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Processing speed and scholastic performance of tribal students: A comparison across gender and subject stream

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Abstract: Scholastic performance of the students is depended on several psychological and environmental factors in which the cognitive ability such as processing speed is an important factor. Indian culture is full of diversity where tribal students belong to Chhattisgarh face a distinct situation during their study and development. Major intention behind this study was to investigate the views of the faculty members of the colleges who reported that tribal students belong to Chhattisgarh had poor understanding of subject matters and made very low response to the questions in basic language like Hindi in daily class room teaching. These factors could highly affect to the academic record of any student, because the general competency level of a student is considered as raw material for scholastic performance. The main objective of this study was to measure the level of processing speed of the information as well as its association with academic performance among tribal students. Comparison between students of arts and science group on both variables (processing speed of the information and academic performance) was the second objective. The study was based on the performance of the students on a simple block design test, along with three years long class room observations, and views of faculties during a District level meeting regarding New Education Policy. Total 345 students of tribal areas including both the genders from arts and science background were selected purposively. Simple block design test of WAIS-III (design no. 1, 2, and 3) were administered to check the ability of processing speed, and marks of 12th class were taken as the measure of scholastic performance of tribal students. Results revealed that all the students have taken more time than limit of 90 seconds. Significant differences in the timing on block design tests and academic marks across gender and subject stream are also present. The association between obtained marks on 12th grade and time duration to complete block design test was found significantly negative. On the basis of results of the present study, it can be concluded that to ensure the better academic performance of tribal students, some tasks should be design to increase their processing speed of the information.

Key Words: *Processing speed, Scholastic Performance, Tribal students*

INTRODUCTION

Indian population has rich diversity that incorporates a large number of cultures, religions, languages, racial differentiation, castes, communities and social groups. The categorization of people in terms of their access to social and economic opportunities and their participation in the developmental act is based on two major factors. First is regional differentiation, which refers to the viability of an area in terms of geographical location. Characteristics of population can be considered second factor in terms of Indian social system, which has invariably been the upper castes, enjoyed the privileges due to their caste status (Singh, 2014). Sujatha (2000) has argued that the dominance of one category over others is based on some predefined strength and rooted in the social stratification system. Inequality and differentiation is everywhere in India, especially in the case of formal education and achievement related concern. One such marginalized group is the Scheduled Tribes. Although central and state governments have attempted to provide all the opportunities to enhance the educational and socio-economic level of tribe population, but to attain the desired development they still needs practical attention of researchers.

The psychology of individual differences begins in attempts to predict scholastic performance that may associated with many variables. Intellectual creativity is such an ability of formation something new and somehow valuable. The created item

may be vague (such as a scientific theory, an idea, a musical composition etc.) or a physical object (such as a painting, an invention or a literary work).

We are dependent on our mental abilities to perform basic activities quickly and efficiently every single day, such as figuring out a good daily need store or listening to a friend and/or giving them advise. The likelihood is that you haven't really considered how long it takes you to complete these tasks. The cognitive skill known as processing speed is what determines how fast you can finish a mental task or comprehend and respond to the information you are exposed to during the day. Although everyone processes information at a different rate, slower processing speeds have an impact on how much information a person can process, react to, and apply. This may cause problems in the workplace or at school. While children and teenagers may feel upset and unable to articulate this challenge, adults may have developed techniques over time to compensate for inadequate processing speed. Although many kids report feeling "less than" or "not as smart" as their peers, it's vital to remember that poor processing speed is not correlated with intellect. Parents and teachers are urged to think about how a sluggish processing speed may affect the academic achievement of child or student. When evaluating a student's processing abilities, there are three broad factors to take into account.

Processing speed is formally an intellectual ability that refers to the speed and efficiency with which an individual can perform mental tasks, such as perceiving, recognizing, and responding to information. Two major categories of processing speed first is General processing which includes decision speed and perceptual speed second specific processing speed functions includes arithmetic and reading fluency. The findings of a number of studies reporting the association between processing speed with children's mathematical achievement (Lin, 2020; Träff et al., 2017; Fung et al., 2014; Cowan et al., 2011; Geary, 2011; Hecht et al., 2001; Lambert & Spinath, 2017; Leikin et al., 2014; Passolunghi & Lanfranchi, 2012; Taub et al., 2008; Rohde & Thompson, 2007; Fuchs et al., 2006), less studies have been conducted to know the association of categories of processing speed to predict mathematical achievement. Cheng et al. (2022) have found that specific processing speed contribute significant role in mathematical achievement however the similar role of general processing speed was not found for mathematical achievement.

According to mental speed assumption of intelligence, the speed of information processing speed creates an important role for cognitive abilities. However, the limited empirical supports have been found that how mental speed associates to real world situations, such as society, academic and job performance? The investigation of the connection between mental speed (or information processing speed) and cognitive ability dates back to Galton's (1883) initial theories, in which he attempted to quantify reaction time as well as various sensory and motor variables in connection to independent measures of intelligence or achievement. However, the speed theory was virtually abandoned after multiple failed attempts to replicate the concept. Roth (1964) found a significant negative correlation between psychometric intelligence and reaction times in choice reaction time task, suggesting that brighter subjects processed information more quickly.

Processing speed generally has been studied as the cognitive ability to quickly, regularly, and fluently perform simple daily life cognitive tasks. Cattell – Horn – Carroll theory of cognitive abilities assums that the processing speed typically includes: perceptual speed, decision speed, arithmetic fluency, and reading fluency (Schneider & Mcgrew, 2012). Mathematical achievement is not only nummaric mental ability but also associated with many other aspects of academic performance. Findings of the few studies reflect that reading comprehension (Cowan et al., 2005) and reading fluency (Fuchs et al., 2021) is associated to mathematical problem-solving. Therefore, processing speed has mainly been tested for the mathematical achievements but indirect assocition would also exist with other aspects of academic performance.

Some opposite evidences could also be seen in the literature. Rindermann and Neubauer (2004) have found no direct effect of processing speed on school performance. However higher cognitive abilities mediate the relation between processing speed and school performance. Tikhomirova and others (2020) found that information processing is important predictor of number sense, but the direct effect was not found for academic performance.

It can be inferred on the bases of above studies that maximum investigations regarding academic achievement have been conducted with mathematical performance and very limited or no study checks attainments of students of arts stream. Cheng's study highlights the gap that the effect of general processing speed can be checked for non mathematical achievement of students. It could be the base for comparison of the processing speed and academic accomplishment of two major study backgrounds as science and arts. Further, gap can be seen with respect of studied sample as no empirical evidence was found regarding tribal students' processing speed and academic achievement.

Therefore it can be said that, processing speed may play a key role in determination of academic success especially among tribal students. Further, it is imparative to understand that, to what extent subject stream and gender of the students could differentiate the students on the said variables? So, the main objective of the present study was to assess the general processing speed and associating it with the academic performance of tribal students. Second objective of the study was to check the differences among tribal students in terms of processing speed and academic accomplishment across gender and two major subject streams as science and arts.

HYPOTHESES

H_1: High processing speed on block design and marks in 12th board exam would show positive association.
H_2: Boys and Girls would show different processing speed on block design and marks in 12th board exam.
H_3: Students studied in arts and science subject stream would show different processing speed on block design and marks in 12th board exam.

METHODS

SAMPLE AND DESIGN

Present study is basically a kind of survey research. To meet the purpose of this study, a total of 345 tribal students (261 boys and 84 girls) from both the subject streams (arts -141 and science - 204) were recruited as sample for the age range of 16 to 22 years. Participants were selected from different colleges of Dantewada district of Chhattisgarh state through the purposive sampling procedure. Sample incorporates a wide variation with respect of geographical belongingness, because students in the selected college were residents of more than 3 districts of Bastar region and residing in the hostels provided by district administration. According to the main objective of this study, the mixed method was used. Primarily the correlation between processing speed (using time consumed in completion of simple block design test) and scholastic performance (using their 12th grade marks associated with the views of faculty members) was performed to understand the association between both variable and letter 2x2 factorial design was used where two levels of gender (male and female) and two levels of subject streams (Arts and Science) were considered as independent variable and processing speed and scholastic performance were considered as dependent.

MEASURES FOR DATA COLLECTION

- Simple block design test of WAIS-III (design no. 1, 2, and 3) to check the ability of processing speed were given to all the participants. Time limit to solve these designs is 90 seconds. Lesser time spent by participants to solve the block designs is the indicators of higher mental processing speed.
- Final marks of 12th grade exam were used as an indicator of academic performance of the participants.

RESULTS

Raw sores of the participants were organized on the data sheet and data were analyses and obtained results are presented below. To understand the association between academic performance and processing speed of students, correlation analysis was done for their final marks in 12th board exam and time taken on block design test.

Table-1: Correlation between time taken on block design test and Marks of students in 12th board exam

	Results of 12th board exam (in %) Boys	**Results of 12th board exam (in %) Girls**	**Results of 12th board exam (in %) Total**
Timing on block design test (in sec.)	-.649** (N=261)	-.608** (N=84)	-.642** (N=345)
	Results of 12th board exam (in %) Arts	**Results of 12th board exam (in %) Science**	
	-.367** (N=141)	-.777** (N=204)	

** p<.01

Results show high negative correlation for all the groups as well as total sample between times spent in completion of block design test and obtain marks in 12th board examination of students. Although, the size of correlation for arts and science subject streams shows more variation. It could be explained that students who have taken average less time to solve the designs scored high marks in their 12th board exam in comparison to those spent more time to make given block designs. A comparative analysis across gender and two major subject streams as arts and science was also done to check possible group differences among students.

Table-2**:** Descriptive Statistics (Means and Standard deviations) on Timing on Block design Test and Marks of students in 12th board exam

Faculty	Gender	Timing on Block Design Tests (in Sec.)		Marks of students in 12th board (in %)		N
		Mean	S.D.	Mean	S.D.	
Arts	Boys	165.26	19.60	44.54	7.51	116
	Girls	152.88	18.22	46.42	7.78	25
	Total	163.06	19.88	44.87	7.56	141
Science	Boys	154.70	20.39	50.12	7.95	145
	Girls	151.27	21.50	50.59	8.11	59
	Total	153.71	20.72	50.26	7.98	204
Total	Boys	159.39	20.69	47.64	8.23	261
	Girls	151.75	20.48	49.35	8.19	84
	Total	157.53	20.87	48.06	8.24	345

Results of mental processing assessment through a simple assembling block design test shows that average students taken nearly double time to complete the task than the given time limit that should be maximum of 90 seconds.

Table-3: 2 X 2 ANOVA Summary table for Timing on Block Design Test

Dependent Variable: Timing on Block Design Test					
Source of variance.	Sum of Squares	df	Mean Square	F	Sig.
Faculty	2041.81	1.00	2041.81	5.01	.026*
Gender	3449.65	1.00	3449.65	8.47	.004**
Faculty * Gender	1104.48	1.00	1104.48	2.71	.100
Error	138852.79	341.00	407.19		
Total	8711571.00	345.00			

*p<.05, **p<.01

Results show that both the main effects of subject stream and gender on processing speed are significant. Although, the effect of gender is significant at the higher level while subject stream show effect for time taken to solve block designs at low level of confidence. Table further show no interaction effect of subject stream and gender on processing speed.

Table-4: 2 X 2 ANOVA Summary table for Marks of students in 12th board exam

Dependent Variable: Marks of students in 12th board exam					
Source of variance.	Sum of Squares	df	Mean Square	F	Sig.
Faculty	1312.63	1.00	1312.63	21.47	.000**
Gender	76.59	1.00	76.59	1.25	.264
Faculty * Gender	27.88	1.00	27.88	0.46	.500
Error	20843.91	341.00	61.13		
Total	820077.36	345.00			

** p<.01

Above table show that only main effect of subject stream on the marks of 12th board exam is significant at the higher level of significance. While the main effect of gender and interaction effect of gender and subject stream on the marks of 12th board exam of students are not significant.

DISCUSSION

The main objective of the present study was to assess the general processing speed of tribal students and its association with their academic performance. Results clearly show that participants had taken too much time to solve the block designs. It indicates very slow mental processing of tribal youth on the task. Significant negative association of their obtained marks in 12th board exam with time consumed in completion of block design test reflect that positive association of academic performance (scholastic performance) with mental processing speed is accordance with the H_1. This result is not much unexpected due to many demographical, geographical, and socio-cultural factors. Real ground observation related to performance of tribal students and feedbacks of faculties involved in higher education institutions in the district was exactly matched with the results of this survey. A district level meeting regarding new education policy in Dantewada (C.G.) on the topic of quality in higher education was conducted by the investigator. Common views of faculties were found as very low response of students towards questioning about understanding of lectures and poor knowledge of basic language like Hindi in daily class room teaching. Annual results are getting very low (Average blow 50 percent pass out ratio in 1st year of Graduation) just because of nearly 90% of fail students in foundation course- English language, and nearly 95% students show aimless selection of courses. Low literacy rate among the tribal population in comparison to the national average (Kumar, 2023) could also be an explanation behind present result. Gordon and others (2018) also have argued that individual differences in processing speed are important in academic achievement among school children. They propose that processing times within mental functioning tasks can be used to predict academic attainment and aid in the development of intervention programmes.

The study further has checked the differences among tribal students in terms of their processing speed and academic accomplishment across gender and two major subject streams as science. Results demonstrate that girls have spent significantly less time on block design and scored little higher 12th grade marks in comparison to boys. Moreover, students of science subject stream have spent significantly less time on block design and scored significantly higher 12th grade marks in comparison to arts group. Hypotheses H_2 and H_3 are supported by these results. Some supporting studies are also conducted. A meta-analysis says that female have better academic self-concept and emotional intelligence as compared to males (Javaid, et.al. 2024). Many researchers are agreed to the notion that the academic empowerment of tribal students would be more effective trough professional education (Nagesh & Ramana, 2024). Major Findings of the study are also supported by general observations of investigators and other educationists who have working experience with these students.

CONCLUSION

Results of the present study depicts a picture of poor processing speed behind low academic accomplishment by tribal students of Chattishgarh. Mental processing speed towards information or tasks can now be considered as an important determinants of academic success among tribal students. Further, statistically significant difference between the students of science and arts subject streams on processing speed on block design and obtained marks in 12th board exam providing insight to treat both the group in different way in the process of their academic development. The concerns of the faculty members teaching in that area towards sub-par academic performance among tribal students also seems right and require appropriate measures to get rid of it.

Therefore, on the basis of results of the present study, it can be concluded that to achieve the goal of quality in higher education and to ensure the better academic performance of tribal students, at least the level of their general mental processing should try to be increased with designing appropriate tools and/or training programs by considering the educational stream of the students. The present results should not be taken as the criticism of tribal students, but an attempt to know the way to develop them according to their circumstances.

LIMITATIONS

The present study was done on a very limited sample and variables with methodological limitation, and could only be more effective when other aspects of the academic performance of tribal students will be studied. It is important to note that processing speed is just one aspect of cognitive function, and that students with slower processing speed can still be successful with appropriate accommodations, strategies, and support.

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REFERENCES

Cheng, D., Shi, K., Wang, N., Miao, X., & Zhou, X. (2022). Examining the differential role of general and specific processing speed in predicting mathematical achievement in junior high school. *Journal of Intelligence, 10*(1), Article 1. https://doi.org/10.3390/jintelligence10010001.

Cowan, R., Donlan, C., Newton, E. J., & Llyod, D. (2005). Number Skills and Knowledge in Children With Specific Language Impairment. *Journal of Educational Psychology, 97*(4), 732–744. https://doi.org/10.1037/0022-0663.97.4.732.

Cowan, R., Donlan, C., Shepherd, D. L., Cole-Fletcher, R., Saxton, M., & Hurry, J. (2011). Basic calculation proficiency and mathematics achievement in elementary school children. *Journal of Educational Psychology, 103*(4), 786–803. https://doi.org/10.1037/a0024556.

Fuchs, L. S., Fuchs, D., Compton, D. L., Powell, S. R., Seethaler, P. M., Capizzi, A. M., Schatschneider, C., & Fletcher, J. M. (2006). The cognitive correlates of third-grade skill in arithmetic, algorithmic computation, and arithmetic word problems. *Journal of Educational Psychology, 98*(1), 29–43. https://doi.org/10.1037/0022-0663.98.1.29.

Fuchs, L. S., Seethaler, P. M., Sterba, S. K., Craddock, C., Fuchs, D., Compton, D. L., Geary, D. C., & Changas, P. (2021). Closing the word-problem achievement gap in first grade: Schema-based word-problem intervention with embedded language comprehension instruction. *Journal of educational psychology*, *113*(1), 86–103. https://doi.org/10.1037/edu0000467.

Fung, W. W., Swanson, H. L., & Orosco, M. J. (2014). Influence of reading and calculation on children at risk and not at risk for word problem solving: is math motivation a mediator?. *Learning and Individual Differences*, *36*(12), 84–91. https://doi.org/10.1016/j.lindif.2014.10.011.

Galton, F. (1883). *Inquiries into human faculty and its development*. London7 Macmillan.

Geary, D. C. (2011). Cognitive predictors of achievement growth in mathematics: A 5-year longitudinal study. Developmental Psychology, 47(6), 1539–1552. https://doi.org/10.1037/a0025510.

Gordon, R., Smith-Spark, J. H., Newton, E. J., & Henry, L. A. (2018). Executive function and academic achievement in primary school children: The use of task-related processing speed. Frontiers in psychology, 9, 582. https://doi.org/10.3389/fpsyg.2018.00582.

Hecht, S. A., Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2001). The relations between phonological processing abilities and emerging individual differences in mathematical computation skills: A longitudinal study from second to fifth grades. *Journal of Experimental Child Psychology, 79*(2), 192-227. https://doi.org/10.1006/jecp.2000.2586.

Javaid, Z. K., Mubashar, M., Mahmood, K., Noor, A., Javed, N., Akhtar, K., & Ali, A. L. (2024). Effect of Emotional Intelligence and Self-concept on Academic Performance: A Systematic Review of Cross-Cultural Research. *Bulletin of Business and Economics (BBE)*, *13*(2), 189-199.

Kumar, C. (2023, April 8). *Analysing the EMRS policy by the government of India for Tribal literacy and empowerment.* https://timesofindia.indiatimes.com/readersblog/layman-academic/analysing-the-emrs-policy-by-the-government-of-india-for-tribal-literacy-and-empowerment-52362/.

Lambert, K., & Spinath, B. (2017). Conservation abilities, visuospatial skills, and numerosity processing speed: Association with math achievement and math difficulties in elementary school children. *Journal of Learning Disabilities, 51*(3), 223-235. https://doi.org/10.1177/0022219417690354.

Leikin, R., Paz-Baruch, N., & Leikin, M. (2014). Cognitive characteristics of students with superior performance in mathematics. *Journal of Individual Differences, 35*(3), 119–129. https://doi.org/10.1027/1614-0001/a000140.

Lin, X. (2020). Investigating the unique predictors of word-problem solving using meta-analytic structural equation modeling. *Educational Psychology Review, 33*(3), 1097 - 1124. https://doi.org/10.1007/s10648-020-09554-w.

Nagesh, A., & Ramana, G. V. (2024). *Empowerment of the schedule tribe students through professional education: A study*. Laxmi Book Publication.

Passolunghi, M. C., & Silvia L. (2012). Domain-specific and domain-general precursors of mathematical achievement: A longitudinal study from kindergarten to first grade. British Journal of Educational Psychology, 82(1), 42–63. https://doi.org/10.1111/j.2044-8279.2011.02039.x

Rohde, T. E., & Thompson, L. A. (2007). Predicting academic achievement with cognitive ability. Intelligence, 35(1), 83-92. https://doi.org/10.1016/j.intell.2006.02.001.

Roth, E. (1964). Die Geschwindigkeit der Verarbeitung von Information und ihr Zusammenhang mit Intelligenz [The speed of information processing and its relation to intelligence]. *Zeitschrift für Experimentelle und Angewandte Psychologie*, 11(4), 616–622.

Schneider, W. J., & McGrew, K. S. (2012). The Cattell-Horn-Carroll model of intelligence. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 99–144). The Guilford Press.

Singh, J. (2014). Emotional intelligence and achievement orientation in tribal youths. *Mind and Society*, *3*(III & IV), 14-18.

Taub, G. E., Keith, T. Z., Floyd, R. G., & Mcgrew, K. S. (2008). Effects of general and broad cognitive abilities on mathematics achievement. *School Psychology Quarterly*, *23*(2), 187–198. https://doi.org/10.1037/1045-3830.23.2.187.

Tikhomirova, T., Malykh, A., & Malykh, S. (2020). Predicting academic achievement with cognitive abilities: Cross-sectional study across school education. *Behavioral sciences (Basel, Switzerland)*, *10*(10), 158. https://doi.org/10.3390/bs10100158

Träff, U., Skagerlund, K., Olsson, L., & Östergren, R. (2017). Pathways to arithmetic fact retrieval and percentage calculation in adolescents. *The British journal of educational psychology*, *87*(4), 647–663. https://doi.org/10.1111/bjep.12170.