



## EFFECT OF STRUCTURAL COMMUNICATION GRID ON ACADEMIC ACHIEVEMENT OF 8TH GRADE SCIENCE STUDENTS

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### **Abstract**

The study was undertaken to check the effect of Formative Assessment (SCG) on academic achievement of 8th grade science students in district DG Khan. The main objectives of the study were to find out the effect of formative assessment (SCG) on the academic achievement of 8th grade science students, to find out the effect of formative assessment (SCG) on mean scores of 8th grade science students in knowledge area, to find out the effect of formative assessment (SCG) on mean scores of 8th grade science students in comprehension area, to find out the effect of formative assessment (SCG) on mean scores of 8th grade science students in application area. The study was conducted on 60 students of 8<sup>th</sup> grade of Government Girls High School No8 Taunsa of District DG Khan. All female students of tehsil Taunsa of the district DG Khan were taken as population. Study was delimited to female students of 8<sup>th</sup> class of public school of district DG Khan. This study was an Experimental study. Design selected for this study was one group pretest posttest. An academic achievement test was designed as pretest that consists of MCQs, Fill in the blanks, Short questions and Essay type question. This test was validated through of subject experts opinion. Pretest was administered to sample of 60 female students of 8<sup>th</sup> class. After selecting the group, intervention was carried out. SCGs was designed by researchers to teach Experimental group. This SCGs were by validated by subject experts. Researchers used traditional method and SCGs to teach the group. Curriculum was the four chapters from general science of 8<sup>th</sup> grade according to PITB syllabus. During teaching process, the researchers used Structural communication grids along with the traditional method. The researchers taught two topics of the chapter in one week. After two-months researchers conducted achievement test as a post test. Post-test was same as pre-test. Experimental group was taught for a period of 4 weeks starting from December 2022. After completion of intervention post test was conducted. Achievement of Experimental group was analyzed through inferential statistics by using t-test (paired sample t-test). Results of data analysis were represented in different tables. It was found that intervention of SCGs had significant effect on the academic achievement of science students. It was concluded that SCGs was proved to be effective to enhance the academic achievement of students in science.

**Keywords:** Structural communication grid, comprehension, academic achievement, knowledge, application



## Introduction

Assessment is a proper way of collecting data that is used to make decisions about students' academic achievement and curriculum (Capper, 2013). Assessment acts as a window that opens in students and allows the instructor to look inside their students. It is used as a formative assessment to measure students' achievement and provides feedback for both students and instructors for an effective learning environment. The purpose of student assessment is to identify students' knowledge and skills. The result of student assessment can help students achieve in learning. Without assessment, learning cannot be done properly. A new paradigm shift has been observed in this regard as more importance is now being given to assessing students for definite learning rather than testing their learning (Black & Wiliam, 2012). This concept focuses more on the implementation of an assessment called formative assessment in place of summative assessment. At the end of a lesson, unit, course, semester, program, or academic year, summative evaluations are used to find out what students have learned and how well they understand it. Summative evaluations are used to figure out how good a course is by seeing if students have learned the material over a certain amount of time. Summative tests are used to measure how well a student did in school at the end of an instructional period. Formative tests, on the other hand, are used to help students learn because teachers use the results to change and improve how they teach during an instructional period. "When the chef tastes the soup, formative assessment occurs" said expert Paul Black. Summative evaluation happens when the customer takes a bite of the soup. Students' performance on "interim" tests given throughout the learning process can be used to predict how well they will do on "summative" tests like final exams or standardized tests. Formative assessment gives teachers a lot of chances for learners to polish their skills by assessing their individual efforts. Many researches have proven that formative assessment is dominant as it helps students assess their learning (Widiastuti, 2020). Formative assessment refers to a tool for seeing problems and learning gaps. The process of asses the knowledge of study as they learn is known as formative assessment. This is an ongoing assessment technique in which teachers create a series of rapid-fire questions and exercises to track learner progress in the overall course. During the learning process, students will come across many problems; they may find it difficult to grasp a concept. Without formative assessments, it will be difficult for teachers to identify when students are struggling and provide appropriate support.

## Structural Communication Grid

A Structural Communication grid (SCG) is a formative assessment that uses a numbered grid to find out how students think. Different from Multiple Choice Questions (MCQs), in this strategy, students have to choose the boxes that best answer the question and then put them in a logical order. This is why a "Structural Communication Grid" is the name for this technology. The main point about SCG is that it gauges actual learning and points out where students are wrong. Solas (1992) talked about how SCGs can be used for formative assessment. Durmus and Karakirik (2005) thought it could be used instead of MCQ. Traditional assessment



methods focus on finding whether students have got knowledge of concepts or not but is not able to identify anything about how minds of the students work. With the advancements in teaching and learning strategies there are many assessments which claim as tools for learning purpose. Structural Communication Grid is one of such formative assessment which may be used for testing the process of learning.

Structural communication grid is highly effective and innovative formative assessment technique which includes a numbered grid that point out the structures of student's cognitive skills. Learner are likely to select the appropriate boxes in to grid which is considerably different from multiple choice questions and then arrange the answers logically. For that reason, this method is known as a structural communication grid for assessment (Johnstone et al., 2000).

The Structural Communication Grid is used to evaluate student learning comprehensively and highlight the areas in which every student could improve. Highly effective and novel, the structural communication grid uses a numbered grid to highlight the underlying structures of a student's thought processes. As opposed to MCQ questions, where students just fill in the blanks, this method requires them to pick the correct boxes in a grid and then arrange the answers. A structural communication grid is an evaluation method developed for this same purpose (Mallea, 2020). Since students can never be sure how many boxes contain the response, SCG can be used to judge students' conceptual understanding of knowledge by having them choose the correct boxes that have probable answers. While the end outcome is important, SCG is more concerned with how the students are evaluated. One of SCG's most crucial feature is the ability to evaluate student progress (Novitasari et al., 2018).

### **Development of Structural Communication Grids**

First of all, the researchers studied a lot of researchers and found the uses and importance of SCGs. Then found different models of SCGs. After that selected content which were to be taught. Discussion with supervisor led the researchers to develop structural communication Grids from four units of General Science Class 8 level. I searched SCGs in the books of Punjab Text Board, but nothing was found. To develop SCG researchers thought about a question according to the learning outcomes and found appropriate answers. Then the researchers spilted the answers into parts and put them randomly in the grid cell. This process carried on till all the grid cells were filled. Grid followed a series of questions for learners. Learners answered by selecting the number of boxes for each question and then put them in a logical order. (Annexure-XIII) The researchers prepared an SCG on the basis of the first three levels of cognitive level.

### **Size of Structural Communicating Grid**

SCG tests have different sizes according to mind level of the students and cells of grid are selected in SCG depending on the age of the student. There is no specific rule for developing the SCG test size. SCG have different sizes (3x3, 3x4, 4x4), which are developed according to the age level of the learners (Johnstone, 2000). In this research, the researchers used SCGs (2x3) and (3x4).



This study follows the behaviorism theory of psychological learning. The three main supporters of behaviorism, Pavlov, Watson, and Skinner, suggested that "learning is a change in observable behavior caused by external stimuli in an environment." Behaviorists' main concern focused on identifying object traits and previous connections. (Walinga, 2014). Behaviorists' theory focuses on lower-level thinking, like rote memorization and cramming, rather than high-level thinking skills. The researchers used different instruments to determine students' learning achievements. These included pencil and paper tests, essay-type, two or three level diagnostic tests, multiple-choice tests, interviews and free answer tests. The aimed of this study was to find the effect of formative assessment (SCG) test on the performance of 8th grade students.

### **Rationale of the Study**

In Pakistan, there are significant challenges related to education quality, student engagement, and learning outcomes, especially in science education (Sajjad, 2019). Improving academic achievement in science is the need of the hour. Assessment plays a vital role in students' achievement. Much research has been performed on assessment development and improvement, but very little literature is present that addresses the assessment, its methodologies, and its impacts. In Pakistan, we are using a very weak system of formative assessment based on multiple-choice questions. Lack of proper funding, absence of policy execution, faulty examination system, shortage of physical facilities, poor teacher quality training system, and a lack of direction in education are the main issues with Pakistan's education. This assessment is highly criticized and reported to develop faulty reasoning for the answers (Marsh, Roediger, Bjork & Bjork, 2007). Most teachers view teaching and learning as two separate entities (Fullan, 2016). In my view, in spite of this statement of Fullan, 2016 many teachers use formative assessment in their teaching. Science teachers have used different types of formative assessment for many years; even though they know that multiple-choice question tests have some limitations of constructed response, they fail to consider proximate classroom testing (Marsh, 2007).

There is a great need to use advanced techniques of formative assessment to improve the academic achievement of students (Frey & Fisher, 2011). Here, Frey and Fisher also use formative assessment as an assessment tool, whereas my stance is that formative assessment may be used as a learning tool. Some innovative formative assessment techniques include Concept Mapping, Self-Assessment Checklists, Peer Assessment, and Structural Communication Grids. Structural communication grids (SCGs) are designed to monitor student progress during the learning process. It also lessens the cognitive burden, sense of fear, and suspicion generally posed by traditional assessment techniques (Epstein, 2002). SCG is a formative assessment to classical MCQ in which teachers assess students' knowledge and reasoning rather than focusing on the right response or guess. Structural Communication Grids provide clarity, organization, and the use of evidence in students' scientific discussions. It promotes self-reflection and encourages a growth mindset. Along with this, teachers may become able to see the

improvement of students' learning, which ultimately enhances their academic achievement. Additionally, the data collected can inform instructional strategies, enabling educators to tailor their teaching to meet diverse learner needs and ultimately improve student outcomes in science education (Frey & Fisher, 2021). The Researchers in this study intends to find out the effect of formative assessment (SCG) on the academic achievement of 8th-grade science students in the first three levels of the cognitive domain, which is knowledge, comprehension, and application.

### **Statement of the Problem**

In Pakistan, teachers often focus on completing the course content without effectively incorporating formative assessments into the teaching process. This lack of formative assessment is linked with lower student academic achievement in science subjects, as it limits opportunities for students to clarify concepts and improve performance. Mostly traditional assessment is used to assess students' academic achievement. This assessment is highly criticized and reported to develop faulty reasoning for the answers (Marsh et al., 2007). Formative assessment techniques, such as the Structural Communication Grid (SCG), have been shown in the literature to enhance academic achievement by promoting a deeper understanding of learning. The SCG, in particular, is an innovative formative assessment that has been demonstrated to improve student performance in general science. The researchers wanted to use the Structural Communication Grid (SCG) as a formative assessment to solve this problem. Therefore, the researchers wanted to find out the effect of SCG on the academic achievement of 8th-grade Science students.

### **Objectives of the Study**

The objectives of the study were to:

1. Find out the effect of formative assessment (SCG) on the academic achievement of 8th-grade science students.
2. Find out the effect of formative assessment (SCG) on the mean score of 8th-grade science students in the knowledge area.
3. Find out the effect of formative assessment (SCG) on the mean score of 8th-grade science students in the comprehension area.
4. Find out the effect of formative assessment (SCG) on the mean score of 8th-grade science students in the application area.

### **Hypotheses**

**H<sub>0</sub>1:** There was no significant difference among the mean scores of Science Students in pre-test and post-test.

**H<sub>A</sub>1:** There was a significant difference among the mean scores of science students in the pre-test and post-test.

**H<sub>0</sub>2:** There was no significant effect of formative assessment (SCG) on the mean scores of the experimental group in the knowledge area.

**H<sub>A</sub>2:** There was a significant effect of formative assessment (SCG) on the mean scores of the experimental group in the knowledge area.



- H<sub>0</sub>3:** There was no significant effect of formative assessment (SCG) on the mean scores of the experimental group in the comprehension area.
- H<sub>A</sub>3:** Formative assessment (SCG) had a significant effect on the mean scores of the experimental group in the comprehension area.
- H<sub>0</sub>4:** There was no significant effect of formative assessment (SCG) on the mean scores of the experimental group in the application area.
- H<sub>A</sub>4:** Formative assessment (SCG) had a significant effect on the mean scores of the experimental group in the application area.

### Delimitations of the Study

This study has the following delimitations:

- Only Government Girls' high schools in Tehsil Taunsa of the district DG Khan were included in this study
- SCG was used as an intervention.
- SCG was developed on the basis of the first three areas of the cognitive domain of Bloom's Taxonomy.
- Four chapters were selected for the development of SCG of 8th grade General science published by the Punjab textbook board Lahore.
- Structural Communication Grid was the type with rows and columns with grid sizes of ( 2x3) and (3x4) were used for the present study.

### Methodology

This research was a one-group pretest-posttest design. A one-group pretest-posttest design is ideal for my research on the effect of formative assessment on the academic achievement of 8th-grade science students, as it allows for a clear measurement of changes in student understanding before and after the intervention. This design facilitates the establishment of a baseline (pretest). It captures the impact of formative assessments (posttest) within the same group, making it effective for identifying learning gains directly attributable to the intervention

O1	X1	O2
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**O1**= Pre-test in experiment one group.

**X1**= Treatment of one group. (SCG Assessment)

**O2**= post-test in the Experimental group.

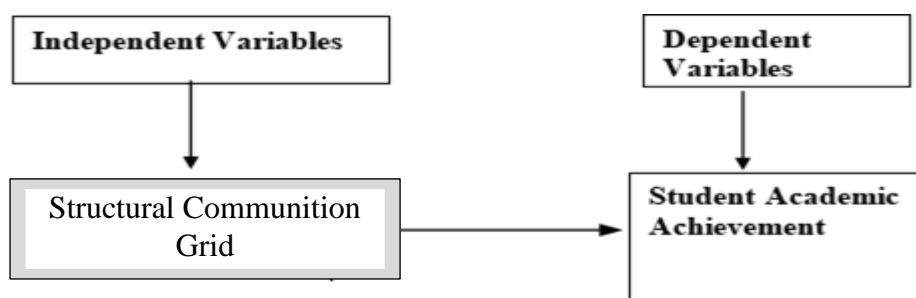
### Sample and Sampling Technique

The researchers selected 60 students as a sample from the population. For the selection of the sample every school was assigned a unique number then researchers selected one school out of 56 schools through lottery method. GGHS NO 8 Taunsa was selected for the present study. There was one section of 8<sup>th</sup> grade science student in GGHS NO 8. Total students were 60 in 8<sup>th</sup> grade of GGHS NO 8. Researchers selected 60 students as a sample. After seeking permission from the

head of the selected school consent from parents were sought through letters.

### Conceptual Framework

Concept of study and perspective of researchers about the variables of this study was shown in In this study, there were two variables i.e., dependent variable and independent variable. Dependent variable was academic achievement of students. The independent variable was SCG used as Formative Assessment.



There were pretest and post-test used as tool and data were collected through pretest and posttest before and after the intervention. Self-developed research tool was used for pretest and posttest from four units of general science of class 8<sup>th</sup>.

The researchers designed an achievement test to assess student achievement. The achievement test covers the learning outcomes of lower levels of cognition domain to measure actual achievement . The researchers prepared an achievement test on the basis of first three level of cognitive level. Table of specification was used for tool development to align the questions with learning objectives. Researcher developed the pool of test items. Initial item pool was 20 for MCQs. After Experts opinions and item analysis 10 items were selected. The test consists of a total of 40 marks. The achievement test consisted of 10 short questions, 10 multiple choice questions, 5 fill in the blanks and one essay type questions. Weightage of cognitive domain in Achievement test are Knowledge (24%), Comprehension (53%) and Application (23%). In the Achievement test 10 items are in knowledge level ,7 items are in comprehension level and 3 items are in application level. The achievement test covered four chapters of general science. Researcher reviewed the test two or three times. Key for test items and rubric for short answers developed by researchers.

### Validity and Reliability

Pretest and posttest developed by researchers in the form of MCQs, Fill in blanks and short questions. Content validity of items in test were ensured through expert opinion. Test provided to five experts of science with MPhil degree, and five-year experience of teaching Elementary classes with professional degree Test revised in the light of their suggestions. Researchers checked the reliability of items using test-retest approach. For pilot testing 120 students of GGHS Taunsa were selected , these students were not part of sample but they were the part of population. The academic achievement test was



taken from them in two different times (with the gap of 15 days). Then scores were collected and compared to analyze the correlation between results. Pearson Coefficient value was calculated, and it was 0.81. It has shown that test is reliable to use.

### **Development of SCG**

To develop SCG researchers thought about a question according to the learning outcomes and found appropriate answers. Then the researchers spilted the answers into parts and put them randomly in the grid cell. This process carried on till all the grid cells were filled. Grid followed a series of questions for learners. Learners answered by selecting the correct number of boxes in logical order for each question (Annexure-XIII). The researchers prepared an SCG on the basis of first three level of cognitive level. The researchers developed an 8 SCG of size (3 x 4) and 16 SCGs of size (2x3) . Each (3x4) SCG consisted of 10 item pools. Total marks of the SCG (3x4) was 10. All SCGs were developed from the content of four chapters. The researchers developed twenty four lesson plan in which SCGs were used. (Annexure-XIV)

The researchers developed 8 SCG (3 x 4) and 16 SCGs (2x3) . Each (3x4) SCG consisted of 10 item pools. The selected content was four chapters (force and pressure, measurement of physical Quantities, Sources and effect of heat energy, Lenses) from 8<sup>th</sup> grade of general science textbook. Content validity of SCG was ensured through five experts of science which have minimum experience of five years to teach Elementary level with MPhil degree in science subject (Annexure-XVI). Before intervention the researchers utilized three days for introductory session. In that session prior knowledge of General science subject of 8<sup>th</sup> class and the problem of students relating to General science were discussed. On fourth day pretest was conducted by the researchers. Permission was taken from administration before start of study. Researchers taught Experimental group by Traditional method. Pretest was conducted before start of the intervention. After intervention of SCGs for 8 weeks posttest was conducted.

Data were collected through pretest , posttest. Information got through SCGs were utilized to improve the teaching and learning process. Data were analyzed through inferential statistics. Paired t-test was used to calculate mean scores. Level of significance for all hypotheses was 0.05.

### **Literature Review**

#### **Alternative Assessment**

Alternative Assessment was developed with the aim of enhancing the academic system. Diagnostic Tree Testing, Word Association Test, the Predict-Observe-Explain Method, Mind Maps, and SCG are some of the most often utilized alternatives to traditional methods of assessment. There has been a significant uptick in the usage of non-traditional methods of testing pupils' knowledge and understanding (Boraie, 2018). Multiple-choice tests and similar conventional methods of knowledge evaluation ask solely about certain facts or concepts assumed to be known by the test taker. This type of assessment depends upon the style of the assessor, but very often,



students use rote memorization rather than employing cognition in the learning process. Those exams reveal nothing about a student's capacity to retain information or their mental framework for understanding new material (Gikandi, 2011). Though convenient, this setup has a number of drawbacks that need to be addressed. These include the subjective nature of assessments, the possibility of inadequate feedback, and the lengthy effort required to score (Andersson & Palm, 2018).

### **Alternative Assessment Techniques**

This is an assessment method that measures a learner's ability in a specific topic rather than their level of knowledge of the topic. The objective of alternative assessment is to enable the learner to present their knowledge. Following are the most commonly used alternative assessment techniques: Diagnostic Tree Testing, Word association Test, Test–Teach–test technique, dynamic assessment technique, predict-observe-explain, Mind Maps, and Structural Communication Grids. As a revolution and advancements in assessment techniques and embedding assessment with the teaching-learning process, alternative assessment techniques are well used for assessing the full knowledge of students' minds. Structural communication Grid, which is an alternative assessment technique, is used to assess students' learning fully and draws attention to each student's weakness. Students who do not pay full attention in class will not be able to understand the lessons, which can lead to misunderstandings fully. Instead of testing what students have learned, it is now more common to evaluate them in order to improve the quality of their education. This demonstrates the significance of using alternate formative assessment techniques in place of summative evaluation.

### **Structural Communication Grid**

Structural communication Grids and their assessment procedures have promoted the production of knowledge in comparison to traditional assessment techniques (Gamor, 2006). According to (Durmas, 2005), a structural communication grid is best practice for student achievement in learning because students become more conscious of their own needs, as well as the needs of others. A group of scientists have used the structural communication Grid to measure Students' attitudes toward chemistry and found that their motivation increased as their skills developed (Leake et al., 2002). Herman & Winters (2015) identified the common characteristics of the Structural communication Grid as allowing pupils to try someone innovative, develop higher thinking skills based on understanding, solve difficulties, get responsibility, and complete tasks. For interaction in the real world and making more logical decisions for better evaluation, a structural communication Grid is best (Corcoran et al., 2004).

It has also claimed that a structural communication Grid would make evaluation more adaptable and generate favorable outcomes in learning. SCG is an alternative assessment method aimed at assessing student meaningful learning and highlighting insufficiencies and problems in the cognitive structure of the knowledge acquired by the student (Bahar et al., 2000). The objective of this study was to investigate the effect of formative assessment (SCG) on academic achievement in



science students.

In the literature, different methods have been described to measure student Achievement in science subjects. The most commonly used method is M C Q S because they are marked objectively and practically. Oberoi did a study that covered a range of tools used by researchers to measure students' achievement in 2017.

### Structural Communication Grid as a Formative Assessment

Durmuş and Karakirik (2011) present the development of a computerized tool for Structural Communication Grids (SCGs) to enhance educational assessment. The study highlights the limitations of traditional multiple-choice tests in capturing students' reasoning and conceptual understanding. SCGs address this by requiring students to organize and relate information within a grid, allowing for a deeper evaluation of their cognitive processes. They emphasized how SCGs effectively reveal students' conceptual understanding by requiring them to organize and relate information sets rather than merely identifying correct answers.

Ahmad, Sultana, and Jamil (2017) investigate the effectiveness of Structural Communication Grids (SCGs) as an alternative assessment tool in 9th-grade biology students. The study assesses the impact of SCGs on students' academic performance, highlighting their ability to promote deeper understanding and retention of biological concepts. By requiring students to organize and relate information, SCGs offer a more comprehensive assessment compared to traditional methods. The study highlights how SCGs offer a more interactive and diagnostic approach to assessment compared to traditional methods, allowing educators better to identify students' strengths and areas for improvement. The findings suggest that SCGs can be a valuable tool in improving science education outcomes. The research concludes that SCGs can significantly enhance students' learning outcomes by fostering critical thinking and improving conceptual clarity in science education.

Aydin (2016) examined the effectiveness of SCGs in diagnosing students' misconceptions in chemistry. The research highlighted how SCGs helped in developing an understanding of chemistry concepts and improved overall academic performance. This approach aligns with the broader goal of fostering autonomous learning and improving educational outcomes in university settings. The article argues that SCGs can be a valuable strategy for fostering student-centered learning, encouraging greater interaction with course material, and improving overall educational outcomes.

### DATA ANALYSIS AND INTERPRETATION

**Table 1**

*Comparison of Pre-test and Post-test on Experimental Group for Student's Achievement*

Group	N	Mean	SD	t	p
Pretest	60	11.1	4.3	19.8	0.00
Posttest	60	34.2	3.08		



Table 1 showed 11.1 was the mean in pretest marks of Experimental group and 34.2 were the mean in posttest marks of Experimental group. 4.3 was the standard deviation of pretest marks of Experimental group and 3.08 in posttest marks of Experimental group. P-value 0.00 was founded to be smaller than significance that is 0.05 so it showed that hypothesis was rejected. It indicates that there was significant difference in students achievements on pretest and posttest of Experimental group. Therefore hypothesis “There was no significant difference among the mean scores of Science Students in pre-test and post-test” was rejected and alternate hypothesis “There was significant difference among the mean scores of Science Students in pre-test and post-test” was accepted.

**Table 2**

*Comparison of Mean Scores of Experimental group in knowledge Area on Pre-test and Post-test mark*

<i>Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-value</i>	<i>p-value</i>
<i>Pretest</i>	<i>60</i>	<i>4.5</i>	<i>0.89</i>	<i>17.9</i>	<i>0.00</i>
<i>Posttest</i>	<i>60</i>	<i>8.4</i>	<i>1.105</i>		

For finding the significant difference among the achievements of students on pretest marks and posttest marks of Experimental group in knowledge area the paired sample t test was applied through SPSS. Table 2 showed the mean of both groups. 4.5 was the mean of pretest marks and 8.4 was the mean of posttest marks. 0.89 was the standard deviation of pretest and 1.105 was the Standard deviation of posttest.

P-value 0.00 was founded to be smaller than significance or alpha value that is 0.05 so it showed that null hypothesis was rejected. It indicates that there was significant difference among pretest and posttest of Experimental group regarding their marks after Experiment. So null hypothesis “There was no significant effect of formative assessment (SCG) on mean scores of Experimental group students in knowledge area” was rejected and alternate hypothesis “There was significant effect of formative assessment (SCG) on mean scores of Experimental group students in knowledge area” was accepted.

**Table 3**

*Comparison of Experimental Group Students on Pretest Marks and Posttest Marks on Comprehension Area*

<i>Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t</i>	<i>p</i>
<i>Pretest</i>	<i>60</i>	<i>3.4</i>	<i>2.5</i>	<i>24.6</i>	<i>0.00</i>
<i>Posttest</i>	<i>60</i>	<i>19.3</i>	<i>1.8</i>		

For finding the significant difference among the achievements of students on pretest marks and posttest marks of Experimental group in comprehension area the paired sample t test was applied through SPSS. Table 3 showed the comparison of

mean of pretest marks and posttest marks of Experimental group.

P-value for pretest and posttest was 0.00 that was less than significance or alpha value 0.05 so it showed that null hypothesis Ho3 “ There was no significant effect of formative assessment (SCG) on mean scores of Experimental group students in comprehension area ” was rejected and alternate hypothesis “There was significant effect of formative assessment (SCG) on mean scores of Experimental group students in comprehension area” was accepted. Mean and standard deviation of pretest is 3.4 and 2.5 respectively, whereas mean score and standard deviation of of posttest is 19.3 and 1.8. Therefore, there was significant difference among scores of pretest marks and posttest marks of experimental group students in comprehension area that indicated that academic achievement of students of Experimental group enhanced on posttest .

**Table 4**

*Comparison of Experimental Group Students on Pretest and Posttest on Application Area*

<i>Group</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Pretest	60	3.2	1.9	5.5	0.00
Posttest	60	6.4	1.7		

For finding the significant difference among the achievements of students on pretest and posttest of Experimental group in application area the paired sample t test was applied through SPSS. Table 4 showed the comparison of mean of Experimental group on pretest marks and posttest marks. P-value for pretest and posttest is 0.000 that is less than significance level 0.05. Mean of pretest marks was 3.2 whereas mean of posttest marks was 6.4. Standard deviation of pretest was 1.9 and posttest was 1.7.

Therefore there was significant difference among scores of pretest and posttest. Academic achievements of students of Experimental group were also enhanced on posttest. Null hypothesis 4 “There was no significant effect of formative assessment (SCG) on mean scores of experimental group students in application area” was rejected and alternate hypothesis “There was significant effect of formative assessment (SCG) on mean scores of Experimental group students in application area” was accepted.

## **Discussion**

In hypothesis H<sub>0</sub>1, mean scores of Experimental group were compared on pretest and aim of this study was to investigate the effect of formative assessment (SCG) on the academic achievement of science students of 8<sup>th</sup> grade in district DG Khan. Findings of this study are in line with Shahzad & Naveed (2019), who conducted a study on the Investigating the Effect of Structural Communication Grids as Conceptual Change Strategies on Student’s Academic Achievement in Biology at Secondary Level. They used quasi Experimental, nonequivalent control group design. They found that there was great difference between the mean scores of



Experimental group before and after Experimental as compared to control group. Effect of Structural Communication Grids was improved students' Academic Achievement in Biology at Secondary Level.

This study supports the findings of EB Kirikkaya (2011) who argued that students assessed by SCG achieved significantly high scores than the students who were not assessed by SCG. The students of control group also showed improvement in their achievement but their achievement was less than the achievement of Experimental group. The mean score of control group was also less than the mean score of Experimental group. Positive correlation was found between the mean scores that the students in the Experimental group. Similarly, in this study, it was found through statistical analysis that present area of achievement through formative assessment of science student of 8<sup>th</sup> grade students was low. Formative assessment through SCG enhanced student's cognitive level of knowledge, comprehension and application area.

Another study was conducted by Duban & kucukyilmaz (2008), titled as "The Opinions of Primary School Teachers Regarding the use of Structural Communication". In this study, the qualitative research method was used. In this study interview technique was used. The Sampling method was used Criteria Sampling. In this research, the participants were selected from high, medium, and low socio-economic levels schools. Twenty primary school teachers were selected as participants of the working group. Findings showed that most of primary school teachers use prepared structural communication grid techniques to increase the achievement level of the students. These findings are supported by present study as SCG also enhanced the academic achievement of students.

Findings of this study verified the results of research, The Conceptual Understanding and Attitude towards Algebra at Secondary School Level. This study was conducted by Shamsa Aziz & Zarina Akhtar (2019). 500 students were selected as sample of the study. An attitude scale and a test based on Structural Communication Grid were used as research instruments. They concluded that these instruments enhanced the academic achievement of students in algebra. As in this study, SCG improved the academic achievement of students.

## Conclusions

The following conclusions were drawn on the basis of findings.

1. The findings of the Posttest showed that mean scores of experimental group were better after intervention of structural communication grids. The data represented in Table 1 depicts that p-value 0.00 was founded to be smaller than significance value that is 0.05. Therefore it is concluded that teaching with SCGs has improved overall achievement of 8th grade science students
2. In the knowledge area the results of the Posttest showed that mean scores of experimental group were better after intervention of structural communication grids. The data represented in Table 2 depicts that P-value 0.00 which was smaller than significance value that is 0.05. Therefore, it is concluded that knowledge of science has improved by the use of SCGs as formative



- assessment for 8th grade science students
3. In the comprehension area the results of the Posttest showed that mean scores of experimental group were better after intervention of structural communication grid. The data represented in Table 3 depicts that the p-value was 0.00 which was smaller than significance value that is 0.05. Therefore, it is concluded that most prominent effect was observed in comprehension area by the use of SCGs as formative assessment for 8th grade science students
  4. In the Application area the results of the Posttest showed that mean scores of experimental group were better after intervention of structural communication grid. The data represented in Table 4 depicts that the p-value was 0.00 which was smaller than significance value that is 0.05. Therefore it is concluded Teaching through (SCG) has positive effect on 8th grade science students in enhancing their ability to apply learned concepts

### Recommendations

In the light of the findings and conclusions of this study, following recommendations are suggested to improve teaching and learning process.

1. Science students performed better as a result of intervention with structural communication grids in academic achievement. Therefore, it is recommended that SCG may be used as a formative assessment along with innovative teaching methods.
2. Department of Education Punjab may conduct trainings to introduce the use of SCGs especially for science teachers in Pakistan.
3. It is recommended that SOLO-based SCGs may be included in science textbooks at middle level to develop students' comprehension of knowledge

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