



INFLUENCE OF LOGICAL AND SPATIAL INTELLIGENCE ON TEACHING PEDAGOGIES OF SECONDARY SCHOOL TEACHERS

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Abstract

Purpose: This study investigated Logical/ Mathematical and Spatial/ Visual Intelligence of male and female teachers in secondary school and its influence on their teaching pedagogies in the subject of science and mathematics.

Methodology: Through a Likert scale questionnaire, data were collected from 252 secondary male and female schoolteachers from both rural and urban areas of district Peshawar.

For data analysis, two-way ANOVA and Pearson Correlation was used. Result found a significant gender difference in visual intelligence where females were found with high level as compared to male and the influence of professional qualification was also noticed in visual intelligence.

Results: Therefore, the study suggested that curriculum developer and policymakers need to focus on the intellectual development of teachers, to enhance their instructional abilities and professional expansion.

Implications/Applications: Besides, results showed a significant positive correlation between Logical/ Mathematical and Spatial/ Visual intelligence with their teaching pedagogies. The findings shed light that teachers' intelligence has a foretelling effect on their pedagogies which ultimately affect students' academic performance.

Keywords: Logical/ Mathematical Intelligence, Spatial/ Visual Intelligence, Teaching Pedagogies, Students' Achievements.

INTRODUCTION

Science and Mathematics, one of the major subjects of the curriculum for grade one to grade twelve, are taught in all private and public sector schools in Pakistan. In studying science and mathematics, students are supposed to learn and grasped an extensive spectrum of concepts. The curriculum of Mathematics and science constitute specific knowledge curriculum contains which requires certain logical and analytical abilities, learners' potentials, efforts and firm attitudes ([Government of Pakistan, 2006](#)). But regrettably, in many public secondary schools in Pakistan, instructors' generally fail to inculcate and develop these vital skills. Resultantly, the majority of the students, even scoring good marks in their annual exams, fails to develop an association of the subject knowledge to their external world ([Government of Pakistan, 2009](#)).

“Pakistani schools (especially public sector) are producing unacceptably low levels of learning outcomes in Math’s and Science — a stark reality which represents a significant and deep-rooted challenge to Pakistan’s economic growth. all science (physical and social) relies on the challenge. Because we resist challenge we produce technicians rather than scientists” ([Khalid,2017](#)).

Teachers mostly impart textbook knowledge to students and asses their knowledge through specifically prescribed tests ([Amirali & Halai, 2010](#); [Mohammad, 2017](#)). According to Mohammad (2017) reports, learning Mathematics and Science mostly involve memorization of rules for formulas and solution of numerical problems, without understanding the basic concepts behind them. It has reported in a survey result ([Khalid, 2017](#)) that students' performance in the subjects of science and mathematics are at deplorable state. Among the five provinces, no one presented an average score of fifty (50%) in these major subjects. The report revealed several factors attributing to the low quality of science and mathematics education have been highlighted. Remarkably, the factors, for example, instructors' poor insufficient subject knowledge, low level of competency in the delivery of knowledge and students and teachers perceptions about these subjects hinder students from increasing conceptual understanding ([Amirali and Halai, 2010](#)).

Instructors still anchored to the obsolete teaching pedagogies that had been followed decades ago. While The recent past has witnessed a massive rapid change in developed countries traditional teaching and learning process in line with technological development, that compels teachers to adopt their indigenous thinking and teaching strategies which are used as a weapon of

the modern age to harness student's skills and attitudes capable of throwing caution to the wind of fast-moving world (Skilbeck & Connell, 2004).

To increase the quality of the science and mathematics education, particularly at the secondary school level, an understanding of the teachers' intellectual abilities and their teaching pedagogies, to help students better understand the subject knowledge, needs to be investigated. Therefore, the current research has sightseen the visual and linguistic abilities of the teachers and its impact on the teaching pedagogies they use in teaching science and mathematics subjects. The results will throw light that how teachers can use their intellectual abilities (visual and linguistic) in suggesting a variety of student's centred instructional techniques suitable to their intellectual capacities. To assess the intellectual capacities of the teacher, the study has employed two intelligences from Howard Gardner Multiple intelligence theory, which provides a broad framework for different intellectual potentials, a human being may possess. According to MI theory, every human being has nine different intelligences and if the proper environment is provided, this intelligence can be enhanced and strengthen. These intelligence included Linguistics Spatial-Visual, Kinesthetic, Logical-Mathematical, Musical, Interpersonal, Intrapersonal Existentialistic and Naturalistic Intelligence (Checkley, 1997; Gardner & Hatch, 1989).

Logical-mathematical intelligence involves critical and coherent thinking. An individual with high Logical intelligence has reasoned, analyzing and problem-solving skills for example professionals like mathematicians, accountants, programmers, scientists, etc. (Isaacs & Carroll, 1999). Whereas individual with high Visual intelligence can describe the visual things around him. Map reading, visualizing, Puzzle-solving, drawing and imagining, are the skills this intelligence carries. Designers, visual artists, mechanics, engineers, and architect are examples of such people (Denig, 2004).

Applications of Teaching Strategies for Logical/ Mthematical and Visual/ Spatial Intelligence

Teaching strategies are instructional practices which help in planning, teaching, and assessing students' learning (Guild 2001). Teaching strategies of logical intelligence consisted of Logical thinking exercises, Classification, and categorizations, Critical thinking movement, and Heuristic strategies which involves open amassing of strategies, parameters, thumb directions, and coherent problem resolving (Rani and Muhammad, 2017).

The imagination of the learning content, visualization of the concepts, demonstration of the knowledge by presenting a model of that, drawing and sketching the contents, graphic symbols. Multiple studies in the existing literature depict the applications seven levels of intelligences on teachers' teaching and learning of the students (Armstrong, 2000; Dickinson, Campbell, & Campbell, 1996). Some of the research studies (L. Campbell, 1997; Checkley, 1997) has reflected the applications of the theory at the secondary school level, and some studies have revealed its foretelling effect on students learning at elemntry school level (Armstrong, 1993, 1994; B. Campbell, 1992, 1994; J. P. Campbell, 1996; Grow, 1995; M. Kornhaber & Fierros, 2000; Lazear, 2000).

Some of the research findings' (Armstrong, 1998; Brooks, 1995; Evans, 1995; Grow, 1995; McClaskey, 1995; Teele, 1996; Tucker & Warr, 1996) have also reported the effects of logical, linguistics, and visual intelligences of the secondary school and on language teachers and, students and but no sufficient work has been published on the applications of visual and logical intelligences at secondary school level teachers, especially in Pakistan, so it will the gap in the literature. Government of Pakistan is taking initiatives to uplift the standards of the overall education system of Pakistan and bring a system which fulfils the potentials and needs of the teachers', students and expectations of the parents. Additionally, this research will open new windows for policymakers, and other researchers to consider Logical/mathematical and spatial/ visual intelligences in curriculum development for teachers training programmes and students textbooks.

This study is quite significant because this research is significant. After all, it paves multiple ways to teachers and students to get concepts of the mathematical and science subject and will let them be creative thinkers and active learners instead of 'parrots'. Additionally, it shows that individual can excel in more than two intelligences at the time and they can use it in their daily routines. Jordan, Lindsay, and Stanovich (1997) Indicated that in single class students comes with diversity in term of their learning styles. Some students feel problems in remembering the formulas, some in solving the numerical equations, some give poor performance in the physics class, some in chemistry in solving the equation and other numerical problems etc. To deal with such diversity of students effectively, teachers need to utilize their logical and visual intelligences in producing the teaching techniques, as we have ample resources for these intelligences.

The current research also aims to examine the correlation between teachers' logical and visual intelligence with their teaching pedagogies. The data will help the instructors to bring comprehensiveness in main topics and concepts. It strengthens the teachers' competencies in developing the basic concepts and content more understandable and enhance the students learning with fascinating and realistic ways.

THEORETICAL FRAMEWORK

The study is based and architected upon the multiple intelligence theory presented Gardner in the year 1983. Since in the era of the 20th century, researchers were observed focused on: linguistics intelligence and logical intelligence and most of the research in MI are farmed in the domain of these two techniques.

A new and innovative approach, when the intelligence quotient (IQ) terminology was used everywhere, was proposed and projected by Howard Gardner. He gives the idea that a man possesses a minimum of nine intelligences and that all nine intelligence of a person works in a complex way and every person possesses all of them. Majority of the people have the abilities to enhance all their intellectual capacities through proper guidance, motivation, and conducive-environment.

Teaching is a scientific art verses techniques and approaches are applied to the compact need of students and to reconcile issue related to teaching. The vital aspect of the Multiple Intelligences theory is the idea of merging Multiple Intelligences teaching techniques and method in the course curriculum. Several kinds of research have suggested that the instructional strategies inline with Multiple Intelligences enhance the learning capacity of students, especially in science courses, it boosts the performance of the students ([Denig, 2004](#); [Ozdenir & Ozcoban, 2004](#); [Thompson & Thornton, 2002](#)). Some other research studies have also indicated positivity in learners' performance and achievements with the utilization of the teaching pedagogies related to different intelligences. '[Koksal and Yel \(2007\)](#) reported the consequences of different intelligences inlined teaching strategies' on students positive approach towards the course, student academic progress and student sustainable growth in the course of biology. Literature studies on MIT ([Abaci, 2007](#); [Durmaz, 2005](#); [Elibol, 2000](#); [Katranci & Bozkuş, 2014](#); [Ozdermir, Guneyisu, & Tekkaya, 2006](#); [Puduk & Baran, 2009](#)), reflecting variables of gender, in which Interpersonal, Naturalistic, and Visual variables presented a significant foretelling impact on teaching techniques, styles, and strategies. Although, the intrapersonal, oral/linguistic, mathematical/coherent/logical, kinesthetic, musical variables correspond to no expressive possessions on teaching techniques, styles, and approaches.

LITERATURE REVIEW

Propounded by Gardner way back in 1983, the Multiple Intelligence (MI) is considered as one of the recent theories that could be used to examine and assess one's mental capabilities along with methods and process of acquiring knowledge and learning. Through Logical /Mathematical Intelligence, one can understand simple numerical patterns –addition, division, multiplication, subtraction, width, breadth-measurement of length etc.

Devising different instructional strategies can easily accommodate students with varying learning needs by employing different methods and approaches to teach various concepts. [Al-Khatib and Hamza \(2009\)](#) argue that teachers must be aware that in the teaching-learning process, there is not just a single and absolute method which teachers apply all the time. But there are so many methods which a teacher can apply according to the content and atmosphere of the class as well as the level of the students.

Some of the research studies ([Gangadevi & Ravi 2014](#); [Serin et al., 2009](#)) has shown no gender differences in term of logical, intrapersonal, kinesthetic and visual intelligences among college students. While some studies on intelligences reflecting gender variable investigated by [Abaci \(2007\)](#); [Baran \(2000\)](#); [Stanford \(2003\)](#); ([Tas \(2007\)](#)); [Sulim \(2012\)](#); [Ucak, Bag, and Usak \(2006\)](#) found that spatial/visual, naturalistic and interpersonal variables have shown a momentous effect on teaching pedagogies and preferences. While intrapersonal, linguistic, mathematical, kinesthetic and musical variables shown no expressive effect on teaching pedagogies. [Mujahid \(2008\)](#) and [Rani & Reba \(2017\)](#) reported in his research that the effects of Logical intelligence and Intrapersonal intelligence teaching strategies are varying. The same findings were reported by [Highland, McNally, and Peart \(1999\)](#), as well as [Al-Khatib and Hamza \(2009\)](#) research findings, which suggested that in devising teaching strategies, the different intellectual potentials of the students and teachers must be kept in mind specifically in logical, visual, and kinesthetic intelligences as theses intelligences affect has been highly reported by previous studies. In another study ([Serin et al., 2009](#)), it was found that logical, interpersonal, spatial/visual intelligences have had a great association with the teaching pedagogies of the elementary school teachers. [Douglas, Burton, and Reese-Durham \(2008\)](#) also concluded that teachers' pedagogies, asserted with logical and visual intelligences, have real-world implications for students and classroom teaching practices.

In 2001, Sherman arranged some activities in visual kinesthetic linguistics, interpersonal intelligence while [Mills \(2001\)](#) investigated activities for musical intelligence. Students were learned through these domains. Researchers pointed out that students learned greater and with more interest through these activities contrary to the lecture method. They suggested considering intelligence specifically musical intelligence as it imparts a great impact on students' mood for learning. In one of an experimental study ([Temur, 2007](#)), it was reported that spatial, interpersonal, and musical intelligence expanded by using some specific exercise while on the other hand linguistics and logical level of intelligences remained moderated in the control group ([Ozdermir et al., 2006](#)).



In the study of [Mousavi, S. & Ahmadi, F. \(2013\)](#), The findings revealed a strong impact of logical, linguistics and spatial Intelligences on the scores of grade five students in the subject of science. The students and teachers both presented positive perspectives about these intelligences. In another experimental research on grade-6 students of METU Ankara College in Turkey, [Akbas \(2004\)](#) highlighted that visual, logical, kinesthetics and linguistics, instructions were effective than the traditional method of teaching. Similarly, [Kornhaber et al. \(2004\)](#) reported. Positive associations between the use of intelligence in teaching strategies and improvements in student behaviours, students standardized test scores, parent participation, and improvements in motivation ([Gul, R., Kanwal, S., & Khan, S 2020](#)), learning, and social adjustment in students with learning disabilities.

[Aini, A. Sunardi, Slamun and Hobri \(2017\)](#) contended that strong logical and visual intelligence provides teachers with multiple instructional ways to nourish and fulfil diverse potentials of the students at every stage of learning. As every intelligence possess a spectrum of multiple teaching strategies, therefore it will help the teachers to develop multiple teaching plans with several assessment techniques ([Gul, 2015](#)), which might be effective in science and mathematics subjects. Secondly, it will provide schoolteachers with a multidisciplinary domain for imparting various concepts to their student.

Research Questions

1. Do teachers’ gender and teachers’ professional experience influence their self-estimated Logical/ Mathematical and Visual Intelligence?
2. To what extent teachers Logical/ Mathematical and Visual Intelligence has an impact on their teaching pedagogies?

METHODOLOGY

This study was descriptive in which a questionnaire was administered to 251 male and female secondary school teacher (SSTs’), who were sampled through a proportionate sampling strategy. Sample participants consisted of 145 male and 106 female SSTs’ (35 % of the population) from both urban and rural areas of district Peshawar, Pakistan. Participants’ confidentiality was maintained in data collection and data analysis process. The questionnaire was consisted of 10 statements to measure the level of logical and visual intelligences and 10 teaching strategies which are related to logical and visual intelligences. the survey data were collected personally b the researcher. Collected data were analyzed in SPSS version 23 through two-way ANOVA and Pearson r correlation coefficient.

Statistical Analysis

Table 1: Profile of teachers Gender and their professional qualification

Teacher Gender	1	Male	145
	2	Female	106
Professional Qualification	1	PTC/ CT	4
	2	B.Ed.	89
	3	M.Ed.	158

Table 1 shows that 145 male and 106 female participated in this study with a professional qualification with a ratio of 4 primary teaching certificate/ certificate of teaching (PTC/CT) qualified teachers, 89 bachelor of education (B.Ed.) qualified teachers and 158 Master of Education (M.Ed.) qualified teachers.

Research Question 1: Do teachers’ gender and teachers’ professional experience influence their self-estimated Logical/ Mathematical and Visual Intelligence?

Table 2: Descriptive Statistics of Logical/ Mathematical Intelligence and Visual Intelligence

	Teacher Gender	Area of School Location	Mean	Std. Deviation	N
Logical Intelligence	Male	Urban / Rural	2.995/ 3.078	.058. / 058	2.881/ 2.963
	Female	Urban / Rural	2.995/ 3.078	.058. / 058	2.881/ 2.963
Visual Intelligence	Male	Urban / Rural	2.99/ 3.05	.558/.597	74/72
	Female	Urban / Rural	3.20/ 3.18	.396. /476	2.881/ 2.963

Table 2 shows that in logical intelligence male with M= 2.995, and 3.07 SD=.058 and female with M= 2.995, SD= 2.881 and 3.078 SD are not significantly different from each other while in Visual intelligence females with M= 3.20, SD= .39 and M= 3.18, SD= .476 have high level of Visual Intelligence as compared to male teachers with M= 2.99, SD= .558 and M= 3.05, SD=.597.

Table 3: Post-hoc Test Result for Logical and Visual Intelligence (Subjects Effects)

Dependent Variable	Source	Type III (Sum of Squares)	df	Mean Square	F	Sig.
Logical Intelligence	Gender	.042	1	.042	.171	.680
	Professional	.356	2	.178	.718	.489
Visual Intelligence	Gender	.001	1	.001	.004	.947
	Professional	1.689	2	.844	3.199	.043

The table 3 indicates that means of gender and professional qualification have not shown statistically significant difference for logical intelligence as $p=.680$ and $.489$ but for visual intelligence, there are significant differences between professional qualification as $p > .05$ which means B.Ed. and M.Ed. degree holders affect their visual intelligence.

Plots of logical and visual intelligence

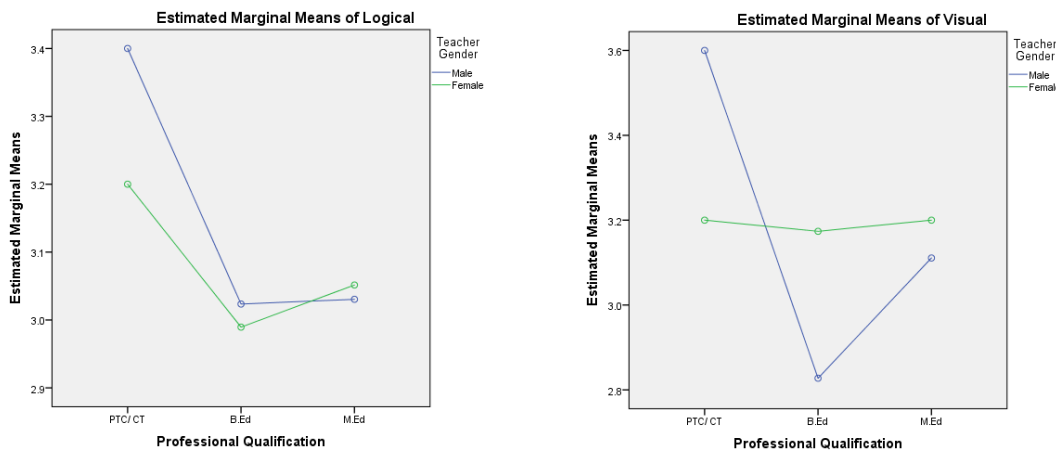


Figure 1: Plots of logical and visual intelligence

The plots of logical and visual intelligence (Figure 1) illustrate that lines do not appear to be parallel therefore a statistically significant interaction is seen here. This shows that among independent variables, gender has no significant effect on logical and visual intelligence while professional qualification has a great effect on visual intelligence.

Research Question 2: To what extent teachers Logical/ Mathematical and Visual Intelligence has an impact on their teaching pedagogies?

Table 4: Correlations among Logical and Visual Intelligence with the Teaching Pedagogies

Correlations		Logical		Visual
		Logical	Visual	Teaching
Logical	P-Correlation	1	.440**	.193**
Visual	P-Correlation	.440**	1	.299**
Logical Teaching	P-Correlation	.193**	.234**	1
Visual Teaching	P-Correlation	.250**	.299**	.380**

The value of Pearson correlation coefficient ($r = +.440$, $n = 253$, $p = .000$) for Logical/ Mathematical, $r = +.193$, $n = 253$, $p = .000$ for Logical Teaching, $r = +.250$, $n = 253$, $p = .000$ for Visual Teaching shows a significant and positive correlation of the logical and visual intelligence with the teaching pedagogies.

DISCUSSION AND CONCLUSION

This study has incorporated logical/ Mathematical and Spatial/ Visual intelligence of the secondary school teachers and examines its effect on their teaching pedagogies in the subject of science and mathematics. Participants with diverse professional qualification and areas of schools participated in the study from Peshawar, one of the developing area of Pakistan. Descriptive statistics results showed no significant difference in female and male secondary school teachers' Logical/Mathematical intelligence; however, visual intelligence was found greater in female as compared to male. Furthermore, ANOVA test results revealed that gender did not influence logical and visual intelligence while a statistically

significant influence of professional education (B.Ed. and M. Ed) was noticed on visual intelligence. The results are quite interesting and significant as it proves that both genders have distinctive intellectual abilities and that these abilities can be enhanced if proper resources are provided. [Armstrong \(2000\)](#) also pointed out that human beings can boost up their weakest level of intelligence to the highest level if a proper environment is provided. Results are in line with the studies of [Snyder \(1999\)](#) who reported female with a high level of logical kinesthetic, visual and linguistics level of intelligences while [Abdul Aziz \(2008\)](#), also reported females with a greater level of intrapersonal, linguistic, visual and kinesthetic intelligence in contrast to male faculty.

However, the findings are in oppose with the results of [Asha, Iyer, and Sen \(2007\)](#), [Hanafiyeh \(2013\)](#) and [McClellan \(2006\)](#), who observed a gender difference in logical/mathematical and visual intelligences.

The generalization of these results might be due to individual interest, age, background, and social influence. Like [Suliman, Kareem, and Iqbal \(2009\)](#) highlighted the social influence as a big factor in gender intellectual differences. Social influence constituted external influence, performance, self-perception, social and moral obligations etc. participants of this study were from Pakistan while the other studies mentioned above were carried out in Singapore, Britain, German and Hawaii so the different results might be due to diverse cultures.

The results of the present study also showed a positive and strong correlation between Logical/ Mathematical and Visual Intelligence and the teaching pedagogies teachers, used in their science and mathematics classrooms. The result is significant because it shed light that intelligence matters in teaching, intelligence has a strong impact on teaching pedagogies and it has a great effect on students learning and their academic performance. [Durmaz \(2005\)](#) Findings support this result because it revealed the impact of interpersonal, naturalistic, and spatial intelligence on teaching pedagogies. [Ozdermir, Guneysu, and Tekkaya \(2006\)](#), [Serin, Serin, Yavuz, and Muhammedzade \(2009\)](#) and [Sulaiman, Abdurahman, and Rahim \(2010\)](#), also reported the foretelling effect of intelligence on teaching pedagogies.

[Highland et al. \(1999\)](#) and [Al-Khatib and Hamza \(2009\)](#), highlighted the necessity of considering the different intelligences of] students, teachers and adopting the most appropriate teaching. This study also supports that skills, behaviour, and concepts are established by arranging curricular and co-curricular concerned with the intellectual strengths of the students using Logical and Visual Intelligence domains.

The study further suggested that policymakers and curriculum developers in Pakistan, especially in Khyber Pakhtunkhwa (KPK) need to consider the domains of intellectual abilities of the teachers and design modules for pre-service in-service and teachers manuals to boost teachers' logical and visual intellectual strengths, to accomplish the needs and abilities of students in their logical and visual intelligences.

AUTHORS' CONTRIBUTIONS

Dr. Rani Gul is the primary author of this research paper. This research paper is a part of her doctoral thesis.

Dr. Sadia Suleman has helped in data interpretation and discussion part.

Dr. Shumaila Mazhar has helped in data interpretation and discussion.

Dr. Tehseen Tahir has contributed to revising the literature review of the paper.

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