Exploring Relationship Between Reaction Time and Academic Achievement in Science Subjects of Middle Stage Students

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ABSTRACT

Reaction Time (RT) denotes the time between stimulus presentation and voluntary response and is a significant measure of sensory-motor integration with cognitive processing rate of human brain. Hence, it is imperative to study the correlation between Reaction Time rate and academic performance of the students for identifying their speed of cognitive process. An investigation was carried out for one-to-one mapping between Reaction Time rate and general proficiency in science subject of Class VIII students from Odisha Adarsha Vidyalaya, Satrusola, Ganjam, Odisha. The main hypothesis of the present study is that there exist tenable and justifiable relationships between the Reaction Time of a student with his/her performance at school in science subject. Furthermore, it was hypothesized that gender differences with respect to Reaction Time also effect on academic performances. The above two hypotheses have been investigated on 38 students (13 boys and 25 girls) who were randomly sampled from the school. The data was gathered using a mixture of Reaction Time tests with an ICT-based tool ("Reaction Tester") and Term-I examination scores on science subject. The performance on science subject was determined from scores of two formative and a single summative test in science as per CBSE's Continuous and Comprehensive Evaluation (CCE) framework.

The mean Reaction Times for both boy and girl students were measured by using techniques of descriptive statistics. The findings revealed that boys had a lesser mean Reaction Time (589 milliseconds) than girls (607 milliseconds), which would establish the fact that the boys have faster cognitive processing rate and also better academic achievement. Further, Pearson's r-correlation coefficient between each pupil's Reaction Time (Y) and academic score (X) was also compared for entire sample of 38 students, and the magnitude of 'r' was found to be $r = -0.51$. This finding suggests moderate negative correlation between Reaction Time and achievement score in science subject. The analysis also confirmed that correlating Reaction Time of each student with his/her score in achievement test in science subject may lead to a meaningful outcome.

Key words: Reaction Time, Academic Achievement, Middle Stage, Correlation coefficient and Science.

INTRODUCTION

All living organisms react to external stimuli. The Merriam-Webster Dictionary defines a stimulus as "an agent (such as environmental change) that influences the activity of a living organism or one of its parts". A stimulus can be a visual change, a sound, a sensation etc. Reaction Time is a measure of the response to a stimulus. Reaction Time is defined as the interval of time between thepresentation of the stimulus and appearance of appropriate voluntary response in the subject. (Jain et. al. 2015). In human being, central nervous system which includes the brain and spinal cord and a complex network of neurons throughout our body work continuously for reacting to external stimuli. The scientific study of reflection time is called mental chronometry. Mental chronometry is the scientific study of cognitive processing speed. The Cognitive processing speed is measured by Reaction Time (RT), which is the elapsed time between the onset of a stimulus (e.g., visual or auditory) and an individual's response. (Kranzler, John H. (2012), Penser, M. (1978).

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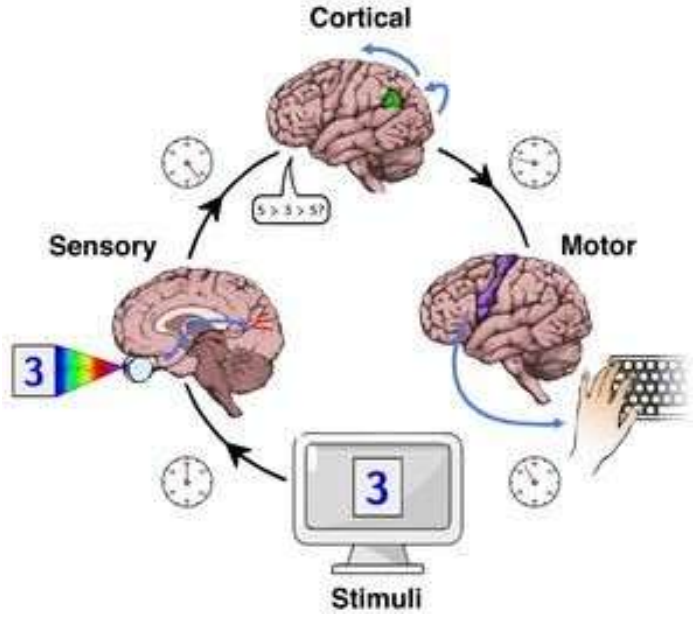

Fig 1.1: Representation of the stages of processing in a typical Reaction Time paradigm

Reaction Time is very important for our everyday lives and needs intact sensory system, cognitive processing, and motor performance. When a learning situation demands our immediate action by the students, it takes some time before they really react and respond. So, Reaction Time is the time student takes to observe, think and act (NCERT, Physics Text book for class XI, Part-1, edition-2006). Reaction Time is a good indicator of sensory-motor coordination and performance of an individual. The speed of Reaction time determines the alertness of a person and it ought tobe lesser in students particular for science learning where alertness is a much-desired virtue. (Batra et. al.2014).

As science is an empirical subject and science learning needs many activities based on experiential leaning which in turns requires high precision and accuracy. Recently, sports-integrated pedagogy has gained significant emphasis in the school science curriculum. In order to make learning more interesting and significant, teachers are gradually incorporating a variety of concepts with a wide range of sports activities. This method of instruction effectively fosters students' growth in the cognitive, affective, and psychomotor domains, guaranteeing comprehensive learning. Additionally, since regular participation in sports and games improves students' alertness, accuracy, and precision, using sports-integrated pedagogy helps reduce students' reaction times. These experiences encourage quick thinking and active participation, making students more receptive and prepared for a variety of assessments (NEP-2020, Para 4.8).

Reaction time is an essential skill in games and sports that directly affects accuracy and performance. For example, to ensure fairness and uniformity, a sprinter's reaction time in the Olympics must be at least 100 milliseconds. Similar to this, players like goalkeepers, slip fielders, and wicketkeepers in football and cricket rely on fast reflexes to react effectively (Fit India Mission, 2019).

Reaction Time (RT) has long been used in cognitive processing research as a crucial metric to comprehend the complexities of mental processes. A seminal work in this field, Chronometric Explorations of Mind introduced the use of Reaction Time to study perception, attention, and information processing (Posner's 1978). Posner's chronometric approach provided empirical support for cognitive theories by breaking down mental tasks into quantifiable time-based components. This approach had a major impact on research in experimental psychology and cognitive neuroscience.

Building on this framework, Jensen (1987) discovered a strong correlation between intelligence and Reaction Time variability using the Hick Paradigm. His research suggested that higher cognitive ability is represented by quicker and more reliable information processing, connecting psychometric tests of intelligence with experimental psychology. The relationship is extended by Deary, Der, and Ford (2001), who examined large-scale population data to confirm that shorter Reaction Times go with higher intelligence scores. This study further solidified the idea that processing speed could act as a good marker of latent cognitive ability and provided at least a glimpse into what might be the mechanisms underlying intelligence. Kranzler and Floyd (2012), in their

effort to concentrate on the area of intelligence testing in educational and clinical settings, managed to compile an exhaustive compilation of evidence-based testing practices on children and adolescents. Their paper is firmly rooted in the Cattell-Horn-Carroll (CHC)theory, and the significance of proper, honest, and culture-fair testing is emphasized, specifically in the application of the concept of Reaction Time and processing speed.

Reaction Time studies have also focused on demographic factors such as age, physical activity, and gender. For example, Batra et al. (2014) conducted an audiovisual Reaction Time study on Indian males, and their results showed that response time slowed with age. Indeed, it has been confirmed that there is an age-related slowing in cognitive as well as motor performance, making it crucial to take into account when evaluating an individual.

Similarly, Jain, Bansal, Kumar, and Singh (2015) examined the impact of physical activity and gender on Reaction Times amongst first-year medical students. The findings showed that persons pursuing physical activities tend to have faster Reaction Times, confirming the hypothesis that exercising helps build efficiency regarding neurophysiological traits. Moreover, it was found that Reaction Times were marginally faster amongst men compared to females, a result consistent with prior cognitive and physiological studies. These findings offer meaningful implications for educational and clinical practices, especially regarding the impact of lifestyle and biological factors on cognitive functioning.

Rationale

The possible relationship between the Reaction Time and performance of human brain and intelligence has tinkered in the inquisitive minds since centuries. It is believed that Reaction Time have impact on cognitive process functioning which is the driving force to take up this study. The teenage of students is the most fragile, fickle and fractious time in life of a human being. But this is the age where they need to be focus for better performance and achievement. Achievement test now days are time bound and computer based. In school curriculum evaluation includes objective, MCQ and computer-based test etc. where students need the quick reaction speed less time with high accuracy. The curiosity to ascertain the impact of Reaction Time on the young minds of tender age of 14 and 15 paved the way for this activity. Reaction Time is given utter importance when it comes to games and sports, intelligence, sensory-motor skills and overall cognitive process. In ancient times, Indian philosophy also paid significant importance on concentration ("*Dharana")* and is included in the eight limbs of yoga (Patanjali, 1990, Vivekananda, S., 1896).

Research Questions

- Is there any relationship between Reaction Time of students and their academic achievement?
- Is there any significant difference in Reaction Time of boys and girls?

Objectives

Objective of the study are as furnished under:

- To find out relationship between Reaction Time and Academic Achievement of the students.
- To find out gender difference, if any, pertaining to Reaction Time.
- To find out gender difference in achievement specifically in science among Class VIII students.

Delimitations

1. As this study focuses on the impact of Reaction Time on young people, the sampling is only done by selecting students of Class VIII of Odisha Adarsha Vidyalaya, Satrusola, Block/Dist.-Ganjam, Odisha.

2. A student may have affinity in a particular science subject and in some other subject he or she may not be doing well. In such case it is difficult to establish relationship between Reaction Time and Academic Achievement. Hence, the study is delimited to academic achievement of students in science subject only as science learning demands more diligent observation.

3. Students those who were habitually irregular in attending classes in the academic year may secure less marks in the term-end examinations. Students whose attendance is less than 75 % are excluded in this study.

Method

Design

The study is descriptive survey type. Reaction Time of student is calculated and the same is analyzed with reference to the academic performance of the target group students.

Sample

The sample of the study was collected from Odisha Adarsh Vidyalaya, Satrusola, situated in the rural area of Ganjam District, Odisha. A total of 38 students from Class VIII participated in the study, including 13 boys and 25 girls. The students were randomly selected from the school. All the students of Class VIII participated in the study.

Tools

Personal Data Capture Form is filled in by all the target group students in which their personal details are mentioned. The key information collected from this form were:

1. Percentage of attendance in term-I (2022-23, 1st semester)

2. Academic performance of the student in term-I. Mark secured in Science in Formative Assessment-I, Formative Assessment-II and Summative Assessment-I. The weightage of Formative Assessment-I and Formative Assessment-II is 20% each and that of Summative Assessment-I is 30%.

3. Medical History of Student.

Focus group discussions: -

Focus group discussions were carried out with limited number of students to develop rapport with the students and to find out if there is any other problem that may hamper findings of this project.

Testing of Reaction Time using ICT tool: -

21st century is the era of Information and Communication Technology. To calculate Reaction Time of a person many ICT tools are available. These ICT tools provide external stimuli like-

i.) Colour Change, ii) Production of sound iii) Vibration of device, etc.

After caution count of 3 to 1, the external stimulus occurs. The student whose Reaction Time needs to be accessed has to react and touch the screen as soon as the stimulus occurs. After five tests the average Reaction Time in milliseconds is given by the App (An application captioned “Reaction Tester” developed by M/s. Nix G Software solutions is used to calculate the Reaction Time of students). This application is easy and user friendly. A free software is available in Google Play Store for Android, IOS and other operating systems.

Collection of Data and Procedure

A sample was chosen consisting of 38 students, who were evaluated for their Reaction Time with the aid of the Reaction Timer Application running on Android-based mobile devices. Before the actual testing was done, the students were adequately oriented on the ICT tool with the aid of an orientation and practice program in order to ensure an understanding of the task, thus reducing errors in the process. After practical sessions were over, the average scores were recorded by testing the reaction time of every student.

This study was conducted at Odisha Adarsha Vidyalaya, Satrusola, Ganjam, a CBSE-affiliated residential school administered by the Government of Odisha. As per the guidelines laid down by the Central Board of Secondary Education (CBSE), the performance of students at this institution has been measured through the scheme of

Continuous and Comprehensive Evaluation (CCE). The criteria of CCE stress upon continuous evaluation in terms of periodic formative evaluations, along with summative evaluations. Thus, it allows a comprehensive assessment of students' academic achievement at a holistic level. However, through this criterion of CCE, students' achievement in science was measured in terms of scores obtained from periodic tests (formative evaluation) and terminal exams (summative evaluation), considering a well-rounded class performance and understanding of concepts. Therefore, application of the criterion of CCE helped in increasing the validity of scores of academic achievements of students, used in this study by reducing biases related to examinations and assessing learners' achievements in a comprehensive and continuous process.

Table 4.1: Examination Pattern

Particulars	**Term-I**			**Term-II**		
Name of Exam	**Formative Assess-ment—I (Periodic Test-I)**	**Formative Assess-ment—II (Periodic Test-II)**	**Summative Assess-ment—I (Half Yearly)**	**Formative Assess-ment—III (Periodic Test-III)**	**Formative Assess-ment—IV (Periodic Test-IV)**	**Summative Assess- ment—II (Annual)**
Max. Mark in Periodic Progress Test in each Subject	40 Marks	40 Marks	80 Marks	40 Marks	40 Marks	80 Marks
Weightage	10%	10%	30%	10%	10%	30%

The examination pattern for Terms I and II is showed in the table, which highlights both formative and summative assessments. Each term consists of one summative assessment with a maximum score of 80 marks and two periodic tests (formative assessments) of 40 marks each. Each summative assessment contributes 30% to the final evaluation, while each periodic test carries 10%. The weightage distribution is balanced across the year. By combining major term-end exams with regular periodic tests, this structure ensures a continuous and thorough assessment approach, enabling students to be assessed on both overall understanding and consistent performance.

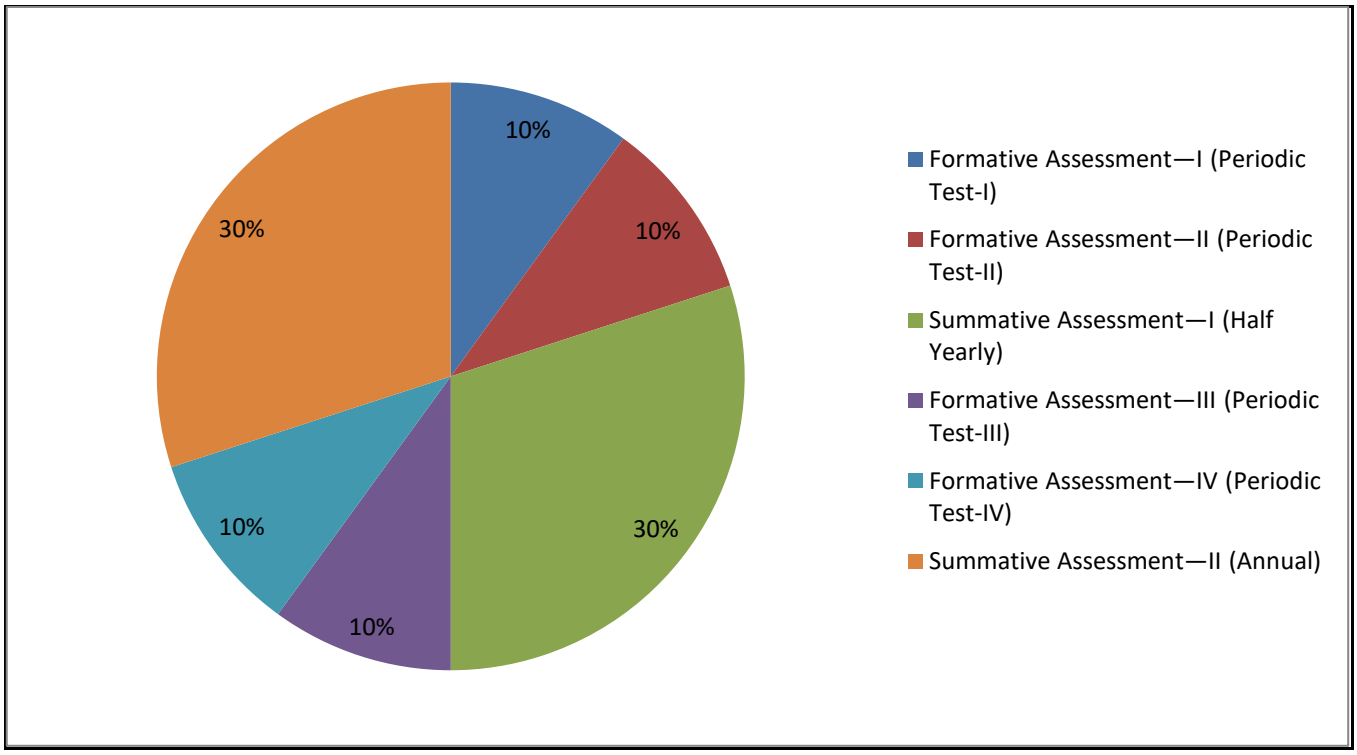

Fig 4.1: Pie chart showing the percentage (%) distribution of formative and summative assessment

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As regards the Summative Assessment for the study of academic achievement of the student only the mark secured in Term-I is taken into consideration.

Presentation of Data

Table 5.1: Showing Reaction Time and Marks of Boys and Girls

Student Index	Gender	Marks	Reaction Time(ms)
1	G	157	387
2	G	119	858
3	G	73	804
4	B	112	490
5	G	71	831
6	B	86	456
7	G	155	386
8	G	153	417
9	B	143	431
10	B	147	396
11	B	118	716
12	G	37	821
13	G	67	497
14	B	104	870
15	G	85	601
16	G	118	630
17	G	55	556
18	G	124	722
19	G	151	379
20	G	121	436
21	G	121	704
22	B	99	694
23	B	93	407
24	G	80	457
25	G	68	713
26	B	142	623
27	B	136	525
28	B	121	723
29	G	77	950
30	G	84	700
31	G	96	717
32	G	135	639
33	B	71	682
34	G	155	450
35	G	143	385
36	G	132	342
37	B	148	694
38	G	148	392

From above table, marks include the academic performance of the student in formative and summative assessment of Term-I and term-II examination whereas the score of Rection Time was calculated by an android application captioned “Reaction Tester” developed by M/s. Nix G Software solutions.

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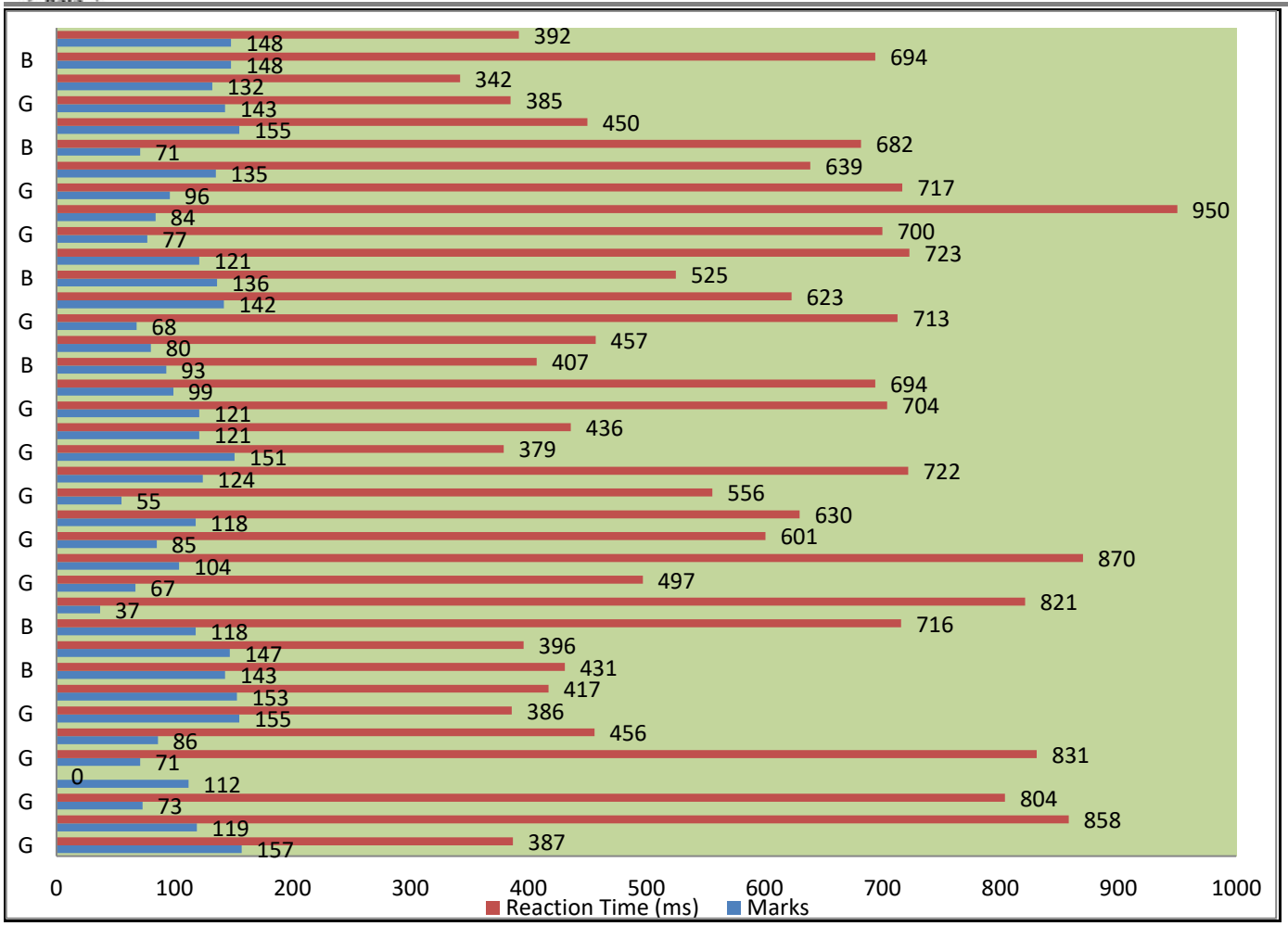

Fig 5.1: Graphical representation of Reaction Time (in millisecond) of Boys and Girls with respect to Marks

The graphical representation of reaction time and marks for boys and girls shows no clear or consistent pattern linking to marks and reaction time. Students with faster reaction times do not necessarily score higher marks, and several students with slower reaction times also achieve high scores. This random distribution of bar lengths indicates that reaction time does not influence academic performance in this sample. Girls appear to have slightly more high scorers, but their reaction times vary just as widely as boys.

Photos showing Students Performing Reaction Time Test with Android App

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Statistical Representation

In accordance with Table no. 5.1 the mean Reaction Time of girl students in the population are-

Table 5.2: Mean Reaction Time of Girls

Class Interval	Frequency (f)	Mid -Point (X)	fX
301-400	06	350.5	2103
401-500	05	450.5	2252.5
501-600	01	550.5	550.5
601-700	03	650.5	1951.5
701-800	04	750.5	3002
801-900	04	850.5	3402
901-1000	02	950.5	1901
Total	**25**		**15162.5**

In accordance with Table no. 5.1 the mean Reaction Time of boy students in the population are-

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Table 5.3: Mean Reaction Time of Boys

Class Interval	Frequency (f)	Mid- Point (X)	fX
301-400	01	350.5	350.5
401-500	04	450.5	1802
501-600	01	550.5	550.5
601-700	04	650.5	2602
701-800	02	750.5	1501
801-900	01	850.5	850.5
Total	**13**		**7656.5**

Data Analysis

As per the data in table no. 5.2

X (Mean) = ∑fX / N

= 15162.5 / 25

= 607 ms

The mean Reaction Time for the girl students of the population is 607 milliseconds.

X (Mean) = ∑fX / N

X (Mean) = 7656.5 / 13 = 589 ms

The mean reaction time for the boy students of the population is 589 Millisecond.

Comparison of Reaction Time of Girls and Boys

Table 6.1: Comparison of Reaction Time

Mean Reaction Time	Girls	Boys
	607 ms	589 ms

Table 6.1 shows girls' and boys' mean Reaction Time. It indicates that, on average, boys react faster than girls on the tested reaction time task. The discrepancy (607 - 589 = 18 ms) indicates boys are 18 milliseconds faster on average. Reaction time is a measure of response speed, typically measured in milliseconds (ms). Lower Reaction Time means a quicker response. The mean Reaction Time for girls is 607 ms and for boys is 589 ms. several studies showed mixed results for the existence of gender differences in reaction time. For instance, Der and Deary (2006) discovered that males tend to have slightly quicker Reaction Times than females on simple tasks, though it is also often negligible. On the contrary, research such as that of Silverman (2006) and Adam et al. (1999) indicates that females might be superior to males in sustained attention and perceptual speed, particularly as the complexity of the task increases. Such disparities point to the effect of different biological, psychological, and environmental aspects on Reaction Time performance. In conclusion, though the present data shows that girls scored higher than boys in this Reaction Time task, analysis with controlled variables and inferential statistics is required to make firmer conclusions.

Comparison of Academic Score

Table 6.2: Comparison of Mean Marks

Mean Marks	Girls	Boys
	109	116

The table presents the mean marks of girls and boys. It shows that the mean marks of girls are 109, while the mean marks of boys are 116. This indicates that, on average, boys scored higher than girls by 7 marks. The difference suggests a comparatively better overall performance of boys in terms of mean marks for the given group. The trend of better mean performance of boys is substantiated by various studies. Duckworth and Seligman (2006) found that gender differences in achievement may differ according to context, where boys have been observed to perform better than girls in areas that demand speed, spatial talents, and problem-solving skills. Likewise, Hyde (2005) asserted that while the difference in achievement is small, an edge has been noticed to be possessed by boys over girls in science-related matters to some extent.

Comparison of Reaction Time and Academic Achievement

Table 6.2: Calculation of Coefficient of Correlation (r)

Student Index	Gender	PT I	PT2	SA I	Total mark	Reaction time	xy	x2	y2
					X	Y			
STUDENT 1	G	38	39	80	157	387	60759	24649	149769
STUDENT 2	G	30	32	57	119	858	102102	14161	736164
STUDENT 3	G	19	17	37	73	804	58692	5329	646416
STUDENT 4	B	28	22	62	112	490	54880	12544	240100
STUDENT 5	G	22	4	45	71	831	59001	5041	690561
STUDENT 6	B	21	18	47	86	456	39216	7396	207936
STUDENT 7	G	39	38	78	155	386	59830	24025	148996
STUDENT 8	G	38	40	75	153	417	63801	23409	173889
STUDENT 9	B	35	32	76	143	431	61633	20449	185761
STUDENT 10	B	38	35	74	147	396	58212	21609	156816
STUDENT 11	B	29	23	66	118	716	84488	13924	512656
STUDENT 12	G	12	7	18	37	821	30377	1369	674041
STUDENT 13	G	19	9	39	67	497	33299	4489	247009
STUDENT 14	B	29	18	57	104	870	90480	10816	756900
STUDENT 15	G	14	19	52	85	601	51085	7225	361201
STUDENT 16	G	37	25	56	118	630	74340	13924	396900
STUDENT 17	G	19	14	22	55	556	30580	3025	309136
STUDENT 18	G	32	31	61	124	722	89528	15376	521284
STUDENT 19	G	38	39	74	151	379	57229	22801	143641
STUDENT 20	G	27	30	64	121	436	52756	14641	190096

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STUDENT 21	**G**	**30**	**29**	**62**	**121**	**704**	**85184**	**14641**	**495616**
STUDENT 22	**B**	**15**	**26**	**58**	**99**	**694**	**68706**	**9801**	**481636**
STUDENT 23	**B**	**23**	**23**	**47**	**93**	**407**	**37851**	**8649**	**165649**
STUDENT 24	**G**	**20**	**25**	**35**	**80**	**457**	**36560**	**6400**	**208849**
STUDENT 25	**G**	**12**	**21**	**35**	**68**	**713**	**48484**	**4624**	**508369**
STUDENT 26	**B**	**36**	**32**	**74**	**142**	**623**	**88466**	**20164**	**388129**
STUDENT 27	**B**	**29**	**34**	**73**	**136**	**525**	**71400**	**18496**	**275625**
STUDENT 28	**B**	**28**	**30**	**63**	**121**	**723**	**87483**	**14641**	**522729**
STUDENT 29	**G**	**20**	**20**	**37**	**77**	**700**	**53900**	**5929**	**490000**
STUDENT 30	**G**	**11**	**26**	**47**	**84**	**950**	**79800**	**7056**	**902500**
STUDENT 31	**G**	**16**	**30**	**50**	**96**	**717**	**68832**	**9216**	**514089**
STUDENT 32	**G**	**33**	**34**	**68**	**135**	**639**	**86265**	**18225**	**408321**
STUDENT 33	**B**	**7**	**13**	**51**	**71**	**682**	**48422**	**5041**	**465124**
STUDENT 34	**G**	**39**	**39**	**77**	**155**	**450**	**69750**	**24025**	**202500**
STUDENT 35	**G**	**33**	**38**	**72**	**143**	**385**	**55055**	**20449**	**148225**
STUDENT 36	**G**	**29**	**35**	**68**	**132**	**342**	**45144**	**17424**	**116964**
STUDENT 37	**B**	**36**	**38**	**74**	**148**	**694**	**102712**	**21904**	**481636**
STUDENT 38	**G**	**38**	**38**	**72**	**148**	**392**	**58016**	**21904**	**153664**
					4245	**22481**	**2404318**	**514791**	**14378897**

Finding correlation coefficient between Reaction Time and academic achievement-

N=38

Let total mark be X and Reaction Time be Y

$\sum X = 4245$

$\sum Y = 22481$

$\sum XY = 2404318$

$\sum X^2 = 514791$

$\sum Y^2 = 14378897$

$(\sum X)^2 = 18020025$

$(\sum Y)^2 = 505395361$

Mathematically, correlation coefficient 'r' can be written as-

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[\,(N\sum X^2 - (\sum X)^2)][\,(N\sum Y^2 - (\sum Y)^2\,)\,]}}$$

$$r = \frac{38(2404318) - (4245)(22481)}{\sqrt{[38(514791) - 18020025][38(14378897) - 505395361]}}$$

$$r = \frac{91,364,084 - 95,431,845}{\sqrt{(19,562,058 - 18,020,025)(546,398,086 - 505,395,361)}}$$

$$r = \frac{-4,067,761}{7,951,000}$$

$$r = -0.51$$

RESULT AND DISCUSSION

Pearson's product–moment correlation coefficient was calculated to study the relationship between academic achievement and reaction time among 38 students. The analysis revealed a moderate negative correlation between academic achievement and reaction time (r = –0.51). This specifies that students with higher academic achievement tend to have shorter (faster) reaction times, whereas students with lower academic achievement tend to exhibit longer (slower) reaction times. The present result is in consonance with earlier research which advocates that faster reaction time is associated with better cognitive processing efficiency and academic performance. Studies by Kail and Salthouse (1994) and Jensen (2006) described that processing speed, as reflected through reaction time, plays an important role in learning, problem-solving, and scholastic achievement. Similarly, Schmidt and Lee (2011) highlighted that quicker reaction time is indicative of efficient neural processing, which positively contributes to performance in both cognitive and academic tasks. Further, educational psychology researches have shown that students who process information more rapidly are better able to attend, respond, and adapt during learning activities, leading to enhanced academic outcomes (Hattie, 2009). The negative correlation obtained in the present study supports the view that reaction time is an important cognitive variable influencing academic achievement, though it may not be the sole determinant. However, some investigators have stated weak or insignificant relationships between reaction time and academic achievement, attributing academic success to a combination of factors such as motivation, learning strategies, teaching methods, and socio-emotional variables (Bloom, 1976). Sheppard and Vernon (2008) reported that reaction time explains very little variance in academic outcomes. Similarly, Deary, Der, and Ford (2001) found that reaction time is not a reliable predictor of academic achievement, despite small correlations with general intelligence. Kosinski's (2013) review also determined that reaction time is influenced by factors such as attention, fatigue, and sensory processing rather than academic ability. Thus, the present results align with existing studies representing that reaction time and academic performance are largely unrelated. In this context, the moderate negative correlation found in the present study suggests that while reaction time contributes to academic achievement, it should be interpreted alongside other cognitive and non-cognitive factors.

Overall, the findings of the present study reinforce existing literature by confirming an inverse relationship between academic achievement and reaction time, thereby highlighting the role of cognitive processing speed in students' academic performance.

CONCLUSION

The present study studied the relationship between academic achievement and reaction time among secondary school students. The findings revealed a moderate negative correlation, indicating that students with higher academic achievement tend to exhibit faster reaction time, while students with lower academic achievement show comparatively slower reaction time. This suggests that cognitive processing speed, as reflected through reaction time, is meaningfully associated with students' academic performance. The result confirms that academic achievement is not solely dependent on content knowledge but is also influenced by underlying

cognitive abilities such as attention, alertness, and speed of information processing. However, the relationship is moderate, implying that academic success is shaped by a combination of cognitive, affective, and environmental factors. Thus, reaction time should be regarded as an important contributing variable rather than a sole predictor of academic achievement.

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