

## The Role of Formative Assessment in Learning Chemistry

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### Abstract

The present paper is based on research study conducted to examine the effects of formative assessment on the achievements of students in chemistry subject. The main purpose of this research was to provide the evidence for a link between formative assessment and student learning [on experimental and control group as well as their comparison and also the comparison of achievements of Boys and Girls]. The posttest experimental design of research was used for this work and this study was carried out for four weeks. 50 Science students of 10<sup>th</sup> class of Govt. Boys Comprehensive School, and 50 Science students of 10<sup>th</sup> Class of Govt. Girls Comprehensive School, were randomly selected for this research. Students were randomly divided into two groups 'Experimental Group and Control Group' having 25 students in each. Posttest (Achievement Test) was used as research tool. After teaching of every week, the experimental group was treated with formative assessment test. While control groups were not treated with formative assessment. After treatment of one month, an achievement test was conducted to both experimental as well as control groups. Data was collected by this test and analyzed by applying the t-test statistically. The analysis of data indicated that those students who were treated with formative assessment show better achievements than those students who were not treated with weekly formative assessment. Finally, the results of this research showed that the use of formative assessment significantly improved the student's learning. Furthermore, it was also proved that the use of formative assessment is necessary for both girls and boys because it has improved

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the achievements both in girls and boys. This study can be proved as an exploratory and offers encouragements for all teachers that this approach has considerable value for the learners.

**Keywords:** Formative assessment, Achievements, Feedback

## **Introduction**

In the present situation of Science learning/education, the attention is being given only to the syllabus which should be covered or taught within the prescribed time period. Therefore, the assessment process is totally ignored, although assessment is a central element in the overall quality of teaching and learning in education. Well-designed assessment sets clear expectations, establishes a reasonable workload (one that does not push students into rote reproductive approaches to study), and provides opportunities for students to self-monitor, rehearse, practice and receive feedback. Assessment is an integral component of a coherent educational experience. Assessment is the daily life of a teacher; designing plans, setting questions, giving feedback and grading are all activities that teachers undertake on a regular basis. Yet, the close examination of such activities can be hindered by constraints caused by the context in which different teaching and learning activities occur and an unawareness of the effect that assessment has on the students themselves. Basically assessment is used by the teacher and students to get the information about learning process because mostly, teachers make decision on the basis of assessment information about their students because of its close links to student learning and to organizational school development.

Assessment has two importance but contradictory functions. Firstly, it measures the final results of the learning process, and it is thus the basis for decisions, e.g. whether student qualifies for continuing studies (summative assessment). Secondly, it measures the intermediary results of the learning process so as to give the students individual feedback about their progress as well as the necessary efforts for future success. It also informs the teacher about the effects of the instruction and how it might be improved (formative assessment). A main asset of formative assessment is that it offers teachers a chance to probe into their students' ways of thinking, analyze their preconceptions and misunderstandings, and thus be prepared for constructivist teaching methods.

Formative assessment is specially designed for those students who have not done well in the classroom or institution. This highlights the gaps between low activeness and high achievements. According to Black & Wiliam, Formative Assessment has positive effect on learning as compare to Summative Assessment effect on learning process. Formative assessment, especially if it is integrated into the teaching and learning process and thus continuously generates information for feedback, has been proven to be a most powerful didactical means to improve learning results (Black & Wiliam, 1998). In some countries like Austria, teachers are responsible for both kinds of assessment.

Formative Assessment in Science Education predicts not only the class room achievements but also indicates that the students gains how much knowledge aligned with science. In other words, in Scientific Literacy measurement is also helpful.

Formative assessment aids learning by generating feedback information that is of benefit to students and to teachers. Feedback on performance, in class or on assignments, enables students to restructure their understanding/skills and build more powerful ideas and capabilities. However, the provision of feedback information is not the sole province of the teacher. Peers often provide feedback – for example in group-work contexts – and students generate their own feedback while engaging in and producing academic work formative assessment also provides information to teachers about where students are experiencing difficulties and where to focus their teaching efforts.

## **Methodology**

The purpose of this study was to examine the Formative Assessment on Students Achievements in Chemistry. There was cause and effect relationship between formative assessment and its effect on student's achievement in chemistry. In order to test relative effectiveness of independent variable (formative assessment), Keeping in view the various factors affecting the internal and external validity of experimental design, posttest only equivalent group design was used for this study to control these variables.

In order to conduct this experimental study, a Boys High school and a Girls High School in Government sector were selected in Multan city in Pakistan. In these schools 50 Girls and 50 Boys Science students were selected. They were divided in to experimental and control groups

having 25 students in each group. Both groups were taught by the researcher by the lecture method. During instruction, oral Formative assessment strategies i.e., planned question answering techniques corresponding to the lesson plan was also used in the experimental groups teaching, while control groups were not treated with such strategies. After teaching five days, the experimental groups were treated with formative assessment in the form of written weekly tests. In this way 4 weekly tests were taken out. A final achievement test was conducted to both experimental and control groups. Data obtained by this test was analyzed statistically.

The achievement test was the tool of this research. The table of specifications was constructed in the light of the content to be covered during each week as shown in Table 1. Formative assessment tests also constructed according to table of specifications. Formative assessment test was constructed and administered every week. Each test comprised of multiple choice, short answer questions items. Each weekly test carried 24 marks. The Posttest (achievement test) was constructed corresponding the contents covered in 4 weeks and administered to both experimental and control groups after the treatments. The details of the treatment are shown in table1.

Table1  
Specification of achievement test and activities

Contents	Knowledge	Understanding	Application	Total Questions
<b>1<sup>st</sup> week</b>				
Introduction of hydrocarbons				
Sources of alkanes				
Preparation of alkanes	4	4	4	12
Properties of alkanes				
Chemical reactions of alkanes				
Uses of alkanes				

<b>2<sup>nd</sup> week</b>				
Occurrence of alkenes				
Preparation of alkenes				
Properties of alkenes	4	4	4	12
Chemical reactions				
Uses				
<b>3<sup>rd</sup> week</b>				
Introduction of Bio-chemistry				
Carbohydrates				
Sources of carbohydrates	4	4	4	12
Uses of carbohydrates				
<b>4<sup>th</sup> week</b>				
Lipids				
Sources and uses				
Nucleic acids	4	4	4	12
Vitamins				
Importance of vitamins				

## Results

The raw scores of the students of experimental and control groups were arranged and then analyzed by using mean score, standard deviation and t-test as statistical tools. The analyzed data have been interpreted in the following tables.

Table 2  
Achievements of Boys Students

Group	N	Mean	SD	t-value	<i>p</i>
Experimental	25	37.92	4.06	9.03	<0.05
Control	25	28.04	3.66		

df (48), table value of t, (2.01)

Table 2 shows that there is significant difference between the mean scores and standard deviation of experimental and control groups of boys. The  $t(c)$  – value is greater than the  $t(b)$  value. This means that formative assessment is more effective than the traditional method so assessment.

Table 3  
Achievements of Girls Students

Group	N	Mean	SD	t-value	p
Experimental	25	39.32	2.74	11.62	<0.05
Control	25	26.88	4.59		

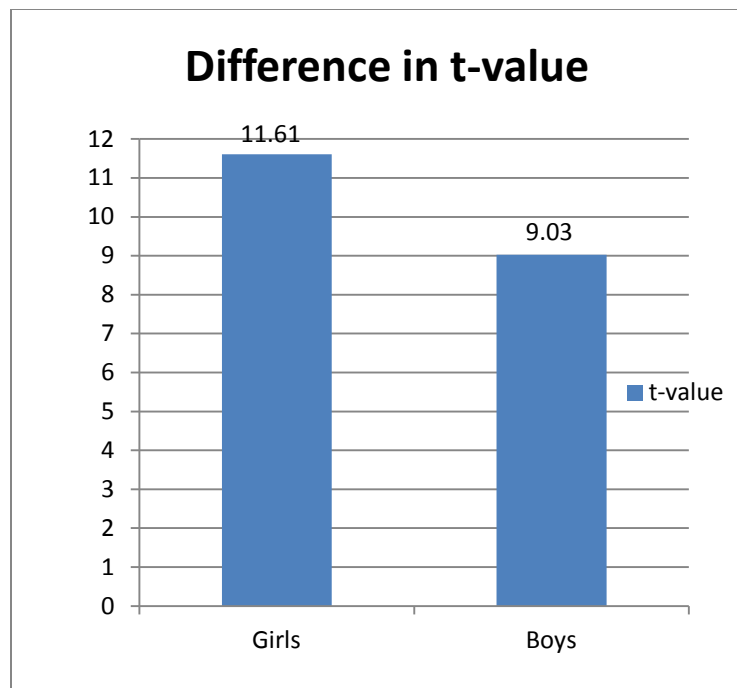
df (48), table value of t, (2.01)

Table 3 shows that in case of the girls there is a significant difference between the mean scores and stand deviation of both groups. The  $t_c$ -value is greater than the  $t$ -value. This shows that formative assessment is more effective than the traditional assessment method.

Table 4  
Comparisons between the achievements of Boys and Girls Students

Group	t-value calculated ( $t_c$ )	t-value tabulated ( $t_b$ )	$p$
Boys	9.03	2.01	<0.05
Girls	11.61	2.01	

Table 4 indicates that there is a significant difference between  $t$ -value calculated and  $t$ - value tabulated between boys and girls. This shows that formative assessment is more effective. It also shows that the girl's achievement is better than the boys. Such achievement was measured through the formative assessment. So the formative assessment method is more effective than the traditional method. The clear picture that emerged from the table 4 is shown in the form of bar diagram as under.



The following results or findings have been drawn from the data analysis of the present study. Keeping in view the objective of the study and hypothesis made for it.

1. Formative assessment has an effect on the academic achievements of the boys.
2. Formative assessment has an effect on the academic achievements of the girls.
3. There is a significant difference between the girls and boys academic achievements.

### Conclusion

The following conclusions were drawn from the instant study. The achievements of boys' and girls' enhanced by the formative assessment instead of traditional assessment. Learners are more motivated towards their academic achievements during session. It helps teachers to assess their student's mental level and abilities and may change their strategies accordingly. The teacher may use the formative assessment strategies in teaching of science subject to enhance the achievements of the students.

There is a need of necessary arrangements for teacher training to aware the teachers about the importance and other related information related to formative assessment specifically and generally about the process of assessment.

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