JIES *Journal of Interdisciplinary Educational Studies*
March 2021,V (I), 14-28

Students' Achievement Scores in Mathematics and Science in during Last Half Decade in Punjab, Pakistan

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Abstract

Govt. of the Punjab taking many initiatives and reforms in school education system including: a) recruitment of new teachers, mentoring and monitoring, provision of Non-Salary Budget (NSB), induction, in-service and promotion link trainings of teachers etc. It seems that Govt. resources are not utilizing in true sense. There are many factors that affect students' learning. In general, curriculum and teaching strategies are the main factors. Examination and Assessment data of Punjab Examination Commission (PEC) explored that 5th grade students' performance in written papers of math and science is almost static and less than 45% and overall (both written and multiple choice) in mathematics and science is 57% and 51% respectively since 2015 while 8th grade students' performance in written papers and overall (both written and multiple choice) of math and science is almost static and less than or almost equal to 50% since 2015. Assessment Data of National Education Assessment System (NEAS) and results of TIMSS 2019 also aligned with these results.

Keywords: *Assessment, Results, Students' Performance*

Introduction

The Assessment Policy Framework (APF) 2019 is focused on a shift from assessment as an end in itself towards assessments that support and encourage learning at all levels of the system. This is aligned with the Government of the Punjab's vision for school education as outlined in the New Deal 2018-2023. The purposes of diagnostic assessment through which to gauge the performance of the education system (student, and the contributing factors surrounding the student) identified in this policy.

Students' performance is one of the major indicator in assessing the quality of Education. Determinants of students' performance have been the subject of ongoing debate among educators, academics, and policy makers. School Education Department (SED) is taking many initiative to improve overall education system especially students learning. Department focused on teachers recruitment and appointed many new science and math teachers during last 6 years. These newly recruited teachers are highly educated and department provided them induction and in-service trainings.

National Education Assessment System (NEAS) and its associated centres in the Provinces (Provincial Education Assessment Centres PEACEs) and Areas (Area Education Assessment Centres – AEACs) were established to*"build assessment capacity at the school, provincial and federal levels to better measure learning outcomes and improve the quality and effectiveness of programme interventions"* and announced its first assessment results in 2005. (NEAS, 2005). Punjab PEACE was renamed as Punjab Education Assessment System (PEAS) and finally merged into Punjab Examination Commission (PEC) in 2014. The main purpose of assessment in Punjab and Pakistan is:

1. **Informing Policy:** the extent to which geography and gender are linked to inequality in student performance.
2. **Monitoring Standards:** how well the curricula are translated into knowledge and skills;
3. **Identifying correlates of achievement**: the principle determinants of student performance and how resource allocation might be re-directed
4. **Directing Teachers' Efforts and Raising Students' Achievements:** Assisting teachers to use data to improve student performance (NEAS, 2005-2019 and PEAS, 2011).

Now School Education Department (SED), Govt. of the Punjab has approved "Assessment Policy Framework (APF) 2019" and start to implement in phase manner since 2020. The main purpose of the APF is:

a. System-level diagnosis of performance at various levels (from student and school up to district and provincial levels)
b. Measurement of change and progression/regression in learning competencies

c. Provision of specific feedback to the SED and its line departments (QAED and PCTB, in addition to PEC) on system and school/student strengths and weaknesses to support educational achievement journeys
d. Support to teachers through key feedback loops for continuous and needs-responsive improvement and adjustment in teaching practices
e. Support to actors across learning system in the development, implementation and analytical use of assessments to institute stronger teaching and learning practices
f. Guidelines for the province in its adoption of global best practices for assessments, as and when required by the Punjab (APF, 2019).

Methodology

Meta-analysis of exams of grade 5 and 8 conducted by Punjab Examination Commission (PEC) and large scale assessment studies conducted by National Education Assessment System (NEAS) and Punjab Examination Commission (PEC) in Punjab and Pakistan participated in international assessment study "Trends in Mathematics and Science Study". These reports are available on websites of NEAS, PEC and TIMSS and also in printed form.

Rationale

Govt. of the Punjab taking many initiatives and reforms in school education system including: a) recruitment of new teachers, mentoring and monitoring, provision of Non-Salary Budget (NSB), induction, in-service and promotion link trainings of teachers etc. It seems that Govt. resources are not utilizing in true sense. SED has to point out reasons for students' continuous poor performance in math and science. PEC's study "Provincial Assessment of Students' Learning (PASL) 2018-2019 has explored that students' of grade 4 are showing poor performance in concepts of math and science. One recommendation for teachers is: "Clarify students' Math concepts especially focus on Fractions, Geometry and Information Handling and Science concepts especially focus on Life Science, Physical Science and Earth Science and help students to learn English in easily way".

Significance

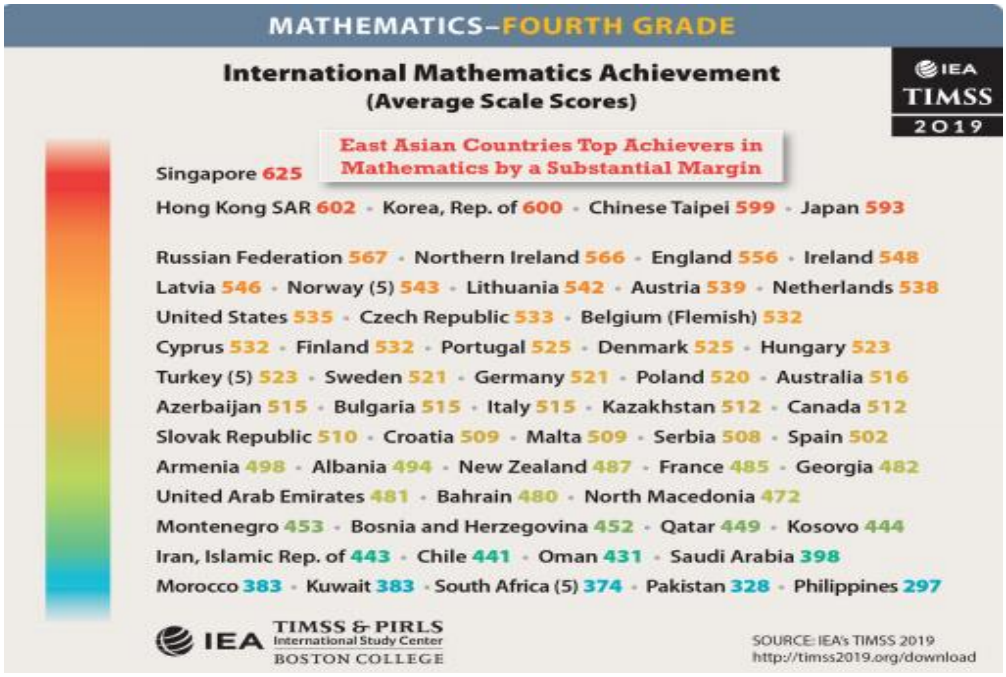
This study may helpful to:

a. In-service (e.g. QAED) and pre-service (Universities etc.) teacher training institutions for making more effective their content based and skill based training programs
b. Curriculum and textbook developing institutions (e.g. PCTB) to revise textbooks and make them according to students' psychological needs
c. School Education Department to take meaningful initiative for improving students' learning

Analysis of TIMSS Report 2019

Pakistan participated in international assessment TIMSS 2019 and it results are announced on 8th December 2020. The measuring scale is 0 to 1000. The results are analyzed using Item Response Theory (IRT).

Figure No.1: Comparison of Mathematics Achievement Scores (TIMSS Report 2019)



It is appreciable that Pakistan participated in international assessment first time. Figure No. 1 explored that Pakistan's achievement score in mathematics is 328 on a scale of 0 to 1000 with mean 500. It is also explored that Pakistan stood at 2nd last position among 58 participating countries. In bird eye view, no Muslim country achieved mean 500 of the scale score even there are much many rich countries are in TIMSS study. These results are also aligned with results of Punjab Examination Commission (PEC) of grade 5 and grade 8 during last decade.

Figure No.2: International Trends in Mathematics Achievement Scores

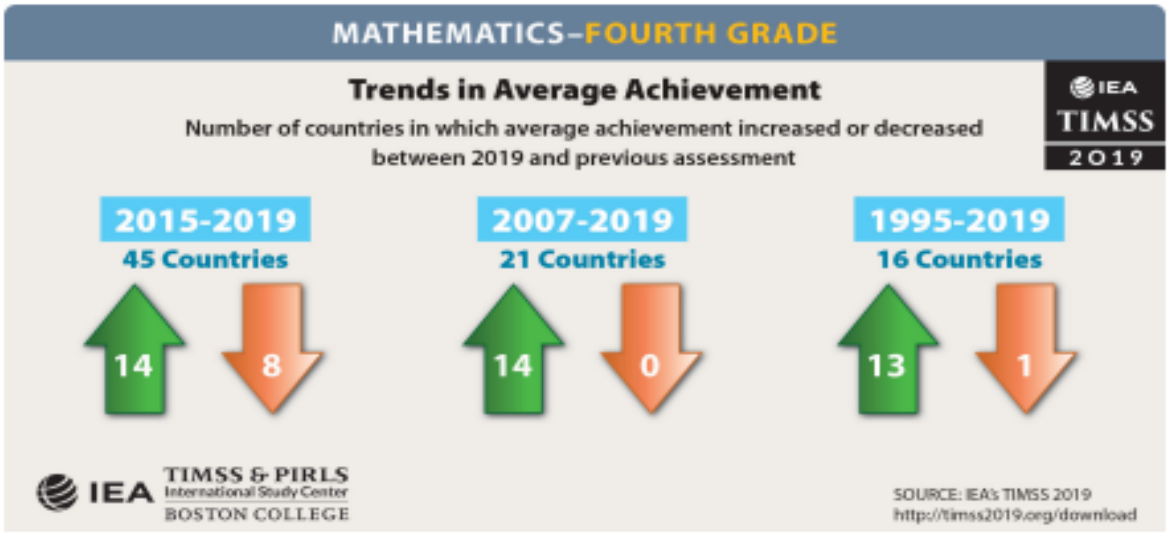


Figure No. 2 explored international trends in mathematics achievement results. A decline is seen in the trends of average achievement scores of TIMSS participating countries.

Figure No.3: TIMSS Benchmarks in Mathematics Achievement Scores

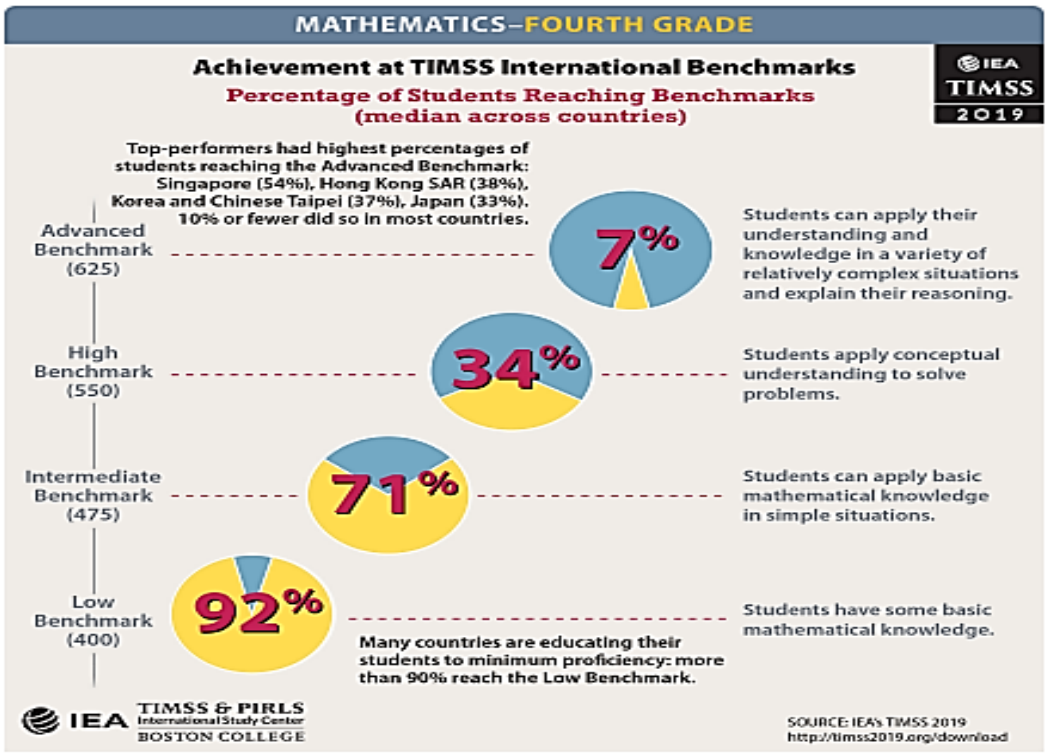


Figure No. 3 explored that Pakistan is standing below the "Low the TIMSS Benchmark for Mathematics". It means that Pakistani students are struggling for minimum proficiency in mathematics at the movement. There is still needed (400-328=72) increase in average mathematics score to reach this low benchmark of minimum mathematics proficiency. At present, students of grade 4 are showing only some basic mathematical knowledge only.

Figure No.4: Comparison of Science Achievement Scores (TIMSS Report 2019)

Figure No. 4 explored that Pakistan's achievement score in mathematics is 290 on a scale of 0 to 1000 with mean 500. In align with mathematics results of TIMSS 2019, Pakistan again stood at 2nd last position among 58 participating countries. In bird eye view, no Muslim country achieved mean 500 of the scale score even there are much many rich countries are in TIMSS study. These results are also aligned with results of Punjab Examination Commission (PEC) of grade 5 and grade 8 during last decade.

Figure No.4: International Trends in Science Achievement Scores (TIMSS Report 2019)

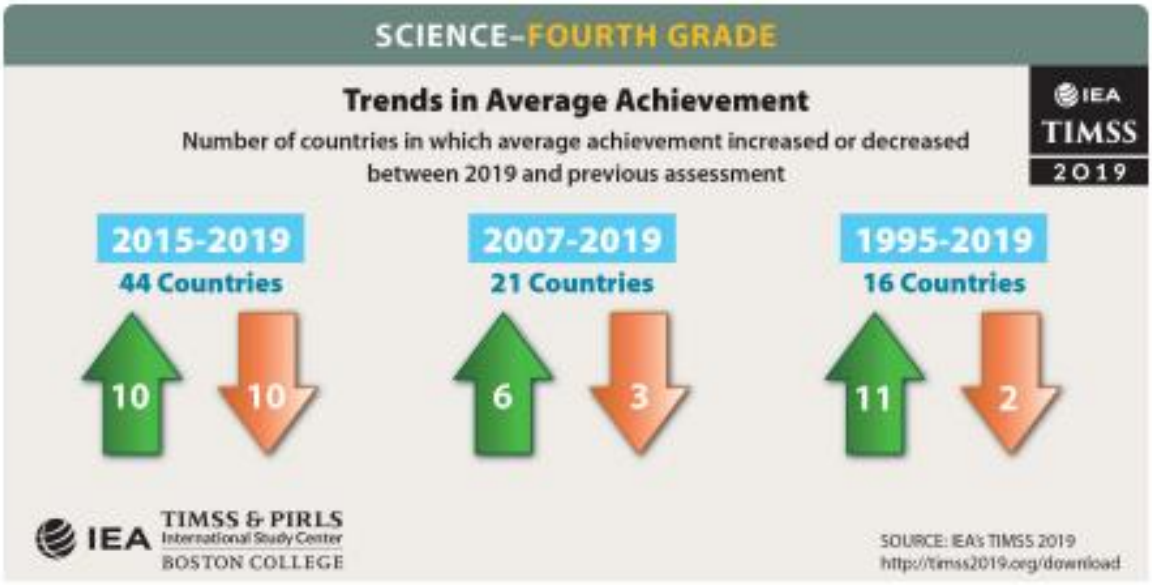


Figure No. 4 explored international trends in science achievement results. A decline is seen in the trends of average achievement scores of TIMSS participating countries.

Figure No.3: TIMSS Benchmarks in Science Achievement Scores (TIMSS Report 2019)

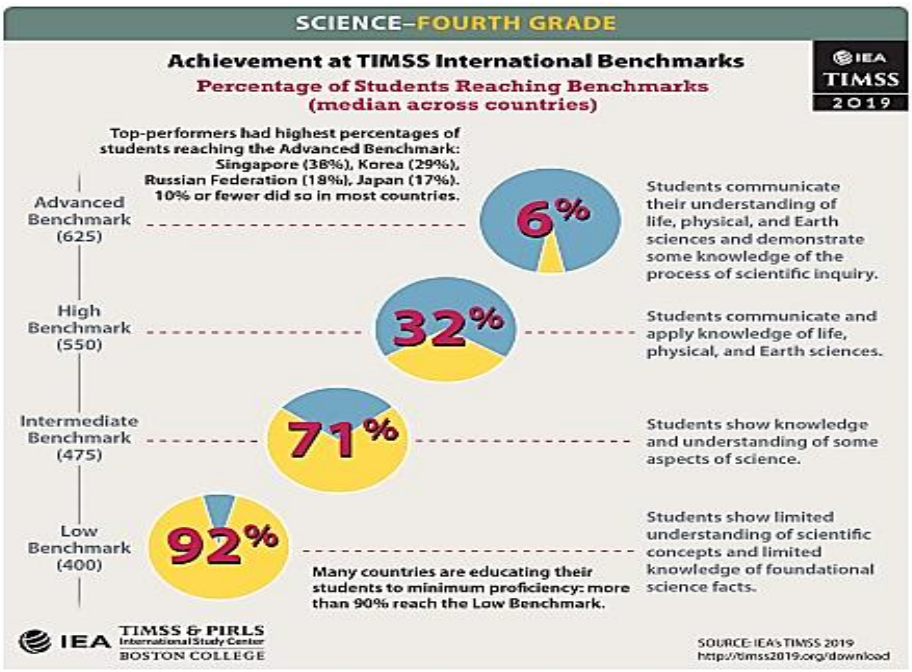


Figure No. 3 explored that Pakistan is standing below the "Low the TIMSS Benchmark for Science". It means that Pakistani students are struggling for minimum proficiency in Science at the movement. There is still needed (400-290=110) increase in average science score to reach this low benchmark of minimum science proficiency. At present, students of grade 4 are not even showing limited understanding of scientific concepts and limited knowledge of foundational science facts.

Analysis of NEAS Reports

National Education Assessment System (NEAS) conducts national achievement testing (NAT) almost in periodically manners. The findings of NAT-2017 are shown in figure No. 6 and 7. The findings explored that students' mean achievement score (484) in mathematics still not reached at mean scale score 500. Only Punjab province is slightly above this mean score. These results are better than TIMSS 2019 results. The difference may be due to construction of Mathematics Assessment Instrument as TIMSS instruments are stimulus based.

Figure No.7: Comparison of Mathematics Achievement Scores (NAT- 2017)

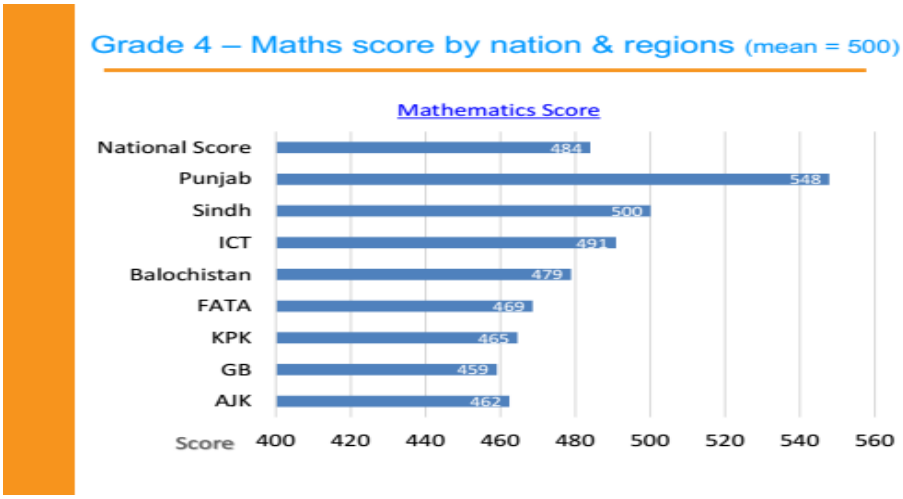
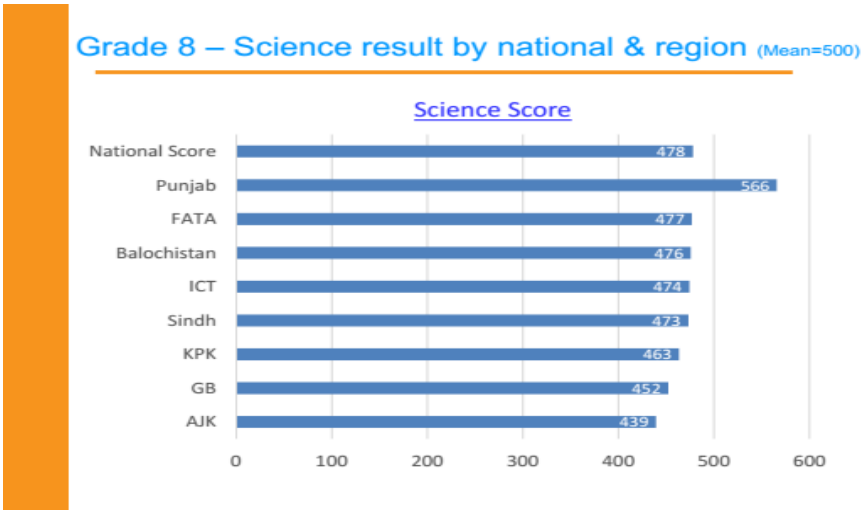


Figure No.8: Comparison of Science Achievement Scores (NAT- 2017)



The findings explored that students' mean achievement score (478) in science still not reached at mean scale score 500. Only Punjab province is slightly above this mean score. These results are better than TIMSS 2019 results. The difference may be due to construction of Science Assessment Instrument.

Analysis of PEC Reports

PEC has comprehensive exam data set, especially, since from its restructuring 2014. About 1.0 million to 1.4 million students are registered for PEC exam of grade 8 every year. The exam data analysis of these students explored that students' performance in written papers and overall (both written and multiple choice) of math and science is almost static and less than or almost equal to 50% since 2015 in PEC exams of grade 8.

Figure No.9: Comparison of Overall Year-Wise Science and Mathematics Achievement Scores of Grade 8 (Source: PEC Exam Reports 2016-2020)

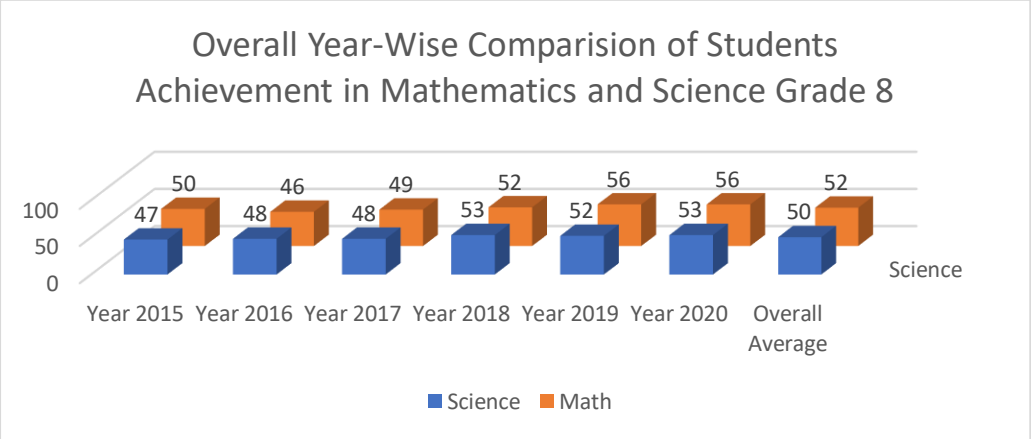
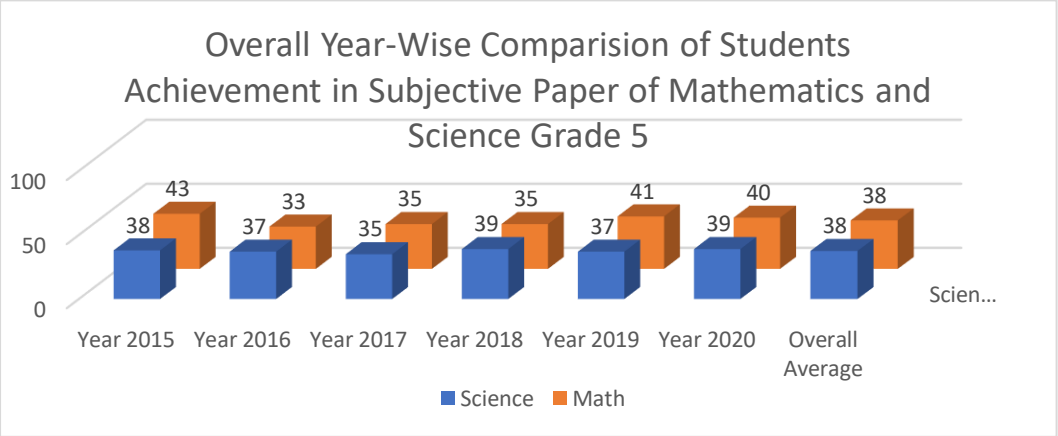


Figure No.10: Comparison of Overall Year-Wise Science and Mathematics Achievement Scores in subjective papers of Grade 5



The exam data analysis of these students explored that students' performance in written papers of math and science is almost static and less than 45% and overall (both written and multiple choice) in mathematics and science is 57% and 51% respectively since 2015 in PEC exams of grade 5.

Figure No.9: Comparison of Overall Year-Wise Science and Mathematics Achievement Scores of Grade 5 (Source: PEC Exam Reports 2016-2020)

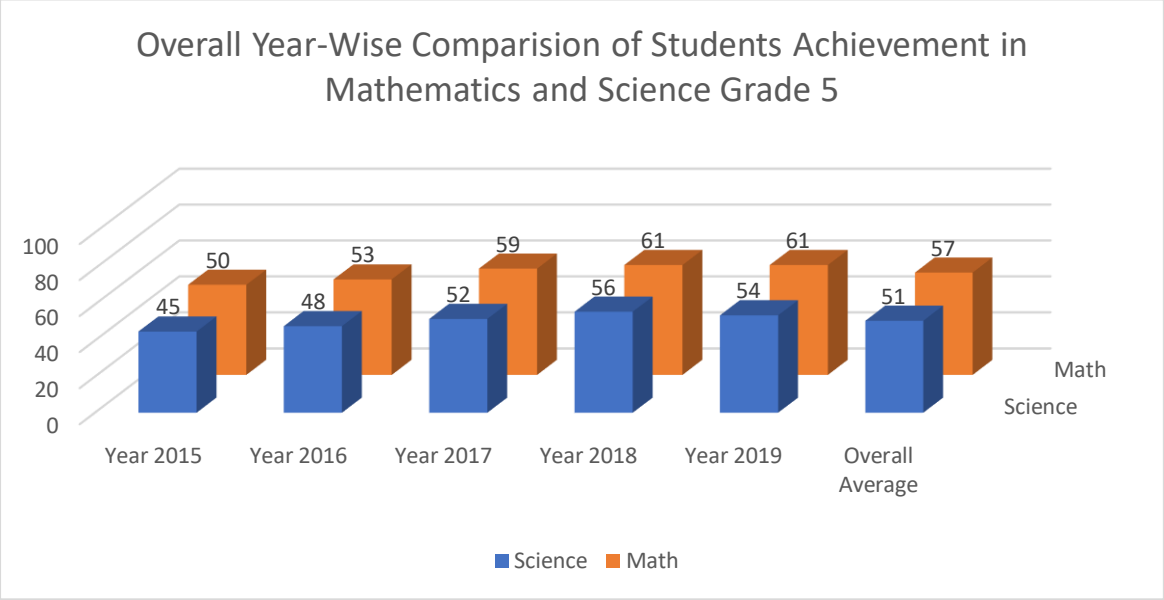
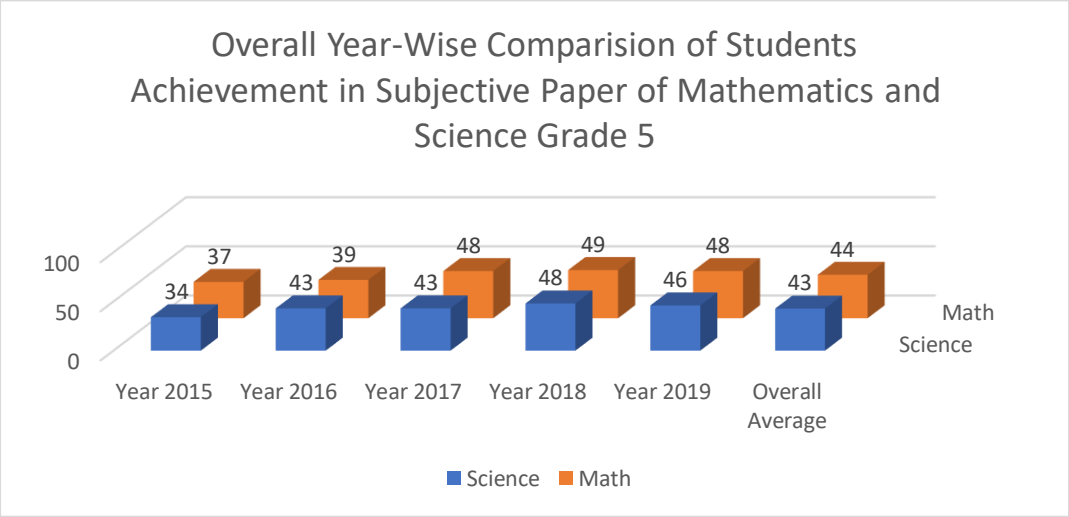


Figure No.10: Comparison of Overall Year-Wise Science and Mathematics Achievement Scores in subjective papers of Grade 5 (Source: PEC Exam Reports 2016-2020)



Comprehensive analysis of PEC exam analysis reports identified weak SLOs in the subject of Mathematics and Science on which students are struggling for better performance.

Students are not performing well on the Following Students Learning Outcomes (SLOs)

Weak SLOs Grade 8, 2016-2018	
Year 2018	Subject
Solve real life problems involving two simultaneous linear equations in two variables.	Mathematics
Find percentage discount.	Mathematics
Calculate mean waited mean, median and mode for un grouped data.	Mathematics
Solve real life problems regarding life and vehicle	Mathematics
Construct a kite when two unequal sides and a diagonal are given.	Mathematics
Describe the measures of central tendency.	Mathematics
Describe the following relations between the pairs of angles when a transversal intersects two parallel lines. · Pairs of corresponding angles are equal. · Pairs of alternate interior angles are equal. ·Pair of interior angles on the same side of transversal is supplementary, and demonstrate them through figures	Mathematics
Verify commutative and associative laws with respect to union and intersection.	Mathematics
Construct frequency table.	Mathematics
Convert Pakistani currency to well-known international currencies.	Mathematics
Demonstrate union and intersection of three overlapping sets through Venn diagram.	Mathematics
Demonstrate the following properties of a parallelogram. • Opposite sides of a parallelogram are equal.	Mathematics

• Opposite angles of a parallelogram are equal. • Diagonals of a parallelogram bisect each other.	
Design and demonstrate the working of a power station.	Science
Plan and conduct a campaign that can help reduce air pollution in their environment.	Science
Compare characteristics related to ear and eye color.	Science
Explain how lenses are used to correct short sightedness and long sightedness.	Science
Compare and contrast the working of a human eye with the lens camera.	Science
Explore the effects and applications of expansion and contraction of solids.	Science
Year 2017	
Solve real life problems involving two simultaneous linear equations in two variables.	Mathematics
Construct a histogram representing frequency table.	Mathematics
Construct a regular hexagon when a side is given.	Mathematics
Construct a rectangle.	Mathematics
State and apply Hero's formula to find the areas of triangular and quadrilateral regions.	Mathematics
Define the term pressure.	Science
Investigate the processes making use of thermal expansion of substance.	Science
Identify the simple devices that generate electricity in daily life.	Science
Design and demonstrate the working of a power station.	Science
Investigate how eyes get used to darkness after sometime.	Science
Compare and contrast the working of a human eye with the lens of camera.	Science
Year 2016	
Solution of Simultaneous Linear Equations: Solve real life problems involving two simultaneous linear equations in two variables.	Mathematics
Frequency Distribution: Construct frequency table.	Mathematics
Describe the term atmospheric pressure.	Science
Explain how genes are introduced into a bacterium.	Science
Differentiate between mitosis and meiosis.	Science
Describe the properties of acids, alkalis and salts.	Science
Describe the importance of exothermic reactions in daily life.	Science
Draw and label human excretory system.	Science
Describe the image formation using a lens by ray diagram.	Science
Suggest the ways to solve the problems that have resulted from space exploration.	Science

Weak SLOs Grade 5, 2016-2018	
Year 2018	Subject
Read a simple bar graph given in horizontal and vertical form.	Mathematics
Solve real life problems involving direct and inverse proportion (by unitary method).	Mathematics
Investigate that light travels in a straight line.	Science
Suggest ways to reduce the impact of non-biodegradable materials.	Science
Describe the role of evaporation and condensation in the water cycle.	Science
Explain the production of static electrical charges in some common materials.	Science

Explain the impact of non-biodegradable materials on the environment.	Science
Year 2017	
Solve appropriate problems of perimeter and area.	Mathematics
Solve real life problems involving conversion, addition and subtraction of units of temperature.	Mathematics
Explain the impact of non-biodegradable materials on the environment.	Science
Year 2016	
Solve real life problems involving conversion, addition and subtraction of units of time.	Mathematics
Solve real life problems involving conversion, addition and subtraction of units of temperature.	Mathematics
Define and identify direct and inverse proportion.	Mathematics
Solve real life problems involving mixed operations of addition, subtraction, multiplication and division.	Mathematics
Solve real life problems involving multiplication of fractions.	Mathematics
Describe the properties of the three states of matter on the basis of arrangement of particles.	Science
Investigate and describe how living things affect and are affected by soils.	Science
Investigate and describe how living things affect and are affected by soils.	Science
Identify similarities and differences among the different types of soil.	Science
Explain main causes of water, air and land pollution.	Science
Compare the structure of a monocot and a dicot seed.	Science

Discussion

There are many factors that influencing students' learning. In general, curriculum, environment, teachers' competencies, home and school environment, students and teachers' interests, relationship, understanding, students' background, socio-economic status, facilities at home and school, teachers" job satisfaction and teaching strategies etc. are the main factors. Revision in curriculum to make it with psychological needs of students that aligned with national aims and philosophy of math and science education and teachers' special differentiating teaching strategies supported with AV aids may contribute towards enhancing students' better understanding towards mathematics and science.

Conclusions

1. Students are not performing well on higher order thinking questions. It explores that teachers should focus on students' creativity and reasoning skills
2. Students writing skills may be improved
3. Students may be involved in practical work
4. Students may be involved in activity based learning.

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