in class assignments and group presentations. **Conclusion:** Overall, these analyses indicated that two distinct factors were underlying student responses to the formative assessment scale items and that these factors were internally consistent. Students liked formative assessment and found it useful in the course of Epidemiology.

KEYWORDS: Factor analysis, reliability, Likert scale, formative assessment.

INTRODUCTION

Formative assessment can be defined as one form of self-assessment by the student, which intends to provide feedback to both the teacher and the student.^[1] Formative assessments can be implemented as pre-, in-, or post-class activities, and they contribute to a course structure that enables students to engage with material and revise their understandings.^[2] As designers of medical curriculum are looking for strategies to invigorate the teaching and learning delivery methods, formative assessments are considered as means of ensuring deeper learning and understanding.^[3] It has been demonstrated that positive perceptions of learning environments lead to deeper study approaches for summative assessments,^[4-5] and that these approaches are associated with higher exam scores.^[6-8]

The teaching of students taking the course of Epidemiology in MD program of College of Medicine is challenging with big batch strength of 120 students; especially with didactic lectures. The concepts cannot be clarified to all the students attending the class nor can their learning be assessed just by summative exams. Therefore it is of utmost importance that some formative

assessments be carried out to aid learning of important concepts and to give hands on experience to the students. Formative assessments in the form of in class assignment with worksheet and group presentations were given to the students. Students' feedback on the assessment was collected by Likert scale. This study was done to evaluate the feedback instrument for validity and reliability, and seek student opinion about formative assessment used in the course so that further batches can be benefitted with a better teaching learning exercise.

MATERIALS AND METHODS

For evaluation of formative assessment, Likert scale with 11 items was constructed by the course director. Responses were on a 5 point Likert-type scale, ranging from 1 = "Strongly disagree", 2 = "Disagree", 3 = "Neither agree nor disagree", 4 = "Agree", 5 = "Strongly agree". Participants were students taking the course of Epidemiology in MD program of College of Medicine. They completed the survey at the end of the course before the final exam. Informed consent was taken from the students.

Data was entered and analyzed in SPSS. Factor analysis was used to see similar pattern of responses in the Likert scale items. Principal components analysis was used with Oblimin rotation. The nature of principal component analysis is exploratory rather than confirmatory.^[9] Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity significance was calculated. Factor coefficients of 0.40 or greater are required for the interpretation of the factor structure.^[10] Scree plot was used to see 'leveling off' of Eigen values. Cronbach's alpha was used to see the internal consistency of the items in each scale. Composite scores were created for significant factors based on the mean of the items. Descriptive statistics was used to describe the factors by mean, standard deviation, skewness and kurtosis. Bar chart was prepared to show the responses of individual items in the scale.

RESULTS

The factorability of the 11 formative assessment items in the Likert scale was examined. It was observed that

items correlated at least 0.3 with at least one other item, suggesting reasonable factorability. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.820, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant ($p < 0.001$). This suggested that each item shared some common variance with other items and therefore reliability was achieved. The communalities were all above 0.3 further confirming that each item shared some common variance with other items. The factor loading matrix for the final solution along with communalities is presented in Table 1. Given these overall indicators, factor analysis was deemed to be suitable with all 11 items. Principal components analysis was used with Oblimin rotation. Eigen values indicated that the first two factors explained 42.8% and 15.4% of the variance respectively.

Table 1: Factor loadings and communalities based on a principal components analysis with oblimin rotation for 11 items from the Formative assessment Likert scale

Items	In class assignment	Group presentation	Extraction
Gives feedback to know mistakes	.939		.827
Gives training to know steps of data analysis	.802		.714
Helps revise lessons for block exams	.871		.776
Helps getting better grades in block exams	.947		.820
It is a good active learning exercise	.744		.641
Gives in depth knowledge of the topic		.845	.845
Helps in identifying important information for presentation		.874	.874
Helps in reviewing my communication skills		.709	.709
Gives feedback which will be useful for future presentations		.446	.446
Attending others' presentations helps to know other topics		.527	.527
It divides works among group members to make it easy		.956	.888

Note. Factor loadings less than 0.3 were suppressed

The two factor solution with 11 items that explained 68% of the variance was preferred because of the 'leveling off' of Eigen values on the Scree plot after two factors (Figure 1). The scree plot is a depiction of the variance extracted at each stage of the factor analysis. The extracted factors were retained. Internal consistency for each of the scales was examined using Cronbach's alpha. The alpha values were 0.914 for in class assignment (5 items) and 0.717 for group presentations (6 items). No substantial increases in alpha for any of the scales could have been achieved by eliminating items.

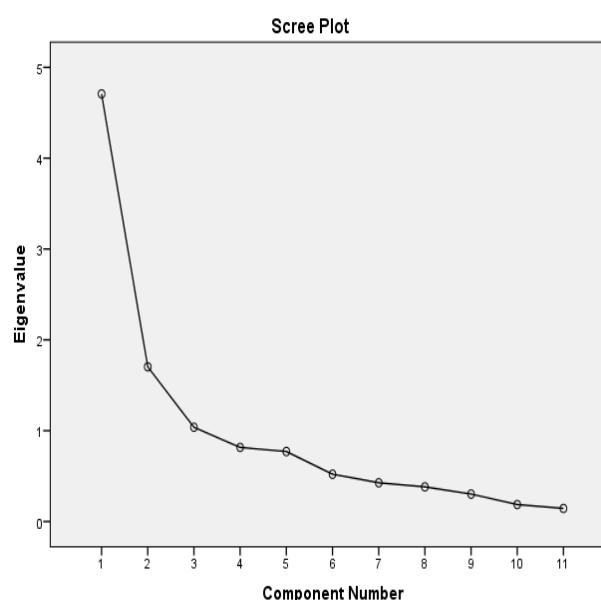


Figure 1: Scree plot for factor analysis.

Composite scores were created for each of the two factors, based on the mean of the items which had their primary loadings on each factor. Descriptive statistics are presented in Table 2. In class assignment was the

formative assessment factor that students reported the most, with a negatively skewed distribution, while group presentation was second in number.

Table 2: Descriptive statistics for the two Formative assessment scale factors.

	No. of items	Mean (SD)	Skewness	Kurtosis	Cronbach's α
In class assignments	5	3.96	-1.366	1.358	0.914
Group presentations	6	3.80	-0.965	1.621	0.717

Participants were 106 females (89.8%) and 12 males (10.2%). For in class assignments, females had higher mean rank (62.75) compared to males (30.75). This difference was statistically significant; Mann Whitney U= 291.00, $p=0.002$. Similarly for group presentations, females had higher mean rank (61.27) compared to males (43.83); Mann Whitney U= 448.00, $p=0.05$.

Most of the students were in the favor of in class assignments for formative assessment (Figure2). Their response can be comprehended as:

- 83.1% students agreed or strongly agreed that it helped them to know their mistakes.
- 82.2% felt that it was a good tool to know the steps of data analysis.
- 88.1% agreed that it helped to revise lessons for block exams.
- 70.4% agreed that it helped in getting better grades in block exams while 14.4% were neutral with their response.
- 64.4% agreed that it was a good active learning exercise while 17.1% were neutral with their response.

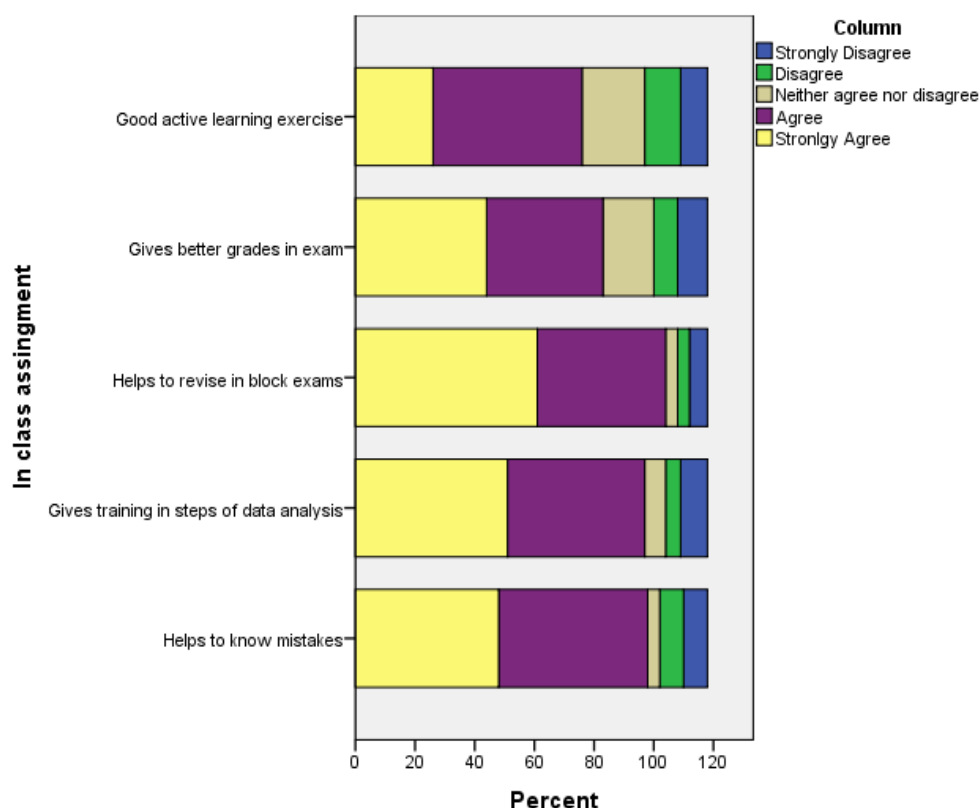


Figure 2: Bar chart on class assignments individual items.

Students liked group presentations a lot as a mean of formative assessment (Figure3). Their responses can be comprehended as:

- 75.4% students agreed that it gave in depth knowledge of the topic.
- 70.4% students agreed that it helped in identifying and organizing important information for presentation.
- 78.8% students agreed that it helped in reviewing their communication skills.
- 68.6% students agreed that it gave feedback which would be useful for future presentations.
- 61.9% students agreed that attending presentations of other groups helped to know other topics.
- 92.4% students agreed that the task divided work among group members to make it easy.

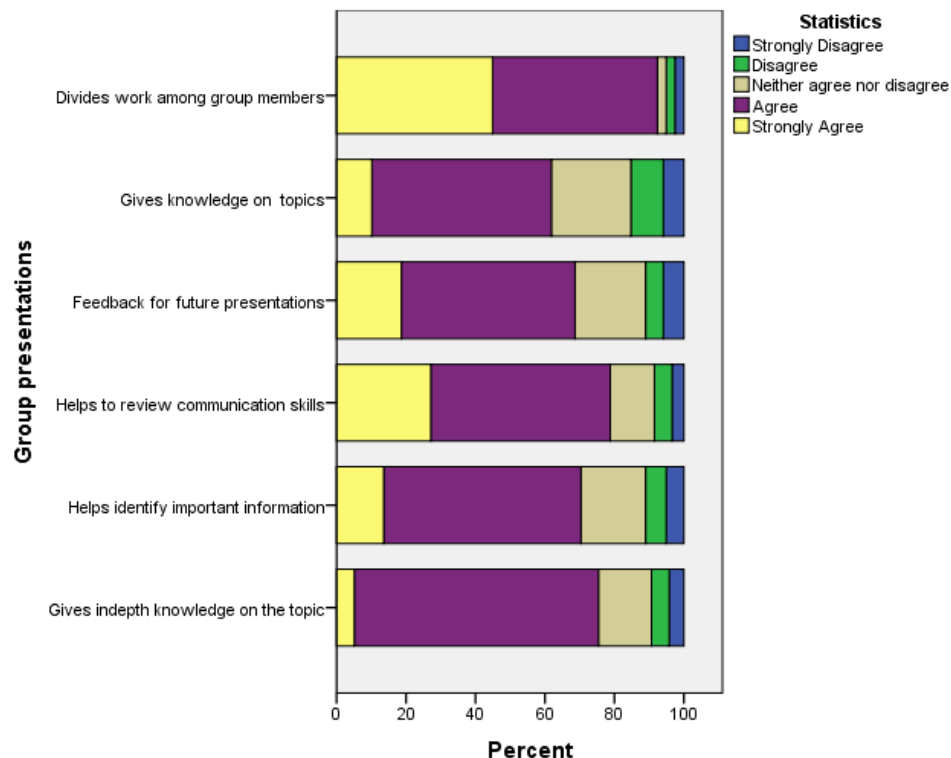


Figure 3: Bar chart on Group presentations individual items.

Mean item summated subscale score for the subscale on class assignments was 19.81 out of the possible average score of 25 based on 5 items in the subscale. Mean item summated subscale score for the subscale on group presentations was 22.80 out of the possible average score of 30 based on 6 items in the subscale. Mean item summated total score for all the items was 42.6.

DISCUSSION

The present study reported that 68.6% students agreed that formative assessments gave feedback which would be useful for future presentations and 75.4% students agreed that it gave in depth knowledge of the topic. 92.4% students in this study agreed that the task divided work among group members makes it easy. Formative assessments are thought to promote learning through the achievement of five key objectives: clarifying learning intentions and criteria for success, revealing evidence of student understanding to the instructor, providing feedback that moves learners' forward, activating students as instructional resources for one another, and activating student ownership of learning.^[11]

As the undergraduate population has become more diverse, United States national reports have called for an increased use of formative assessments which improve learning for all students.^[12,13] The students studying in Oman are also from diverse culture and belong to different countries across the globe, thus calling for the appropriate use of formative assessments in line with US findings. This study reported that formative assessment was considered by 64.4% students as a good active learning exercise. The formative assessments are

perceived to assist students in terms of their extent of understanding the course material and therefore planning their subsequent learning activities.^[14] Bandura proposed that repeated exposure to successful testing experiences in students with increased anxiety will promote self-efficacy for subsequent tests.^[15] However disorientation and resistance can result when students' prior experiences and expectations clash with novel teaching techniques.^[16,17]

The present study reported that 88.1% students agreed that formative assessment helped them to revise lessons for block exams and 70.4% agreed that it helped in getting better grades in exams. There are studies reporting that formative quizzes enhance the summative exam performances in the undergraduate medical and dental students.^[18-21] These findings are in line with the concept that retrieval practice, quizzing in particular, directly boosts exam outcomes, and overall academic performance.^[22]

In the current study the factorability of the 11 formative assessment items was examined. Kaiser-Meyer-Olkin measure of sampling adequacy was 0.820 and Bartlett's test of sphericity was significant ($p < 0.001$). This suggested that each item shared some common variance with other items and therefore reliability was achieved. The factor analysis has been widely acknowledged as a central procedure for developing Likert scales.^[23] Hatcher and Stepanski indicate interpretation of factors and of items correlating with factors is subjective.^[24] Lin et al believed that the KMO < 0.50 is interpreted as rare factor analysis, the values between 0.50 to 0.70 is

interpreted as medium factor analysis, values between 0.70 to 0.80 is considered as custom factor analysis, value between 0.80 to 0.90 is desired factor analysis and values more than 0.90 is interpreted as excellent factor analysis.^[25] Factors with Eigen values greater than 1.25 were retained only.^[26] The Cronbach's alpha values were 0.914 for in class assignment (5 items) and 0.717 for group presentations (6 items). A Cronbach's alpha of > 0.70 is considered to be an acceptable reliability coefficient for determining the internal consistency of the scale.^[23]

CONCLUSION

Overall, these analyses indicated that two distinct factors were underlying student responses to the formative assessment scale items and that these factors were internally consistent. However, each of the factors could probably be strengthened through rewriting of items with lower primary loadings and possibly adding new items. Students liked both in class assignment and group presentation in formative assessment and found it useful in the course of Epidemiology. It is recommended to use formative assessments in the course for better understanding of the subject and activating student ownership of learning.

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