Exploring Key Factors Leading to Low Performance in Mathematics of J & K Students in the Programme for International Student Assessment (PISA): A Rational Analysis

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ABSTRACT
Mathematics is one of the core subjects in the curriculum at national and international level as the direct implication on fostering various important qualities such as creativity, logical and abstract thinking, problem solving, originality and curiosity among the learners, by the subject Mathematics. However, it is quite disheartening to note that the low performance of Indian students at international assessment in Mathematics as reported by PISA 2009, Indian students ranked second last among 73 countries. Kumar & Karimi (2010) found that the anxiety in Mathematics has a negative effect with Mathematics performance and achievement though it has also been found that a degree of cognitive anxiety (worry and concern) may motivate students to try harder. Also, (Guin, 2018) observed that Phobia in Mathematics is not genetic but highly contagious. Every negative comment to the subject like it is hard, boring, abstract, useless etc. puts a negative image about Mathematics among the children. In the present study, the author has critically reasoned out the key factors leading to low performance of the students such as emphasis on rote memory than competency skills like critical, collaborative and creative thinking, connection the school knowledge to real life setting, rigidity in problem solving, shortage of qualified professional Mathematics teachers, more emphasis on completion of syllabus rather than meaningful learning of Mathematics concepts, inadequate Mathematics laboratories, improper teaching methods, system of assessment, student's understanding of conceptual and procedural knowledge in the main operations, rigidity in problem solving, etc. The present paper also highlighted the pedagogical factors, administration factors, institutional factors and evaluation factors in order to reason out the present status of mathematics learning in specific context to Indian schools. The paper has also been supported with the inferences drawn through an empirically conducted pilot study by the investigator on teachers and students with the purpose to identify the factors affecting the performance of students in Mathematics. The study has also included some concrete suggestions and recommendations to be employed at micro (Classroom level) and macro level (Administration/Institutional level) so as to improve performance of the learners in Mathematics.
Keywords: *Mathematics, PISA, Evaluate, Low performance*

INTRODUCTION

Education is the key factor to build up the nation as a whole and develop the people. According to Nelson Mandela, "Education is the most powerful weapon which you can use to change the world. If you want to destroy the future of any nation, no need to wage war with them, defunct their education, they will no longer live on the map of the world."(Yeasmin, 2017). Mathematics is one of the core subjects in the curriculum at national and international level as it is a subject with broad applicability to everyday life (Kour, 2017). Thus, it is not incorrect if we say that from home to workplace, Mathematics tools have become a part of our day-to-day life. Furthermore, the development of civilization, science and technology, Mathematics appears to be the most developed branch of the science for the reason that the universe is written in a Mathematical language and all kinds of information needs to Mathematics (Keklikci , Ersozlu, & Arslan , 2012). The National Education Policy (1986) emphasized that Mathematics should be visualized as the vehicle to train a child to think, analyse, reason and articulate logically. This objective can be achieved by better understanding of the subject (Bhatti, 2018). After that, RTE, 2009 became effective from 1st of the April, 2010 in which free and compulsory education is every child's right up to elementary level and Mathematics is an important subject in the school curriculum as it disciplines the mind, systemizes one's thought and reasoning (Yeasmin, 2017). The government flagship programmes namely Sarva Shiksha Abhiyan & Rashtriya Madhyamik Shiksha Abhiyan have been successful in ensuring access, equity and quality at elementary and at secondary level of education respectively. But in spite of all of these efforts, quality education (especially in Mathematics and Science) for elementary education became an emergence to policy makers, educators and teachers in India. In the Programme for International Student Assessment (PISA, 2009), a worldwide international survey by the Organization for Economic Co-operation and Development (OECD) which aims to evaluate education system so as to know how well the 15-year-old students scholastic performance in mathematics, science, and reading; who are nearing the end of their elementary education can apply what they learn in school to real-life situation. In response to the question "What is important for citizens to know and be able to do?" and to the need for cross-nationally comparable evidence on student performance, the Organisation for Economic Co-operation and Development (OECD) launched the Programme for International Student Assessment (PISA) in 1997. PISA assesses key knowledge and skills that are essential for full participation in modern societies. PISA is the most comprehensive and rigorous international programme to assess student performance and to collect data on the student, family and institutional factors that can help to explain differences in performance. As a consequence, the results of PISA have a high degree of validity and reliability (OECD, 2017). Thus, the central objective of PISA is to provide cross-nationally comparable evidence of students' performance on the skills that are judged to be important for adult life. It provides a new basis for policy dialogue and for collaboration in defining and operationalizing educational goals (Breakspear, 2014).PISA's unique features include its:

- **Orientation of the Policy** so as to shape their learning in and outside school by highlighting differences in performance patterns and identify the characteristics of schools and education systems that perform well.

- **Innovative Concept of Literacy** which refers to students' capacity to apply knowledge and skills in key subjects, and to analyse, reason, interpret and solve problems in a variety of situations.
- **Relevance to Life Long Learning** as PISA asks students to report on their motivation to learn, their beliefs about themselves and their learning strategies.
- **Regularity** which enables countries to monitor their progress in meeting key learning objectives.
- **Breadth of coverage** means an average of about 60 countries and economies participated in this assessment.

Indian students from two of its states (Tamil Nadu and Himachal Pradesh) participated in 2009 and the results weren't very good. They were ranked about 72 out of 74. This performance of the students showed their skill and competency in the particular subject, which makes all of us wonder What are the reasons for poor performance in mathematics and science in spite of good efforts by the government in school education. Mathematics is much more than a collection of techniques for getting answers and much more than a collection of definitions, theorems and proofs. The idea of teachers explaining rules on the chalkboard, giving examples of the rules in operation and then setting exercises to solve on their own are no longer in use. This philosophy of Mathematics teaching was questioned when psychologists began to study how children see the world around them. Investigations were made by psychologists into how and why children came to understand Mathematical concepts. Mathematics teaching today has taken into account this research and now follows the way children learn rather than what may be described as a 'logical' development of Mathematics topics (Gbolagade , Waheed, & Sangoniyi , 2013). Kumar & Karimi (2010) found that the anxiety in Mathematics has negative effect with Mathematics performance and achievement though it has also been found that a degree of cognitive anxiety (worry and concern) may motivate students to try harder. Also, (Guin, 2018) observed that Phobia in Mathematics is not genetic but highly contagious. Every negative comment to the subject like it is hard, boring, abstract, useless etc. puts a negative image about Mathematics among the children. If teachers change their general attitude towards the mathematics subject in their regular classroom teaching, behavioural motivation has to be given along with the good method of teaching and manage the mathematics anxiety of students by making effective coping strategies, then the mathematics anxiety would be reduced among the secondary school students, a study was done on the J&K students (Baliya & Thappa, 2017). Keklikci , Ersozlu, & Arslan (2012) conducted a study on "A Research on the Elementary School Students' Math Fears in Turkey" with an objective to examine the views of elementary school students, parents and teachers on the reasons for mathematical fears. The results of the present research paper showed that one-quarter of the students were afraid of Mathematics, experienced stress as a result of the extreme importance the families impose on math courses, and not satisfied that courses have been trained with the existing teaching methods and techniques. Further, it was concluded that the parents attribute the greatest importance to Mathematics, and teachers need to change their traditional approaches of Mathematic teaching to a more moderate and democratic one. Das & Das (2013) conducted a study on Math's anxiety: the poor problem-solving factors in school Mathematics. The results of the

study showed that Math anxiety is encouraged by over emphasis on drill, parent's unrealistic expectations, by negative classroom experience which leads the consequences like Math avoidance, distress etc. Sa'ad, Adamu and Sadiq (2014) pointed that shortage of well trained teachers, inadequate of teaching facilities, lack of funds to purchase necessary equipment, poor quality of textbooks, large classes, poorly motivated teachers, lack of laboratories and libraries, poorly coordinated supervisory activities, interference of the school system by the civil services, incessant transfer of teachers and principals, automatic promotion of pupils, the negative role of public examinations on the teaching-learning process and inequality in education opportunities all hamper the smooth acquisition of Mathematics knowledge. Also, one of the greatest causes of poor performance in Mathematics among secondary schools' students in Mathematics is phobia. Swarnlata (2014) conducted a research study titled 'overcoming Maths phobia and found that to a great extent, student's attitude towards Maths and their phobia for the subject teachers teaching Math and teacher can reduce the fear of Math by being friendly, encouraging self-confidence, providing support and encouragement and accommodating students to adopt activity based learning and learning by doing. This study also revealed that Math phobia affects a student's attitude towards the subject. In addition, the prime reason for poor performance may be fear and anxiety students have towards Math. Shahrill, Abdulla & Yousof (2015) conducted a study on "Factors Affecting Student's Performance in Mathematics: Case Studies in Three Primary Schools" and the findings of the study revealed various factors like high support and involvement of the principal both directly or indirectly to the Mathematics teacher, student's literacy abilities in understanding Mathematics problems parents involvement etc. were held responsible for affecting student's performance in Mathematics. Das, Das & Kashyap (2016) in their study enquired the relationship between performance in Mathematics and students' attitude towards the subject in secondary schools and found that for better performance in Mathematics there is great need to develop a positive attitude towards the subject. Student's perceptions on learning the subject Mathematics settled in their mind have to be changed by the concerned teachers and parents to develop an attitude towards the subject. The findings of the study also revealed that along with emotional factors like anxiety, self efficacy, teacher's pedagogy would be emphasized parallel so that the students become more inquisitive and gain an effective understanding on Mathematics. Nwoke & Charles (2016) in their study revealed that teachers were of positive perception of factors causing Mathematics phobia among secondary school students which includes, teaching methods, inability to solve Mathematical problems, poor teacher-students relationship, giving too many assignments, non-application of potent instructional materials, use of abusive words, non-conducive learning environment, poor Mathematics background, students negative attitude towards Mathematics, abstract nature of Mathematics and lack of reading materials. Sule, Hussaini, Bashir & Garba (2016) conducted a study on "Mathematics Phobia among Senior Secondary School Students: Implication for Manpower Development in Science Education in Nigeria". The results of the present paper revealed that students without phobia achieved more in Mathematics than those with phobia and also a significant difference between male and female in the performance of students with Mathematics phobia was observed in favor of the male. Further, it was recommended that secondary schools in the state should have Mathematics laboratories

where students will engage in practical Mathematics learning so that the abstract nature of the subject may be minimized thereby arousing their interests and hence reducing the phobia in that particular subject. The study of Kour (2017) revealed that Math-phobia exists among students, which is characterized by feverish feelings in Math class, difficulty in understanding Math problem among others. On the other hand, the present research paper also highlighted causes of Maths-phobia which includes shortage of qualified Mathematics teachers, the lack of adequate in-service training programmes, a lack of proper incentives for Mathematics teachers, and an inherent fear of Mathematics, poor student-teacher relationship, non conductive environment for math class among others. Thus, Rigorous efforts should be made by all stakeholders in solving the poor student-teacher relationship, non conductive environment for math class among others. Guin (2018) in his theoretical paper "Psychological Perspective of Mathematics Phobia" argued that Mathematics Phobia develops, in most cases, during early years of a child due to family and peers influence, wrong method of teaching creates anxiety among students in many occasion and students do not feel interest when they do not find the real utility of the subject. Further, there is no unique and definite cause of phobia in Mathematics; rather a combination of different factors like- physiological, psychic, social, cognitive and environmental may be at play. The study of Sharma (2019), which was done on the secondary school students of Kathua district of J&K, revealed that there was a significant effect of Mathematics achievement on the self efficacy of the secondary school students. It further recommended that teachers should teach the students by using new instructional techniques and strategies like problem solving, project method and personalized system of instructions for the students. Also, as per National Achievement Survey NAS (2017), the learning report of Jammu & Kashmir revealed that an average percentage of correct scores of class 8^{th} students in Mathematics and Language is 37 and 43 respectively which is less than the average percentage of correct scores of the whole country.

The above mentioned studies indicated that Mathematics learning is being affected by various factors like attitude, teaching methods, psychological factors, environmental factors etc which leads to low performance of the students. The studies also indicated that there is dire need to take some reformative steps to enhance the performance level of students as per the International Standards with special context PISA (Programme for International Student Assessment). This further indicates that there is a large scope of research work to be done to collect the concrete inputs from various stakeholders for making Mathematics learning and performance of J&K students at par with the norms of assessment affairs like PISA.

OBJECTIVE

The objective of the present research is to explore the factors leading to low performance of J&K students in PISA for Mathematics.

METHODS & PROCEDURES

In order to explore the key factors leading to low performance in Mathematics among the students of Jammu & and Kashmir, investigators explored the research problem in two phases:

A. Document Analysis- During this phase of research, the investigators did the analysis of research studies carried out in J&K territory, various reports like National Assessment Survey of Jammu and Kashmir, news connected to the Jammu & Kashmir with the help of internet, online journals and websites, libraries etc. for the theoretical base to the problem under study. Along with this, the author(s) of the present paper also reviewed research studies and reports that was done at national and international level on Mathematics learning.

B. Empirical Study- In this phase of the research, the empirical evidences in terms of different stakeholders have been taken into consideration by the authors so as to provide empirical support to the theoretical base of the selected problem.

Sample of the present study includes different stakeholders viz students, teachers, pupil teachers, pupil teacher educators and PG students of various universities from department of Mathematics, constituting the final sample, in order to obtain different perspectives regarding Mathematics Learning as they were present in their workplace when the authors went for data collection in their respective institutions. Here, Purposive sampling technique has been used for the selection of samples. For the collection of the data, the researchers used the group interview method which is based on six broad themes. The investigators themselves act as a moderator during the group interview along with the floating of the theme for the interview. Further for the analysis, the data which was collected from different stakeholders, then demarcated under different themes.

RESULTS & DISCUSSIONS

The results of the data collected have been depicted in the form of main observation about the factors affecting Mathematics learning of J&K students regarding school students, school teachers, pupil teachers, pupil teacher educators and PG students from HEIs in the table A below:

S.No	Target Group	Main Observation about Factors that affects Mathematics Learning	Converged Inferences
1.	School Students	● Lack of Student's Interest ● Lack of Concept Clearance ● Increased in Difficulty Level ● Absence of Joyfulness ● Parent's Pressure on Mathematics ● Lack of Teacher's Interest ● Heavy Loads of Exercise ● Rigidity of Correctness	The main observation about factors that affects MathematicsLearning leads to obtained the key factors which are as follows: ● Lack of Skill and Competent Teachers ● Inappropriate Methods of Teaching for the Subject Mathematics ● Lack of Connection with Real Life Situations ● Lots of Homework ● No Democratic Environment for Expression ● Orthodox Notion about Mathematics Subject develop Fear among Students ● Lack of Concept Clearance ● Lack of Teacher's Motivation
2.	School Teachers	● Lack of Teacher's Effort ● Lack of Appropriate Teaching Aids ● Lack of Concept Clearance ● Orthodox Notion of Mathematics as a Burden ● No Connection with Real Life Settings	
3.	Pupil Teachers	● No Democratic Environment for Student's Expressions ● No Practical Things ● Heavy Syllabus ● Teacher's Negligence to Slow Learners ● Lots of Homework	
4.	Pupil Teacher Educators	● Lack Inappropriate Teaching Methods ● Lack of Interest ● Applicability to Real Life Situations ● Lack of Teacher's Motivation ● Unpleasant Experiences of Student's in Mathematics	

5.	PG Students of HEIs	● Inappropriate Method of Teaching ● Increased Rote memory ● No Democratic Environment ● Level of the Individual ● Change the C ● Lack of competent and Skilled Teachers ● Practical Inapplicability of the Mathematics Problems	

Table A

Form the above table A, which depicts the main observation about the factors that affects the Mathematics learning of different target group which includes school students, school teachers, pupil teachers, pupil teacher educators and students pursuing post-graduation in Mathematics, formerly, with the help of the listed factors by different stakeholders who involved in the Focused Group Interview, the authors of the present research paper draw Converged Inferences which primes to obtained the Key Factors that supposed to affect the Mathematics learning leading to low performance of J&K students in that particular Subject. Among the key factors, Lack of connection of mathematics learning with Real Life Settings is one of the prominent factors mentioned by almost all target groups during the Focussed Group Discussion. This further implies that without the applicability of mathematics learning in real life situations, it is considered as vague by the students which lead to lack the interests of the students as whatever they are learning is of no use in reality. Also, the school's teachers only focussed on solving the problems given in the exercises of the units by Chalk and Talk method rather than Activity based method and Project Method which makes the students feel the burden of homework. Concern about doing well in the subject by the parents and teachers due to orthodox notion that Mathematics is a difficult subject and not everyone's cup of tea, may motivate the child to work hard but when such concern becomes very strong it may have a negative effect on performance. Such negative performance helps to develop anxiety or phobia among the learners causing low performance of the learner in the subject Mathematics. Lack of clear understanding about the basic concepts also emerged as a key factor from the findings which indicates that if the concept of any topic is not clearly understood by the learner, then it also affects the performance of the student. Concept clarity depends on the level or ability of the individual, teaching method employed by the teacher, difficulty or abstract nature of the content, interest of the student etc. Another key factor of low performance in the subject Mathematics is child is not able to express his or her thoughts ideas, queries and opinion in the Mathematics Class, this grows the seed of doubt in the mind of the child that lowers the self-confidence of the individual to perform well in that subject which lead to develop doubt in the mind of the child.(Guin, 2018) observed that Phobia in Mathematics is not genetic but highly contagious, this implies that if teacher do not motivate or inspire the students in order to develop the interest of the student in Mathematics, then it will also affect the performance of the students. Last but not the least, a skilled and competent teacher in mathematics, on whom the whole things rely will affect the learning performance of the students in the subject.

CONCLUSION & IMPLICATIONS

The present paper revealed that there is no unique and definite factor of low performance of Jammu and Kashmir students in Mathematics in PISA rather there are multi dimensional factors leading to the poor index of performance of J&K students in various testing programmes including PISA. The results of the study also helped in finding the gaps in the transactional practices adopted by Mathematics teachers at different levels and thereby suggesting the ways and means to build up a path of optimal success for J & K students in forthcoming PISA programme probably to be held in 2021. Those emerged factors are as: lack of teacher's motivation, lack of skill and competent teachers, inappropriate methods of

teaching for the subject Mathematics, lack of connection with real life situations, lots of homework, no democratic environment for expression, orthodox notion about Mathematics subject develop fear among students and lack of concept clearance.

Mathematics plays a very important role in the life of an individual and also in the development of a nation. Mathematics as a subject is very vital in terms of scientific, economic and technological growth due to its usage not only in the fields of science such as Engineering, Geography, Physics, Chemistry, Medicine, Biology, Astronomy etc but also in the fields of art. In other words, it is said that the development of the one's nation depends on both the quantity and quality of Mathematics being offered in the school system which further depends on the availability of professionally skilled and competent Mathematics teachers. Following are some specific recommendations by authors in order to increase the performance of the students in Mathematics learning:

- Mathematics teachers along with a good and appropriate method of teaching should be competent enough that he/she motivates the learner in the classroom so that a positive attitude towards mathematical learning has to be encouraged.
- Mathematics laboratories and libraries should be established in the schools so that students' interest can be developed by physical and visual things rather than abstract ideas.
- Various competitions like debates, quizzes and Mathematics Olympiad should be organised by the school on a regular basis.
- Special in-services training should be provided by the Education Department of the universities to the subject specific teachers in order to make them aware of new and innovative techniques of teaching-learning process.
- Heavy loads of the problems in the exercise should be reduced and replaced by innovative projects in the mathematics subject.
- Parents should also engage their children in Math activities that are meaningful, encourage their children's interest in Mathematics, and let them know they can succeed.
- There should be flexibility in terms of assessment of Mathematics is concerned that is inspite of solving questions by pen and paper real objects can be made available to the students and asked them to find out that problem.
- A teacher of Mathematics is not only responsible for the instruction of Mathematical concepts, but is also responsible for helping students 'learn to learn Mathematics".
- Teachers should give real-life situations for the concept to be taught in the classroom so that they can understand its practical applicability.

REFERENCES

Kumar, V., & Karimi, A. (2010). Mathematics Anxiety, Mathematics Performance and Overall Academic Performance in High School Students. *Journal of the Indian Academy of the Applied Psychology, 36*(1), 147-150.

Keklikci , H., Ersozlu, Z. N., & Arslan , M. (2012). A Research on the Elementary School Students' Math Fears in Turkey. *Research Journal of International Studies*(24), 59-68. Retrieved from https://www.researchgate.net/publication/319288881

Das, G.C. and Das, R. (2013). Maths anxiety: The poor problem-solving factor in school mathematics. *International Journal of Scientific and Research Publication*, volume 3.

Gbolagade , A. M., Waheed, A. A., & Sangoniyi , S. O. (2013). Demystifying MathematicsPhobia in Schools for Transforming Nigeria in Attaining Vision 20:2020. *International Journal of Academic Research in Business and Social Sciences, 3*(2), 188-196. Retrieved from www.hrmars.com/journals.

Breakspear, S. (2014). How does PISA shapes education policy making? Why how we measure learning detemines what counts in education. *seminar series 240* (pp. 1-16). East Melbourne Victoria: Centre for Strategic Education.

Sa'ad, T.U., Adamu, A. & Sadiq, A.M. (2014). The causes of poor performance in Mathematics among public senior secondary school student in Azare Metropolis of Bauchi State, Nigeria. *IOSR Journal of Research & Method in Education* 4(6), 32-40

Sharma, S.L. (2014). overcoming maths phobia. Retrieved on January 19th, 2017, from http://m.timesofindia.com

Das, G. C., Das, R., & Kashyap, M. P. (2015). An Investigation on the Relationship Between Performance in Mathematicsand students' Attitude Towards the Subject in Secondary Schools of Guwahati. *Indian Journal of Applied Science, 5*(6), 142-145.

Shahrill, M., Abdulla, N. A., & Yousof, H. H. (2015). Factors Affecting Student's Performance in Mathematics: Case Studies in Three Primary Schools. *EARCOME 7* (pp. 1-15). Cebu : Research Gate.

Nwoke, B. I., & Charles, N. U. (2016). Causes and Solutions of MathematicsPhobia Among Secondary School Students. *Research on Humanities and Social Sciences, 6*(20), 105-109.

Sule , B., Hussaini , M. M., Bashir , U. S., & Garba , A. (2016). MathematicsPhobia among Senior Secondary School Students: Implication for Manpower Development in Science Education in Nigeria. *International Journal of Education and Evaluation, 2*(8), 16-21. Retrieved from www.iiardpub.org

Baliya, J. N., & Thappa, S. R. (2017). Effect of Phobia Management Programme on the MathematicsAnxiety of Secondary School Students. *Confluence of Knowledge, 5*(2), 7-19.

Kour, G. (2017). Math-Phobia: Causes and Remedies. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, 1248-1250.

NAS (2017). Jammu and Kashmir State Learning Report: NCERT. Retrieved from www.jkeducation.gov.in.

OECD (2017), "What is PISA?", *in PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving,* OECD Publishing, Paris. DOI: https://doi.org/10.1787/9789264281820-2-en

Yeasmin, M. (2017). Areas of Weakness in Mathematicsof the Students Completing Elementary Education. *International Journal of Recent Advances in Multidisciplianry Research, 04*(01), 2184-2186.

Bhatti, N. (2018). CAI and conventional Method for Retention of Mathematics: An Experimental Study. *International conference on Mathematics& Science*. doi:10.1088/1742-6596/1157/3/032079

Guin, D. K. (2018). Psychological Perspective of Mathematics Phobia. *International Journal of Research and Analytical Reviews*, 861-865.