MEMORY PROFILES OF HIGH SCHOOL STUDENTS IN MIZORAM

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
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MEMORY PROFILES OF HIGH SCHOOL STUDENTS IN MIZORAM

BY

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<u>Certificate</u>

This is to certify that the present piece of Thesis titled, "**Memory Profiles of High School Students in Mizoram"** is the bonafide research conducted by Lalnunpuii under my supervision. She worked methodologically for her dissertation which is submitted for the Doctor of Philosophy in Psychology under Mizoram University.

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DECLARATION

Mizoram University

June, 2023

I, Lalnunpuii, hereby declare that the subject matter of this Thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University or Institute.

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I would give special thanks to the people who mean the world to me, my mother, my brother, and my sisters. I am forever thankful to my family for their unconditional love and support throughout the entire thesis process

This thesis is dedicated to the loving memory of my father, Vanlalawia (1960-2018)

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Table of Contents

List of Tables

List of Figures

List of Appendices

Table- 2: *Mean comparison between High and low academic achievers on the sub-scales of The PGIMS*

Level of Academic Achievement	Statistics	PGI-Memory Scale (sub-scales)									
		RM	REM	MB	A&C	DR	IR	VRSP	VRDP	VR	RG
High Academic achiever	Mean	5.83	4.81	7.99	20.16	8.88	11.00	4.49	13.06	11.56	9.34
	SD	0.37	0.39	1.16	4.29	1.30	0.96	0.67	1.58	1.11	1.13
Low Academic achiever	Mean	5.67	4.56	5.79	13.50	7.28	8.28	3.40	10.56	9.33	6.62
	SD	0.47	0.60	1.81	3.95	1.80	2.07	1.06	2.32	1.70	2.11
Total	Mean	5.75	4.69	6.90	16.85	8.09	9.65	3.95	11.82	10.45	7.99
	SD	0.43	0.52	1.88	5.29	1.76	2.10	1.04	2.34	1.81	2.17

Note. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table- 3: *Mean comparison between Urban and Rural on the sub-scales of The PGIMS*

Ecology	Statistics	PGI-Memory Scale (sub-scales)									
		RM	REM	MD	A&C	DR	IR	VRSP	VRDP	VR	RG
Urban	Mean	5.79	4.74	7.54	17.89	8.48	10.55	4.18	12.21	11.06	8.65
	SD	0.41	0.48	1.61	5.15	1.54	1.35	0.91	2.33	1.59	1.66
Rural	Mean	5.71	4.64	6.26	15.82	7.70	8.76	3.72	11.43	9.86	7.33
	SD	0.45	0.55	1.91	5.25	1.87	2.33	1.11	2.29	1.83	2.40
Total	Mean	5.75	4.69	6.90	16.85	8.09	9.65	3.95	11.82	10.45	7.99
	SD	0.43	0.52	1.88	5.29	1.76	2.10	1.04	2.34	1.81	2.17

Note. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-4: *Mean comparison between males and females on the sub-scales of The PGIMS*

Gender	Statistics	PGI-Memory Scale (sub-scales)									
		RM	REM	MB	A&C	DR	IR	VRSP	VRDP	VR	RG
Male	Mean	5.79	4.71	6.50	17.50	7.70	9.29	3.79	11.32	9.93	8.35
	SD	.411	.507	1.889	5.138	1.922	2.318	1.081	2.337	1.946	1.945
Female	Mean	5.72	4.66	7.29	16.20	8.47	10.01	4.11	12.30	10.97	7.63
	SD	.450	.536	1.784	5.382	1.484	1.808	.975	2.242	1.510	2.315
Total	Mean	5.75	4.69	6.90	16.85	8.09	9.65	3.95	11.82	10.45	7.99
	SD	.432	.521	1.877	5.294	1.756	2.104	1.040	2.338	1.814	2.166

Note. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-5: *Mean comparison between eight (8) groups: High Academic Achiever Urban Male (HAUM), High Academic Achiever Urban Female (HAUF), High Academic Achiever Rural Male (HARM), High Academic Achiever Rural Female (HARF), Low Academic achiever Urban Male (LAUM), Low Academic achiever Urban Female (LAUF), Low Academic achiever Rural Male (LARM), Low Academic achiever Rural Female (LARF) on PGI-Memory scale (Subscales)*

Groups (academic Achievement x Ecology x Gender	Statistics	PGI-Memory Scale (sub-scales)									
		RM	REM	MB	A&C	DR	IR	VRSP	VRDS	VR	RG
HAUM	Mean	5.93	4.93	8.03	21.90	9.15	10.75	4.52	12.65	11.30	9.93
	SD	0.27	0.27	1.17	4.02	1.15	0.49	0.55	1.59	1.14	0.27
HAUF	Mean	5.85	4.83	9.00	20.32	9.33	11.88	4.90	13.97	12.85	9.40
	SD	0.36	0.39	0.00	4.36	0.94	0.46	0.30	1.00	0.36	1.06
HARM	Mean	5.80	4.78	7.50	19.62	8.27	10.55	4.22	12.28	10.85	9.10
	SD	0.41	0.42	1.32	4.28	1.45	1.11	0.86	1.92	0.95	1.41
HARF	Mean	5.76	4.73	7.46	18.80	8.78	10.83	4.32	13.32	11.24	8.93
	SD	0.44	0.45	0.90	4.02	1.37	0.97	0.65	1.11	0.58	1.19
LAUM	Mean	5.72	4.64	6.15	15.05	7.26	9.92	3.38	10.62	10.21	8.08
	SD	0.46	0.54	1.31	4.14	1.79	1.56	0.96	2.48	1.32	1.58
LAUF	Mean	5.68	4.55	6.95	14.23	8.15	9.65	3.90	11.55	9.85	7.20
	SD	0.47	0.60	1.68	3.37	1.21	1.23	0.81	2.45	1.23	1.67
LARM	Mean	5.70	4.50	4.30	13.38	6.10	5.95	3.00	9.73	7.37	6.28
	SD	0.46	0.64	1.09	2.81	1.77	1.50	1.11	2.01	1.37	1.80
LARF	Mean	5.60	4.55	5.75	11.40	7.63	7.65	3.33	10.35	9.93	4.98
	SD	0.50	0.64	1.96	4.44	1.75	0.77	1.16	1.98	1.15	2.06

Note. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-6: Showing significant difference between high and low academic achievers: Mann-Whitney U test

Level of academic achievement	Statistics	RM	REM	MB	AC	DR	IR	VRSP	VRDP	VRT	RT
High academic achiever	Mean Rank	173.17	177.02	177.02	213.32	219.26	201.81	209.27	219.51	217.71	219.19
Low Academic achiever		147.67	143.77	143.77	107.01	101.00	118.67	111.12	100.75	102.57	101.07
	Mann-Whitney U	10760.00	10139.00	10139.00	17015.00	3338.50	6148.00	4948.00	3299.00	3588.50	3350.50
	Z	-3.30	-4.09	-4.09	-10.46	-11.45	-8.20	-9.58	-11.66	-11.35	-11.77
	r	0.18	0.23	0.23	0.58	0.64	0.45	0.53	0.65	0.63	0.66
	Asymp. Sig.	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**

Note: *indicates $p< 0.05$; **indicates $p< 0.01$ significant. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-7: *Showing significant difference (Mann-Whitney U test) between Urban and Rural samples on the sub-scales of PGIMS*

Ecology	Statistics	RM	REM	MB	AC	DR	IR	VRDP	VRSP	VRT	RT
Urban	Mean Rank	166.79	167.00	192.55	177.03	179.77	196.81	179.36	176.96	188.52	186.55
Rural		154.29	154.08	128.85	144.18	141.47	124.65	141.88	144.24	132.83	134.77
	Mann-Whitney *U*	11799.00	11766.00	7704.00	10171.50	9735.50	7027.00	9801.00	10182.00	8344.00	8657.00
	Z	-1.62	-1.59	-6.27	-3.18	-3.78	-7.08	-3.81	-3.19	-5.49	-5.16
	R	0.09	0.08	0.35	0.17	0.21	0.39	0.21	0.17	0.30	0.28
	Asymp. Sig.	0.11	0.11	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-8: *Showing significant difference (Mann-Whitney U test) between Male and Female samples on Sub-scales of PGIMS*

Gender	Statistics	RM	REM	MB	AC	DR	IR	VRDP	VRSP	VRT	RT
Male	Mean Rank	165.79	163.78	140.52	169.88	142.73	146.79	139.98	146.44	137.24	175.28
Female		155.28	157.26	180.23	151.24	178.05	174.04	180.76	174.38	183.47	145.90
	Mann-Whitney *U*	11959.00	12278.00	9622.50	11308.00	9974.50	10620.00	9537.00	10564.50	9101.50	10449.00
	Z	-1.36	-0.80	-3.91	-1.81	-3.48	-2.67	-3.98	-2.84	-4.56	-2.93
	R	0.07	0.04	0.21	0.10	0.19	0.14	0.22	0.15	0.25	0.16
	Asymp. Sig.	0.17	0.42	0.00**	0.07	0.00**	0.01*	0.00**	0.00**	0.00**	0.00**

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

Table-9: *Showing correlation (Spearman) among the Dependent Variables on PGI-MS Sub-scales.*

PGI-MS subscales	Remote Memory	Recent memory	Mental Balance	Attention and concentration	Delayed Recall	Immediate Recall	Verbal Retention for Similar Pairs	Verbal Retention for Dissimilar Pairs	Visual Retention	Recognition
Remote Memory	1	.13*	.13*	.15**	.11*	.16**	0.10	0.10	0.11	.17**
Recent Memory		1	.22**	.26**	.14*	.18**	.12*	0.04	.25**	.12*
Mental Balance			1	.46**	.45**	.59**	.421**	.44**	.52**	.41**
Attention and Concentration				1	.34**	.51**	.36**	.43**	.43**	.56**
Delayed Recall					1	.50**	.32**	.43**	.41**	.33**
Immediate Recall						1	.45**	.48**	.66**	.60**
Verbal Retention for Similar Pairs							1	.36**	.47**	.35**
Verbal Retention for Dissimilar Pairs								1	.43**	.46**
Visual Retention									1	.46**
Recognition										1

** Correlation is significant at the 0.05 level (2-tailed).*

*** Correlation is significant at the 0.01level (2-tailed).*

Introduction

Memory is defined as how a person retains and draws on past experiences to use that information in the present (Tulving, 2000; Tulving & Craik, 2000). In modern society, to find a good career, develop new skills, succeed in business, and live an organized life, a good memory skill serves as one of the central tools to achieve these goals. But in a wider context, there is far more to memory than recalling names, remembering birthdays, a list of groceries to buy, or the route to the way home, memory has been presented in different forms throughout history. According to memory experts, it remains a vital repository of political success and was considered to play an important role in the path to spiritual fulfilment. For many in today's world, memory can impart knowledge from generation to generation, allowing the high-tech industry to evolve. Memory has made possible the development of biographical memoirs of notable ancestors, literature, and science to name a few. More personally, memory holds the collection of the most sentimental or mesmerizing experiences and the image of beloved ones. Memory makes us fully human because it allows us to make sense of existence and prepare for the future, increasing chances of survival, not only as a community but also individually. The characteristics of memory require reproducing correctly what has been previously learned. Hence, memory provides a mental workspace that is used in many important activities in learning and is assumed to be a pure measure of a student's learning potential. Considering the above-aforementioned characteristics of memory, it is safe to say that memory also plays a paramount importance in students' academic life. Memory is regarded in the academic field as another essential component of cognitive abilities that has a great impact on academic achievement (Gathercole et al., 2006; Abraham et al., 2016).

Academic achievement refers to individuals' performance outcomes in relation to learning goals and is typically reflected in indicators such as grades, test scores, and rank in class (Spinath, 2012). The dictionary defines achievement as "the act of accomplishing or finishing. Something accomplished successfully, especially by means of exertion, skill, practice, or perseverance" (Cassidy, 1931). Academic achievement is defined as the performance outcomes of instruction (Bücker et al., 2018). Educationists and teachers are always anxious about the academic achievement of students. Academic achievement is often viewed as having implications that play out across life stages and on multiple levels. Educational psychologists are clearly passionate about the study of academic achievement. In an attempt to investigate what determines learners' academic outcomes, researchers have come up with more questions than answers. One of the most crucial stages in a student's life is high school education, which is also, in the vast majority of countries, the stage of the educational continuum when students' physical, mental, and emotional development happens at the fastest rate. High school may be seen as the last "incubation period" for adolescents to study, discover, and become ready for their future further education, professional careers, and adulthood. Given that adolescence is one of the sensitive periods for substantial developmental change, including changes in cognitive processes, improvements in executive function, attention, and processing speed, it is particularly the adolescent developmental phase at this educational level (Lerner & Galambos, 1998). Furthermore, according to some research, the peak performance for cognitive abilities such as working memory, short-term memory, and long-term recognition memory occurred throughout adolescence (Skalaban et al., 2022). Individual differences in cognitive capacities can, however, exist even among adolescents and can manifest in a variety of ways, including differences in intellectual ability (e.g., IQ), attention, cognition-emotion integration, decision-making, memory, and executive function. Rinn and Plucker (2004) noted that further study of adolescents of high ability is of special interest to higher educational institutions and their attempts to improve both scholastic and non-scholastic opportunities. This age marks the beginning of a new milestone in a person's development, a transition out of childhood and into adulthood. Although some interest has been paid to the development of some of these dimensions of college students' memory ability (e.g., Dolgova et al., 2020, studied the relationship between memory properties and academic performance of college students), a review of the extant literature could find some contradicting relating this memory ability to academic achievement in this population.

The role of memory among students is reflected in the vast amount of related research focusing on the teaching and learning process (Pantziara & Philippou, 2015). Among school beginners, memory is considered to be a good predictor of academic achievement and is essential in the acquisition of fundamental literacy and numeracy concepts, hence memory is thought to be a significantly more valid measure of predicting school performance than IQ testing and is less affected by socioeconomic status (SES) and linguistic proficiency (Campbell et al., 1997; Laing & Kamhi, 2003; Engel et al., 2008). So, it is probable that students who have inadequate capacity to process, store, retain, or later retrieve information will have difficulty succeeding in learning activities like recalling class lectures, experiments, and arithmetic problems that constitute a significant component in the acquisition of knowledge and complicated skills, and subsequent academic achievement requires this knowledge. Memory is believed to be one of the most important cognitive functions of living organisms and is often predicted corollary linkage between memory and academic performance on academic achievement (John & Jaquith, 1996) but there is little evidence from specialized research to support this contention, especially among adolescents. Accordingly, the role of memory dysfunction as a cause of problems in academic performance is receiving increased attention in the assessment of students' cognitive functioning. From previous studies, memory deficits likely contribute to difficulties in learning and poor academic progress among learners (Gathercole et al., 2006). A relationship exists between working memory and intelligence, where they are both related to academic learning but remain dissociable cognitive skills (Alloway & Copello, 2013). Researchers have reported that children who fail to perform adequately in academics without any apparent limitation had deficits in basic psychological processes. Defects in psychological processes which include cognitive abilities in perception, language, memory, attention, concept formation, problem-solving, and the like act as intrinsic limitations or deficiencies that interfere with the child's learning (Carte et al., 1996).

Gender refers to the characteristics of women, men, girls, and boys that are socially constructed. It is the state of being male or female in relation to the social and cultural roles that are considered appropriate for men and women (Collins, n.d.). Gender is a social construct, it is not biologically determined but a concept equivalent to race or class (Offorma, 2004). This definition suggests that gender is socially or culturally constructed characteristics and roles, which are associated with males and females in society. It is different from sex which is a biological distinction in appearance (morphology) and function (physiology) as well as reproductive contributions of men and women (Erickson-Schroth & Davis, 2020). The difference in academic achievement due to gender differences is crucial to educationists. The literature has revealed that there are gender differences in cognitive ability. There are several particular areas that are brought to mind rather immediately when thinking about the subject of whether there are differences in cognitive ability between males and females. Researchers have known for some time that the spatial and recognition domains are particularly important to the subject of cognitive gender differences as they produce noticeable differences in favour of males (Linn & Petersen, 1985; Benbow, 1988; Hyde et al., 1990; Hedges & Nowell, 1995; Voyer et al., 1995). Although verbal abilities used to be considered to favour women (Maccoby & Jacklin, 1974), in contrast, more recent findings revealed that, depending on the task under considered verbal abilities could indeed favour males (Hedges & Nowell, 1995; Hyde & Linn, 1988).

This knowledge gap was mirrored in Maccoby and Jacklin's (1974) observations on gender differences in learning and memory. While Maccoby and Jacklin (1974) were able to explore differences between men's and women's performance on list-learning tests, they were unable to address gender differences for a broad range of other significant types of episodic memory abilities. Maccoby and Jacklin (1974) provide one theory for interpreting gender differences in memory: "Males and females do not differ in general memory ability, but interest, motivation, and training may influence the nature of what is remembered". It failed to offer any testable predictions other than the fact that one sex should not dominate over the other in all aspects of memory, which is an important area where it fell short. At the time Maccoby and Jacklin (1974) wrote their landmark book, many believed that spatial, recognition, and verbal abilities were the only areas where cognitive gender differences occurred.

Rural refers to a geographic area that is located outside towns and cities and the population living in rural areas or countryside whereas cities, towns, and suburbs are classified as **Urban** areas. Urban have high population density and rural areas have low population density (National Geographic, n.d.). Rural schools are widely

perceived to be inferior to urban schools. This notion extends to implying that there are inequalities in school achievement levels between rural and urban areas. These variations in academic achievement between rural and urban areas extend to many other socially desired outcomes such as aptitude, intellect, interest, and aspiration. The issue of potential rural-urban inequalities in academic achievement appears to be widespread, and it has sparked controversy among researchers. The hypothesis that students in rural areas obtain an inferior education than their urban counterparts is known as the 'deficit model' of the rural society and lifestyle (Fan & Chen, 2001).
This chapter continues by presenting the theoretical framework of memory.

MEMORY

Memory- is defined in psychology as the faculty of encoding, storing, and retrieving information (Squire, 2009). “Memory is the means by which people draw on their past experiences in order to use this information in the present' (Sternberg, 1999). The dynamic mechanisms involved in storing, retaining, and retrieving information about an event (Bjorklund, 2011; Crowder, 2014). Its processes are precise acts of utilising information to make it available later or to bring that information back into its current stream of processing (Radvansky, 2017). As a result, learning occurs throughout events of studying in the processes of human memory-encoding, storage, and retrieval, while retrieval aids in assessing the learned contents. Psychologists investigated learning using study trials and a test. The fundamental premise is that learning occurs during study phases, whereas retrieval (test) simply analyses material gained during previous study phases. In educational systems, the same theory is followed; learning occurs during lectures, reading, and study groups. Tests have been developed to assess what has been acquired or learned through studying. These assessments or evaluations of learned knowledge are referred to as tests. The progress in understanding memory leads to investigating its role in multiple related areas like learning to read, mathematics, and generally in school success or academic achievement.

During the 1950s, the interest in studying memory began with the arrival of the cognitive revolution. One of the foundational works in the cognitive paradigm concerned human memory (Miller, 1956), it was presented at the MIT conference in 1956. Additionally, Neisser (1967) defined cognitive psychology as the science which deals with the study of all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. This definition refers explicitly to the processes of human memory, which are encoding, storage, and retrieval. Since then, several models of memory function have been put forth, including the models developed by Waugh and Norman in 1965 and Atkinson and Shiffrin in 1968. Furthermore, it is thought that human memory is a complex cognitive system made up of numerous structures and functions that aid in the processing of information. Researchers have shown that there is no one memory system or store, and they have discovered several separate memory structures that can operate mostly independently of one another. Furthermore, according to several theories and models, these memory structures can be separated based on their capacities, processing speed, and storage capacities.

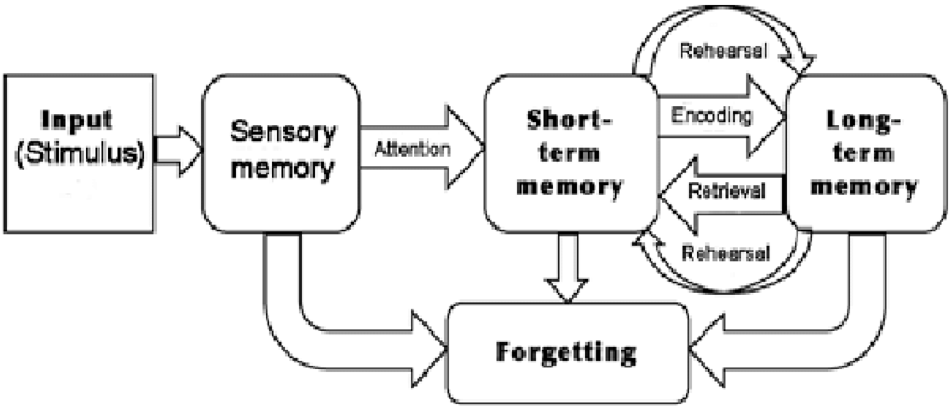
There are numerous major memory models (Murdock, 2003; McAfoose & Baune, 2009) and based on the data available at the time, researchers proposed a memory model in the mid-1960s, distinguishing two memory structures first proposed by William James (1970), namely primary memory, which holds temporary information currently in use, and secondary memory, which holds information permanently or for a very long time (Waugh & Norman, 1965). Three years later, Atkinson and Shiffrin (1968) suggested an alternate memory model based on three memory stores. To better understand memory systems and processes, the two theories are presented and defined namely the Atkinson-Shiffrin Memory Model (1968) and Baddeley's Working Memory Model (1986).

A. **Atkinson-Shiffrin Memory Model (1968)**

Atkinson and Richard Shiffrin (1968) conceptualised memory in terms of three memory stores: a sensory store, capable of storing relatively limited amounts of information for very brief periods; a short-term store, capable of storing information for somewhat longer periods but with relatively limited capacity; and a long-term store, of very large capacity, capable of storing information for very long periods, perhaps even indefinitely (Richardson-Klavehn & Bjork, 2003).

Figure-1

Atkinson-Shiffrin Memory Model



Source: Chang et al (2012)

Although the Atkinson-Shiffrin model concentrates on passive memory storage regions, it also mentions various control processes that regulate information flow between stores. The sensory storehouse serves as the initial repository for a vast amount of information before it is transferred to the short- and long-term stores. In his doctoral dissertation at Harvard University, George Sperling (1960) examined the issue of how much information a person can take in during a single, fleeting glance at a set of stimuli. He discovered the iconic store, a discrete visual sensory register that stores information for only brief periods and gets its name from the fact that the information is stored as icons (Sternberg & Sternberg, 2011).

i) **Short-Term Memory**

According to the Atkinson-Shiffrin model, memories are stored in short-term storage for around 30 seconds unless they are rehearsed. Instead of being stored visually, information is stored acoustically. It also contains certain control systems that manage the flow of information to and from long-term storage, where a person may save data for a longer period. Miller (1956) found that the short-term memory capacity for a variety of objects appears to be around seven items, plus or minus two. It can be recalled as a string of, say, 20 characters or numbers if it breaks it down into 7 significant pieces. Both verbal and visual inputs can be stored in short-term memory.

Memory span on Short Term Memory

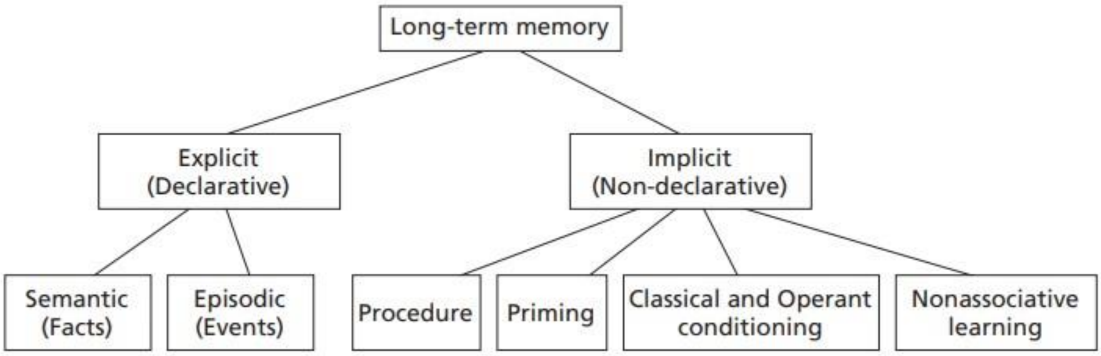
Bolton (1892) suggested that according to a teacher's evaluation of a student’s achievement, the memory span has a maximum score that is normally around six digits, and it increases with age rather than IQ. Inferring from this, he stated: "The memory span measures the power of concentrated and prolonged attention". A digit test was reported by Binet and Simon (1905) as being appropriate for evaluating intellect in youngsters between the ages of 7 and 11 and was added to a preliminary battery of intelligence tests. The Stanford edition of the Binet-Simon intelligence scale, developed by Terman in 1916, is a revised and expanded version of Binet and Simon (1908) scale that includes a significantly more challenging exercise of repeating six digits backward known as ‘attention/concentration’ and ‘freedom from distractibility’ (Atkinson et al., 1989; Crawford et al., 1989; Crawford, 1992).

ii) **Long-Term Memory**

Long-term memory (LTM) refers to memories from past experiences, which can be implicit or explicit. Implicit memory contains processes and abilities demonstrated by skilled behaviour (Bauer, 2005). Contrarily, explicit memory enables people to recall and recognise names, dates, locations, and events, and it operates consciously because people are aware that the memory representation is based on prior experience. Semantic LTM and episodic LTM are the two additional subcategories that are separated under explicit memory. Tulving proposed the ideas of episodic and semantic memory (Tulving, 1972).

Figure-2

Division of Long-term memory (LTM)



Note. Division of Long-Term Memory. From Solso et al. 2013, p. 214

Tulving (1972) distinguishes between episodic memory and semantic memory. Semantic memory is related to facts that are strongly encoded in the mind and do not require any effort to retrieve, whereas episodic memory refers to memory for personal events and temporal-spatial relations among these events, such as "what," "when," and "where" of daily life events.

According to certain theories, long-term memory has a limitless capacity (Bahrick, 2000; Brady, 2008). Additionally, Penfield (1969) hypothesised that long-term memories might be permanent. Using empirical approaches on older participants, some researchers discovered conflicting data. They assessed participants' memories of names and photos of their high school friends after a period of time (Bahrick et al., 1975), and they discovered that there was minimal loss of certain memory-related information. According to Murre and his colleagues (2006), working memory, or short-term memory is the 'gateway' to long-term memory since it depends on the temporary activation of long-term memory traces. Based on this concept, one may hypothesise that people with outstanding working memory will also have excellent long-term memory (Murre et al., 2006).

iii) **Working Memory (WM)**

The concept of working memory (WM), which is a capability that temporarily retains a constrained amount of information in the brain for manipulation to aid the capacities for learning and thinking, has been the subject of several research. Everyone uses working memory as a tool to help us function effectively and efficiently in all facets of our lives. It is regarded as one of the most important indicators of academic achievements such as maths (e.g., Alloway & Alloway, 2010; Bos et al., 2013; Friso & Bergsma, 2020) and reading comprehension (e.g., Alloway & Alloway, 2010; Dolean et al., 2021; Atkinson & Martin, 2022). Furthermore, WM has been linked to academic achievement in reading and writing (Abu-Rabia & Siegel, 2003). Children in school require WM on a daily basis for a range of activities such as following teacher directions or recalling words they were instructed to write down (Alloway & Alloway, 2010). Working memory research assesses a student's ability to acquire knowledge rather than what the student has previously acquired. This is significant since it can predict results apart from the student's IQ (Alloway, 2011). WM has also been found to be closely related to other cognitive processes, particularly abilities necessary for academic success (Alloway & Alloway, 2010) as a result of these relationships between WM and long-term memory and academic success, WM is frequently confused for another type of intelligence or for executive functioning as a whole. Previous research has found that students with poor ability to store material over brief periods fail to progress normally in literacy tasks, which may be related to difficulties with working memory; additionally, good scores are significantly correlated with performance on comprehension, counting, arithmetic, and reasoning tasks (DeStefano & LeFevre, 2004).

The term "working memory" was initially used by Miller and his colleagues to describe a part of the human information processing system that was in charge of the executive control of cognition and behaviour as well as a means of short-term storage (Miller et al., 1960). Although Waugh and Norman (1965) hypothesised that their short-term store could be viewed as a working memory responsible for encoding techniques, search strategies, and other control processes. Later, Atkinson and Shiffrin (1971) proposed a more thorough explanation in which WM was fundamental to all aspects of human cognition and acted as a bridge to long-term memory. The existence of a component known as a visuospatial "sketchpad" or "scratchpad" was substantiated by later studies by Baddeley and his colleagues (Baddeley et al., 1975).

B. **The Multi-Component Model of Working Memory (Baddeley AD, Hitch GJ, 1974)**

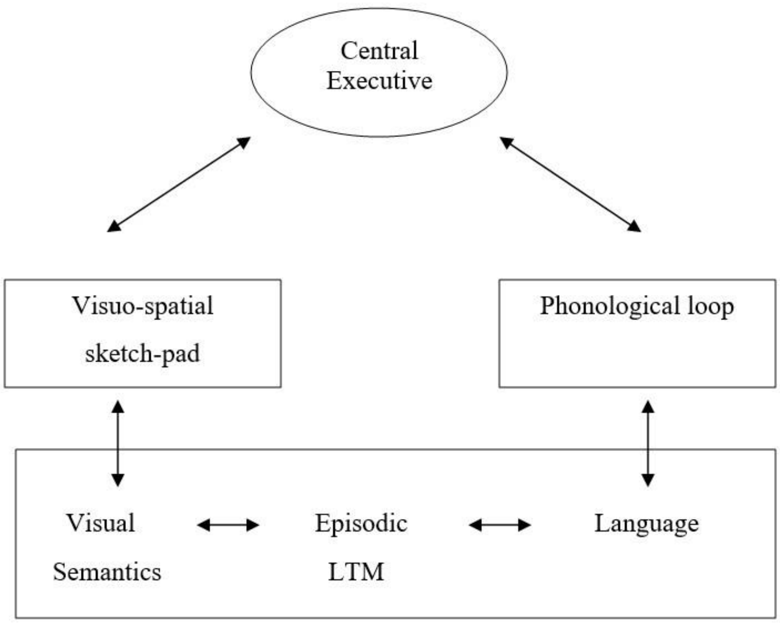
Baddeley and Hitch (1974) proposed four functional components of working memory: a central executive, a phonological loop, a visuospatial sketchpad, and an episodic buffer (Baddeley, 2000). Each of the proposed components is discussed below.

1) ***The central executive (CE)***

A central executive (CE) is a type of control system with is recognised as being in charge of a number of regulatory processes, including attention, action control, and problem-solving as well as manipulating information in working memory as well as two unimodal storage systems: the phonological loop and the visuospatial sketchpad (Baddeley, 1986, 2000). The CE is a flexible system that controls and regulates cognitive processes such as task coordination, shifting tasks, retrieval techniques, and selective attention and inhibition (Baddeley et al.,1998). Complex span tasks such as digit span backward, reading span (Daneman & Carpenter, 1980), listening span (Siegel & Ryan, 1989), and counting span (Case et al., 1982) are well-known measures of CE capacity. The central executive appears to be primarily involved in complex cognitive functions as a source of attentional regulation, allowing the focusing of attention, dividing of attention across concurrent activities, and as one component of attentional switching. However, simple representation and maintenance may be independent of the central executive, unless it necessitates the complex binding and integration of information. Executive processes appear to be involved whenever information within the stores needs to be manipulated. Other working memory elements support the central executive in a number of these tasks (RepovŠ & Baddeley, 2006).

Figure-3

Baddeley Model of Working Memory



Note. Baddeley's model of Working Memory. Adapted from Baddeley, 2012, p. 11, Figure 2.

2) ***The phonological loop (PL)***

The task of storing and retaining auditory information falls under the purview of the phonological loop. PL consists of two parts: an articulatory control process similar to subvocal speech (mental verbalization) and a phonological store that stores memory traces in an acoustic or phonological form that fades over time (Baddeley, 1986). The phonological store retains the information sound rather than its meaning by holding it in a phonological code, a type of representation. On the other hand, the active management and processing of data in the phonological storage is carried out through the articulatory rehearsal process. It also goes by the name "inner voice" since it entails mentally repeating or rehearsing information to preserve it in working memory. This process is believed to be crucial for activities requiring manipulating verbal information, such as mental arithmetic or recalling a phone number since it helps to refresh and lengthen the lifetime of information in the phonological storage. To update the memory trace, the purpose of the articulatory rehearsal process is to retrieve and re-articulate the information stored in this phonological storage. Additionally, information from other modalities enters the phonological store only after being recoded into phonological form, a task carried out by articulatory rehearsal, whereas speech input enters the phonological store automatically.

Typically, simple span tasks like numbers, words, pseudowords, or phrases are used to assess PL capacity. In these exercises, participants are instructed to repeat back verbally provided stimuli in the sequence that they were presented. When compared to between two and three items at age four to roughly six items at age twelve, verbal memory span (a measure of the maximum amount of unrelated verbal items that can be retained in the right sequence) shows an average two- to threefold increase (Hulme et al., 1984).

3) ***The Visuospatial Sketchpad (VSSP)***

According to Baddeley and Hitch (1974), the visuospatial sketchpad is the "workspace for holding and manipulating visuospatial information" and serves a variety of purposes, such as facilitating spatial task execution, monitoring changes in the visual field over time, maintaining spatial orientation, and guiding movement through space. Logie (1995) proposed that the VSSP has two main subcomponents: a visual store where physical characteristics of objects and events are thought to be represented in the visual store and a spatial mechanism that is allegedly used for planning movements and may also serve as a rehearsal function by activating the visual store's contents. The separation of visual and spatial inputs in the VSSP has been corroborated by neuroanatomical and cognitive research (Pickering et al., 2001). H. Logie and Pearson (1997) investigated the separability of visual and spatial short-term memory by administering a visual patterns task and a Corsi block-type task and observing the age-related increase in performance for each task (H. Logie & Pearson, 1997). Pickering, Gathercole, and Peaker (1998) used versions of the visual pattern span and Corsi blocks task to investigate the relationship between visual memory and spatial memory span. The theory that improvements in pattern span may be due to the increasing use of non-visual strategies in older children is supported by experimental research (Hitch et al., 1988), performance on psychometric testing (Mather, 1994; Hartman, 2007), and electrophysiological findings (Licht et al., 1992).

4) ***Episodic Buffer***

The fourth component of WM is the episodic buffer, which has been fractionated from the CE in the most recent revision of the working memory model (Baddeley, 2000). The episodic buffer is proposed to use multidimensional codes to integrate representations from components of working memory and long-term memory into unitary episodic representations that may correspond to conscious experience. As it is thought to provide direct inputs into episodic long-term memory, this component of working memory may provide an important gateway for learning (Prabhakaran et al., 2000; Zhang et al., 2004). It combines information from the phonological loop, visuospatial sketchpad, and long-term memory into a single representation that may be temporarily stored. The episodic buffer is in charge of keeping track of the order and timing of events, which is necessary for forming a coherent representation of our experiences. It also serves as a link between working and long-term memory, allowing data to be transferred between the two systems. The episodic buffer is hypothesised to have a role in a variety of cognitive activities, including language comprehension, problem-solving, and decision-making.

Tasks Used for Measuring Memory

Many theorists have put forth and clarified a number of models to explain how the memory functions. To study memory, researchers have created a variety of tasks that call for participants to recall random information in various ways. These tasks include recall versus recognition memory.

Recall

Recall is the process of recalling facts, words, or other items from memory. The three basic recall task types employed in research are serial recall, free recall, and cue recall (Lockhart, 2000). Items are recalled in the precise sequence in which they were presented in the serial recall, such as ordering a list of fruits as follows: apple, banana, mango, and repeating the list in the same order. With free recall, a person may recall objects in whatever sequence they want (Golomb et al., 2008). The third type of task is "paired-associates recall," often known as cued recall. Participants are taught the pairings Kevin-Samantha and Chair-Pen before being asked to produce the pairing for Kevin (Samantha) (Lockhart, 2000). Retention on these tests increases as the amount of practice is increased (Ebbinghaus, 1913; Krueger, 1929; Postman, 1962). The importance of retentive recall in clinical practice is evident from the studies done on the cases of Korsakoff's psychosis, where they are found to be average in immediate recall of the word and much poorer on delayed free recall (Victor et al., 1959; Butters, 1981; Victor, 1989; Sullivan & Pfefferbaum, 2009).

Recognition

Recognition also refers to "tapping" receptive knowledge, which entails picking out or otherwise identifying a thing as a person has seen before. Receptive simply means "responsive to a stimulus." An individual responded to stimuli presented in a recognition-memory task by deciding whether or not they have seen them before. Participants in recognition experiments must distinguish between previously studied objects and novel stimuli that have never been shown before. In the realm of cognitive psychology, there is a lot of debate over the factors that impact recognition memory. Traditionally, prevailing theories have sought to characterise recognition memory as being dependent on a single process of familiarity, in which responses are formed based on some level of confidence that individuals use to distinguish between "old" and "new" things (Yonelinas, 2001). In recent years, however, more studies have linked episodic recognition memory to two different components: recollection and familiarity (Yonelinas, 2001). Recollection is a process similar to recall in which the correct identification of an object is based on the specific features associated with the item and its concrete relationship to the item's initial presentation (Yonelinas, 2001; Schwartz et al., 2005). Other judgements made during recognition research are assumed to rely on the concept of familiarity, in which responses are influenced by the resemblance of the probing item and previously stored information in memory (Schwartz et al., 2005).

Unavoidable recognition memory errors cause an individual to occasionally fail to recognised someone with whom they had previously conversed casually. In other cases, people mistakenly believe they know a stranger from a campus event and start a conversation with them. These errors are not confined to poor memory: Lachman and Field (1965) requested people to study a single list of 50 common words 128 times and discovered that the percentage of studied words that are named "old" reached a maximum of 88%, while the incorrect recognition of an unstudied word remained around 2%. Even though this performance level is good, free recall of the words examined under exactly the same circumstances was 98% accurate and error-free.

Relearning also referred to as savings, is the process of counting the number of trials necessary to re-learn previously learned material (Bauer, 2005; Sasaki, 2008). In particular, the anticipation of recall tasks elicits higher levels of information processing than the anticipation of recognition tasks (Standing et al., 1970). William's (1968) scale for the measurement of memory consists of digits span, nonverbal (Ray-Devis) learning, verbal learning, delayed recall (pictorial recognition) with prompt and without prompt, and memory for remote events. Of these, delayed recall test has been proven to be the best indicator of cerebral pathology (White et al., 1969). These tasks are used to measure the following domains of memory mentioned below.

Remote memory- Refers to the distant past, measured on the order of years, or even decades (Rich, 2011). Frankland and Bontempi (2005) studies have identified different regions of the prefrontal cortex as playing a crucial role during remote memory recall. The prefrontal cortex consists of several highly interconnected regions, including the anterior cingulate, prelimbic, and infralimbic cortices. Episodic memory and Autobiographical memory materials are frequently measured in remote memory recall. Episodic memory refers to memory for particular events situated in space and time, as well as the underlying cognitive processes and neural mechanisms involved in remembering those events. A key ingredient of episodic memory that distinguishes it from other forms of memory is the retrieval of information regarding the spatial and/or temporal context in which the remembered event occurred.

Autobiographical memory refers to memory for one's personal history (Robinson, 1976). Examples might include memories of experiences that occurred in childhood, the first time learning to drive a car, and even such memories as where a person is born. Brewer (1986) divided autobiographical memories into categories of personal memories, autobiographical facts, and generic personal memories. Personal memories are memories of specific events in one's life that are accompanied by imagery. As such, personal autobiographical memories are thought by some to be the real-world analogue to episodic memories as studied in the lab, because they are the episodes of one's life as dated in space and time. On the other hand, autobiographical facts are facts about the person that is devoid of personally experienced temporal or spatial context information. For example, a person knows when and where they were born, but they cannot remember the event. Finally, generic personal memory refers to more abstract knowledge about oneself (what a person is like) or to acquired procedural knowledge such as knowledge of how to ride a bicycle, ski, or play a musical instrument.

Despite the conceptual overlap across classification schemes, a unique feature of autobiographical memory is that it must directly relate to oneself or one's sense of personal history. A variety of techniques have been used to examine autobiographical memory. One approach is to simply ask people to report the most important personal events of their life (e.g., Fitzgerald, 1988; Berntsen and Rubin, 2002; Rubin and Berntsen, 2003) or to report self-defining memories (e.g., Conway et al., 2004). Another frequently used method is to ask people to describe for each of a given set of cue words the first personal memory that comes to mind, e.g., being given the word window and asked to retrieve a discrete event from the past involving a window. This task is known as the Galton–Crovitz cueing technique after its inventor (Galton, 1879) and its first modern proponent (Crovitz and Schiffman, 1974). Briefly, usually exhibit three striking features (Rubin et al., 1986; Janssen et al., 2005). The first is that people tend to recall very little from the first few years of their life. This is referred to as childhood amnesia. Second, people tend to recall quite a few events from early adulthood, roughly the ages 15–25. The effect is called the reminiscence bump because when the number of memories retrieved from various periods of life is graphed over the life span, there is a bump in the era of 15–25 years. More memories are reported from this period than from any other. The reminiscence bump may reflect the fact that the cultural life script in Western cultures has many events during this critical time period (finishing high school, often going to college, getting married, obtaining a job). Bohn and Berntsen (2011) showed that when children are asked to predict events that would happen in their lives, they also showed a reminiscence bump. Finally, most reported events are recalled from the last few years, which (like many other examples of good recall of recent information) is known as the recency effect.

One interesting discovery in recent years is that some individuals have “highly superior autobiographical memory.” These individuals can recall all the days of their lives in the distant past. The condition is relatively rare, but over 50 individuals have been identified as having this condition (Roediger et al., 2008). Accordingly, the retrieval of autobiographical memories guides future decisions and problem-solving (directive function), promote social interactions (social function), and helps the development and sustaining of a self-concept (self-function) (Kaya, 2018). Therefore, autobiographical knowledge shared in memories contains self-related past, present and future constructions in terms of goals, plans, decisions, problem-solving strategies, etc (Bluck, 2003).

Recent memory- Refers to a type or stage of memory in which an individual recalls information recently presented (Gromisch, 2011). Items that are related to twenty-four hours of self-chore activity. Recall of recent memories is associated with activation of the hippocampus, and lesioning or inactivating the hippocampus preferentially disrupts the recall of recent memories (Frankland & Bontempi, 2005). To remember what one did yesterday is an example of an everyday episodic memory task, in which a female advantage as compared to males has sometimes been reported in the literature.

Mental balance- Refers to the ability to learn the sequential order of items or events, which is a critical aspect of episodic memory also known as temporal sequencing (Pirogovsky et al., 2013).

Attention and concentration- Attention is the act of focusing one's awareness on something external or internal for a certain amount of time (Solso et al., 2013). During this time, other interests or objects of attention can be set aside. According to common beliefs, attention is essential for academic achievement. The ability to pay attention is a prerequisite for mastering the current work. Cognitive processes that enable the selection of, focus on, and sustained processing of information. The object of attention can either be environmental stimuli actively being processed by sensory systems, or associative information and response alternatives generated by ongoing cognitive activity (Cohen, 2011). Concentration refers to the deliberate attempt to compensate for high task difficulty. As people concentrate, they engage more in the task with the purpose to maintain a desirable level of performance (Sörqvist, 2016). In any regular task, attention is crucial. The fact that people's attention is constantly moving and changing depending on their wants and interests is a significant aspect of human nature. Adolescents deal with a variety of psychological, physical, and emotional issues that hinder their ability to study and lower their academic achievement. One of the key elements that might impact children's academic success is attention. The intact function of memory and attention is essential for children to cope with the high scholastic demands of today. It has been shown that children with deficits in these functions have learning difficulties that are often accompanied by behavioral problems (De Jong, 1998, McLean & Hitch, 1999). According to Balushi (2015), student’s academic success in terms of retention and comprehension capacity is impacted by their ability to pay attention in class. Without regard to whether a student has previously been diagnosed with attention deficit hyperactivity disorder (ADHD), Pope (2010) found that students who score higher on the inattention subscale are more likely to achieve a lower final average percentage mark (APM) and are significantly less likely to finish their degree within three years. This finding emphasises the importance of focusing on the identification and provision of support for students with elevated ADHD symptomatology, particularly inattention characteristics.

Immediate recall- refers to the type or stage of memory in which an individual recalls information recently presented, such as a street address or telephone number, although this information may be forgotten after its immediate use. Immediate memory is frequently tested in assessing intelligence or neurological impairment. It is a measure of short-term memory capacity (American Psychological Association, 2007). Immediate memory was initially referred to as a passive, short-term repository for critical information prior to its transfer to and retention in long-term memory. Despite the fact that there is a wealth of data to support the distinction between short-term and long-term memory, it rapidly became clear that the first conceptualizations of short-term memory as a passive holding region were unduly simplistic. As a result, Atkinson and Shiffrin (1971) and Baddeley and Hitch (1974) advocated, among others, that immediate memory be conceptualised as a more dynamic memory system, with its primary purpose being the execution of cognitive operations critical for a variety of tasks. Baddeley and Hitch (1974) advocated for a memory system that could store and manipulate present memory contents while also updating information in memory to achieve task goals. To emphasise the requirement for actively working with information rather than merely storing it, they gave this system the name "working memory" (Miller et al., 1960; Atkinson and Shiffrin, 1971). Working memory is typically thought of as a mechanism in charge of active maintenance and online manipulation of information across brief periods of time. Working memory is now at the forefront of the explanation of complex cognitive operations because of the emphasis on the requirement for a dynamic immediate memory system. Working memory and immediate memory may be thought of as a group of temporary memory systems that activate quickly after the information is given. The term "nondeclarative memory" refers to a diverse group of skills that allow for the ability to pick up knowledge unconsciously. Motor, perceptual, and cognitive abilities, priming, adaptation-level effects, simple classical conditioning, habits, and phylogenetically earliest types of experience-dependent behaviour like habituation and sensitization are all examples of non-declarative memory. It also includes adaptation-level effects (Byrne, 2017). Performance, rather than recall, is the manner through which memory is represented in these cases. Immediate memory refers to what can be actively remembered from the instant knowledge is gained. The subject of present thinking is the information, which is currently at the centre of attention. The capacity of the immediate memory is quite limited. One example of how this type of memory expresses itself is the ability to repeat back a short string of digits. Because of intact immediate memory, amnesic persons can engage in conversation and appear entirely normal to a casual observer. In fact, if the amount of information to be retained is not extremely significant (such as a three-digit number), patients can retain the information for minutes or for as long as they can by practicing it. In this instance, it may be said that the patients explicitly rehearsed the information from their immediate memory. Working memory is the term for this rehearsal-based activity, which is separate from the medial temporal lobe system. The challenge for amnesic individuals is when they have to recollect more information than their immediate memory can handle (usually when they have to remember a list of eight or more items), or when they have to recall the knowledge after a long delay or after a period of distraction. An individual will recall fewer things than their healthy counterparts in these circumstances when the working memory limit is reached.

Delayed recall- Refers to the ability to recollect information acquired earlier. Frequently used in laboratory studies of memory, delayed recall is also used in neuropsychological examinations to determine the rate of loss of information presented earlier, in comparison to established norms (American Psychological Association, 2007). Contrary to what Crowder (1993) hypothesised, if there is a working memory process distinct from the rest of memory, there are only a few ways in which the two forms of memory may be fundamentally different. First, as indicated by Miller (1956), working memory could be restricted to a small number of items. The duration that each item may remain in working memory without needing to be repeated, refreshed, or renewed may instead be the limit rather than the number of things themselves. Researchers have put a delay between the elements that need to be recalled and the memory test in order to test this theory. Usually, a distracting task has been added to the "retention interval" to avoid rehearsing during the recall delay. The best-known researchers on delayed recall are Peterson and Peterson (1959); additional pertinent references are Broadbent and Brown (1958). It was anticipated that interference with memory for an item depended on the presence of additional, similar items in accordance with commonly established verbal learning principles. However, Peterson and Peterson (1959) offered letter triads, followed by a variable-duration phase of counting backward by threes or fours. Although it is a difficult assignment, it was decided that since the letters and numbers are so different, they shouldn't interfere with one another. is quite a demanding task, but it was considered that the letters and numbers are very dissimilar and should not interfere with one another. In opposition to that anticipation, when the time for counting backward was prolonged up to 18 s, the trio of letters was noticeably forgotten. Unfortunately, the debate on the cause of the impact of delay has not yet been resolved to everyone's satisfaction; it is an issue of contention that can be further studied. However, Peterson and Peterson (1959) suggested that their findings were due to the fact that information in working memory has a temporal limit and decays with time.

Humans have several senses, thus there are numerous methods to both detect and encode new information. Raw sensory data can be received through the senses of visual, auditory, or olfactory, among other modalities. It is difficult to separate these modalities because taste and smell are so closely related and because memory for tastes has not been well investigated. While kinesthetic memory (for muscle movements) is a well-researched topic, haptic memory—which refers to memory for skin sensations—is not. It has been discovered via research on memory for information presented in various sensory modalities that there are striking similarities and variances in how modality impacts memory function.

Visual-Spatial Retention: Refers to the ability to retain information from recently attended and fixated objects. It Assesses visual perception, nonverbal memory, and constructional abilities (Sivan, 1992). The concept of non-verbal memory is somewhat less advanced than that of verbal memory, according to Kintsch (1972). The psychology literature has now included studies on non-verbal memory (Hebb, 1968; Bahrick & Boucher, 1968). Therefore, it is important that every model of memory has to incorporate some provision for non-verbal memory for further understanding of its concept. Visual-spatial memory, or simply spatial memory, is the term used to describe memory for scenes and spatial relationships. Humans' ability to drive about town and squirrels' ability to locate hidden acorn caches are both examples of this form of memory in operation. Although both spatial memory and episodic memory depend on the hippocampus and its surroundings, some theorists have claimed that since spatial memory necessitates the formation of mental maps, it differs from episodic memory and other relational (semantic) memory systems (O'Keefe & Nadel, 1978). However, Mackintosh (2002) suggested that spatial learning is equivalent to other associative learning methods. First established in the 1960s, the hippocampus plays a crucial role in the temporal organisation of memory that has been linked to spatial memory. The hippocampus especially contributes to memory for time, according to an examination of recent findings from the lesion, electrophysiological, and functional neuroimaging research (Eichenbaum, 2013, 2014; Davachi & Dubrow, 2015). The most basic kind of spatial knowledge may consist of knowing the names and looks of objects or environmental features (a hill, a trail crossing, etc.) and places (a mountain top, a small city park, etc.). Spatial memory is used to recall the locations of these elements and their spatial relationships. Despite being a particular kind of object and location information, this sort of knowledge is sometimes referred to as "landmark knowledge" (Siegel & White, 1975). Numerous things and places in their surroundings that do not serve as landmarks are easily recognisable by people. Landmarks play a special role in navigation and spatial memory (Couclelis et al., 1987). They are used to indicate navigational goals (such as, "I'm going to Swimming Centre"), the locations of other objects (such as, "Turn right at the Post office"), the locations of changes in direction (such as, "Turn right at the Post office"), and to maintain course (such as, "You'll pass Noah Foundation School on your right"). Landmark knowledge is the first type of spatial knowledge to be learned, and it sets the basis for all other types of spatial knowledge, according to Siegel and White's (1975) theory of spatial knowledge acquisition. Route knowledge is the understanding of the paths that connect different sites. The bare minimum of route knowledge is a list of landmarks and the decisions and steps that go along with them. The steps necessary to get to the next important place are specified by the activities on a route (for instance, turning left at the Post office and driving to the City Park). In Siegel and White's (1975) original formulation, route knowledge did not initially convey distance, temporal duration, or turning angles. Chrastil and Warren (2015) argue that this fundamental, nonmetric form of route knowledge should be distinguished from graph knowledge. Although not to the exclusion of other signals, humans and numerous other organisms appear to be sensitive to the form of their immediate surroundings and rely on it to reorient. With enough exposure to an environment, humans may occasionally acquire knowledge about its overall layout or survey knowledge. The gradual accumulation of quantitative spatial relations is the best method to characterise how spatial knowledge is acquired. Even when an environment is fully understood, spatial knowledge gets distorted and disorganised throughout the learning process, and it doesn't seem to be limited to qualitative, nonmetric data. Various people have varying degrees of ability to gain survey knowledge from navigation (McNamara, 2017; Carpenter, 2017).

Verbal Retention: Refers to the associated with the memorization and retention of lists of words (Ruchkin et al., 1999). There are four major verbal learning tasks-free recall, serial learning, recognition or verbal discrimination learning, and paired associate learning (D'Amato, 1970). Retention on these tests increases as the amount of practice is increased (Ebbinghaus, 1913; Krueger, 1929; Postman, 1962). Language-based memory recoding and storing is likely the most effective method for humans. Even if events were delivered in a different style (visual, aural, or even olfactory or kinesthetic), people can retain them as verbal knowledge. The priority of verbal coding has long been accepted by psychologists, and Glanzer and Clark (1964) even put up the verbal loop theory, which postulated that all human experience is encoded in language. Though subsequent research has shown that this idea was somewhat exaggerated and that there are other types of coding as well, verbal coding and verbal memory continue to play a crucial role in human cognition. A growing body of research on text and discourse memory has suggested that it has clear implications for education.

Much of the relevant literature is reviewed in the present study which will be focusing in the next chapter, ***Chapter II Review of Literature***

Review of Literature

This chapter discussed previous studies of some of the effects of academic achievement, gender, and ecology on memory, memory profiles of typical and atypical populations, and correlation among the sub-scales of Post Graduate Institute- Memory Scales. The literature has revealed that academic achievement is linked with memory abilities, gender differences, and ecology in other cultures.

Memory and Academic Achievement

Memory represents the core of cognitive ability and memory capacity is considered to be able to predict performance in many cognitive tasks (Swanson, 1993; Engle, 2002), and it also significantly correlates with performance in word recognition, reading comprehension, spoken language comprehension, following directions, developing vocabulary, written expression, and reasoning (Engle, 1996; Engle et al.,1999; Dehn, 2008) all of which are crucial for academic achievement. From previous studies, memory deficits likely contribute to difficulties in learning and poor academic progress among learners (Gathercole & Alloway, 2008). Ezeugwu and colleagues (2016) suggested that student achievement is significantly determined by their cognitive abilities. According to Rohde and Thompson (2007), general cognitive ability has a significant relationship with academic success. Cognitive ability, as an important predictor of academic achievement, also plays a restricting role in the academic success of children and adolescents (Xu, 2015). Previous research investigated the links between cognition and outcomes in school and discovered that cognition is closely related to academic achievement (Zhou et al., 2020; Shi & Qu, 2022). Prabha and Dhanalakshmi (2022) discovered a substantial association between cognitive ability and academic achievement of Salem district high school students. Dolgova and associates (2020) studied the relationship between memory properties and the academic performance of college students and found that most college students have high and medium memory properties, which means that the indicators of the memory properties and academic performance of college students are correlated and according to their findings, there is a relationship between the level of memory development and the success of educational activities. Cognitive abilities and academic achievement relationship across schooling from the first to the eleventh grade was also analyzed by Tikhomirova and colleagues (2020), Information processing speed, visuospatial working memory, number sense, and fluid intelligence were considered predictors of general academic achievement, which was derived from grades in mathematics, language, and biology among 1560 students who were in grades 1 ±11 at general education schools and were aged from 6.8 to 19.1 years (50.4% were boys) and results revealed that the relationships between cognitive characteristics and academic success differ at each level of schooling. However, at a high level of school education, no statistically significant relationships between cognitive characteristics and academic success were found. It was shown that the contribution of cognitive characteristics to individual differences in academic success decreases in the period from primary to complete level of general education, which may point toward the greater importance of motivational and personal predictors of academic success.

Short-term memory (STM) and academic achievement

Short-term memory (STM) is the ability to rapidly form neural connections, store information briefly in an active state, and recall information for a very brief period, often only seconds (Knudson et al., 2021). Regarding the impact of STM on academic achievement, it seems that children who have trouble reading have trouble with reading faces that need them to keep information in order of presentation for a brief period of time, including digit span and word span (McDougall et al., 1994; Swanson et al., 1998). This shortcoming might be related to deficits in the STM's rehearsal process (Henry & Millar, 1993). Another set of results demonstrated the critical role that short-term phonological storage plays in word recognition (Jorm, 1983; Carlesimo et al., 2006; Steinbrink & Klatte, 2008; Zhao et al., 2015). Additionally, some research showed that STM tasks like word and digit span allow one to discern between good and poor readers (Torgesen & Houck, 1980). This conclusion was supported by consistent findings showing the Wechsler IQ scale's digit span subtest as it is capable of identifying children who struggle with reading (Loughan et al., 2012).

As with verbal ability, there is no unitary definition of verbal memory. It generally refers to the associated with the memorization and retention of lists of words (Ruchkin et al., 1999). Steinbrink and Klatte (2008) examined the serial recall performance in German second-grade students with poor vs. good reading and spelling abilities and were presented with four-item lists of common nouns for immediate serial recall. Their findings showed that deficits in verbal short-term memory have been identified as one-factor underlying reading and spelling disorders. The findings imply that the challenges of poor readers are caused by the inefficient use of the phonological loop rather than avoidance of the phonological loop. In contrast to this, the findings of Zhao and colleagues (2015) in three trial conditions, investigated the underlying mechanism of the verbal short-term memory deficit in Chinese children with developmental dyslexia and normal children, revealing effects of phonological, visual, and semantic similarity, respectively. The results suggested that the verbal short-term memory deficit in Chinese dyslexics might not result from insufficient activation of phonological information, which implied that the memory deficit of dyslexia is more likely to be related to other factors.

In a study by John and Jaquith (1996) to determine the impact of short-term memory on standardised achievement scores, 546 students from a private school in the Southeast of the United States examined their auditory and visual digit spans compared to their Stanford Achievement Test (SAT) scores and the findings indicated that performance on the SAT increases along with digit span, and it further shows a correlation between digit span and grade-level function which concluded improving VWXGHQWV¶ OHYHOV RI DFademic performance would require them to improve their auditory and visual processing.

The findings of Abraham and colleagues (2016) showed significant differences in performance between the two groups on both tasks, suggesting the impacts of auditory STM and academic achievement by examining the auditory short-term memory using the digit span and monosyllable span test among 60 students aged 7 to 8 who were divided into two groups depending on their academic performance.

On the other hand, several research showed that STM tasks cannot distinguish between academic achievement, for example, between good and poor readers (Felton & Brown, 1991). Additionally, other findings suggested that reading difficulties are not caused by deficits in STM processes like rehearsal and chunking (Cohen, 1981; Swanson, 1983a, 1983b). According to previous research, there is no connection between STM and performance on verbal tasks or mathematical activities (Chiang & Atkinson, 1976). Generally speaking, it is asserted that STM and cognitive task performance have only weak relationships.

Numerous studies have shown that deficits in memory can cause problems in a variety of academic domains, including maths and reading. El-Mir (2019) conducted research on how memory affects academic achievement. They examined how several memory functions, including working memory (WM), short-term memory (STM), and long-term memory (LTM), affect academic achievement. Long-term memory (LTM) is the ability to store information for an extended period, which can range widely in duration, but frequently for a lifetime (Knudson et al., 2021). However, the relationships between working memory and learning task performance were the main emphasis. Based on the findings that working memory capacity conditioned achievement in word recognition and reading comprehension in language and concluded that measurements of working memory might be used to predict performance in various cognitive tasks, such as reading. Below, the focus of this review on the role of working memory in academic achievement is presented. In order to determine the academic achievement of primary school students (74 students aged 8–9 years old), Quilez-Robres and colleagues (2021) looked at the relationship between intelligence quotient (IQ), short-term memory, and study habits. Academic success has a strong relationship to intelligence, short-term memory, and study habits. The study also implies that study habits as a protective factor of academic achievement.

Working memory (WM) and academic achievement

Working memory is a theoretical construct within cognitive psychology that refers to the structures and processes used for temporarily storing and manipulating information (Working Memory, 2015). Working memory refers to the system or systems that are assumed to be necessary in order to keep things in mind while performing complex tasks such as reasoning, comprehension and learning (Baddeley, 2010). Baddeley and Hitch (1974) model has been adopted in most studies examining the relationship between working memory and academic achievement. In both typical and atypical school-going children, working memory is a critical cognitive skill related to measurements of reading, writing, spelling, mental arithmetic (Swanson & Sachse-Lee, 2001), spatial abilities, and computational scores and overall academic achievement (Margolin, 1984; Caramazza et al., 1987; Berninger & Swanson, 1994; DeStefano & LeFevre, 2004; Alloway & Copello, 2013).

Beginning in preschool and continuing through tertiary studies, working memory is considered to be an essential skill (Alloway et al., 2005; Alloway & Gregory, 2013). Poor arithmetic performance is also characterised by weak verbal working memory skills because people with these problems process information more slowly and struggle to keep up with timed tasks and fast presentation of information. Due to their frustration, some students decide to drop out of school or college (Alloway, 2006) and moreover, over time, repeated successes in academic, LQWHUSHUVRQDO RU RWKHU LPSRUWDQW GRPDLQV of mastery, self-esteem, and sense of psychological well-being. Conversely, repeated experiences with failure may lead to low self-esteem, poor self-confidence, feelings of hopelessness and distress, and other problems related to psychological adjustment (Mofatteh, 2020).

Previous research has shown the relationship between Working memory and overall academic achievement. Working memory, as measured by verbal and visuospatial complex span tasks, has been strongly correlated with national curriculum test scores at 7, 11, and 14 years old (Gathercole & Pickering, 2000a, 2000b; Jarvis & Gathercole, 2003; Gathercole et al., 2004). There are also strong links between working memory, learning, and academic achievement. As a construct, working memory is thought to be crucial for the learning of reading, writing, and spelling in typically developing children (Carramazza et al.,1981; Margolin, 1984; Berninger & Swanson, 1994; Swanson et al., 2004).

Working memory capacity is considered to significantly correlates with performance in word recognition, reading comprehension, spoken language comprehension, following directions, developing vocabulary, written expression, and reasoning (Engle, 1996; Engle et al.,1999; Dehn, 2008). Working memory span measures are intended to explain individual differences in learning (Swanson et al., 1990; Gathercole et al., 2006). Additionally, research found that Working memory deficits lead to failures in various learning activities, including recalling and following instructions and mental arithmetic (Gathercole et al., 2006). Additional evidence demonstrates how learning English and mathematics is significantly impacted by poor WM (Swanson, 1999; Bull & Scerif, 2001; Jarvis & Gathercole, 2003; Gathercole et al., 2004; Alloway et al., 2005).

Similarly, children who struggle with English and mathematics have poor working memory (Gathercole & Pickering, 2000). However, the majority of studies on the relationship between Working memory and academic achievement focused on the function of Working memory in language processing, particularly reading. Furthermore, measurements of Working memory capacity correlate with reading performance (Daneman & Carpenter, 1980; Zahn et al., 2022). In addition, researchers found strong relationships between word recognition and several complicated memory span tests, such as Working memory span (Daneman & Carpenter, 1980; Gathercole & Pickering, 2000).

While visuospatial scores are often associated with achievement in mathematics and science, verbal and visuospatial complex working memory scores account for a modest but unique amount of variation in performance on school-based language test scores (assessed in English) (Jarvis & Gathercole, 2003). Children with poor academic performance are typically assessed using the standard psychometric procedure intelligence scale, which has drawn criticism (Dehn, 2008) because intelligence tests are often criticised of being more culturally biased than Working memory tests.

More recent studies have revealed that Working memory capacity assessments are a better predictor of academic achievement than intelligence tests (Swanson, 2004; Alloway et al., 2005; Gathercole et al., 2006; DeMarie & Lopez, 2014). In contrast to IQ, working memory examines a potential to learn, whereas IQ tests often measure already learned material (Alloway & Copello, 2013). According to some evidence (Colom et al., 2004; Kane et al., 2005), a measure of working memory can provide an almost perfect prediction of performance on tests of general ability. Studies have shown that in addition to executive central deficits, poor comprehenders also have poor Working memory capacity (Yuill & Oakhill, 1991). Previous studies also suggest that it is the central executive component of working memory that is most important for mathematics (Bayliss et al., 2003; Friso-van den Bos et al., 2013) and other associated academic fields (Daneman & Carpenter, 1980; Dehn, 2008; Engle, 1996; Engle et al.,1999; Zahn et al., 2022)

According to Alloway and colleagues (2009), students with learning difficulties such as Attention-deficit/hyperactivity disorder (ADHD), attention deficit disorder (ADD), and other attention, hyperactivity, or energy-related problems have difficulty focusing, recalling, and transferring information to memory. Over three thousand children aged from 5 to 11 were evaluated, and approximately 300 of them were found to have "very low working memory scores." The findings of Gropper and Tannock (2009) reported that students with ADHD had substantial deficits in auditory and spatial tasks and a strong link between Grade Point Average (GPA) and auditory † verbal Working memory. Lower GPAs also showed deficits in auditory and special tasks and auditory verbal working memory.

Aronen and colleagues (2005) studied the associations of the performance in audio- and visuospatial working memory tasks to teacher-reported academic achievement and psychiatric symptoms were evaluated in a sample of fifty-five 6 –13-year-old school children. The results showed that good spatial working memory performance was associated with academic success at school. Children with low working memory performance, especially audio spatial memory, were reported to have more academic and attentional/behavioural difficulties at school than children with good working memory performance. The results suggest that working memory deficits may underlie some learning difficulties and behavioural problems related to impulsivity, difficulties in concentration, and hyperactivity.

The findings of Tariq and Noor (2012) suggested that students with working memory difficulties take a much longer time to process information. They cannot handle timed tasks and information that is presented quickly. As a result, individuals frequently give up on the activities entirely out of frustration. According to Engel de Abreu and colleagues (2015), one factor in early readers' difficulty reading might be a deficit of working memory or cognitive flexibility. These conclusions are further supported by Hall's findings (Hall, 2015), which provided young children with a series of memory tasks and then associated the tasks with academic achievement. It also discovered that the better students performed on these tasks, the more probable it was that they would be proficient learners. Students that have greater Working memory often perform better in school, according to researchers. Higher-working memory capacity individuals kept on-task thoughts better and mind-wandered less during hard activities requiring focus and effort, according to Kane and colleagues (2007). These previous findings suggested that working memory is a risk factor for academic failure in adolescents with attention problems (Rogers et al., 2011).

Working memory is crucial for verbal reasoning and literary comprehension (Baddeley & Hitch, 1974). Therefore, working memory is crucial to both the abilities related to English/Language Arts as well as to Mathematics and other academic-related subjects. Studies by Ishak and colleagues (2011) demonstrated the link between working memory and academic achievement. According to Gropper and Tannock WKHUH H[LVWV GHILQLWHO\ D VLJQLILFDQW FR
science and mathematics and working memory. Working memory and learning science have a beneficial association in schooling (Yuan et al., 2006).

Associations between working memory and long-term or subsequent recognition memory have been shown in children (Gathercole & Adams, 1994; Lloyd et al., 2009; Jeneson & Squire, 2011; Marton & Eichorn, 2015; Skalaban et al., 2022). Thus, overall working memory performance predicted immediate and long-term recognition performance regardless of age. Visual memory scores highlighted a favorable tendency in predicting reading comprehension in a study by Kulp and colleagues (2002) on the relationship between visual memory and academic achievement. Math, reading comprehension, and overall academic achievement are all significantly associated with poor visual memory.

Visuospatial working memory is responsible for storing and processing visual information related to spatial positioning and visual stimuli observed during direct perception or extracted from long-term memory (Bull et al., 2008; Tikhomirova, 2017). Visuospatial working memory is a significant predictor of academic success in virtually all areas of scientific knowledge, from mother-tongue acquisition (Verbitskaya et al., 2015; Verbitskaya et al., 2020) to mathematics (Van Der Sluis et al., 2005; Bull et al., 2008). Additionally, it has been shown that working memory can be related to different aspects of mathematical knowledge, including understanding the concepts of basic arithmetic operations, complex mathematical calculations, and spatial relations in geometry (Rodic et al., 2015).

Attention and Academic Achievement

Attention is the act of focusing one's awareness on something external or internal for a certain amount of time (Solso et al., 2013). During this time, other interests or objects of attention can be set aside. According to common beliefs, attention is essential for academic achievement. The ability to pay attention is a prerequisite for mastering the current work. In our regular tasks, attention is crucial. The fact that people's attention is constantly moving and changing depending on their wants and interests is a significant aspect of human nature. Adolescents deal with a variety of psychological, physical, and emotional issues that hinder their ability to study and lower their academic achievement. One of the key elements that might impact children's academic success is attention. The intact function of memory and attention is essential for children to cope with the high scholastic demands of today. It has been shown that children with deficits in these functions have learning difficulties that are often accompanied by behavioral problems (De Jong, 1998, McLean & Hich, 1999). According to Balushi (2015), VWXGHQW¶V academic success in terms of retention and comprehension capacity is impacted by their ability to pay attention in class. Without regard to whether a student has previously been diagnosed with attention deficit hyperactivity disorder (ADHD), Pope (2010) found that students who score higher on the inattention subscale are more likely to achieve a lower final average percentage mark (APM) and are significantly less likely to finish their degree within three years. This finding emphasises the importance of focusing on the identification and provision of support for students with elevated ADHD symptomatology, particularly inattention characteristics.

Reading and math achievement all of which are crucial for academic achievement, decreased in children with attention issues (Rabiner et al., 2016). Moreover, it has been shown that children with attention deficits have learning difficulties that are often accompanied by behavioural problems (De Jong, 1998, McLean & Hich, 1999).

In a study on the relationship between attention problems and classroom learning, Rabiner and colleagues (2016) found that many students with attention deficits also have academic difficulties. According to Lamba (2014) and Podila (2019), 10% of students had poor concentration, while 46% had average concentration, meaning that students would find it difficult to memorise without classroom concentration. Additionally, the findings of Milovanovic (2017), found a correlation between attention and school performance in a total sample of 350 adolescents, by using instruments that possess a determined validity, results suggested that the indication of attention represented significant factors in the school performance of adolescents and students who have lower academic achievements perform significantly differently from students with higher academic achievements.

The findings of Gallen and colleagues (2023) suggested that sustained attention is a crucial cognitive ability that improves over time and reliably predicts significant real-world outcomes, including academic achievement. They found that attention was positively correlated with success on broad academic measures (state-wide standardised test scores) and targeted tests (math fluency and reading comprehension) in a sample of over 700 students aged 9 to 14.

Memory profiles of the typical and atypical population

A large collection of studies have profiled working memory in children with Autistic Spectrum Disorder (Williams et al., 2006; Habib et al., 2019; Alloway & Lepere, 2019), specific language impairment (SLI) (Archibald & Gathercole, 2006; Marton & Schwartz, 2003; Riccio et al., 2007; Nickisch & Von Kries, 2009), Down Syndrome (Buckley et al., 1995; Costa et al., 2015; Godfrey & Lee, 2018), Williams Syndrome (Vicari et al., 1996; O'Hearn et al., 2009), Attention Deficit/Hyperactivity Disorder (Alloway, 2011; Cockcroft, 2011; Strand et al., 2012), dyslexia (Gathercole et al., 2006; Steinbrink & Klatte, 2008), dyscalculia, and general intellectual disabilities (Gathercole & Baddeley, 1990; Alloway, 2006; Alloway et al., 2006). Below are the previous studies on memory profiles of both typical and atypical populations.

Ratcliff et al (2011) studied the correlation between IQ and associative recognition tasks and found that IQ scores were positively correlated with drift rates.

Older adults and adults with lower IQ have smaller values of drift rate and an interaction between age and IQ in the associative recognition task such that IQ has a larger effect on drift rate for younger adults and a smaller effect for older adults. For young adults, there are large differences in the drift rates for the different IQ levels. For the very old adults, there are only small differences in the drift rates for the different IQ levels, and for the oldest adults there was essentially no effect of IQ on drift rates in the associative task, as opposed to an effect of similar size as for younger adults with low IQ adults showing greater decline with age than higher IQ adults. In contrast, for item recognition, IQ has a similar effect on drift rate across all three age groups.

The findings of De Smedt and colleagues (2007) investigated working memory in children with Velo-cardio-facial syndrome (VCFS) and found that children with VCFS had considerably poorer listening span but there is no difference in counting span or digit span backward compared to controls. When group differences in IQ were also included, only nonword repetition and digit span forward showed significant differences (De Smedt et al., 2008).

Nehra and colleagues (2014) compared the memory functioning profile in patients with Traumatic brain injury (TBI) and Subarachnoid Hemorrhage (SAH), as well as the effect of age, education, and gender on the memory profile of patients with TBI and SAH of the same. Both groups (TBI and SAH) were assessed on the PGI-Memory Scale, and Memory scores were low in both TBI and SAH instances, demonstrating that there is a strong association between (TBI) and short/long-term cognitive deficits affecting memory loss, attention deficit, and language, regardless of damage severity. Furthermore, only two domains, delayed recall and recognition ability were found to be statistically significant, indicating that there are fewer chances of impairment in their delayed memory (assessing verbal memory) and recognition ability (visual memory), respectively, as compared to TBI.

Dr. Rajendra Kumar Sharma and Mr. Vikas Sharma (2017) examined visual and auditory short-term memory in undergraduates aged 16 to 20 years old, evaluating the rapidity and specificity of response to both visual and auditory stimuli across ten domains. The study included 60 psychology undergraduate and non-psychology students ranging in age from 16 to 20 years. Non-psychology students score significantly lower on the PGI memory test than psychology students. As a result, it is concluded that stream is associated with increased PGI memory scores in psychology students.

Subash Raj (2016) used the PGI memory scale (PGIMS) to correlate three distinct forms of memory (Recent memory, Remote memory, and Mental balance) with Hb concentration in a healthy elderly population aged 50 to 70 years and concluded that a tendency of dependence on remote memory with Hb. When graphing Mental balance scores against comparable Hb levels, a similar substantial correlation with a slope of 1.04 is found. However, the results for recent memory are not substantially correlated these results implied that the neural components for each form of memory differ.

Gupta and colleagues (2019) investigated the cognitive state of alcohol-dependent individuals, as well as the effect of abstinence from alcohol for one month, and compared the results to controls. This research evaluated the following two cognitive domains: Memory and intelligence are two aspects of intelligence. The study found that alcoholics had a higher rate of impairment in several domains of memory on the PGI- Memory Scale than controls. There was a significant difference in remote memory, visual retention, and visual recognition, but not in recent memory, mental balance (Working memory), attention and concentration, immediate and delayed recall, and retention for similar and dissimilar pairs. However, A similar study conducted by Bhat and Gambhir (2011) revealed that even after one month of abstinence and treatment, there was a substantial difference in all of the above-mentioned memory sub-domains as compared to the control group.

Halder and colleagues (2016) studied neurocognitive functioning in normal aging subjects, specifically domains of memory, verbal fluency, and response inhibition, and the findings suggested impairment in memory functions in the normal aging population; it also points out that remote and recent memory is generally intact in the healthy aged population compared to immediate memory. Akhouri and associates (2014) found a relationship between the immediate, recent, and remote memory of patients with depression and anxiety, and came to the conclusion that immediate, recent memory is impaired in depression and anxiety patients but remote memory remains intact.

A study by Luo and Craik (2008) reported that normal aging should have a greater effect on performance in subtests that rely heavily on self-initiated processing (for example, free recall test) and those that involve associative information (for example, paired associate tests), but the smaller effect on performance in tests that rely on generic ideas (for example, recall of story's gist) and those that involve a higher level of environmental support (for example, recognition tests). The types of memory that decline most with age are working memory and episodic memory. Episodic memory is responsible for remembering events and experiences that have happened to us personally and shows the greatest age-related difference. Studies have reported that subjective memory impairment (SMI) may be the first manifestation of future dementia in elderly subjects (Gauthier, 2006; Jessen et al., 2007). A high prevalence of SMI (70%) was found in their study, which was more frequent in women; however, age and education did not impact on prevalence (Brucki & Nitrini, 2009).

Gender differences in memory profiles

The difference in academic achievement due to gender differences is crucial to educationists. The literature has revealed that there are gender differences in cognitive ability. There are several particular areas that are brought to mind rather immediately when thinking about the subject of whether there are differences in cognitive ability between males and females. Researchers have known for some time that the spatial and recognition domains are particularly important to the subject of cognitive gender differences as they produce noticeable differences in favour of males (Linn & Petersen, 1985; Benbow, 1988; Hyde et al., 1990; Hedges & Nowell, 1995; Voyer et al., 1995). Although verbal abilities used to be considered to favour women (Maccoby & Jacklin, 1974), in contrast, more findings revealed that, depending on the task under considered verbal abilities could indeed favour males (Hyde & Linn, 1988; Hedges & Nowell, 1995).

A previous review of the literature revealed gender differences in verbal recall, which indicates a clear pattern in which men will have better memory for tasks requiring spatial information as compared to women (Loftus et al., 1987). Females often perform better on jobs requiring verbal information, whether they are adults or children. Lowe (2003) Studied gender differences in short-term memory across 14 different measures in children and adolescents and revealed a profile of normal differences in patterns of memory test performance across gender, with women performing better on verbal tasks and men performing better on spatial tasks. Females tend to perform better than males in verbal-based episodic memory tasks, as opposed to spatial-based memory tasks (Herlitz & Yonker, 2002). Females generally access their memories faster than males (Davis, 1999) date them more precisely (Skowronski et al., 1991) and use more emotional terms when describing memories (Fuentes & Desrocher, 2013). Superior verbal memory for females also appears to be independent of intelligence level (Herlitz & Yonker, 2002). Additionally, females also have greater specificity for events imagined to occur in the future (Wang et al., 2011).

In general, females outperform males on autobiographical memory (particularly with high retrieval support via verbal probing (Fuentes & Desrocher, 2013), random word recall (Herlitz et al., 1997) story recall (Dixon et al., 2004) auditory episodic memory (Pauls et al., 2013) semantic memory (driven by superiority in fluency) (Maitland et al., 2004), and face recognition tasks (Herlitz & Yonker, 2002; Heisz et al., 2013). For race recognition tasks, females particularly have better recognition memory for female faces and greater face perception (Lewin & Herlitz, 2002; Megreya et al., 2011). This may be a result of females being more familiar with female faces (Rehnman & Herlitz, 2007), which aligns with other work showing that recognition memory is superior for individuals who are of the same ethnic background as themselves (Bothwell et al., 1989). Females also have been shown to have greater scanning behaviour at encoding (Heisz et al., 2013), which may also contribute to their superior recognition memory.

Herlitz and Rehnman (2008) findings indicate that gender differences are produced during the course of verbal episodic memory tests. Women may have a little, overall episodic-memory advantage, which may be increased by their superior verbal output to men's disadvantage in visuospatial tasks. Pauls and his colleagues (2013) investigated differences in episodic memory dependent on task type among 366 females and 330 males ranging in age from 16 to 69. Men performed better than women on tasks requiring auditory memory, whereas older men and male adolescents performed better on tasks requiring visual episodic and working memory.

Women were more likely than men to correctly respond to a single function cue, according to Yonelinas and FROOHDJXHV¶ (2010) assessment of recognition performance. However, women did not perform as well as men on double function cues, presumably because they were more prone to associative interference, as evidenced by the higher likelihood that they would do so. In a comparable manner, the earlier research investigated the effects of gender on verbal and visuospatial Working Memory maintenance tasks in a large and homogeneous sample of young healthy subjects and found significant gender effects on both the behavioural and neurofunctional level and provided evidence for a slightly lower capacity in both Working Memory modalities in females (Zilles et al., 2016).

However, Pauls and his colleagues (2013) analysed the relationship between gender and memory and examined the effects of age on the overall memory-related functioning among a sample of 366 women and 330 men, aged between 16 and 69 years of age and found that women outperformed men on auditory memory tasks, whereas male adolescents and older male adults showed higher level performances on visual episodic and visual working memory measures. Similarly, Garg and his colleagues (2017) investigated the status of auditory and visual short-term memory in 60 healthy young adults in Uttarakhand, aged 17 to 21 †30 men and 30 women. According to the results, men performed significantly lower on the "Memory Test" than women did. Females outperform males in both Auditory Memory and Visual Memory.

On a verbal memory and recognition task, Temple and Cornish (1993) examined gender differences among a nonclinical sample of 64 girls and 64 men, aged 9 to 21. In this verbal memory challenge, Temple and Cornish discovered that women performed better than men. Different research that looked at gender differences, found that male preschoolers and kindergarteners performed considerably better on a visual-spatial working memory test than their female counterparts (Robinson et al., 1996). Similar results were obtained by Huang (1993), who discovered that Chinese teenage girls outperformed adolescent boys on a verbal memory task and adolescent boys outperformed adolescent females on a visual-spatial memory challenge.

Males are better at using working memory, according to earlier research by Lynn and Irwing (2008). Similarly, Adyalkar (2019) examined the relationships between short-term memory (STM) and gender among participants aged 18 to 20 and results showed that females have better short-term memory than men in terms of recall on the word recall test. The findings of Heisz and his colleagues (2013) revealed individual differences in episodic memory. Females outperformed males on recognition-memory tests, and this advantage was directly related to females' scanning behavior at encoding these results implied that a strategy of increased scanning at encoding may prove to be a simple way to enhance memory performance in other populations with memory impairment. In line with these findings, a study by Wang (2013), results have shown females' advantage in face memory in which females outperformed males with regard to recognition memory.

In contrast to these findings, Simotas (1996) examined the effects of age and gender on two different types of implicit memory tasks, perceptual and conceptual, in 120 healthy volunteers, including 60 young men and women ages 18 –25 and 60 elderly men and women ages 55 –88. The results showed no significant main effects or interactions of age or gender. In addition, working memory and academic achievement were found to be the same in both males and females, according to research by Tariq and Noor (2012) on working memory and academic achievement of science university students. The study showed no differences in working memory between male and female university science students. Trahan and Quintana (1990) investigated gender effects on verbal and visual memory performance in normal adults (age range: 18 –91 years). Results revealed no differences between males and females for Delayed VR, however, there were Male-female differences for the Immediate VR task that were marginally significant. While performing a task that measured visual recognition memory, Aliotti and Rajabiun (1991) found no relationship between gender and test performance. Similar results obtained by Forrester and Geffen (1991) when 40 girls and 40 boys between the ages of 7 and 15 participated in an auditory learning test found no significant gender differences on a task measuring visual recognition memory. Ishak and colleagues (2012) studied at the Universiti Kebangsaan Malaysia and showed that there was no significant difference between males and females in average working memory. Likewise, R. Prabha, and K. Dhanalakshmi (2022) found that there is no significant difference between male and female higher secondary school students in their Systematic ability, Intuitive ability, and overall Cognitive ability. Gender was found to account for less than 5% of the variance in children's performance on cognitive and academic tasks.

. R L U D (2021) ¶ V comparative study conducted with higher education boy and girl students to assess the difference in different types of memory between sexes and found that significant difference in five subscales i.e., remote memory, recent memory, mental balance, attention and concentration, and retention of dissimilar pairs. Among five subscales except in recent memory male score has outperformed female and the difference in the score was significant. Similarly, Asperholm (2020) examined the gender differences in episodic memory variance in 535 studies including 962,946 individuals conducted between 1973 and 2013. Men exhibited larger variations than women in both verbal episodic memory tasks and spatial episodic memory tasks, according to the findings.

Additionally, Chan and Abu Bakar (2021) explored gender variations in working memory performance, including both verbal and visuospatial working memory performance, and the findings revealed a substantial gender difference in verbal and visuospatial working memory ability, with males performing more rapidly than females in both tasks. In terms of accuracy, female participants outperformed their male counterparts in the verbal test, which is consistent with previous studies. However, no gender differences in visuospatial task performance were found based on the total number of accurate recalls.

Voyer and colleagues (2007) found that Object identity memory tasks showed significant gender differences that were homogeneous and in favor of women. Herlitz and his associates (1997) examined potential gender differences in episodic memory, semantic memory, primary memory, and priming. 530 women and 470 men, randomly sampled from the city of Umeå, Sweden, 35 –80 years of age, participated in the study. There were no differences between men and women with regard to age or education, or on a measure of global intellectual functioning. As has been demonstrated previously, men outperformed women on a visuospatial task and women outperformed men on tests of verbal fluency. In addition, the results demonstrated that women consistently performed at a higher level than men on the episodic memory tasks, although there were no differences between men and women on the tasks assessing semantic memory, primary memory, or priming.

In the findings of Speck and colleagues (2000), gender differences in brain activation during working memory tasks were examined with fMRI and results show highly significant gender differences in the functional organization of the brain for working memory. These gender-specific differences in the functional organization of the brain may be due to gender differences in problem-solving strategies or neurodevelopment.

Wang (2013) investigated young adults and compared with men, women recorded a greater number of event details at the encoding phase and provided more detailed and accurate memories at the delayed recall, although there was no gender difference in the forgetting function during retention which shed new light on the mechanisms underlying gender differences in episodic memory. Boman (2004) revealed that girls outperformed boys in episodic and semantic memory materials. Previous studies included an extensive analysis of gender differences in autobiographical narratives and the results indicated that females expressed more affect, connection, and factual elaboration than males across all narratives, and that feminine typicality predicted increased connectedness in narratives (Grysman, 2016)

Robert and Savoie (2006) studied the possible gender differences in terms of accuracy (but not speed) of working-memory processes. Men and women completed a series of working-memory tasks respectively involving verbal and visuospatial information, as well as a double-span task involving both classes of information and found that men and women were not found to differ significantly in any type of working memory save in the double-span task where women surpassed men. The patterns of task intercorrelation were largely similar in both genders.

According to Hirnstein and colleagues (2022), women are thought to fare better in verbal abilities, especially in verbal fluency and verbal-memory tasks and a meta-analysis revealed that women/girls outperformed men/boys in phonemic fluency but not in semantic fluency for which the sex/gender difference appeared to be category-dependent. Women/girls also outperformed men/boys in recall and recognition. Although effect sizes are small, the female advantage was relatively stable over the past 50 years and across lifetimes, and concluded that a small female advantage in phonemic fluency, recall, and recognition exists.

Fuentes and Desrocher (2013) studied an undergraduate sample of 50 men and 50 women were assessed using the Autobiographical Interview (Levine et al., 2002). Women recalled more episodic information compared to men in the high retrieval support condition, whereas no gender differences were found in the low retrieval support condition. No gender differences were found in the production of semantic details.

Miller and Bichsel (2004) evaluated the relations between visual and verbal working memory; state, trait, and math anxiety; gender; and applied and basic math performance in 100 adults. Both visual and verbal working memory were found to be significant factors in accounting for the variance in math performance measured broadly, differing from findings in previous studies. Herrmann and his colleagues (1992) demonstrated that people hold beliefs about how well others perform everyday memory tasks according to gender and investigated whether gender stereotypes concerning everyday memory have any validity and found that women recalled more of the shopping list than men whereas men recalled more of the directions than women.

Gender differences among children and adolescents were examined on 14 separate measures of short-term memory and results revealed only two significant differences in absolute scores across gender on the 14 memory subtests. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on spatial tasks (Lowe, 2003). Adams and colleagues (2015) investigated the gender differences in the relationships between working memory in both the visuo-spatial and verbal domains and children's alphabet transcription and text writing abilities were investigated and revealed no significant group differences between boys and girls in working memory or writing performance. Regression analyses revealed that verbal short-term memory abilities predicted the alphabet transcription skills of boys but not girls.

It is evinced that from the above previous literature investigating the association between memory test scores and gender in children, adolescents, and adults has produced mixed results (Aliotti & Rajabiun, 1991; Boivin, 1991; Forrester & Geffen, 1991; Huang, 1993; Temple & Cornish, 1993; Robinson et al., 1996; Ullman et al., 1997). The literature presents a complicated picture of gender interactional effects on cognitive abilities and academic achievement.

Ecology and academic achievement

Rural schools are widely perceived to be inferior to urban schools. This notion extends to implying that there are inequalities in school achievement levels between rural and urban areas. These variations in academic achievement between rural and urban areas extend to many other socially desired outcomes such as aptitude, intellect, interest, and aspiration. The issue of potential rural-urban inequalities in academic achievement appears to be widespread, and it has sparked controversy among researchers. The hypothesis that students in rural areas obtain an inferior education than their urban counterparts is known as the 'deficit model' of the rural society and lifestyle (Fan & Chen, 2001).

The factors of differences in academic achievement between Urban and Rural are many from the past literature. Many classical and contemporary studies have determined the role of non-cognitive factors such as family characteristics (Ramos, Duque & Nieto, 2012), the availability of resources and technology, socioeconomic status variations, and teacher quality (Gaviria & Barrientos, 2001; Brown and Swanson, 2001; Rangel & Lleras, 2010). Rowley (2018) and Shikalepo (2020) argues that rural schools face challenges that can lead to unfavourable educational outcomes for their students. One of such challenges as pointed out by Ertl and Plante (2004) is in terms of information and communication technology (ICT) usage (Saxena, 2017), which is usually lacking in rural areas. Nielson (2004) observes that rural students are advantaged by small class sizes and enjoy more individual attention from teachers than their urban counterparts. However, a small amount of research has examined the cognitive factors that are considered an important factor in academic outcomes which represents the theoretical point of the research present in this current research. Despite the fact that research on the impact of ecology (urban or rural) on VWXGHQWV¶ DFDG achievement in the United States began in the mid-1980s (Ramos et al., 2012) there is only a small number of studies that examine the effect of ecology and memory ability on academic achievement among the targeted population.

Some studies debunk the urban-UXUDO LQIOXHQFH RQ VWXGHQW Ya) 2006; Yusuf & Adigun, 2010). Other studies have found that students in urban areas exhibit better performance than their rural counterparts in mathematics, reading, and science (2¶NZX Owoeye & Yara, 2011; Chianson, 2012; Ijenkeli et al., 2012;

Ajai & Imoko, 2013). In other studies, however, students from rural schools were found to have performed better than those from urban areas (Alspaugh, 1992; Haller et al., 1993; Alspaugh & Harting, 1995).

Field and colleagues (2001) compared rural students' academic performance to that of urban students in a number of critical areas and discovered that students from privileged family backgrounds † including those from families with higher socioeconomic status † are linked to higher academic achievement, which in turn has a significant impact on that person, with cognitive ability being one of those effects (Steinberg et al.,1996). According to a study by Rohde and Thompson (2007), there is evidence that general cognitive ability has a significant relationship with academic achievement. The potential causes for the differences in cognitive ability between rural-urban VWXGHQWV¶ academic achievement may be due to the reason that urban life requires different cognitive abilities than life in remote rural areas. For instance, in the city, reading and math skills are commonly required of individuals. This is less common in rural areas, where communication is less frequent through the printed word and the economy is based on trading rather than monetary transactions.

The measuring of how much a child's upbringing and the quality of their schooling contribute to their learning outcomes and cognitive development is a topic of much controversy and data from the United States and England revealed pioneering findings (Coleman et al., 1966; Peaker, 1971). According to these findings, influences occurring prior to school had a greater impact on student performance than did school resources. In countries with low incomes, Heyneman and Loxley (1982, 1983) discovered that school characteristics contributed more than family background. More recent studies have questioned the extent to which, when fully accounting for backgrounds, school resources are effectively resulted in improved cognitive outcomes and failed to confirm the negative association between the country's income and the proportion of variance in learning outcomes explained by school characteristics (Baker et al., 2002; Hanushek & Luque 2003).

According to Castro and Rolleston (2015) students attending rural schools in Peru demonstrate extremely poor learning outcomes and obtain results significantly below those of students in urban schools. They measured the contribution of school and early childhood influences to the difference in cognitive development observed,

at the age of 8, between urban and rural children in Peru and found that between 35 and 40 percent of the gap in cognitive skill between urban and rural 8-year-old children is related to differences in school inputs (years of schooling, school and teacher characteristics) received between the ages of 6 and 8. These findings suggested that µSDVW LQIOXHQFHV¶ PRVWO\ UHODWHG WR WKH OHDU
was exposed up until the age of 5. Empirical work that has analysed the cognitive skill gap between indigenous and nonindigenous Peruvian children has found that family variables contribute more than school variables (Hernandez-Zavala et al., 2006) and that differences in child and household characteristics contribute significantly more than differences in community-level variables (Arteaga & Glewwe, 2014). In addition, evidence favouring the role of household characteristics also seems consistent with the fact that setbacks in cognitive development affecting children from disadvantaged backgrounds emerge during early childhood and remain fairly unchanged once these children enter school.

Children in urban and rural areas may face different demands on their cognitive abilities, depending on parental expectations and the tasks given to children. It has been suggested lack of stimulating cognitive activity is considered to be the most significant modifiable risk factor to decrease cognitive function. Tripathi and Tiwari (2011) suggested male subjects living in urban areas, having more than a high school education, and with a college education and living with spouses were found to perform better than their other counterparts. And according to Chandra and FROOHDJXHV¶ (2001) theory, cognitive impairment may go unrecognised among the elderly in a low-demand society. In the developed world's contemporary societies, where novel devices that rely on memory (as well as executive skills) are routinely incorporated into daily life, and in rural areas, these devices are not easily accessible. These may provide lesser cognitive stimulation as compared to Urban.

Wang and his colleagues (2019) studied the disparities and relative factors between primary and junior secondary students in urban and rural/mountainous areas of Yunnan province in terms of cognitive abilities that are important for many decisions and academic performance. They suggested that there were huge differences in cognitive abilities including working memory, attention, and reasoning ability.

Specifically, rural and mountainous students had poorer overall cognitive abilities, especially reasoning abilities, compared with their urban counterparts, which is consistent with the previous report on cognitive ability development of Chinses children and adolescents aged 6-15 (Xu, 2010). Additionally, the findings in primary students from both urban and rural/mountainous areas of Yunnan showed that cognitive abilities were associated with parental support, teacher-student relationships, and friendship quality. Likewise, the finding in junior secondary students indicated that cognitive abilities were strongly associated with friendship quality. Therefore, the higher cognitive ability scores of urban students are possible because urban students tend to have more equitable access to educational resources and better parental support as their parents tend to be better educated and utilize more strict parenting techniques (Smetana, 2000). Some variables chosen to reflect student ¶V health status as the causal relation between nutritional status and cognitive skill has also been documented (Outes-Leon et al., 2011).

Das and Hazarika (2020) investigated the creative abilities of students from rural and urban secondary schools in the Dibrugarh district of Assam and found that students from urban secondary schools are better than their rural counterparts in all dimensions of creativity and can be concluded that students hailing from urban secondary schools are more creative in comparison to rural secondary school students.

Dartmouth College (2013) Researchers at Dartmouth College have found that children growing up in rural poverty score significantly lower on visual working memory tests than their urban counterparts. However, children in urban poverty score slightly lower on tests of verbal working memory. The study results were also groundbreaking because they demonstrated a gap between the verbal and visual working memories of children living in rural poverty. None of the other groups included in the study -- kids from high-income rural, high-income urban, and low-income urban backgrounds -- performed significantly better in one area than the other (Tine, 2014; Tine, 2017).

Based on previous literature, it was expected that rural High School students would show memory deficits compared with their Urban High School V W X G H Q W V ¶ counterparts (Xu, 2010; Dartmouth College, 2013; Tine, 2014; Tine, 2017; Wang et al., 2019). It is interesting to note from the literature review that, like many other issues in education, research comparing rural students with their urban counterparts in academic achievement has yielded inconsistent findings.

Most psychological studies of differences in cognitive abilities have relied upon urban, schooled children and adults from industrialized countries as their subjects. Despite the long interest in the topic, we know very little about possible differences in memory abilities related to academic achievement in other populations or in other cultures. Reports have most frequently concentrated on mathematics (CAI et al., 2013; Nizoloman, 2013; Menon, 2016; Peng et al., 2016; Giofrè et al., 2018; Silverman & Ashkenazi, 2022). and reading (Lummis & Stevenson, 1990; Chiappe et al., 2000; Osaka et al., 2002; Bader, 2016; Arias et al., 2021), and a few studies have compared urban and rural in other cognitive abilities like creativity (Das & Hazarika, 2020) and IQ (Kumari et al., 2017) but few research focus on the differences on PHPRU\ DELOLWLHV RQ VWXGHQWV¶ DFDGHPLF DFKLH

The statement of the problem of the present study is presented in the next chapter, ***Chapter III Statement of the Problem.***

Statement of the Problem

Memory theories and research findings demonstrate the relevance of memory in everyday life, particularly in the field of education. First, memory is essential for most higher-level cognitive processes, such as recall, retention, decision-making, strategy utilisation, processing speed, and broad attention, all of which are commonly employed in daily life and in academic activities (McGrew & Woodcock, 2001; McNamara & Scott, 2001; Dehn, 2008). The importance of memory in students is mirrored in the huge quantity of relevant research concentrating on the teaching and learning process (Pantziara & Philippou, 2015). Previous research has revealed a contradictory result on the link between memory and academic success (Gathercole et al., 2003). Additionally, the results of previous research that examined different memory functions in connection to academic performance, either independently or combined, are also challenging to integrate.

Beginning in preschool and continuing through tertiary studies, working memory (WM) is considered to be an essential skill (Alloway et al., 2005; Alloway & Gregory, 2013). Poor arithmetic performance is also characterised by weak verbal working memory skills because people with these problems process information more slowly and struggle to keep up with timed tasks and fast presentation of information. Due to their frustration, some students decide to drop out of school or college (Alloway, 2006). And from previous studies, memory deficits likely contribute to difficulties in learning and poor academic progress among learners (Gathercole & Alloway, 2008). Researchers have reported that children who fail to perform adequately in academics without any apparent limitation had deficits in basic psychological processes. Defects in psychological processes which include cognitive abilities in perception, language, memory, attention, concept formation, problem-solving, and the like act as intrinsic limitations or deficiencies that interfere with the child’s learning (Carte et al., 1996).

Regarding the impact of short-term memory (STM) on academic achievement, it seems that children who have trouble reading have trouble with reading faces that need them to keep information in order of presentation for a brief period of time, including digit span and word span (McDougall et al., 1994; Swanson et al., 1998). This shortcoming might be related to deficits in the STM's rehearsal process (Henry & Millar, 1993). Another set of results demonstrated the critical role that short-term phonological storage plays in word recognition (Jorm, 1983). Additionally, some research showed that STM tasks like word and digit span allow one to discern between good and poor readers (Torgesen & Houck, 1980). This conclusion was supported by consistent findings showing the Wechsler IQ scale's digit span subtest is capable of identifying children who struggle with reading (Mishra et al., 1985).

El-Mir, Mohammed (2019) conducted research on how memory affects academic achievement. They examined into how several memory functions, including working memory (WM), short-term memory (STM), and long-term memory (LTM), affect academic achievement. However, the relationships between WM and learning task performance were the main emphasis. Based on the findings that WM capacity conditioned achievement in word recognition and reading comprehension in language and concluded that measurements of WM might be used to predict performance in various cognitive tasks, such as reading.

WM capacity is considered to be able to predict performance in many cognitive tasks (Swanson, 1993; Engle, 2002), and it also significantly correlates with performance in word recognition, reading comprehension, spoken language comprehension, following directions, developing vocabulary, written expression, and reasoning (Engle, 1996; Engle et al.,1999; Dehn, 2008). WM span measures are intended to explain individual differences in learning (Swanson et al., 1990; Gathercole et al., 2006). Additionally, research found that WM deficits lead to failures in various learning activities, including recalling and following instructions and mental arithmetic (Gathercole et al., 2006).

Furthermore, measurements of WM capacity correlate with reading performance (Daneman & Carpenter, 1980; Zahn et al., 2022). In addition, researchers found strong relationships between word recognition and several complicated memory span tests, such as WM span (Daneman & Carpenter, 1980; Gathercole & Pickering, 2000). More recent studies have revealed that WM capacity assessments are a better predictor of academic achievement than intelligence tests (Swanson, 2004; Alloway et al., 2005; Gathercole et al., 2006; DeMarie & Lopez, 2014). According to some evidence (Colom et al., 2004; Kane et al., 2005), it is suggested a measure of working memory can provide a prediction of performance on tests of general ability. Moreover, the retrieval of remote memories like autobiographical memories guides future decisions and problem-solving (directive function), promote social interactions (social function), and helps the development and sustaining of a self-concept (self-function) (Kaya, 2018). Therefore, autobiographical knowledge shared in memories contains self-related past, present and future constructions in terms of goals, plans, decisions, problem-solving strategies, etc (Bluck, 2003). Rinn and Plucker (2004) noted that further study of adolescents of high ability is of special interest to higher education institutions and their attempts to improve both scholastic and non-scholastic opportunities. This age marks the beginning of a new milestone in a person's development, a transition out of childhood and into adulthood. Although some interest has been paid to the development of some of these dimensions of college students' memory ability (e.g., Dolgova et al., 2020, studied the relationship between memory properties and academic performance of college students), a review of the extant literature could find some contradicting relating this memory ability to academic achievement in this population. Therefore, the relationship between these constructs in younger (adolescent) populations is examined in the present study.

Additionally, the literature has revealed that there are gender differences in cognitive ability. There are several particular areas that are brought to mind rather immediately when thinking about the subject of whether there are differences in cognitive ability between males and females. Researchers have known for some time that the spatial and recognition domains are particularly important to the subject of cognitive gender differences as they produce noticeable differences in favour of males (Linn & Petersen, 1985; Benbow, 1988; Hyde et al., 1990; Hedges & Nowell, 1995; Voyer et al., 1995). Although verbal abilities used to be considered to favour women (Maccoby & Jacklin, 1974), more recent findings reveal that, depending on the task under considered verbal abilities could indeed favour males (Hedges & Nowell, 1995; Hyde & Linn, 1988).

A previous review of the literature revealed gender differences in verbal recall, which indicates a clear pattern: It is assumed that men will have better memory for tasks requiring spatial information as compared to women (Loftus et al., 1987). Females often perform better on jobs requiring verbal information, whether they are adults or children. Lowe and colleagues (2003) Studied gender differences in short-term memory across 14 different measures in children and adolescents and revealed a profile of normal differences in patterns of memory test performance across gender, with women performing better on verbal tasks and men performing better on spatial tasks.

Similar to this, Herlitz and Rehnman's (2008) findings indicate that gender differences are produced during the course of verbal episodic memory tests. Women may have a little, overall episodic-memory advantage, which may be increased by their superior verbal output to men's disadvantage in visuospatial tasks. Pauls and colleagues (2013) investigated differences in episodic memory dependent on task type among 366 females and 330 males ranging in age from 16 to 69. Men performed better than women on tasks requiring auditory memory, whereas older men and male adolescents performed better on tasks requiring visual episodic and working memory. Working memory, executive functions, short-term memory, long-term memory, visuospatial and linguistic abilities, etc. were the major areas of attention in the previous studies (Margolin, 1984; Caramazza et al., 1987; Berninger & Swanson, 1994; Swanson & Sachse-Lee, 2001; DeStefano & LeFevre, 2004; Swanson et al., 2004; Alloway & Copello, 2013). Research examining the different memory components and the larger impact of memory on academic success is few. It seems likely that there are achievement differences between high and low performers that are associated with variations in memory profiles. This current study extends past findings by contrasting the performance of high and low academic achievers on a number of memory-related tasks.

Additionally, it is commonly assumed that rural schools are inferior to urban schools, and subsequent conclusions from this viewpoint indicate that student achievement levels differ between urban and rural areas. Researchers examined the academic performance of rural students to that of urban students in a number of crucial areas, and they found that more privileged family backgrounds—including those who come from families with greater socioeconomic status—are linked to higher academic achievement (Steinberg et al., 1996; Field et al., 2001). Strong evidence supports the notion that a child's familial socioeconomic status (SES) has a substantial impact on that individual, with cognitive ability being one of those effects (Hackman et al., 2010; Luby et al., 2013; Johnson et al., 2016; Brody et al., 2017). The study aims to contrast the memory profiles of urban and rural students. Hence, the study aims to create a memory profile for the population it is studying, and using a single battery of memory tests enables a more comprehensive assessment of memory performance.

While considering ways to encourage academic achievement, it is essential to keep students' memory abilities in mind. Comparing different memory profiles of high achievers and low achievers might help identify memory profile elements that are particularly important for efficient learning and high-performance outcomes.

The following Objectives were framed for the present study:

1) To examine the group difference in Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition among the groups

2) To identify the correlation between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) on the samples

3) To examine the independent effect of ‘gender’, ‘ecology’, and ‘level of academic achievement ‘on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

4) To study the interaction effect of ‘ecology x gender’, ‘gender x level of academic achievement’, and ‘ecology x level of academic achievement’ on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) on the samples.

Hypothesis:

The following hypotheses are framed to meet the objectives of the study:

1) There will be mean difference that (i) higher scores in high-level academic achievers than low-academic achievers, (ii) higher scores in Urban students than Rural students, (iii) and higher scores in Females than males on Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition with a significant difference level.

2) There will be a significant positive correlation between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition).

3) There will be a significant independent effect of 'level of academic achievement', 'ecology', and 'gender' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

4) There will be a significant interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

The methods and procedures that were aimed to be incorporated to achieve the objectives of the study are outlined in the next chapter in ***Chapter IV Methods and Procedures.***

Method and Procedure

Sample:

The study comprised 320 High School students of Mizoram (aged 16 years to 19 years comprises with equal representation of the '**level of academic achievement**', '**ecology**', and '**gender**' selected through random sampling procedures. The sample identification was done in a multi-stage sampling procedure: Firstly, more than 600 representatives of Low and High academic achievers were selected from the examinations of the last three years (2020, 2021, and 2022 Annual Examinations) from the examination result books maintained by the schools from different parts of Mizoram. High academic achieves were students who scored continuously higher than 80% marks, and Low academic achievers were who scored lower than 50% marks in their last three years' examination results.

Secondly, equal representatives of '**rural'** and '**urban'** from the two representative groups under the independent variables of **'ecology'** were randomly sampled. Aizawl District emerged as being highly developed, followed by Lunglei District and Chhimtuipui District, based on the quantitative index Zokaitluangi (1997) that defined low, moderate, and high degree of regional development in Mizoram. Thus, half of the selected samples identified as **rural** (village) was randomly drawn from Private and Government High Schools of Chhimtuipui District and the other half collected from **urban** areas (city) was randomly drawn from Private and Government High Schools of Aizawl District.

Thirdly, half of the selected sample were equal representation of '**male'** and '**female'** from the two representative groups under the independent variables of **'gender'** were drawn from the selected High Schools following the objectives of the study. The students were randomly selected, a Mini-mental status examination was used for screening, and those having any infirmities were excluded. At the final stage, the equal representatives of '**level of academic achievement**' (High academic achiever and Low academic achiever), '**ecology**' (urban and rural), and '**gender**' (male and female) were attempted, comprises of 320 school students [*160 High academic achievers {80 Urban (40 Male and 40 Female){ and 80 Rural (40 Male and 40 Female)} and 160 Low academic achievers{80 Urban (40 Male and 40*

Female) and 80 Rural (40 Male and 40 Female)}] selected using *a* random method of sample selection, the extraneous variable which may include socio-demographic variables (SES status, types of school, substance use. etc.) was kept under control.

Tools Used:

1) ***Informed Consent form:*** An Informed consent form was constructed by the researcher for the purpose of the study. These include comprehending information appropriately to make an autonomous decision on all four criteria of information disclosure, competence, comprehension, and voluntariness of an individual to make a decision depends on his/her ability to understand relevant information, appreciate the nature of situation along with its consequence, to reason the given information, and the ability to communicate choice. It also included an explanation of the purpose and benefits of the study (Dunn & Jeste, 2001). Appendix- I
2) ***Demographic Questionnaire*:** A demographic questionnaire was constructed by the researcher for the purpose of the study. These include home language, the language of educational instruction, substance abuse, parental occupation, Study habits, and chronic illness – all of which contribute to a child's cognitive development (Tinajero & Loizillon, 2010) presented under Appendix- II.
3) ***The PGI-Memory Scale:*** This tool was constructed by Pershad & Wig (1977). The Post Graduate Institute Memory Scale gives a valid clinical evaluation of memory functions. Constructed and standardized on the Indian population, the PGIMS is a standard and reliable measure of memory. It is a comprehensive scale to measure verbal and non-verbal memory and has been extensively used in Indian studies. It consists of 10 sub-tests:
   - *i.* *Remote Memory*- This sub-test measures the ability to remember personal/ historical events of the past. There are six items in this subtest and each correct answer is to be scored one. Thus, the maximum score is six.
   - *ii.* *Recent Memory*- This subtest measures the ability to remember relatively new information. It consists of five items. Thus, the maximum score is five.
   - *iii.* *Mental Balance*- Temporal Sequencing is the cognitive area assessed. It consists of three items. The first item is an alphabet that is scored 3 if all are correct within 15 seconds, scored 2 if all are correct beyond 15 seconds,

scored 1 irrespective of time required with one error/omission, and scored 0 if more than one error/omission. The second item is counting backward (20-1) and the scoring will be the same as in item 1. The third item is counting backward by 3's subtraction. The score is 3 if all are correct within 30 seconds, scored 2 if all are correct beyond 30 seconds, scored 1 irrespective of time required with one error/omission, and scored 0 if more than one error/omission. Thus, the maximum score is nine.

iv. *Attention and Concentration (Digit span)*- Attention and Concentration, Mental control, and Working memory are the cognitive area assessed. It consists of digits that are to be read by the tester and immediately participants need to repeat it either in the same order or reverse order as he/she is instructed. Digits need to be read out at one digit per second. The number of digits is counted separately for both digit backward and digit forward. For Digit forward number of digits in the longest series and for Digit Backward digits in the longest series of any of the two sets correctly reproduced in reverse order, is scored. The maximum score for DF and DB is 8+8=16.

v. *Delayed Recall*- Short-Term memory is the cognitive area assessed. There are lists of five names each of common objects. The name of the common objects is read from list 1 and then asked the participants to recall the name of common objects after the expiry of the one-minute post-presentation period. In the same manner, the second list is also administered. Each ticked word is counted in two lists and one point is for each score. The maximum score is 5+5=10.

vi. *Immediate Recall*- Verbal working memory is the cognitive area assessed. There are three sentences of increasing length, the first sentence has three clauses, the second has four clauses and the third has 5 clauses. Immediately after the presentation, the participant is said to recall. Each correctly recalled clause is scored one and the maximum score is 3+4+5=12.

vii. *Verbal Retention for Similar Pairs*- Simple Learning Ability is the cognitive area assessed. In this subtest, there are five noun-noun pairs. The second noun is to be asked after reading the first noun to the participant. One mark for each correction of the associated word of the pair is to be given. The total maximum score on this subtest is 5.

viii. *Verbal Retention for Dissimilar Pairs*- New Learning Ability is the cognitive area assessed. In this subtest, there are five noun-objective pairs are given and three trials are given. In each trial, the stimulus is presented in random order as written against each pair. One mark for each correct reproduction and the maximum score on this sub-test is 5+5+5=15

ix. *Visual Retention*- Visuospatial memory is the cognitive area assessed. In this subtest, there are five cards, and each card is presented for 15 seconds. After 30 seconds participant is asked to draw the same design from his/her memory. Each figure correctly reproduced from card 1 to 3 are scored 2 each and card 4 is scored 3 and card 5 is scored 4.

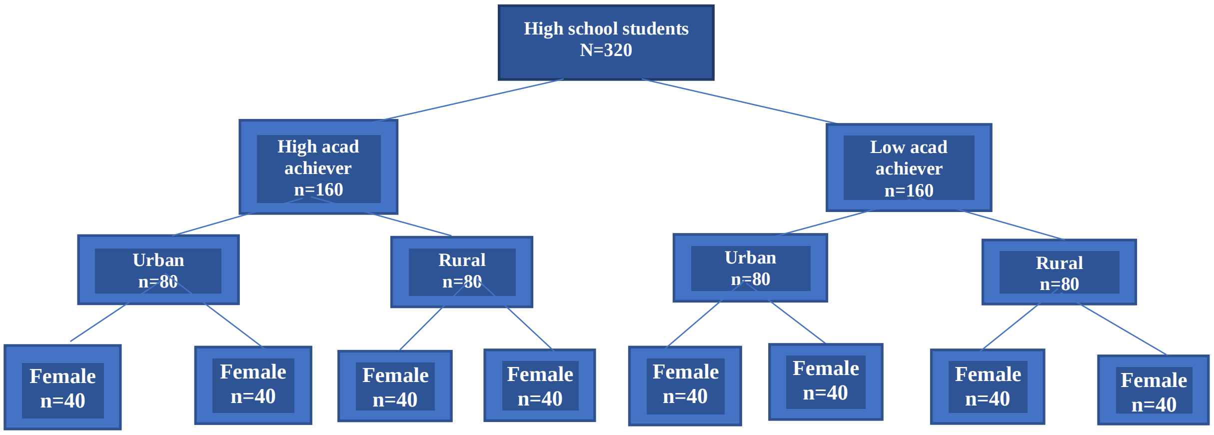
x. *Recognition*- Visual & verbal memory is the cognitive area assessed. In this subtest, there are two cards of similar size. One for having pictures of 10 common objects and the second for having pictures of 20 common objects for recognition. Each object correctly identified and named is given a score of one. An object correctly identified but either not named or wrongly named or showing inability to name is to be given a score of ½. To minimize the effect of guessing numbers of wrongly identified objects are to be counted and deducted from the number of correctly identified objects. The range of scores in this subtest is 0 to 10.

It contains a set of 5 cards for the subtest XI i.e., Visual Retention Also contains a set of 2 cards for the subtest IX and X i.e., Visual Recognition and Delayed Visual Recognition. In one set of cards, contains pictures of 10 common objects and the second set of cards contains pictures of 20 common objects. Normally it takes 15-20 minutes for its administration. The scoring was done using mean and standard deviation for the whole study sample (irrespective of age) to maintain the homogeneity of the sample scores. After scoring each subtest, the scores were added to the total score of the full test. The maximum possible score for the full test was 115. The tool was a standardized one. It was found to have a correlation of .71 with the Boston Memory Scale and .85 with the Wechsler Memory Scale. The test-retest method was used to assess the internal consistency which reached a satisfactory reliability score of r = 0.86. A specimen copy of PGI-MS may be seen at Appendix-III

Design of the study

The design of this study was 2 x 2 x 2 factorial designs (2 gender x 2 ecology x 2 levels of academic achievement) having 8 groups under study, and each cell has equally matched its representation: 320 high school students [160 High academic achievers {80 Urban (40 male and 40 female) and 80 rural (40 male and 40 female)} and 160 Low academic achievers {Urban (40 male and 40 female) and 80 rural (40 male and 40female}] were served as the sample in the study.

Fig-4: Diagram of sample characteristics (2 x 2 x2 factorial designs)



Data collection procedure:

The study starts with the identification and selection of samples as per objectives. Procurement of necessary permission from school authorities was taken for the study. After the samples were identified, necessary permission was taken, and oral and written informed consent was procured from each study sample. The benefits of the study were explained to all the study participants. Clearly explained that the participants may withdraw from the study at any time without any penalty. Assurance was given to the participants that confidentiality would be maintained throughout the study. The participants were clearly informed about what they had to perform during the conduction of the scale. The demographic questionnaire was administered to all participants and assisted in the identification of confounding variables that could affect the data. The administration of the PGI-MS was done to the selected samples with due care of instructions as given in the manual and APA research Ethical Code (2002). To ascertain different types of memories, the P.G.I Memory Scale was used. It contains 10 subtests. Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed recall, Immediate recall, Retention for similar pairs, Retention for dissimilar pairs, Visual Retention and Recognition (Appendix-II). Each student was tested individually in a well-illuminated quiet room at the participating school. The essential items required for the test were placed on the table before calling the participants into the room. The participant was called in and was made comfortable and rapport was established. A casual conversation was started and also motivated to do their best without any unnecessary pressure for each participant. The researcher made sure that the participants understood the test and after the necessary instructions were given and understood by the participant, the test began. The procedure was repeated for each student.

Statistical Analysis:

Subject-wise scores on PGI-Memory Scale/subscales were separately prepared and analysed to check their psychometric adequacy for measurement purposes among High school students.

The data was analyzed using IBM's Statistical Package for the Social Sciences (SPSS 26).

Firstly, the psychometric adequacy of the memory battery tests was analyzed and found Cronbach alpha and split-half reliability coefficient (of the subscales and full scales) and inter-scale relationships relate to the constructs in the targeted population and employed for the present study for the collection of data.

Secondly, the mean values were calculated for comparison of the test scores between the groups, and the Skewness and Kurtosis of the sub-scales to check the nature of the data distributions for further analysis. Levene's tests of homogeneity of variance and Browne- Forsythe Robust test of equality of variances were employed for choosing appropriate statistics; resulted showed non-parametric statistics may be used for further analysis.

Thirdly, Correlation was calculated to determine the relationship between the variables for the samples and for that Spearman correlation was employed.

Fourthly, 2x2x2 factorial design with Kruskal-Wallis H statistics was employed to examine the independent and interaction effects of the level of academic achievement, ecology, and gender on the dependent variables. Also, since the PGI-Memory Scale is a verbal test and performance test and violated assumptions for parametric tests, a non-parametric test i.e., Kruskal - Wallis H tests was employed to evaluate the differences between the different comparison groups on the memory variables.

To portray the result to be easier to understand, diagrams and graphs were used when appropriate to display and outline the general nature of the participants among the groups on the measures.

Results of the present study were presented in the next ***Chapter V Results and Discussions.***

Results and Discussion

The Present study entitled *"Memory Profiles of High School Students in Mizoram"* aimed to create a memory profile for high school students using a single battery of memory tests which will yield a more comprehensive assessment of memory performance related to academic achievement along with gender and ecology level differences. The study focuses on the differences in memory ability related to **academic achievement (high** and **low academic achiever)**, **ecology** (**rural** and **urban**), and **gender** (**males** and **females**) and to determine the independent effect and interaction effect of **'levels of academic achievement'** (**high** and **low academic achiever), 'gender'** (**males** and **females),** and **'ecology'** (**rural** and **urban**) on sub-scales of PGI-Memory Scales (PGIMS; Pershad & Wig, 1977) namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition among the target population.

It was hypothesised that (i) higher scores in high-level academic achievers than low-academic achievers on Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition with a significant difference level. It was also hypothesised that (ii) higher scores in urban students than rural students on Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition with a significant difference level. It was predicted that (iii) higher scores in Females than males in Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition with a significant difference level. It was expected that a positive significant correlation between the dependent variables (Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition). It was expected that a significant independent effect of **'Level of**

academic Achievement', 'Ecology', and **'Gender'** on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition) among the samples. It was expected significant interaction effect of '**ecology** x **gender**', '**gender** x **level of academic achievement**', and '**ecology** x **level of academic achievement**' on the dependent variables among the samples.

The study comprised 320 High School students of Mizoram (aged 16 years to 19 years) with equal representation of the '**level of academic achievement**', '**ecology**', and '**gender**' selected through random sampling procedures. The sample identification was done in a multi-stage sampling procedure. More than 600 representatives of Low and High academic achievers were selected from the examinations of the last three years (2020, 2021, and 2022 Annual Examinations) from the examination result books maintained by the schools from different parts of Mizoram. High academic achieves were students who scored continuously higher than 80% marks, and Low academic achievers were who scored lower than 50% marks in their last three years' examination results. The equal representatives of '**level of academic achievement**' (High academic achiever and Low academic achiever), '**ecology**' (**urban** and **rural**), and '**gender**' (**males** and **females**) were attempted, comprises of 320 school students [*160 High academic achievers {80 Urban (40 Males and 40 Females){ and 80 Rural (40 Males and 40 Females)} and 160 Low academic achievers{80 Urban (40 Males and 40 Females) and 80 Rural (40 Males and 40 Females)}]* selected using *a* random method of sample selection, the extraneous variable which may include socio-demographic variables (SES status, types of school, substance use, etc.) was kept under control.

The design of this study was 2 x 2 x 2 factorial designs (2 gender x 2 ecology x 2 levels of academic achievement) having 8 groups under study, and each cell has equally matched its representation: 320 high school students [160 High academic achievers {80 Urban (40 male and 40 female) and 80 rural (40 male and 40 female)} and 160 Low academic achievers {Urban (40 male and 40 female) and 80 rural (40 male and 40female}] were served as the sample in the study.

Demographic Questionnaire and The PGI-Memory Scale (PGI-MS; Pershad

& Wig, 1977) were employed for the assessment of memory performance of the samples, all prescribed instructions are given in the manuals and APA guidelines for research were followed.

Sample Characteristics

The sample was categorized based on academic achievement, i.e. 160 High academic achievers were students who scored continuously higher than 80% marks, and 160 Low academic achievers scored lower than 50% marks in their last three years' examination results in the Figure 1-4. Each of these two groups consisted of 80 rural students and 80 urban students, again equally categorised based on their gender into 40 males and 40 females for both urban and rural.

Figure-5: *Distribution of samples into levels of academic achievement*

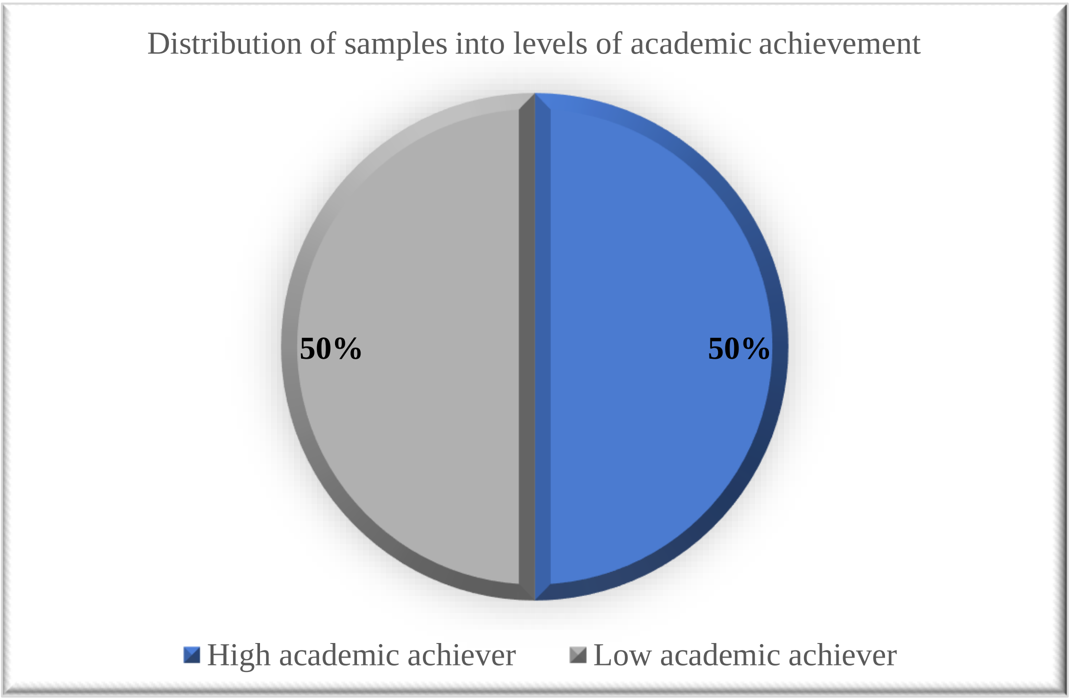


Figure-6: *Ecology Distribution of samples*

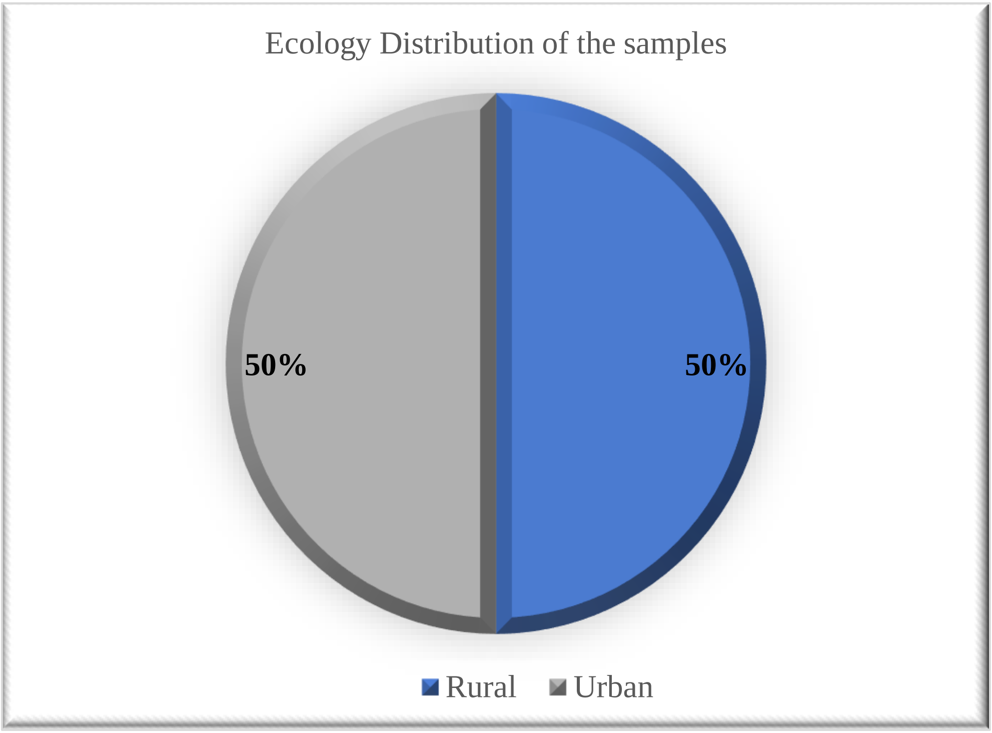


Figure-7: *Gender Distribution of the samples*

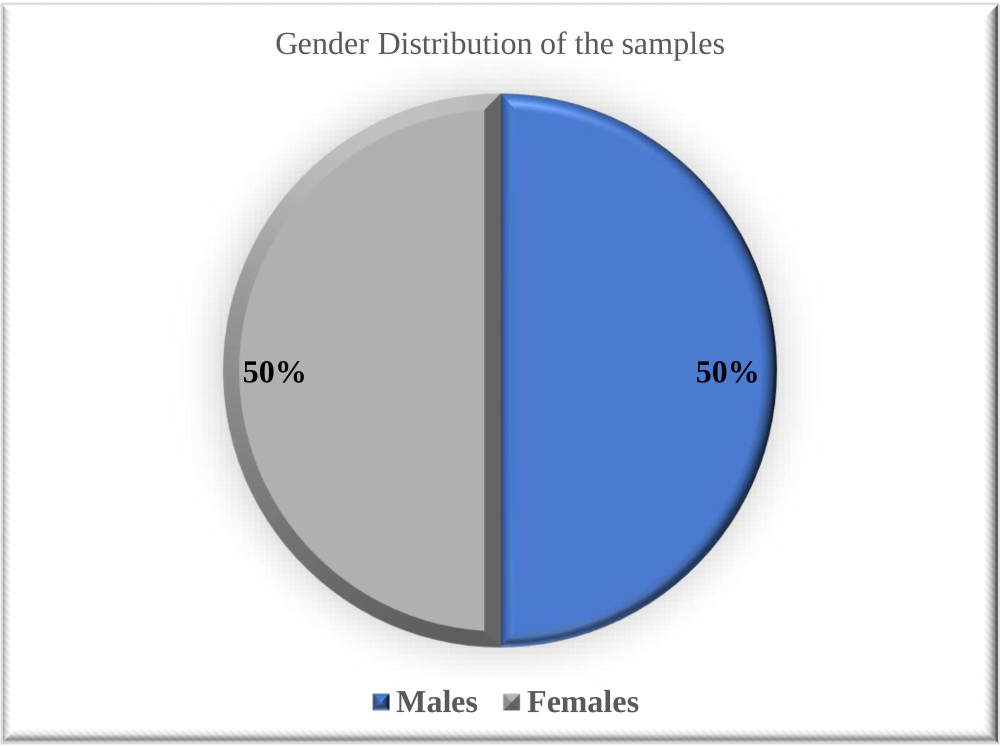
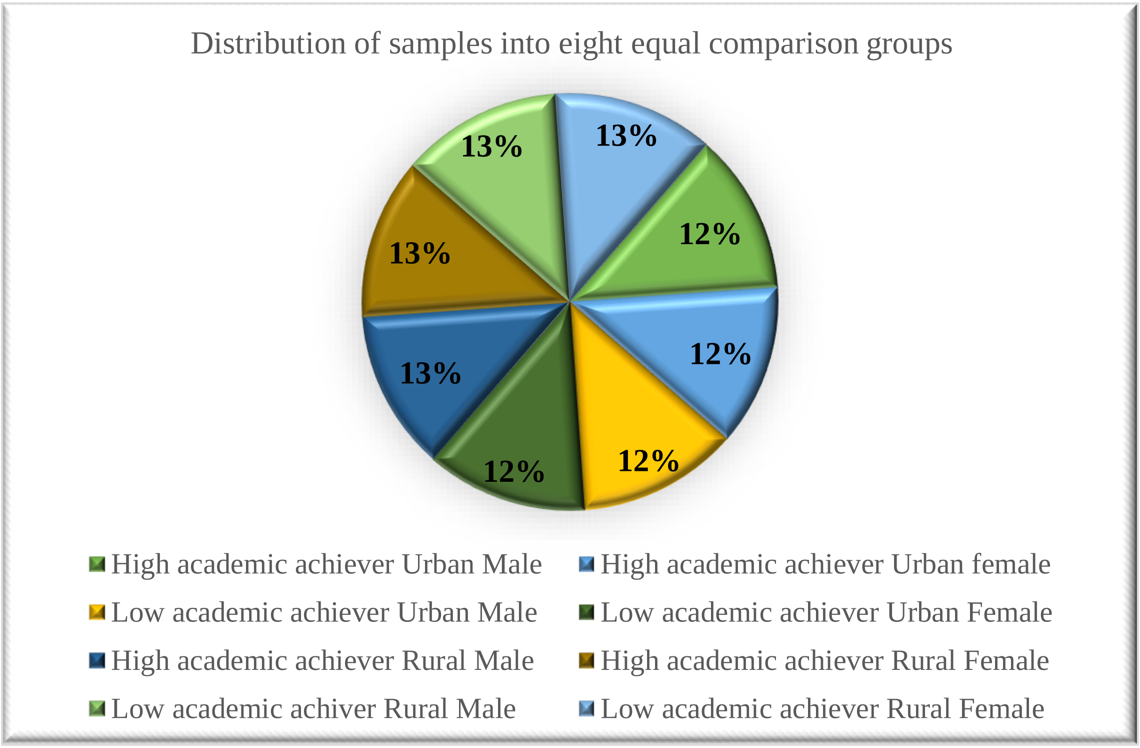


Figure-8: *Distribution of samples into eight equal comparison groups*



Subject-wise scores on subscales of the PGI-Memory Scales- remote, recent memory, mental balance, digit span- attention and concentration, Immediate recall, delayed, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition were prepared for the whole samples, High Academic achiever Urban Male (HAUM), High Academic achiever Urban Female (HAUF), High Academic achiever Rural Male (HARM), High Academic achiever Rural Female (HARF), Low Academic achiever Urban Male (LAUM), Low Academic achiever Urban Female (LAUF), Low Academic achiever Rural Male (LARM), Low Academic achiever Rural Female (LARF),

Results Analysis of the present study was done in a phased manner:

1) Checking of missing raw data and outliers,

2) Psychometric properties of PGI-Memory Scales/Subscales for the samples

3) Comparison of Mean scores of the samples on dependent variables (Mean, SD, and Mann-Whitney U test)

4) Relationship between the dependent variables (Spearman correlation)

5) Interaction effect and Kruskal Wallis H analysis of variance

1) **Checking of missing raw data and outlier**

The raw data set was checked for missing raw data and extreme outliers. Since there were outliers, further analysis was carried on.

2) **Psychometric properties of PGI-Memory Scales/Subscales for the samples**

Although PGI-Memory Scale for Adults developed by Prashad and Wig (1988) was developed for adults with age norms for an age range from 20-69 years of age whereas the PGI-Memory Scale for Children developed by Kohli et al (1998) has age norms between 7-14 years of age, and no separate scale for adolescents in between the two scales. As such, PGI-Memory Scale for adults has been used for adolescents in earlier research to study memory functions (Gajre et al., 2008; Joshi & Arya, 2017; Sharma et al., 2018; Shenoy et al., 2019). However, to ensure the applicability among adolescents of the targeted population pilot study was conducted and the results confirmed the applicability of the scale (Cronbach's Alpha ≥.60) on all the sub-scales of PGI-Memory Scales.

Psychometric analyses of the scales and subscales were done by employing Microsoft Office Excel 2013 and IBM's Statistical Package for the Social Sciences (SPSS 26). The psychological scales used in the present study were originally constructed for an adult population with age norms 20-69. Thus, before applying to the present study, it was thought needed to check the appropriateness and verify the trustworthiness of the scales for the population under study.

Accordingly, the reliabilities of all the subscales i.e., (i) Remote Memory, (ii) Recent Memory, (iii) Mental Balance, (iv) Attention and Concentration, (v) Delayed Recall, (vi) Immediate Recall (vii) Verbal Retention for Similar Pairs, (viii) Verbal Retention for Dissimilar Pairs (ix) Visual Retention and (x) Recognition in the present study were calculated using Cronbach's Alpha.

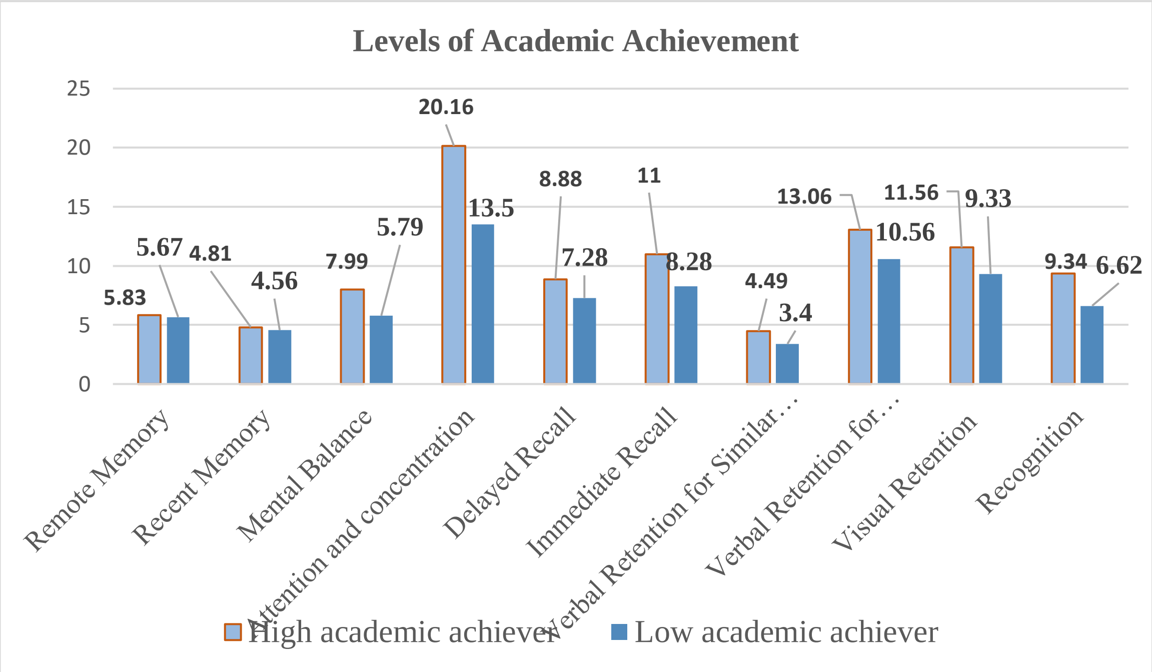
Psychometric Properties of the Scales

Table-1: *Showing Mean, SD, and Reliability of PGI-Memory Scales/Subscales for the samples*

Subscales	*M*	*SD*	Reliability	N of item
Remote Memory	1.28	1.36	.60	6
Recent Memory	.95	1.28	.66	5
Mental Balance	6.90	1.88	.71	3
Attention and Concentration	13.85	5.29	.71	10
Delayed Recall	8.09	1.76	.60	10
Immediate Recall	9.65	2.10	.76	3
Verbal Retention for Similar Pairs	22.84	3.31	.63	5
Verbal Retention for Dissimilar Pairs	11.81	2.34	.61	15
Visual Retention	10.45	1.81	.61	5
Recognition	7.99	4.69	.73	10

Table-1 shows the reliability of the ten subscales of PGI-Memory Scales (PGIMS). The internal consistency of the scales was calculated using Cronbach's Alpha and all the scales and subscales were found to be highly reliable (Table 1). The Remote Memory consists of 6 items (α = .60), Recent Memory subscale consists of 5 items (α = .66), Mental Balance subscale consists of 3 items (α = .71), the Attention and Concentration subscale consists of 10 items (α = .71), Delayed Recall subscale consists of 10 items (α = .60), Immediate Recall subscale consists of 3 items (α = .76), Verbal Retention for Similar Pairs subscale consists of 5 items (α = .63), Verbal Retention for Dissimilar Pairs subscale consists of 15 items (α = .61), Visual Retention subscale consists of 5 items (α = .61), and Recognition subscale consists of 10 items (α = .73) respectively of the PGIMS appeared to have good internal consistency. The tool was considered reliable and hence, was used in this study.

Figure-9: *Mean comparison between High and Low academic achievers on PGI-Memory scales (Sub-scales)*



Note: The graph shows the mean comparison of Levels of academic achievement (High and Low academic achievers) on the ten subscales of PGI-Memory Scales.

Table-2 showing Mean comparison between the group- **high academic achievers** and **low academic achievers** were calculated and **high academic achievers** are showing higher scores than **low academic achievers** on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition. A visual representation of Mean comparison between the group- **high academic achievers** and **low academic achievers** is depicted in **Figure- 9.**

Results show that **high academic achievers** have a higher level of memory performance than **low academic achievers**. These findings confirmed the first hypothesis set forth for the study that It was expected that (i) **higher scores** in **high-level academic achievers** than **low-academic achievers**. These results corresponded to the findings of the previous researcher that the substantial association between memory and achievement (Dean, 2006; Kane et al., 2007; Rabiner, 2016; Lamba, 2014; Podila, 2019). This finding is in agreement with the findings of Zhou and colleagues (2020) investigated the links between cognition and outcomes in school and discovered that cognition is closely related to academic achievement. Also in line with the study of John and Jaquith (1996), Abraham and colleagues (2016) and El-Mir (2019) who found that several memory functions, including working memory (WM), short-term memory (STM), and long-term memory (LTM), affect academic achievement and based on the findings that working memory capacity conditioned achievement in word recognition and reading comprehension in language and concluded that measurements of working memory might be used to predict performance in various cognitive tasks, such as reading and also, Rabiner (2016) found the relationship between academic achievement and attention difficulties, which suggests that attention issues frequently have a serious negative impact on student's academic achievement. The findings is also in line with Dolgova and associates (2020) who studied the relationship between memory properties and the academic performance of college students and found that most college students have high and medium memory properties, which means that the indicators of the memory properties and academic performance of college students are correlated and according to their findings, there is a relationship between the level of memory development and the success of educational activities.

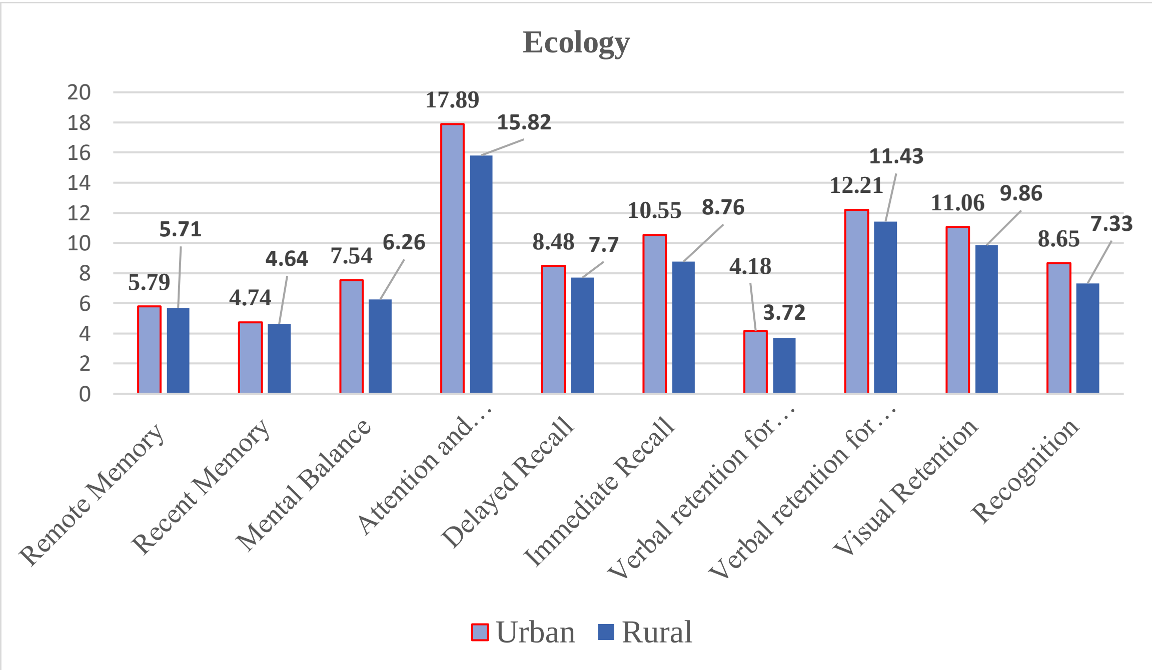
This current study has been able to show that memory ability is a significant factor with respect to student achievement among Mizo High School students. From the current findings, raising students' levels of academic achievement would need them to improve their auditory and visual processing. As a result, working memory is found to be crucial for verbal reasoning and literary comprehension as noted by Baddeley and Hitch (Baddeley & Hitch, 1974).

Baddeley and Hitch Model (1974) suggested that working memory plays a vital part in verbal reasoning and prose comprehension and in addition, Working Memory's ability predicts academic success (Baddeley & Hitch, 1974). Earlier studies showed that working memory was found to be strongly related to academic success and to measures of reading, writing, spelling, mental arithmetic, measurement and spatial abilities, and computational scores in both typical and atypical school-going children (Margolin, 1984; Caramazza et al., 1987; Berninger & Swanson, 1994;

Swanson & Sachse-Lee, 2001; DeStefano & LeFevre, 2004; Swanson et al., 2004; Alloway & Copello, 2013).

In accordance with previous findings, overall memory performance was significantly higher among high academic achievers in the current study as compared to low academic achievers, indicating that high academic achievers had better memory capacity as compared to low academic achievers. These findings imply that many children who struggle to pay attention will also struggle in academics. Thus, the results of this study found implications that individuals with memory deficits may show significantly lower academic performance. As a result, earlier comprehensive memory screenings are necessary to understand the strengths and weaknesses of children's memory skills that may assist professionals working with children to improve instructional planning, programming decisions, treatment recommendations, and accommodations to benefit their academic success.

Figure-10: *Mean comparison between Rural and Urban on PGI-Memory Scales (Sub-Scales)*



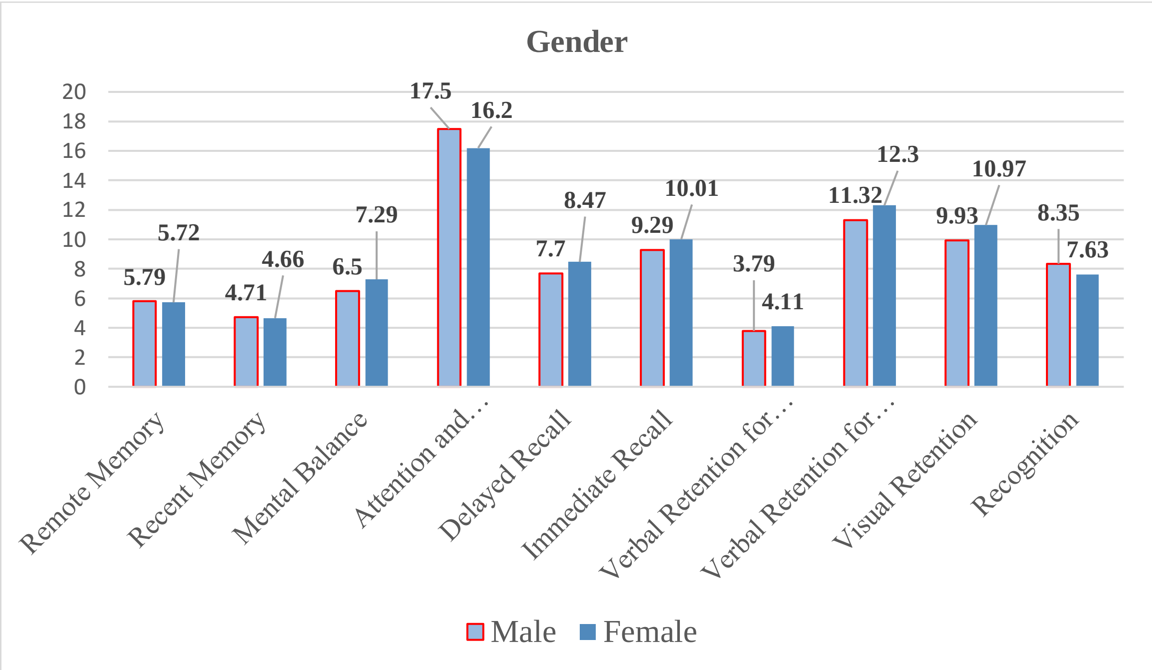
Note: The graph shows the mean comparison of Ecology (Rural and Urban) on the ten subscales of PGI-Memory Scales.

Table 3 showing Mean comparison between **urban** and **rural** was calculated and **urban** are showing higher scores on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition. These findings confirmed the first hypothesis set forth for the study that It was expected that (ii) **higher scores in urban students than rural students'**. The current findings was supported by Wang et al (2019), Alspaugh and Harting (1995), Haller and colleagues (1993), Jones and Ezeife (2011), and Sumi and colleagues (2021) who suggested that students in rural schools had lower scores in cognitive performance as compared to students in urban schools. Furthermore, the current study provides strong support for the hypothesis that students in rural performed lower in memory tasks than students in urban. The conclusions drawn from this perspective suggested that student achievement levels are significantly different with respect to urban and rural. A visual representation of Mean comparison between the group- **urban** and **rural** is depicted in **Figure- 10.**

The possible explanation for the difference in memory ability between urban and rural students is that residence in the city or the countryside might influence the strength of location differences in cognitive abilities. City life requires cognitive functions that are different from those necessary for daily life in remote rural villages. In the city, for example, individuals are frequently confronted with the need to read and calculate. This is less likely to be the case in remote areas of the countryside, where communication occurs less frequently through the printed word and the economy relies on bartering rather than on monetary transactions. Depending upon parental expectations and the duties assigned to children, the demands made on the cognitive abilities of boys and girls in the two environments may differ (Stevenson et al., 1990). Therefore, cognitive stimulation on cognitive may lead to improved memory ability (Bonnechère et al., 2021).

The current findings highlighted the significant role of memory abilities in academic performance and explored the differences in memory abilities between urban and rural students. Based on the aforementioned findings, it is proposed by prior research that early identification of cognitive deficits among students and the implementation of strategies to improve cognitive ability might improve students' overall development and hence support improved academic performance (Zhang et al., 2022). Therefore, the teachers, educators, and school authorities, especially at the High School level of Education; are suggested to offer more exposure and stimulating environments to students belonging to rural backgrounds. The study examined for the first time the rural-urban disparity among High school level school students on the dimensions of memory abilities, especially in north-east India. Results show that the mean comparison between urban and rural, urban scores higher than rural on all the PGI-Memory Scale sub-scales namely- Remote memory, Recent memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition.

Figure-11: *Mean comparison between Males and Females on PGI-Memory Scales (Sub-Scales)*



Note: The graph shows the mean comparison of Gender (Males and Females) on the ten subscales of PGI-Memory Scales.

Table 4 showing Mean comparison between **males** and **females** on each dependent variable and results showed that males were showing higher scores than females on Recent Memory, Remote Memory, Attention, and Concentration, and Recognition whereas, females were showing higher scores than their male counterparts on Mental Balance, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs and Visual Retention on PGIMS. A visual representation of Mean comparison between the group- **Males** and **Females** depicted in **Figure- 11.**

Results suggested that Female seems to perform better on Verbal memory task as compared to Males in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first hypothesis "It was expected that **(iii) higher scores in Females than males"** was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al., 2017). In contrast to our findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

The findings also revealed that there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females and are in confirmatory to the statement that the principle for understanding gender differences in memory, males and females do not differ in overall memory ability (Maccoby & Jacklin, 1974). Likewise, previous studies found Working Memory and academic achievement were found to be equal in both males and females with no gender differences. (Aliotti & Rajabiun, 1991; Forrester & Geffen, 1991; Ullman et al.,1997; Tariq & Noor, 2012)

The current findings revealed that females perform better than males in the Verbal Retention task, which had interesting gender-related results. This was also consistent with the findings of Loftus and colleagues (1987) where in gender differences in verbal memory suggest a clear pattern: Females, whether adults or children, appear to do better on tasks involving which is consistent with previous studies that female participants outperformed their male counterparts in the verbal test (Temple & Cornish, 1993; Huang, 1993; Murre et al., 2013; Chan & Abu Bakar, 2021).

Likewise, Herlitz and Rehnman (2008) also suggest women may have a minor, general episodic-memory advantage, which can be augmented by the advantage women have over men in verbal production and negated by the male advantage in visuospatial tasks. The advantage that women have in auditory episodic memory may be explained by their advantage in verbal abilities and recall seems to be highly correlated with verbal ability (Daneman & Carpenter, 1983; Pauls et al., 2013). In addition, the potential sex differences in memory function, which extend to various memory domains, such as autobiographical memories, semantic memory, and memory recognition. Potential sex differences in memory are likely attributed to a multitude of factors, including various psychological (e.g., different processing strategies and learning strategies) and physiological parameters (e.g., brain structure, hormonal, and neurotransmitter differences) (Loprinzi & Frith, 2018). According to Adyalkar (2019), females have better short-term memory than men in terms of recall on the word recall test. In contrast to the current findings, Forrester and Geffen (1991) found no gender differences in verbal learning tasks.

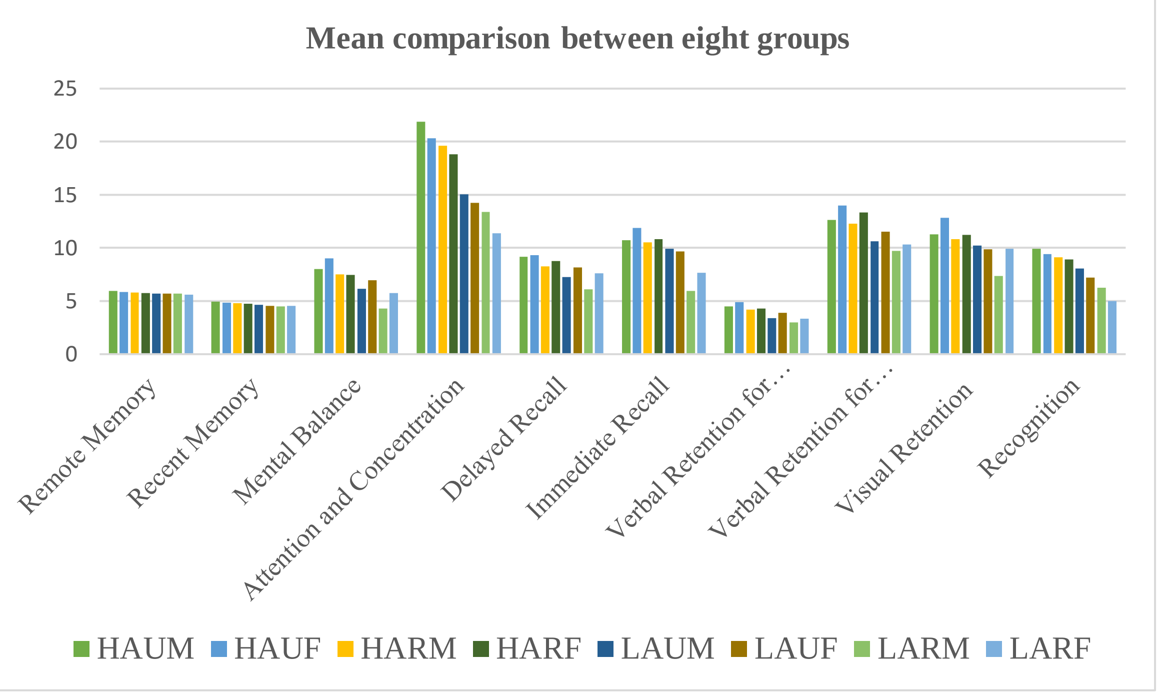
These findings also revealed that males outperformed females on Recognition task which is consistent with earlier studies by Lowe (2003), and this may be due to that men's superior visual memory performance has been determined to be due to their better visuospatial abilities (Loftus et al., 1987; Huang, 1993; Pauls et al., 2013). However, according to Temple and Cornish (1993) findings as well as Bridge (2006) findings from two recognition experiments that used graphically presented travel photographs to test memory function, the results for both genders (males and females) are largely identical. In contrast, Heisz and his colleagues (2013) found that females outperformed males on recognition-memory tests, and this advantage was directly related to females' scanning behavior at encoding.

Whether there are gender differences in memory performance was one of the current key study topics. The findings from this study substantially indicate the presence of such variations. Nevertheless, females do not perform better than males in all of the PGI-Memory sales subscales. There were no statistically significant differences between males and females on the measures of remote memory, recent memory, and attention and concentration. Females did, however, perform better than males in most of the subscales in the areas of delayed recall, immediate recall, Verbal

Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, and Visual Retention.

Table 5 showing Mean comparison between eight (8) groups- High Academic Achiever Urban Male (HAUM), High Academic Achiever Urban Female (HAUF), High Academic Achiever Rural Male (HARM), High Academic Achiever Rural Female (HARF), Low Academic Achiever Urban Male (LAUM), Low Academic Achiever Urban Female (LAUF), Low Academic Achiever Rural Male (LARM), Low Academic Achiever Rural Female (LARF) was calculated and High academic achiever Urban Male (HAUM) was showing highest scores compared to all the other seven groups HAUF, HARM, HARF, LAUM, LAUF, LARM and LARF on remote memory, Recent Memory, Attention, and Concentration and Recognition. Whereas, High Academic Achiever Urban Female (HAUF) scores the highest compared to all the other seven groups HAUM, HARM, HARF, LAUM, LAUF, LARM, and LARF on Mental Balance, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, and Visual Retention.

Figure-12: *Mean comparison between eight groups: High Academic Achiever Urban Male (HAUM), High Academic Achiever Urban Male (HAUF), High Academic Achiever Rural Male (HARM), High Academic Achiever Rural Female (HARF), Low Academic achiever Urban Male (LAUM), Low Academic achiever Urban Female (LAUF), Low Academic achiever Rural Male (LARM), Low Academic achiever Rural Female (LARF) on PGI-Memory scale (Subscales)*



Note: The graph shows the mean comparison of eight groups (HAUM, HAUF, HARM, HARF, LAUM, LAUF, LARM, and LARF) on the ten subscales of PGI-Memory Scales.

2) Mann Whitney *U* Test for measures of differences between the comparison groups on the dependent variables

Analysis of data was done to evaluate the differences and independent effect between the different comparison groups on the dependent variables as mentioned in ***Hypothesis – 1*** of the present study that there would be significantly (i) **higher scores in high-level academic achievers than low-academic achievers**, (ii) **higher scores in Urban students than Rural students**, (iii) and **higher scores in Females than males** on remote memory, recent memory, mental balance, digit span- attention and concentration, Immediate recall, delayed, retention for similar pairs, retention for dissimilar pairs, visual retention, and recognition and ***Hypothesis - 3:*** 'It was expected that a significant independent effect of 'level of academic Achievement', 'ecology', and 'gender' on the dependent variables (RM, REM, MB, A&C, IR, DR, RSP, RDP, VR, and RG) among the samples.

In Table- 6, A Mann-Whitney U test was performed to evaluate whether **high academic achievers** and **low academic achievers** differed on the ten subscales of PGI-Memory Scales. The results revealed that **high academic achievers** had significantly higher scores than **low academic achievers** on all the 10 subscales of PGI-Memory Scales. High academic achiever scores were significantly higher in the Remote memory (Mean Rank = 173.17) than low academic achiever (Mean Rank = 147.67) at $p < 0.01$ level with small effect ($U = 10760.00$; $z = -3.30$; $p < 0.01$; $r = 0.18$), High academic achiever scores were significantly higher in the Recent Memory (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with a small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; $r = 0.23$), High academic achiever scores were significantly higher in the Mental Balance (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; r = 0.23), High academic achiever scores were significantly higher in the Attention and concentration (Mean Rank = 213.32) compared to low academic achiever (Mean Rank = 107.01) at $p < 0.01$ level with large effect ($U = 17015.00$; $z = -10.46$; $p < 0.01$; $r = 0.58$), High academic achiever scores were significantly higher in the Delayed Recall (Mean Rank = 219.26) compared to low academic achiever (Mean Rank = 101.00) at $p < 0.01$ level with large effect ($U = 3338.50$; $z = -11.45$; $p < 0.01$; $r = 0.64$), High academic achiever scores were significantly higher in the Immediate Recall (Mean Rank = 201.81) compared to low academic achiever (Mean Rank = 118.67) at $p < 0.01$ level with medium effect ($U = 6148.00$; $z = -8.20$; $p < 0.01$; $r = 0.45$), High academic achiever scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 209.27) compared to low academic achiever (Mean Rank = 111.12) at $p < 0.01$ level with large effect ($U = 4948.00$; $z = -9.58$; $p < 0.01$; $r = 0.65$), High academic achiever scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank = 219.51) compared to low academic achiever (Mean Rank = 100.75) at $p < 0.01$ level with large effect ($U = 3299.00$; $z = -11.66$; $p < 0.01$; $r = 0.53$), High academic achiever scores were significantly higher in the Visual Retention (Mean Rank = 217.71) compared to low academic achiever (Mean Rank = 102.57) at $p < 0.01$ level with large effect ($U = 3588.50$; $z = -11.35$; $p < 0.01$; $r = 0.63$), High academic achiever scores were significantly higher in the Recognition (Mean Rank = 219.19) compared to low academic achiever (Mean Rank = 101.07) at $p < 0.01$ level with large effect ($U = 3350.50$; $z = -11.77$; $p < 0.01$; $r = 0.66$).

From the current findings, in ‘levels of academic achievement’, high academic achiever scores were significantly higher as compared to low Academic Achiever in Remote memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively. This confirmed the First and third hypothesis set forth for the study that ‘It was expected that (i) higher scores in high-level academic achievers than low-academic achievers’ was in accordance with the study and was supported. This finding was supported by earlier studies that discovered a very substantial association between memory and achievement supported this conclusion (John & Jaquith, 1996; Kulp et al., 2002; Rabiner, 2004; Dean, 2006; Lamba, 2014; Podila, 2019; Quílez-Robres et al., 2021).

In **Table 7**, A Mann-Whitney U test was performed to evaluate whether **Urban** and **Rural** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **Urban** and **Rural** in which **Urban** had significantly higher scores than **Rural** on 8 subscales of PGI-Memory Scales. This confirmed the First and third hypotheses set forth for the study that (ii) higher scores in **Urban** students than **Rural** students. In Remote memory there was no significant difference between Urban (Mean Rank = 166.79) and Rural (Mean Rank = 154.29), (U = 11799.00; z = -1.62; p = 0.11; r = 0.09), and Recent Memory between Urban (Mean Rank= 167.00) compared to Rural (Mean Rank = 154.08), (U = 11766.00; z = -1.59; p = 0.11; r = 0.08). Urban scores were significantly higher in the Mental Balance (Mean Rank = 192.55) compared to Rural (Mean Rank = 128.85) at p<0.01 level with medium effect (U = 7704.00; z = -6.27; p <0.01; r = 0.35), Urban scores were significantly higher in the Attention and Concentration (Mean Rank = 177.03) compared to Rural (Mean Rank = 144.18) at p < 0.01 level with small effect (U = 10171.50; z = -3.18; p < 0.01; r = 0.17), Urban were significantly higher in the Delayed Recall (Mean Rank = 179.77) compared to Rural (Mean Rank = 141.47) at p < 0.01 level with small effect (U = 9735.50; z = -3.78; p < 0.01; r = 0.21), Urban scores were significantly higher in the Immediate Recall (Mean Rank = 196.81) compared to Rural (Mean Rank = 124.65) at p < 0.01 level with medium effect (U = 7027.00; z = -7.80; p < 0.01; r = 0.39), Urban scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 176.96) compared to Rural (Mean Rank = 144.24) at p <

0.01 level with small effect (*U* = 10182.00; *z* = -3.19; *p* < 0.01; *r* = 0.17), Urban scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank = 179.36) compared to Rural (Mean Rank = 141.88) at *p* < 0.01 level with small effect (*U* = 9801.00; *z* = -3.81; *p* < 0.01; *r* = 0.21), Urban scores were significantly higher in the Visual Retention (Mean Rank = 188.52) compared to Rural (Mean Rank = 132.83) at *p* < 0.01 level with medium effect (*U* = 8344.00; *z* = -11.35; *p* < 0.01; *r* = 0.30), Urban scores were significantly higher in the Recognition (Mean Rank = 186.55) compared to Rural (Mean Rank = 134.77) at *p* < 0.01 level with small effect (*U* = 8657.00; *z* = -5.16; *p* <0.01; *r* = 0.28).

In ecology, there was a significant difference between urban and rural in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition. However, there was no significant difference between urban and rural in Remote memory and Recent Memory. Thus, the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students' was in accordance with the study and was supported. The finding was supported by Alspaugh (1992), Alspaugh and Harting (1995), and Haller et al (1993) research and found that students in rural schools had lower scores in memory performance as compared to students in urban schools.

In Table 8, A Mann-Whitney U test was performed to evaluate whether **males** and **females** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **males** and **females** in which **females** had significantly higher scores than **males** on 6 subscales of PGI-Memory Scales. This confirmed the first and third hypotheses set forth for the study that (iii) higher scores in females than males students. There was no significant difference in Remote memory between males (Mean Rank = 165.79) and females (Mean Rank =155.28) at *p* < 0.01 level (*U* = 11959.00; *z* = -1.36; *p* = 0.17; *r* = 0.07). There was no significant difference in Recent Memory between males (Mean Rank = 163.78) compared to females (Mean Rank = 157.26) at *p* < 0.01 level (*U* = 12278.00; *z* = -0.80; *p* = 0.42; *r* = 0.04). There was no significant difference in Attention and concentration Between males (Mean Rank = 169.88) compared to females (Mean Rank = 151.24) at *p* < 0.05 level (*U*= 11308.00; *z* = -1.81; *p* = 0.07; *r* = 0.10). Females scores were significantly higher in the Mental Balance (Mean Rank = 180.23) compared to males (Mean Rank = 140.52) at $p < 0.01$ level with a small effect ($U = 9622.50$; $z = -3.91$; $p < 0.01$; $r = 0.21$), females were significantly higher in the Delayed Recall (Mean Rank = 178.05) compared to males (Mean Rank = 142.73) at $p < 0.01$ level with a small effect ($U = 9974.50$; $z = -3.48$; $p < 0.01$; $r = 0.19$), females scores were significantly higher in the Immediate Recall (Mean Rank = 174.04) compared to males (Mean Rank = 146.79) at $p < 0.01$ level with a small effect ($U = 10620.00$; $z = -2.67$; $p < 0.01$; $r = 0.14$), females scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 174.38) compared to males (Mean Rank = 146.44) at $p < 0.01$ level with a small effect ($U = 10564.50$; $z = -2.84$; $p < 0.01$; $r = 0.15$), females scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank =180.76) compared to males (Mean Rank = 139.98) at $p < 0.01$ level with a small effect ($U = 9537.00$; $z = -3.98$; $p < 0.01$; $r = 0.22$), females scores were significantly higher in the Visual Retention (Mean Rank = 183.47) compared to males (Mean Rank = 137.24) at $p < 0.01$ level with a small effect ($U = 9101.50$; $z = -4.56$; $p < 0.01$; $r = 0.25$), males scores were significantly higher in the Recognition (Mean Rank = 175.28) compared to females (Mean Rank= 145.90) at $p < 0.01$ level with a small effect ($U = 10449.00$; $z = -2.93$; $p < 0.01$; $r = 0.16$).

Gender differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) significant differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first and third hypothesis "It was expected that (iii) higher scores in females than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al., 2017). In contrast to the present findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

3) Relationship between the dependent variables

Analysis of data was done to examine the relationship between dependent variables as mentioned in Hypothesis - 2 that 'A positive significant correlation was expected between the dependent variables (remote memory, recent memory, mental balance, Attention and concentration, Immediate recall, delayed recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition)', and the correlation between the dependent variables was calculated. **Spearman Correlation** was employed to determine the significant relationship between the dependent variables.

Results of the Spearman correlation in **Table- 9** revealed significant correlations among the dependent variables.

Remote Memory shows a significant positive relationship with Recent Memory (r = .13, p < .05), Mental Balance (r = .13, p < .05), Attention and Concentration (r = .15, p < .01), Delayed Recall (r = .11, p < .05), Immediate Recall at .01 level (r = .16, p < .01) and Recognition (r = .17, p < .01).

Recent Memory shows a significant positive relationship with Mental Balance (r = .22, p < .01), Attention and Concentration (r = .26, p < .01), Delayed Recall (r = .14, p < .05), Immediate Recall (r = .18, p < .01), Verbal Retention for Similar Pairs (r = .12, p < .01), Visual Retention (r = .25, p < .01) and Recognition (r = .12, p < .05) respectively.

Mental Balance shows a significant positive relationship with Attention and Concentration (r = .46, p < .01), Delayed Recall (r =.45, p = <.01), Immediate Recall (r =.59, p < .01); Verbal Retention for Similar Pairs (r= .421, p < .01), Verbal Retention for Dissimilar Pairs (r = .44; p > .01), Visual Retention (r = .52, p < .01) and Recognition (r = .41, p < .01) respectively.

Attention and Concentration show a significant positive relationship with Delayed Recall (r = .34, p = < .01), Immediate Recall (r = .51, p < .01), Verbal

Retention for Similar Pairs (r = .36, p < .01), Verbal Retention for Dissimilar Pairs (r = .43, p > .01), Visual Retention (r = .43, p > .01) and Recognition (r = .56, p > .01).

Delayed Recall showed a significant positive relationship with Immediate Recall (r = .50, p < .01), Verbal Retention for Similar Pairs (r = .32, p < .01), Verbal Retention for Dissimilar Pairs (r = .43, p < .01), Visual Retention (r = .41, p < .01) and Recognition (r = .33, p < .01) respectively.

Immediate Recall showed a significant positive relationship with Verbal Retention for Similar Pairs (r = .45, p < .01), Verbal Retention for Dissimilar Pairs (r = .48, p < .01), Visual Retention (r = .66, p < .01), and Recognition (r = .60, p < .01).

Verbal Retention for Similar Pairs showed a significant positive relationship with Verbal Retention for Dissimilar Pairs (r = .36, p < .01), Visual Retention (r = .47, p < .01), and Recognition (r = .35, p < .01).

Verbal Retention for Dissimilar Pairs showed a significant positive relationship with Visual Retention (r = .43, p < .01) and Recognition (r = .46, p < .01). Visual Retention showed a positive relationship with Recognition (r = .46, p < .01) respectively.

The highest significant positive correlation was found between Visual Retention and Immediate Recall (r = .66, p < .01)

The above findings confirmed the second hypothesis of the present study that there would be a significant positive correlation between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition). The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of Remote Memory, which was shown to have no significant correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no significant correlation with Visual Retention or Dissimilar Pairs. In support, Dr. Subash Raj (2016) examined the relationships between Hb Concentration and Remote Memory, Recent Memory, and Mental Balance, finding that it strongly affects Remote Memory and Mental Balance but not Recent Memory. Akhouri and Javed (2014) on the other hand, discovered a connection between the immediate, recent, and remote memories of patients with depression and anxiety and concluded that while immediate and recent memories are impaired in these individuals, remote memories are intact.

Yet according to Sreekanth and colleagues (2015) research, there is a strong correlation between visual memory (Drishta Smriti) and auditory memory (Shruta Smriti) in various phenotypes (Prakriti). Gupta and colleagues (2019) also discovered that alcoholics have significantly more cognitive impairment than controls in all PGI-Memory scale domains. According to Thapliyal and colleagues (2016), research on neurocognitive functioning, almost all memory-related functions—including mental balance, attention and concentration, delayed recall, verbal retention for dissimilar pairs, visual retention, and recognition, immediate recall, verbal retention for similar pairs, and visual retention—are dysfunctional among alcoholics, indicating that if one neurocognitive domain is impaired other domains are likely to be impaired.

4) Kruskal - Wallis H Test for measures of the interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement' on the dependent variables.

Since the data violated assumptions for parametric tests, a non-parametric test i.e., the Kruskal - Wallis H Test was calculated to examine any significant interaction between independent variables on dependent variables as mentioned in ***Hypothesis - 4***: 'There will be a significant interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

Kruskal – Wallis Analysis of variance indicated the interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement', and 'level of academic achievement x ecology x gender' on the dependent variables for the whole sample. Results of the independent samples Kruskal - Wallis H test are presented in **Table 10 – 13 b.**

Table-10: Showing interaction effect (Independent Samples Kruskal - Wallis H Test) of 'ecology' and 'gender' on the subscales of PGIMS among the samples.

Dependent Variables	ecology x gender	N	Mean Rank	χ 2	Df	*P*	*η2*
RM	Urban Male	80	172.00	4.876	3	.181	0.005
	Urban Female	80	162.00				
	Rural Male	80	160.00				
	Rural Female	80	148.00				
REM	Urban Male	80	174.33	4.279	3	.233	0.004
	Urban Female	80	160.16				
	Rural Male	80	153.76				
	Rural Female	80	153.76				
MB	Urban Male	80	165.49	55.783	3	.00**	0.16
	Urban Female	80	218.49				
	Rural Male	80	115.09				
	Rural Female	80	142.93				
A&C	Urban Male	80	185.18	12.211	3	.007*	0.02
	Urban Female	80	167.43				
	Rural Male	80	153.23				
	Rural Female	80	136.17				
DR	Urban Male	80	168.83	28.041	3	.00**	0.08
	Urban Female	80	190.93				
	Rural Male	80	117.31				
	Rural Female	80	164.94				
IR	Urban Male	80	183.48	58.747	3	.00**	0.18
	Urban Female	80	211.25				
	Rural Male	80	111.85				
	Rural Female	80	135.43				
VRSP	Urban Male	80	160.46	24.374	3	.00**	0.07
	Urban Female	80	199.28				
	Rural Male	80	133.86				
	Rural Female	80	148.40				
VRDP	Urban Male	80	153.32	26.470	3	.00**	0.07
	Urban Female	80	200.89				
	Rural Male	80	127.39				
	Rural Female	80	160.40				
VR	Urban Male	80	172.48	52.554	3	.00**	0.16
	Urban Female	80	205.39				
	Rural Male	80	103.48				
	Rural Female	80	160.65				
RG	Urban Male	80	205.36	37.629	3	.00**	0.11
	Urban Female	80	168.68				
	Rural Male	80	146.28				
	Rural Female	80	121.69				

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. RM= Remote Memory; REM= Recent Memory; MB= Mental Balance; AC= Attention and Concentration; DR= Delayed Recall; IR= Immediate Recall; VRSP= Verbal Retention for Similar Pairs; VRDP= Verbal Retention for Dissimilar Pairs; VRT= Visual Retention; RT= Recognition.

A Kruskal-Wallis H test (**table-10**) showed that across **'ecology x gender'** there was a statistically significant difference on **MB** between the mean rank of 165.49 (Urban Males), 218.49 (Urban Females), 115.09 (Rural Males) and 142.93 (Rural females) were significant, χ^2 (3) = 55.783, *p* = .000, on **A&C** between the mean rank of 185.18(Urban Males), 167.43 (Urban Females), 153.23 (Rural Males), and 136.17 (Rural females) were significant, $\chi2$ (3) = 12.211, *p* = .007, on **DR** between the mean rank score of 168.83 (Urban Males), 190.93 (Urban Females), 117.31 (Rural Males), and 164.94 (Rural females) were significant, $\chi2$ (3) = 28.041, *p* = .000, on **IR** between the mean rank score of 183.48 (Urban Males), 211.25 (Urban Females), 111.85 (Rural Males), and 135.43 (Rural females) were significant, $\chi2$ (3) = 58.747, *p* = .000, on **VRSP** among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 24.374, *p* = .000, with a mean rank score of 160.46 for Urban Males, 199.28 for Urban Females, 133.86 for Rural Males, and 148.40 for Rural females; on **VRDP** among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 26.470, *p* = .000, with a mean rank score of 153.32 for Urban Males, 200.89 for Urban Females, 127.39 for Rural Males, and 160.40 for Rural females; on **VR** among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 52.554, *p* = .000, with a mean rank score of 172.48 for Urban Males, 205.39 for Urban Females, 103.48 for Rural Males, and 160.65 for Rural females; on **RG** among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 37.629, *p* = .000, with a mean rank score of 205.36 for Urban Males, 168.68 for Urban Females, 146.28 for Rural Males, and 121.69 for Rural females.

'***Ecology***' and '***gender***' has a significant interaction effect with an effect size of 16% on Mental Balance; 2% on Attention and Concentration; 8% on Delayed Recall; 18% on Immediate Recall; 7% on Verbal Retention for Similar Pairs; 7% on Verbal Retention for Dissimilar Pairs; 16% on Visual Retention; 11% on Recognition respectively which accept the Forth Hypothesis.

A Kruskal-Wallis H test (**table – 11**) showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across '**gender x level of academic achievement**' i.e on **RM** among HAM, HAF, LAM and LAF, χ^2 (3) = 12.516, *p* = .006, with a mean rank score of 178.00 for HAM, 168.00 for HAF, 154.00 for LAM, and 142.00 for LAF; **REM** among HAM, HAF, LAM and

Table-11: Showing interaction effect (Independent Samples Kruskal - Wallis H Test) of 'gender' and 'level of academic achievement' on the subscales of The PGIMS for the samples.

Dependent Variables	gender x level of academic achievement	N	Mean Rank	χ 2	Df	*P*	*η2*
RM	HAM	80	178.00	12.516	3	.006*	0.02
	HAF	80	168.00				
	LAM	80	154.00				
	LAF	80	142.00				
REM	HAM	80	182.68	17.271	3	.001*	0.04
	HAF	80	171.01				
	LAM	80	145.41				
	LAF	80	142.90				
MB	HAM	80	200.19	128.321	3	.00**	0.39
	HAF	80	227.83				
	LAM	80	80.39				
	LAF	80	133.59				
A&C	HAM	80	229.27	136.800	3	.00**	0.42
	HAF	80	211.24				
	LAM	80	109.13				
	LAF	80	92.36				
DR	HAM	80	191.77	80.524	3	.00**	0.24
	HAF	80	211.93				
	LAM	80	94.37				
	LAF	80	143.94				
IR	HAM	80	196.15	142.564	3	.00**	0.44
	HAF	80	242.04				
	LAM	80	99.18				
	LAF	80	104.64				
VRSP	HAM	80	195.57	95.768	3	.00**	0.29
	HAF	80	217.85				
	LAM	80	98.75				
	LAF	80	129.83				
VRDP	HAM	80	182.34	108.065	3	.00**	0.33
	HAF	80	236.31				
	LAM	80	98.37				
	LAF	80	124.98				
VR	HAM	80	188.14	147.642	3	.00**	0.46
	HAF	80	246.82				
	LAM	80	87.82				
	LAF	80	119.23				
RG	HAM	80	231.57	145.248	3	.00**	0.45
	HAF	80	206.29				
	LAM	80	120.07				
	LAF	80	84.08				

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. HAM= High Academic Achiever Male; HAF= High Academic Achiever Female; LAM= Low Academic Achiever Male; LAF= Low Academic Achiever Female.

LAF, χ^2 (3) = 17.271, p = .001, with a mean rank score of 182.68 for HAM, 171.01 for HAF, 145.41 for LAM, and 142.90 for LAF; **MB** among HAM, HAF, LAM and LAF, χ^2 (3) = 128.321, p = .000, with a mean rank score of 200.19 for HAM, 227.83 for HAF, 80.39 for LAM, and 133.59 for LAF; on **A&C** among HAM, HAF, LAM and LAF, χ2 (3) = 136.800, p = .000, with a mean rank score of 229.27 for HAM, 211.24 for HAF, 109.13 for LAM, and 92.36 for LAF, on **DR** among HAM, HAF, LAM and LAF, χ^2 (3) = 80.524, p = .000, with a mean rank score of 191.77 for HAM, 211.93 for HAF, 94.37 for LAM, and 143.94 for LAF; **IM** among HAM, HAF, LAM and LAF, χ^2 (3) = 142.564, p = .000, with a mean rank score of 196.15 for HAM, 242.04 for HAF, 99.18 for LAM, and 104.64 for LAF; **VRSP** among HAM, HAF, LAM and LAF, χ^2 (3) = 95.768, p = .000, with a mean rank score of 195.57 for HAM, 217.85 for HAF, 98.75 for LAM, and 129.83 for LAF; **VRDP** among HAM, HAF, LAM and LAF, χ^2 (3) = 108.065, p = .000, with a mean rank score of 182.34 for HAM, 236.31 for HAF, 98.37 for LAM, and 124.98 for LAF; **VR** among HAM, HAF, LAM and LAF, χ^2 (3) = 147.642, p = .000, with a mean rank score of 188.14 for HAM, 246.82 for HAF, 87.82 for LAM, and 199.23 for LAF; **RG** among HAM, HAF, LAM and LAF, χ^2 (3) = 145.248, p = .000, with a mean rank score of 231.57 for HAM, 206.29 for HAF, 120.07 for LAM, and 84.08 for LAF respectively.

‘***Gender***’ and ‘***level of academic achievement***’ has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 39% on Mental Balance; 42% on Attention and Concentration; 24% on Delayed Recall; 44% on Immediate Recall; 29% on Verbal Retention for Similar Pairs; 33% on Verbal Retention for Dissimilar Pairs; 46% on Visual Retention; 45% on Recognition respectively which accept the Forth Hypothesis.

A Kruskal-Wallis H test (**table – 12**) showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across ‘**ecology x level of academic achievement**’ i.e on **RM** among HAU, HAR, LAU and LAR, χ^2 (3) = 13.722, p = .003, with a mean rank score of 182.00 for HAU, 164.00 for HAR, 152.00 for LAU, and 144.00 for LAR; **REM** among HAU, HAR, LAU and LAR, χ^2 (3) = 19.486, p = .000, with a mean rank score of 186.56 for HAU, 167.13 for HAR, 147.93 for LAU, and 140.39 for LAR; **MB** among HAU, HAR, LAU and LAR, χ^2 (3) = 149.379, p = .000, with a mean rank score of 246.46 for HAU, 181.55 for

Table-12: Showing interaction effect (Independent Samples Kruskal - Wallis H Test) of 'ecology' and 'level of academic achievement' on the subscales of The PGIMS for the samples.

Dependent Variables	ecology x level of academic achievement	N	Mean Rank	$\chi 2$	Df	*P*	$\eta 2$
Remote Memory	HAU	80	182.00	13.722	3	.003	0.03
	HAR	80	164.00				
	LAU	80	152.00				
	LAR	80	144.00				
Recent Memory	HAU	80	186.56	19.486	3	.00**	0.05
	HAR	80	167.13				
	LAU	80	147.93				
	LAR	80	140.39				
Mental Balance	HAU	80	246.46	149.379	3	.00**	0.46
	HAR	80	181.55				
	LAU	80	137.53				
	LAR	80	76.46				
Attention and Concentration	HAU	80	234.27	143.446	3	.00**	0.44
	HAR	80	206.24				
	LAU	80	118.34				
	LAR	80	83.16				
Delayed Recall	HAU	80	223.14	81.348	3	.00**	0.25
	HAR	80	180.55				
	LAU	80	136.61				
	LAR	80	101.70				
Immediate Recall	HAU	80	238.59	196.257	3	.00**	0.61
	HAR	80	199.60				
	LAU	80	156.14				
	LAR	80	47.68				
Verbal Retention for Similar Pairs	HAU	80	229.40	104.170	3	.00**	0.32
	HAR	80	184.02				
	LAU	80	130.34				
	LAR	80	98.24				
Verbal Retention for Dissimilar Pairs	HAU	80	220.53	102.442	3	.00**	0.31
	HAR	80	198.12				
	LAU	80	133.68				
	LAR	80	89.67				
Visual Retention	HAU	80	246.16	157.550	3	.00**	0.49
	HAR	80	188.80				
	LAU	80	131.72				
	LAR	80	75.33				
Recognition	HAU	80	238.75	165.363	3	.00**	0.51
	HAR	80	199.11				
	LAU	80	135.29				
	LAR	80	68.86				

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. HAU= High Academic Achiever Urban; HAR= High Academic Achiever Rural; LAU= Low Academic Achiever Urban; LAR= Low Academic Achiever Rural.

HAR, 137.53 for LAU, and 76.46 for LAR; **A&C** among HAU, HAR, LAU and LAR, χ^2 (3) = 143.446, *p* = .000, with a mean rank score of 234.27 for HAU, 206.24 for HAR, 118.34 for LAU, and 83.16 for LAR; **DR** among HAU, HAR, LAU and LAR, χ^2 (3) = 81.348, *p* = .000, with a mean rank score of 223.14 for HAU, 180.55 for HAR, 136.61 for LAU, and 101.70 for LAR; **IR** among HAU, HAR, LAU and LAR, χ^2 (3) = 196.257, *p* = .000, with a mean rank score of 238.59 for HAU, 199.60 for HAR, 156.14 for LAU, and 47.68 for LAR; **VRSP** among HAU, HAR, LAU and LAR, χ^2 (3) = 104.170, *p* = .000, with a mean rank score of 229.40 for HAU, 184.02 for HAR, 130.34 for LAU, and 98.24 for LAR; **VRDP** among HAU, HAR, LAU and LAR, χ^2 (3) = 102.442, *p* = .000, with a mean rank score of 220.53 for HAU, 198.12 for HAR, 133.68 for LAU, and 89.67 for LAR; **VR** among HAU, HAR, LAU and LAR, χ^2 (3) = 157.550, *p* = .000, with a mean rank score of 246.16 for HAU, 188.80 for HAR, 131.72 for LAU, and 75.33 for LAR; **RG** among HAU, HAR, LAU and LAR, χ^2 (3) = 165.363, *p* = .000, with a mean rank score of 238.75 for HAU, 199.11 for HAR, 135.29 for LAU, and 68.86 for LAR respectively.

‘***Ecology***’ and ‘***level of academic achievement***’ has a significant interaction effect with an effect size of 3% on Remote Memory; 5% on Recent Memory; 46% on Mental Balance; 44% on Attention and Concentration; 25% on Delayed Recall; 61% on Immediate Recall; 32% on Verbal Retention for Similar Pairs; 31% on Verbal Retention for Dissimilar Pairs; 49% on Visual Retention; 51% on Recognition respectively which accept the Forth Hypothesis. The findings of the study show that rural students had a higher PGI Memory Scales/subscales mean score than rural students. The Kruskal-Wallis H analysis of variance test shows that there is significant interaction between students’ ecology and their levels of academic achievement on their memory. Therefore, this present study has shown that ecology and levels of academic achievement interact to explain students’ memory ability among Mizo High School Students.

A Kruskal-Wallis H test (**table-13 a and table-13 b**) showed that across ‘***level of academic achievement** x **ecology** x **gender***’ there was a statistically significant difference in **REM** between the mean rank of 194.34 (HAUM), 178.79 (HAUF),

Table-13 a: Showing interaction effect (Independent Samples Kruskal - Wallis H Test) of ‘Level of academic achievement’, ‘gender’, and ‘ecology’ on the subscales of The PGIMS for the samples.

Dependent Variables	Ecology x Gender x Levels of Aca Ach	N	Mean Rank	χ 2	Df	*P*	*η2*
Remote Memory	HAUM	40	188.00	15.934	7	.026	0.02
	HAUF	40	176.00				
	HARM	40	168.00				
	HARF	40	160.00				
	LAUM	40	156.00				
	LAUF	40	148.00				
	LARM	40	152.00				
	LARF	40	136.00				
Recent Memory	HAUM	40	194.34	21.481	7	.003	0.04
	HAUF	40	178.79				
	HARM	40	171.01				
	HARF	40	163.24				
	LAUM	40	154.32				
	LAUF	40	141.53				
	LARM	40	136.50				
	LARF	40	144.28				
Mental Balance	HAUM	40	215.43	172.944	7	.00**	0.53
	HAUF	40	277.50				
	HARM	40	184.95				
	HARF	40	178.15				
	LAUM	40	115.56				
	LAUF	40	159.49				
	LARM	40	45.23				
	LARF	40	107.70				
Attention and Concentration	HAUM	40	246.99	146.758	7	.00**	0.44
	HAUF	40	221.55				
	HARM	40	211.55				
	HARF	40	200.93				
	LAUM	40	123.36				
	LAUF	40	113.31				
	LARM	40	94.90				
	LARF	40	71.41				
Delayed Recall	HAUM	40	218.31	96.925	7	.00**	0.29
	HAUF	40	227.98				
	HARM	40	165.23				
	HARF	40	195.88				
	LAUM	40	119.34				
	LAUF	40	153.88				
	LARM	40	69.40				
	LARF	40	134.00				

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. HAUM = High Academic Achiever Urban Male, HAUF = High Academic Achiever Urban Female, HARM = High Academic Achiever Rural Male, HARF = High Academic Achiever Rural Female, LAUM = Low Academic Achiever Urban Male, LAUF = Low Academic Achiever Urban Female, LARM = Low Academic Achiever Rural Male, LARF = Low Academic Achiever Rural Female.

Table-13 b: Showing interaction effect (Independent Samples Kruskal - Wallis H Test) of 'Level of academic achievement', 'gender', and 'ecology' on the subscales of The PGIMS for the samples.

Dependent Variables	Ecology x Gender x Levels of Aca Ach	N	Mean Rank	χ 2	Df	*P*	*η2*
Immediate Recall	HAUM	40	199.66	215.174	7	.00**	0.67
	HAUF	40	277.51				
	HARM	40	192.64				
	HARF	40	206.56				
	LAUM	40	167.29				
	LAUF	40	144.99				
	LARM	40	31.06				
	LARF	40	64.29				
Verbal Retention for Similar Pairs	HAUM	40	208.90	113.692	7	.00**	0.34
	HAUF	40	249.90				
	HARM	40	182.24				
	HARF	40	185.80				
	LAUM	40	112.01				
	LAUF	40	148.66				
	LARM	40	85.49				
	LARF	40	111.00				
Verbal Retention for Dissimilar Pairs	HAUM	40	189.61	120.190	7	.00**	0.36
	HAUF	40	251.45				
	HARM	40	175.08				
	HARF	40	221.16				
	LAUM	40	117.04				
	LAUF	40	150.32				
	LARM	40	79.70				
	LARF	40	99.64				
Visual Retention	HAUM	40	200.34	200.237	7	.00**	0.62
	HAUF	40	291.98				
	HARM	40	175.94				
	HARF	40	201.66				
	LAUM	40	144.63				
	LAUF	40	118.81				
	LARM	40	31.01				
	LARF	40	119.64				
Recognition	HAUM	40	254.70	175.339	7	.00**	0.54
	HAUF	40	222.80				
	HARM	40	208.44				
	HARF	40	189.78				
	LAUM	40	156.03				
	LAUF	40	114.55				
	LARM	40	84.11				
	LARF	40	53.60				

Note. * Indicates $p < 0.05$; **indicates $p < 0.01$ significant. HAUM = High Academic Achiever Urban Male, HAUF = High Academic Achiever Urban Female, HARM = High Academic Achiever Rural Male, HARF = High Academic Achiever Rural Female, LAUM = Low Academic Achiever Urban Male, LAUF = Low Academic Achiever Urban Female, LARM = Low Academic Achiever Rural Male, LARF = Low Academic Achiever Rural Female

171.01 (HARM), 163.24 (HARF), 154.32 (LAUM), 141.53 (LAUF), 136.50 (LARM) and 144.28 (LARF) were significant, χ^2 (7) = 21.481, *p* = .003, on **MB** between the mean rank of 215.43 (HAUM), 277.50 (HAUF), 184.95 (HARM), 178.15 (HARF), 115.56 (LAUM), 159.49 (LAUF), 45.23 (LARM) and 107.70 (LARF) were significant, χ^2 (7) = 172.944, *p* = .000, on **A&C** between the mean rank of 246.99 (HAUM), 221.55 (HAUF), 211.55 (HARM), 200.93 (HARF), 123.36 (LAUM), 113.31 (LAUF), 94.90 (LARM) and 71.41 (LARF) were significant, χ^2 (7) = 146.758, *p* = .000, on **DR** between the mean rank of 218.31 (HAUM), 227.98 (HAUF), 165.23 (HARM), 195.88 (HARF), 119.34 (LAUM), 153.88 (LAUF), 69.40 (LARM) and 134.00 (LARF) were significant, χ^2 (7) = 96.925, *p* = .000, on **IR** between the mean rank of 199.66 (HAUM), 277.51 (HAUF), 192.64 (HARM), 206.56 (HARF), 167.29 (LAUM), 144.99 (LAUF), 31.06 (LARM) and 64.29 (LARF) were significant, χ^2 (7) = 215.174, *p* = .000, on **VRSP** between the mean rank of 208.90 (HAUM), 249.90 (HAUF), 182.24 (HARM), 185.80 (HARF), 112.01 (LAUM), 148.66 (LAUF), 85.49 (LARM) and 111.00 (LARF) were significant, χ^2 (7) = 113.692, *p* = .000, on **VRDP** between the mean rank of 189.61 (HAUM), 251.45 (HAUF), 175.08 (HARM), 221.16 (HARF), 117.04 (LAUM), 150.32 (LAUF), 79.70 (LARM) and 99.64 (LARF) were significant, χ^2 (7) = 120.190, *p* = .000, on **VR** between the mean rank of 200.34 (HAUM), 291.98 (HAUF), 175.94 (HARM), 201.66 (HARF), 144.63 (LAUM), 118.81 (LAUF), 31.01 (LARM) and 119.64 (LARF) were significant, χ^2 (7) = 200.237, *p* = .000, and on **RG** between the mean rank of 254.70 (HAUM), 222.80 (HAUF), 208.44 (HARM), 189.78 (HARF), 156.03 (LAUM), 114.55 (LAUF), 84.11 (LARM) and 53.60 (LARF) were significant, χ^2 (7) = 175.339, *p* = .000 respectively.

‘***Level of academic achievement***’, ‘***ecology***’, and ‘***gender***’ has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 53% on Mental Balance; 44% on Attention and Concentration; 29% on Delayed Recall; 67% on Immediate Recall; 34% on Verbal Retention for Similar Pairs; 36% on Verbal Retention for Dissimilar Pairs; 62% on Visual Retention; 54% on Recognition respectively which accept the Forth Hypothesis.

These findings proved the final hypothesis that there was a significant interaction effect of ‘**level of academic achievement**’, ‘**ecology**’, and ‘**gender**’ on the subscales of The PGIMS for the samples i.e. significant interaction effect of ‘**ecology** x **gender**', '**gender** x **level of academic achievement**', '**ecology** x **level of academic achievement**' on the dependent variables (RM, REM, MB, A&C, IR, DR, RSP, RDP, VR, and RG) among the samples. The recent study is urgently needed for expanding the existing body of research and to help implement intervention programmes because there is a dearth of literature that supports the current findings.

The result of the present study may be summarized as follows concerning the theoretical expectation (hypothesis) set forth for the study:

1) The results revealed that in **levels of academic achievement**, high academic achiever scores were higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, and Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively which accepts the first hypothesis.

2) The results revealed that in **ecology**, there was a difference between urban scores were higher in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition as compared to rural. However, there was no difference between urban and rural in Remote memory and Recent Memory. This proved the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students.

3) **Gender** differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no difference in Remote memory, Recent Memory, and Attention and Concentration compared between Males and Females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. This confirmed the first hypothesis "It was expected that (iii) higher scores in females

than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males.

4) Results of the Spearman correlation revealed significant correlations among the dependent variables. The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of Remote Memory, which was shown to have no significant correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no significant correlation with Verbal Retention for Dissimilar Pairs. This finding supported the second hypothesis, which stated that the study would reveal the significant relationship between the dependent variables (Remote, Recent Memory, Mental Balance, Digit Span-Attention and Concentration, Immediate Recall, Delayed, Retention for Similar, Retention for Dissimilar Pairs, Visual Retention and Recognition) on the Samples.

5) **Levels of academic achievement** have a significant independent effect with an effect size of 18% on Remote Memory, 23% on Recent Memory, 23% on Mental Balance, 58% on Attention and Concentration, 64% on Delayed Recall, 45% on Immediate Recall, 53% on Verbal Retention for Similar Pairs, 65% on Verbal Retention for Dissimilar Pairs, 63% on Visual Retention and 66% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**level of academic achievement**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. High academic achiever scores were significantly higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively.

6) **Ecology** has a significant independent effect with an effect size of 35% on Mental Balance, 17% on Attention and Concentration, 21% on Delayed Recall, 39% on Immediate Recall, 17% on Verbal Retention for Similar Pairs, 21% on Verbal Retention for Dissimilar Pairs, 30% on Visual Retention and 28% on Recognition. This finding supported the third hypothesis that there will be a significant independent

effect of '**Ecology**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Urban scores were significantly higher as compared to rural in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition respectively. However, there was no significant difference between urban and rural in Remote memory and Recent Memory among the samples.

7) **Gender** has a significant independent effect with an effect size of 21% on Mental Balance, 19% on Delayed Recall, 14% on Immediate Recall, 15% on Verbal Retention for Similar Pairs, 22% on Verbal Retention for Dissimilar Pairs, 25% on Visual Retention and 16% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**Gender'** on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Females were significantly higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were significantly higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females.

8) **Ecology** and **gender** have a significant interaction effect with an effect size of 16% on Mental Balance, 2% on Attention and Concentration, 8% on Delayed Recall, 18% on Immediate Recall, 7% on Verbal Retention for Similar Pairs, 7% on Verbal Retention for Dissimilar Pairs, 16% on Visual Retention and 11% on Recognition. This finding supported the fourth hypothesis set forth for the study.

9) **Gender** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 2% on Remote Memory, 4% on Recent Memory, 39% on Mental Balance, 42% on Attention and Concentration, 24% on Delayed Recall, 44% on Immediate Recall, 29% on Verbal Retention for Similar Pairs,

33% on Verbal Retention for Dissimilar Pairs, 46% on Visual Retention and 45% on Recognition. This finding supported the fourth hypothesis set forth for the study.

10) **Ecology** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 5% on Recent Memory, 46% on Mental Balance, 44% on Attention and Concentration, 25% on Delayed Recall, 61% on Immediate Recall, 32% on Verbal Retention for Similar Pairs, 31% on Verbal Retention for Dissimilar Pairs, 49% on Visual Retention and 51% on Recognition. This finding supported the fourth hypothesis set forth for the study.

11) **Levels of Academic Achievement, Ecology,** and **Gender** were used as independent variables in the memory tests. The findings indicate a statistically significant interaction effect of '**level of Academic Achievement, Ecology,** and **gender**' on all the PGI-Memory sub-scales with an effect size of 2%, 4%, 53%, 44%, 29%, 67%, 34%, 36%, 62% and 54% respectively which accept the fourth hypothesis. The level of Academic Achievement had a clear effect on the test scores of PGIMS. participants with high academic achievers outperformed those with low academic achievers on all tests. The results also revealed gender effects, though these were small, with females outperforming males on verbal tests and the reverse pattern on recognition tests.

Summary and Conclusions

The present study entitled "*Memory Profiles of High School Students in Mizoram*" aimed to study the memory profiles of the level of academic achievement (**high and low academic achievers**), ecology (**urban and rural**), and gender (**males and females**) among High school students in Mizoram. Hence, the study aims to create a memory profile for the population it is studying, and using a single battery of memory tests enables a more comprehensive assessment of memory performance. While considering ways to encourage academic achievement, it is essential to keep students' memory abilities in mind. Comparing different memory profiles of high achievers and low achievers might help identify memory profile elements that are particularly important for efficient learning and high-performance outcomes.

It was hypothesised that (i) higher scores in high-level academic achievers than low-academic achievers, (ii) higher scores in Urban students than Rural students, (iii) and higher scores in Females than males on Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition with a significant difference level. A positive significant correlation was expected between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition). It was also hypothesized that a significant independent effect of 'level of academic achievement', 'ecology', and 'gender' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. There will be significant interaction effect of 'ecology x gender', 'ecology x level of academic achievement', 'gender x level of academic achievement', and 'ecology x gender x level of academic achievement' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

To achieve the objectives and hypothesis of the study 320 High School students of Mizoram a state in the northeast of India, (aged 16 years to 20 years) comprised equal representation of the **level of academic achievement**' (High academic achiever and Low academic achiever), '**ecology**' (urban and rural), and '**gender**' (male and female) were attempted comprising *160 High academic achievers {80 Urban (40 Male and 40 Female){ and 80 Rural (40 Male and 40 Female)} and 160 Low academic achievers{80 Urban (40 Male and 40 Female) and 80 Rural (40 Male and 40 Female)}* selected using a random method of sample selection, the extraneous variable which may include socio-demographic variables (SES status, types of school, substance use. etc.) was kept under control.

The design of this study was 2 x 2 x 2 factorial designs (2 gender x 2 ecology x 2 levels of academic achievement) having 8 groups under study, and each cell has equally matched its representation: 320 high school students [160 High academic achievers {80 Urban (40 male and 40 female) and 80 rural (40 male and 40 female)} and 160 Low academic achievers {Urban (40 male and 40 female) and 80 rural (40 male and 40female}] were served as the sample in the study.

A demographic questionnaire was administered to all participants and assisted in the identification of confounding variables that could affect the data. The PGI-Memory Scale (PGIMS), constructed by Pershad and Wig (1977) was used for the evaluation of memory functions among the students. The PGIMS contained 10 sub-tests: Remote memory, Recent memory, Mental balance, Digit span- Attention and concentration, mental control, Immediate recall, Delayed recall, Verbal Retention for similar pairs, Verbal Retention for dissimilar pairs, Visual retention, and Recognition, all prescribed instructions are given in the manuals and APA guidelines for research were followed.

The study starts with the identification and selection of samples as per objectives. Procurement of necessary permission from school authorities was taken for the study. After the samples were identified, necessary permission was taken, and oral and written informed consent was procured from each study sample. The purpose of the study was explained to all the study participants. Clearly explained that the participants may withdraw from the study at any time without any penalty. Assurance was given to the participants that confidentiality would be maintained throughout the study. The participants were clearly informed about what they had to perform during the conduction of the scale. The demographic questionnaire was administered to all participants and assisted in the identification of confounding variables that could affect the data. The administration of the PGI-MS was done to the selected samples with due care of instructions as given in the manual and APA Research Ethical Code (2002). To ascertain different types of memories, the P.G.I Memory Scale was used. It contains 10 subtests. Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed recall, Immediate recall, Verbal Retention for similar pairs, Verbal Retention for dissimilar pairs, Visual Retention, and Recognition. Each student was tested individually in a well-illuminated quiet room at the participating school. The essential items required for the test were placed on the table before calling the participants into the room. The participant was called in and was made comfortable and rapport was established. A casual conversation was started and also motivated to do their best without any unnecessary pressure for each participant. The researcher made sure that the participants understood the test and after the necessary instructions were given and understood by the participant, the test began. The procedure was repeated for each student.

Sample Characteristics

The sample was categorized based on academic achievement, i.e., 160 High academic achievers were students who scored continuously higher than 80% marks, and 160 Low academic achievers scored lower than 50% marks in their last three years' examination results. Each of these two groups consisted of 80 rural students and 80 urban students, again equally categorised based on their gender into 40 males and 40 females for both urban and rural.

Subject-wise scores on subscales of the PGI-Memory Scales- remote, recent memory, mental balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal retention for similar, Verbal retention for dissimilar pairs visual retention, and recognition were prepared for the whole samples High Academic

Achiever Urban Male (HAUM), High Academic Achiever Urban Female (HAUF), High Academic Achiever Rural Male (HARM), High Academic Achiever Rural Female (HARF), Low Academic Achiever Urban Male (LAUM), Low Academic Achiever Urban Female (LAUF), Low Academic Achiever Rural Male (LARM), Low Academic Achiever Rural Female (LARF).

Results Analysis of the present study was done in a phased manner:

1) Checking of missing raw data and outlier

The raw data set was checked for missing raw data and extreme outliers. Since there were outliers, further analysis was carried on.

2) Psychometric properties of PGI-Memory Scales/Subscales for the samples

Although the PGI-Memory Scale for Adults developed by Prashad and Wig (1977) was developed for adults with age norms for an age range from 20-69 years of age whereas the PGI-Memory Scale for Children developed by Kohli et al (1998) has age norms between 7-14 years of age, and no separate scale for adolescents in between the two scales. As such, PGI-Memory Scale for adults has been used for adolescents in earlier research to study memory functions (Gajre et al., 2008; Rajendran et al., 2016; Joshi & Arya, 2017; Chakravarty et al., 2019; Pandey et al., 2021). However, to ensure the applicability among adolescents of the targeted population pilot study was conducted and the results confirmed the applicability of the scale ($r > .50$) on all the sub-scales of PGI-Memory Scales.

Psychometric analyses of the scales and subscales were done by employing Microsoft Office Excel 2013 and IBM's Statistical Package for the Social Sciences (SPSS 26). The psychological scales used in the present study were originally constructed for an adult population with age norms 20-69. Thus, before applying to the present study, it was thought needed to check the appropriateness and verify the trustworthiness of the scales for the population under study.

Accordingly, the reliabilities of all the subscales i.e., (i) Remote Memory, (ii) Recent Memory, (iii) Mental Balance, (iv) Attention and Concentration, (v) Delayed Recall, (vi) Immediate Recall (vii) Verbal Retention for Similar Pairs, (viii) Verbal Retention for Dissimilar Pairs (ix) Visual Retention and (x) Recognition in the present study were calculated using Cronbach's Alpha.

The internal consistency of the scales was calculated using Cronbach's Alpha and all the scales and subscales were found to be highly reliable where, Remote Memory consists of 6 items (α = .60), Recent Memory subscale consists of 5 items (α = .66), Mental Balance subscale consists of 3 items (α = .71), the Attention and Concentration subscale consists of 10 items (α = .71), Delayed Recall subscale consists of 10 items (α = .59), Immediate Recall subscale consists of 3 items (α = .76), Verbal Retention for Similar Pairs subscale consists of 5 items (α = .63), Verbal Retention for Dissimilar Pairs subscale consists of 15 items (α = .61), Visual Retention subscale consists of 5 items (α = .61), and Recognition subscale consists of 10 items (α = .73) respectively of the PGIMS appeared to have good internal consistency. The tool was considered reliable and hence, was used in the present study.

3) Mean comparison between the groups

High academic achievers and **low academic achievers** were calculated and *high academic achievers* are showing higher scores than ***low academic achievers*** on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition.

Results show that **high academic achievers** seem to have a higher level of memory performance than **low academic achievers**. These results corresponded to the findings of the previous researcher that the substantial association between memory and achievement (Dean, 2006; Kane et al., 2007; Lamba, 2014; Rabiner, 2016; Podila, 2019). This finding is in agreement with the findings of Zhou and colleagues (2020) investigated the links between cognition and outcomes in school and discovered that cognition is closely related to academic achievement. Also in line with the study of John and Jaquith (1996), Abraham and colleagues (2016) and El-Mir (2019) who found that several memory functions, including working memory (WM), short-term memory (STM), and long-term memory (LTM), affect academic achievement and based on the findings that working memory capacity conditioned achievement in word recognition and reading comprehension in language and concluded that measurements of working memory might be used to predict performance in various cognitive tasks, such as reading and also, Rabiner (2016) found the relationship between academic achievement and attention difficulties, which suggests that attention issues frequently have a serious negative impact on student's academic achievement. The findings is also in line with Dolgova and associates (2020) who studied the relationship between memory properties and the academic performance of college students and found that most college students have high and medium memory properties, which means that the indicators of the memory properties and academic performance of college students are correlated and according to their findings, there is a relationship between the level of memory development and the success of educational activities.

This current study has been able to show that memory ability is a significant factor with respect to student achievement among Mizo High School students. From the current findings, raising students' levels of academic achievement would need them to improve their auditory and visual processing. As a result, working memory is found to be crucial for verbal reasoning and literary comprehension as noted by Baddeley and Hitch (Baddeley & Hitch, 1974).

Baddeley and Hitch Model (1974) suggested that working memory plays a vital part in verbal reasoning and prose comprehension and in addition, Working Memory's ability predicts academic success (Baddeley & Hitch, 1974). Earlier studies showed that working memory was found to be strongly related to academic success and to measures of reading, writing, spelling, mental arithmetic, measurement and spatial abilities, and computational scores in both typical and atypical school-going children (Margolin, 1984; Caramazza et al., 1987; Berninger & Swanson, 1994; Swanson & Sachse-Lee, 2001; DeStefano & LeFevre, 2004; Swanson et al., 2004; Alloway & Copello, 2013).

In accordance with previous findings, overall memory performance was significantly higher among high academic achievers in the current study as compared to low academic achievers, indicating that high academic achievers had better memory capacity as compared to low academic achievers. These findings imply that many children who struggle to pay attention will also struggle in academics. Thus, the results of this study found implications that individuals with memory deficits may show significantly lower academic performance. As a result, earlier comprehensive memory screenings are necessary to understand the strengths and weaknesses of children's memory skills that may assist professionals working with children to improve instructional planning, programming decisions, treatment recommendations, and accommodations to benefit their academic success.

Mean comparison between **urban** and **rural** was calculated and **urban** are showing higher scores on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition than compared to their **rural** counterpart which was in supported by previous studies (Haller et al., 1993, Alspaugh & Harting, 1995; Jones & Ezeife, 2011; Wang et al., 2019; Sumi et al., 2021) which suggest that students in rural schools had lower scores in memory performance as compared to students in urban schools. Furthermore, the current study provides strong support for the hypothesis that students in **rural** performed lower in memory tasks than students in **urban**. The conclusions drawn from this perspective suggest that student achievement levels are significantly different with respect to **urban** and **rural**.

The possible explanation to the difference in memory ability between urban and rural students is that city life requires cognitive functions that are different from those necessary for daily life in remote rural villages. In the city, for example, individuals are frequently confronted with the need to read and to calculate. This is less likely to be the case in remote areas of the countryside, where communication occurs less frequently through the printed word and the economy relies on bartering rather than on monetary transactions. Depending upon parental expectations and the duties assigned to children, the demands made on cognitive abilities for boys and girls in the two environments may differ (Stevenson et al., 1990). Therefore, cognitive stimulation on cognitive may lead to improved memory ability (Bonnechère et al., 2021).

The current findings highlighted the significant role of memory abilities in academic performance and explored the differences of memory abilities between urban and rural students. Based on the aforementioned findings, it is proposed by prior research that early identification of cognitive deficits among students and the implementation of strategies to improve cognitive ability might improve students' overall development and hence support improved academic performance (Zhang et al., 2022). Therefore, the teachers, educators, and school authorities, especially at the High

School level of Education; are suggested to offer more exposure and stimulating environments to students belonging to rural backgrounds. The study examined for the first time the rural-urban disparity among High school level school students on the dimensions of memory abilities, especially in north-east India.

Mean comparison between **males** and **females** on each dependent variable and **males** were showing higher scores than **females** on Recent Memory, Remote Memory, Attention and Concentration and Recognition whereas, **females** were showing higher scores than their **male** counterparts on Mental Balance, Delayed Recall, Immediate Recall, Verbal retention for similar pairs, Verbal Retention for Dissimilar Pairs and Visual Retention on PGIMS.

Results suggested that Female seems to perform better on Verbal memory task as compared to Males in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first hypothesis "It was expected that **(iii) higher scores in Females than males"** was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al., 2017). In contrast to our findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

The findings also revealed that there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females and are in confirmatory to the statement that the principle for understanding gender differences in memory, males and females do not differ in overall memory ability (Maccoby and Jacklin, 1974). Likewise, previous studies found Working Memory and academic achievement were found to be equal in both males and females with no gender differences. (Aliotti & Rajabiun, 1991; Forrester & Geffen, 1991; Ullman et al.,1997; Tariq & Noor, 2012)

The current findings revealed that females perform better than males in the Verbal Retention task, which had interesting gender-related results. This was also consistent with the findings of Loftus and colleagues (1987) where in gender differences in verbal memory suggest a clear pattern: Females, whether adults or children, appear to do better on tasks involving which is consistent with previous studies that female participants outperformed their male counterparts in the verbal test (Temple & Cornish, 1993; Huang, 1993; Murre et al., 2013; Chan & Abu Bakar, 2021). Likewise, Herlitz and Rehnman (2008) also suggest women may have a minor, general episodic-memory advantage, which can be augmented by the advantage women have over men in verbal production and negated by the male advantage in visuospatial tasks. The advantage that women have in auditory episodic memory may be explained by their advantage in verbal abilities and recall seems to be highly correlated with verbal ability (Daneman & Carpenter, 1983; Pauls et al., 2013). In addition, the potential sex differences in memory function, which extend to various memory domains, such as autobiographical memories, semantic memory, and memory recognition. Potential sex differences in memory are likely attributed to a multitude of factors, including various psychological (e.g., different processing strategies and learning strategies) and physiological parameters (e.g., brain structure, hormonal, and neurotransmitter differences) (Loprinzi & Frith, 2018). According to Adyalkar (2019), females have better short-term memory than men in terms of recall on the word recall test. In contrast to the current findings, Forrester and Geffen (1991) found no gender differences in verbal learning tasks.

These findings also revealed that males outperformed females on Recognition task which is consistent with earlier studies by Lowe (2003), and this may be due to that men's superior visual memory performance has been determined to be due to their better visuospatial abilities (Loftus et al.,1987; Huang, 1993; Pauls et.al., 2013). However, according to Temple and Cornish (1993) findings as well as Bridge (2006) findings from two recognition experiments that used graphically presented travel photographs to test memory function, the results for both genders (males and females) are largely identical. In contrast, Heisz and his colleagues (2013) found that females outperformed males on recognition-memory tests, and this advantage was directly related to females' scanning behavior at encoding.

Whether there are gender differences in memory performance was one of the current key study topics. The findings from this study substantially indicate the presence of such variations. Nevertheless, females do not perform better than males in all of the PGI-Memory sales subscales. There were no statistically significant differences between males and females on the measures of remote memory, recent memory, and attention and concentration. Females did, however, perform better than males in most of the subscales in the areas of delayed recall, immediate recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, and Visual retention.

4) Mann Whitney *U* Test for measures of differences between the comparison groups on the dependent variables

Analysis of data was done to evaluate the independent effect of '**level of academic Achievement**', '**ecology**', and '**gender**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal retention for similar pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition) among the sample.

The results revealed that **high academic achievers** had significantly higher scores than **low academic achievers** on all the 10 subscales of PGI-Memory Scales. High academic achiever scores were significantly higher in the Remote memory (Mean Rank = 173.17) than low academic achiever (Mean Rank = 147.67) at $p < 0.01$ level with small effect ($U = 10760.00$; $z = -3.30$; $p < 0.01$; $r = 0.18$), High academic achiever scores were significantly higher in the Recent Memory (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with a small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; $r = 0.23$), High academic achiever scores were significantly higher in the Mental Balance (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; r = 0.23), High academic achiever scores were significantly higher in the Attention and concentration (Mean Rank = 213.32) compared to low academic achiever (Mean Rank = 107.01) at $p < 0.01$ level with large effect ($U = 17015.00$; $z = -10.46$; $p < 0.01$; $r = 0.58$), High academic achiever scores were significantly higher in the Delayed Recall (Mean Rank = 219.26) compared to low academic achiever (Mean Rank = 101.00) at $p < 0.01$ level with large effect ($U =$ 3338.50; $z = -11.45$; $p < 0.01$; $r = 0.64$), High academic achiever scores were significantly higher in the Immediate Recall (Mean Rank = 201.81) compared to low academic achiever (Mean Rank = 118.67) at $p < 0.01$ level with medium effect (U = 6148.00; z = -8.20; $p < 0.01$; r = 0.45), High academic achiever scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 209.27) compared to low academic achiever (Mean Rank = 111.12) at $p < 0.01$ level with large effect (U = 4948.00; z = -9.58; $p < 0.01$; r = 0.65), High academic achiever scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank = 219.51) compared to low academic achiever (Mean Rank = 100.75) at $p < 0.01$ level with large effect (U = 3299.00; z = -11.66; $p < 0.01$; r = 0.53), High academic achiever scores were significantly higher in the Visual Retention (Mean Rank = 217.71) compared to low academic achiever (Mean Rank = 102.57) at $p < 0.01$ level with large effect (U = 3588.50; z = -11.35; $p < 0.01$; r = 0.63), High academic achiever scores were significantly higher in the Recognition (Mean Rank = 219.19) compared to low academic achiever (Mean Rank = 101.07) at $p < 0.01$ level with large effect (U = 3350.50; z = -11.77; $p < 0.01$; r = 0.66).

From the current findings, in 'levels of academic achievement', high academic achiever scores were significantly higher as compared to low Academic Achiever in Remote memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively. This confirmed the First and third hypothesis set forth for the study that 'It was expected that (i) higher scores in high-level academic achievers than low-academic achievers' was in accordance with the study and was supported. This finding was supported by earlier studies that discovered a very substantial association between memory and achievement supported this conclusion (John & Jaquith, 1996; Kulp et al., 2002; Rabiner, 2004; Dean, 2006; Lamba, 2014; Podila, 2019; Quílez-Robres et al., 2021).

A Mann-Whitney U test was performed to evaluate whether **urban** and **rural** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **urban** and **rural** in which **urban** had significantly higher scores than **Rural** on 8 subscales of PGI-Memory Scales. This confirmed the First and third hypotheses set forth for the study that (ii) higher score in **urban** students than **rural** students. In Remote memory there was no significant difference between Urban (Mean Rank = 166.79) and Rural (Mean Rank = 154.29),

(U = 11799.00; z = -1.62; p = 0.11; r = 0.09), and Recent Memory between Urban (Mean Rank= 167.00) compared to Rural (Mean Rank = 154.08), (U = 11766.00; z = -1.59; p = 0.11; r = 0.08). Urban scores were significantly higher in the Mental Balance (Mean Rank = 192.55) compared to Rural (Mean Rank = 128.85) at $p<0.01$ level with medium effect (U = 7704.00; z = -6.27; p <0.01; r = 0.35), Urban scores were significantly higher in the Attention and Concentration (Mean Rank = 177.03) compared to Rural (Mean Rank = 144.18) at p < 0.01 level with small effect (U = 10171.50; z = -3.18; p < 0.01; r = 0.17), Urban were significantly higher in the Delayed Recall (Mean Rank = 179.77) compared to Rural (Mean Rank = 141.47) at p < 0.01 level with small effect (U = 9735.50; z = -3.78; p < 0.01; r = 0.21), Urban scores were significantly higher in the Immediate Recall (Mean Rank = 196.81) compared to Rural (Mean Rank = 124.65) at p < 0.01 level with medium effect (U = 7027.00; z = -7.80; p < 0.01; r = 0.39), Urban scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 176.96) compared to Rural (Mean Rank = 144.24) at p < 0.01 level with small effect (U = 10182.00; z = -3.19; p < 0.01; r = 0.17), Urban scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank = 179.36) compared to Rural (Mean Rank = 141.88) at p < 0.01 level with small effect (U = 9801.00; z = -3.81; p < 0.01; r = 0.21), Urban scores were significantly higher in the Visual Retention (Mean Rank = 188.52) compared to Rural (Mean Rank = 132.83) at p < 0.01 level with medium effect (U = 8344.00; z = -11.35; p < 0.01; r = 0.30), Urban scores were significantly higher in the Recognition (Mean Rank = 186.55) compared to Rural (Mean Rank = 134.77) at p < 0.01 level with small effect (U = 8657.00; z = -5.16; p <0.01; r = 0.28).

In ecology, there was a significant difference between urban and rural in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition. However, there was no significant difference between urban and rural in Remote memory and Recent Memory. Thus, the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students' was in accordance with the study and was supported. The finding was supported by Alspaugh, (1992), Alspaugh and Harting (1995), and Haller and colleagues (1993) research and found that students in rural schools had lower scores in memory performance as compared to students in urban schools.

A Mann-Whitney U test was performed to evaluate whether **males** and **females** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **males** and **females** in which **females** had significantly higher scores than **males** on 6 subscales of PGI-Memory Scales. This confirmed the first and third hypotheses set forth for the study that (iii) higher scores in females than males' student. There was no significant difference in Remote memory between males (Mean Rank = 165.79) and females (Mean Rank =155.28) at $p < 0.01$ level ($U = 11959.00$; $z = -1.36$; $p = 0.17$; $r = 0.07$). There was no significant difference on Recent Memory between males (Mean Rank = 163.78) compared to females (Mean Rank = 157.26) at $p < 0.01$ level ($U = 12278.00$; $z = -0.80$; $p = 0.42$; $r = 0.04$). There was no significant difference on Attention and concentration Between males (Mean Rank = 169.88) compared to females (Mean Rank = 151.24) at $p < 0.05$ level (U= 11308.00; $z = -1.81$; $p = 0.07$; $r = 0.10$). Females scores were significantly higher in the Mental Balance (Mean Rank = 180.23) compared to males (Mean Rank = 140.52) at $p < 0.01$ level with a small effect ($U = 9622.50$; $z = -3.91$; $p <0.01$; $r = 0.21$), females were significantly higher in the Delayed Recall (Mean Rank = 178.05) compared to males (Mean Rank = 142.73) at $p < 0.01$ level with a small effect ($U = 9974.50$; $z = -3.48$; $p < 0.01$; $r = 0.19$), females scores were significantly higher in the Immediate Recall (Mean Rank = 174.04) compared to males (Mean Rank = 146.79) at $p < 0.01$ level with a small effect ($U =10620.00$; $z = -2.67$; $p < 0.01$; $r = 0.14$), females scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 174.38) compared to males (Mean Rank = 146.44) at $p < 0.01$ level with a small effect ($U = 10564.50$; $z = -2.84$; $p < 0.01$; $r = 0.15$), females scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank =180.76) compared to males (Mean Rank = 139.98) at $p < 0.01$ level with a small effect ($U = 9537.00$; $z = -3.98$; $p < 0.01$; $r = 0.22$), females scores were significantly higher in the Visual Retention (Mean Rank = 183.47) compared to males (Mean Rank = 137.24) at $p < 0.01$ level with a small effect ($U = 9101.50$; $z = -4.56$; $p < 0.01$; $r = 0.25$), males scores were significantly higher in the Recognition (Mean Rank = 175.28) compared to females

(Mean Rank= 145.90) at $p < 0.01$ level with a small effect ($U = 10449.00$; $z = -2.93$; $p < 0.01$; $r = 0.16$).

Gender differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) significant differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first and third hypothesis "It was expected that (iii) higher scores in females than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al.,2017). In contrast to the present findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

5) Relationship between the dependent variables

Analysis of data was done to examine the relationship between dependent variables. Spearman Correlation was employed to determine the significant relationship between the dependent variables.

Remote Memory shows a significant positive relationship with Recent Memory ($r = .13$, $p < .05$), Mental Balance ($r = .13$, $p < .05$), Attention and Concentration ($r = .15$, $p < .01$), Delayed Recall ($r = .11$, $p < .05$), Immediate Recall at .01 level ($r = .16$, $p < .01$) and Recognition ($r = .17$, $p < .01$).

Recent Memory shows a significant positive relationship with Mental Balance ($r = .22$, $p < .01$), Attention and Concentration ($r = .26$, $p < .01$), Delayed Recall ($r = .14$, $p < .05$), Immediate Recall ($r = .18$, $p < .01$), Verbal Retention for Similar Pairs ($r = .12$, $p < .01$), Visual Retention ($r = .25$, $p < .01$) and Recognition ($r = .12$, $p < .05$) respectively.

Mental Balance shows a significant positive relationship with Attention and Concentration ($r = .46$, $p < .01$), Delayed Recall ($r =.45$, $p = <.01$), Immediate Recall ($r =.59$, $p < .01$); Verbal Retention for Similar Pairs ($r= .421$, $p < .01$), Verbal Retention for Dissimilar Pairs ($r = .44$; $p > .01$), Visual Retention ($r = .52$, $p < .01$) and Recognition ($r = .41$, $p < .01$) respectively.

Attention and Concentration shows a significant positive relationship with Delayed Recall ($r = .34$, $p = < .01$), Immediate Recall ($r = .51$, $p < .01$), Verbal Retention for Similar Pairs ($r = .36$, $p < .01$), Verbal Retention for Dissimilar Pairs ($r = .43$, $p > .01$), Visual Retention ($r = .43$, $p > .01$) and Recognition ($r = .56$, $p > .01$).

Delayed Recall showed a significant positive relationship with Immediate Recall ($r = .50$, $p < .01$), Verbal Retention for Similar Pairs ($r = .32$, $p < .01$), Verbal Retention for Dissimilar Pairs ($r = .43$, $p < .01$), Visual Retention ($r = .41$, $p < .01$) and Recognition ($r = .33$, $p < .01$) respectively.

Immediate Recall showed a significant positive relationship with Verbal Retention for Similar Pairs ($r = .45$, $p < .01$), Verbal Retention for Dissimilar Pairs ($r = .48$, $p < .01$), Visual Retention ($r = .66$, $p < .01$), and Recognition ($r = .60$, $p < .01$).

Verbal Retention for Similar Pairs showed a significant positive relationship with Verbal Retention for Dissimilar Pairs ($r = .36$, $p < .01$), Visual Retention ($r = .47$, $p < .01$) and Recognition ($r = .35$, $p < .01$).

Verbal Retention for Dissimilar Pairs showed a significant positive relationship with Visual Retention ($r = .43$, $p < .01$) and Recognition ($r = .46$, $p < .01$). Visual Retention showed a positive relationship with Recognition ($r = .46$, $p < .01$) respectively.

The highest significant positive correlation was found between Visual Retention and Immediate Recall ($r = .66$, $p < .01$)

The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of Remote Memory, which was shown to have no correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no correlation with Visual Retention or Dissimilar Pairs. In support, Dr Subash Raj S (2016) examined the relationships between Hb Concentration and Remote Memory, Recent Memory, and Mental Balance, finding that it strongly affects Remote Memory and Mental Balance but not Recent Memory. Akhouri and Javed (2014) on the other hand, discovered a connection between the immediate, recent, and remote memories of patients with depression and anxiety and concluded that while immediate and recent memories are impaired in these individuals, remote memories are intact.

Yet according to Sreekanth and colleagues (2015) research, there is a strong correlation between visual memory (Drishta Smriti) and auditory memory (Shruta Smriti) in various phenotypes (Prakriti). Sharma, however, observed that students' visual short-term memory (STM) has a higher mean reaction time than their auditory STM. Gupta and colleagues (2019) also discovered that alcoholics have significantly more cognitive impairment than controls in all PGI-Memory scale domains. According to Thapliyal and colleagues (2016), research on neurocognitive functioning, almost all memory-related functions—including mental balance, attention and concentration, delayed recall, verbal retention for dissimilar pairs, visual retention, and recognition, immediate recall, verbal retention for similar pairs, and visual retention—are dysfunctional among alcoholics, indicating that if one neurocognitive domain is impaired other domains are likely to be impaired.

6) Kruskal - Wallis H Test for measures of the interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement' on the dependent variables

Since the data violated assumptions for parametric tests, a non-parametric test i.e., Kruskal - Wallis H Test were calculated to examine any significant interaction effect of '**ecology x gender**', '**gender x level of academic achievement**', '**ecology x level of academic achievement**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

The results showed that across '**ecology x gender**' there was a statistically significant difference on MB between the mean rank of 165.49 (Urban Males), 218.49 (Urban Females), 115.09 (Rural Males) and 142.93 (Rural females) were significant, $\chi2$ (3) = 55.783, *p* = .000, on A&C between the mean rank of 185.18 (Urban Males), 167.43 (Urban Females), 153.23 (Rural Males), and 136.17 (Rural females) were significant, $\chi2$ (3) = 12.211, p = .007, on DR between the mean rank score of 168.83 (Urban Males), 190.93 (Urban Females), 117.31 (Rural Males), and 164.94 (Rural females) were significant, $\chi2$ (3) = 28.041, p = .000, on IR between the mean rank score of 183.48 (Urban Males), 211.25 (Urban Females), 111.85 (Rural Males), and 135.43 (Rural females) were significant, $\chi2$ (3) = 58.747, p = .000, on VRSP among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 24.374, p = .000, with a mean rank score of 160.46 for Urban Males, 199.28 for Urban Females, 133.86 for Rural Males, and 148.40 for Rural females; on VRDP among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 26.470, p = .000, with a mean rank score of 153.32 for Urban Males, 200.89 for Urban Females, 127.39 for Rural Males, and 160.40 for Rural females; on VR among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 52.554, p = .000, with a mean rank score of 172.48 for Urban Males, 205.39 for Urban Females, 103.48 for Rural Males, and 160.65 for Rural females; on RG among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 37.629, p = .000, with a mean rank score of 205.36 for Urban Males, 168.68 for Urban Females, 146.28 for Rural Males, and 121.69 for Rural females.

‘**Ecology**’ and ‘**gender**’ has a significant interaction effect with an effect size of 16% on Mental Balance; 2% on Attention and Concentration; 8% on Delayed Recall; 18% on Immediate Recall; 7% on Verbal Retention for Similar Pairs; 7% on Verbal Retention for Dissimilar Pairs; 16% on Visual Retention; 11% on Recognition respectively which accept the Forth Hypothesis.

(Note: HAM = High Academic Achiever Male, HAF = High Academic Achiever Female, LAM = Low Academic Achiever Male, LAF = Low Academic Achiever Female, RM = Remote Memory, REM = Recent Memory, MB = Mental Balance, AC = Attention and Concentration, DR = Delayed Recall, IR= Immediate Recall, VRSP = Verbal Retention for Similar Pairs, VRDP = Verbal Retention for Dissimilar Pairs, VRT = Visual Retention and RT = Recognition)

A Kruskal-Wallis H test showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across ‘**gender x level of academic achievement**’ i.e on **RM** among HAM, HAF, LAM and LAF, χ^2 (3) = 12.516, p = .006, with a mean rank score of 178.00 for HAM, 168.00 for HAF, 154.00

for LAM, and 142.00 for LAF; **REM** among HAM, HAF, LAM and LAF, χ^2 (3) = 17.271, p = .001, with a mean rank score of 182.68 for HAM, 171.01 for HAF, 145.41 for LAM, and 142.90 for LAF; **MB** among HAM, HAF, LAM and LAF, χ^2 (3) = 128.321, p = .000, with a mean rank score of 200.19 for HAM, 227.83 for HAF, 80.39 for LAM, and 133.59 for LAF; on **A&C** among HAM, HAF, LAM and LAF, χ2 (3) = 136.800, p = .000, with a mean rank score of 229.27 for HAM, 211.24 for HAF, 109.13 for LAM, and 92.36 for LAF, on **DR** among HAM, HAF, LAM and LAF, χ^2 (3) = 80.524, p = .000, with a mean rank score of 191.77 for HAM, 211.93 for HAF, 94.37 for LAM, and 143.94 for LAF; **IM** among HAM, HAF, LAM and LAF, χ^2 (3) = 142.564, p = .000, with a mean rank score of 196.15 for HAM, 242.04 for HAF, 99.18 for LAM, and 104.64 for LAF; **VRSP** among HAM, HAF, LAM and LAF, χ^2 (3) = 95.768, p = .000, with a mean rank score of 195.57 for HAM, 217.85 for HAF, 98.75 for LAM, and 129.83 for LAF; **VRDP** among HAM, HAF, LAM and LAF, χ^2 (3) = 108.065, p = .000, with a mean rank score of 182.34 for HAM, 236.31 for HAF, 98.37 for LAM, and 124.98 for LAF; **VR** among HAM, HAF, LAM and LAF, χ^2 (3) = 147.642, p = .000, with a mean rank score of 188.14 for HAM, 246.82 for HAF, 87.82 for LAM, and 199.23 for LAF; **RG** among HAM, HAF, LAM and LAF, χ^2 (3) = 145.248, p = .000, with a mean rank score of 231.57 for HAM, 206.29 for HAF, 120.07 for LAM, and 84.08 for LAF respectively.

‘**Gender**’ and ‘**level of academic achievement**’ has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 39% on Mental Balance; 42% on Attention and Concentration; 24% on Delayed Recall; 44% on Immediate Recall; 29% on Verbal Retention for Similar Pairs; 33% on Verbal Retention for Dissimilar Pairs; 46% on Visual Retention; 45% on Recognition respectively which accept the Forth Hypothesis.

(Note: HAU= High Academic Achiever Urban, HAR= High Academic Achiever Rural, LAU= Low Academic Achiever Urban, LAR= Low Academic Achiever Rural, RM= Remote Memory, REM= Recent Memory, MB= Mental Balance, AC= Attention and Concentration, DR= Delayed Recall, IR= Immediate Recall, VRSP= Verbal Retention for Similar Pairs, VRDP= Verbal Retention for Dissimilar Pairs, VRT= Visual Retention and RT= Recognition)

A Kruskal-Wallis H test showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across '**ecology x level of academic achievement**' i.e on **RM** among HAU, HAR, LAU and LAR, χ^2 (3) = 13.722, p = .003, with a mean rank score of 182.00 for HAU, 164.00 for HAR, 152.00 for LAU, and 144.00 for LAR; **REM** among HAU, HAR, LAU and LAR, χ^2 (3) = 19.486, p = .000, with a mean rank score of 186.56 for HAU, 167.13 for HAR, 147.93 for LAU, and 140.39 for LAR; **MB** among HAU, HAR, LAU and LAR, χ^2 (3) = 149.379, p = .000, with a mean rank score of 246.46 for HAU, 181.55 for HAR, 137.53 for LAU, and 76.46 for LAR; **A&C** among HAU, HAR, LAU and LAR, χ^2 (3) = 143.446, p = .000, with a mean rank score of 234.27 for HAU, 206.24 for HAR, 118.34 for LAU, and 83.16 for LAR; **DR** among HAU, HAR, LAU and LAR, χ^2 (3) = 81.348, p = .000, with a mean rank score of 223.14 for HAU, 180.55 for HAR, 136.61 for LAU, and 101.70 for LAR; **IR** among HAU, HAR, LAU and LAR, χ^2 (3) = 196.257, p = .000, with a mean rank score of 238.59 for HAU, 199.60 for HAR, 156.14 for LAU, and 47.68 for LAR; **VRSP** among HAU, HAR, LAU and LAR, χ^2 (3) = 104.170, p = .000, with a mean rank score of 229.40 for HAU, 184.02 for HAR, 130.34 for LAU, and 98.24 for LAR; **VRDP** among HAU, HAR, LAU and LAR, χ^2 (3) = 102.442, p = .000, with a mean rank score of 220.53 for HAU, 198.12 for HAR, 133.68 for LAU, and 89.67 for LAR; **VR** among HAU, HAR, LAU and LAR, χ^2 (3) = 157.550, p = .000, with a mean rank score of 246.16 for HAU, 188.80 for HAR, 131.72 for LAU, and 75.33 for LAR; **RG** among HAU, HAR, LAU and LAR, χ^2 (3) = 165.363, p = .000, with a mean rank score of 238.75 for HAU, 199.11 for HAR, 135.29 for LAU, and 68.86 for LAR respectively.

'**Ecology**' and '**level of academic achievement**' has a significant interaction effect with an effect size of 3% on Remote Memory; 5% on Recent Memory; 46% on Mental Balance; 44% on Attention and Concentration; 25% on Delayed Recall; 61% on Immediate Recall; 32%
on Verbal Retention for Similar Pairs; 31% on Verbal Retention for Dissimilar Pairs; 49% on Visual Retention; 51% on Recognition respectively which accept the Forth Hypothesis.

These findings proved the final hypothesis that there was significant interaction effect of '**level of academic achievement**', '**ecology**' and '**gender**' on the subscales of The PGIMS for the samples i.e. significant interaction effect of '**ecology** x **gender**', '**gender** x **level of academic achievement**', '**ecology** x **level of academic achievement**' on the dependent variables (RM, REM, MB, A&C, IR, DR, RSP, RDP, VR and RG) among the samples. The research suggested that there is an interaction effect between level of academic achiever, ecology and gender among the samples. The recent study is urgently needed for expanding the existing body of research and to help implement intervention programmes because there is not enough literature that supports the current findings.

(Note: HAUM = High Academic Achiever Urban Male, HAUF = High Academic Achiever Urban Female, HARM = High Academic Achiever Rural Male, HARF = High Academic Achiever Rural Female, LAUM = Low Academic Achiever Urban Male, LAUF = Low Academic Achiever Urban Female, LARM = Low Academic Achiever Rural Male, LARF = Low Academic Achiever Rural Female, RM = Remote Memory, REM = Recent Memory, MB = Mental Balance, AC = Attention and Concentration, DR = Delayed Recall, IR = Immediate Recall, VRSP = Verbal Retention for Similar Pairs, VRDP = Verbal Retention for Dissimilar Pairs, VRT = Visual Retention and RT= Recognition)

A Kruskal-Wallis H test showed that across '**level of academic achievement** x **ecology** x **gender'** there was a statistically significant difference on **REM** between the mean rank of 194.34 (HAUM), 178.79 (HAUF), 171.01 (HARM), 163.24 (HARF), 154.32 (LAUM), 141.53 (LAUF), 136.50 (LARM) and 144.28 (LARF) were significant, χ^2 (7) = 21.481, p = .003, on **MB** between the mean rank of 215.43 (HAUM), 277.50 (HAUF), 184.95 (HARM), 178.15 (HARF), 115.56 (LAUM), 159.49 (LAUF), 45.23 (LARM) and 107.70 (LARF) were significant, χ^2 (7) = 172.944, p = .000, on **A&C** between the mean rank of 246.99 (HAUM), 221.55 (HAUF), 211.55 (HARM), 200.93 (HARF), 123.36 (LAUM), 113.31 (LAUF), 94.90 (LARM) and 71.41 (LARF) were significant, χ^2 (7) = 146.758, p = .000, on **DR** between the mean rank of 218.31 (HAUM), 227.98 (HAUF), 165.23 (HARM), 195.88 (HARF), 119.34 (LAUM), 153.88 (LAUF), 69.40 (LARM) and 134.00 (LARF) were significant, χ^2 (7) = 96.925, p = .000, on **IR** between the mean rank of 199.66 (HAUM), 277.51 (HAUF), 192.64 (HARM), 206.56 (HARF), 167.29 (LAUM), 144.99 (LAUF), 31.06 (LARM) and 64.29 (LARF) were significant, χ^2 (7) = 215.174, p = .000, on **VRSP** between the mean rank of 208.90 (HAUM), 249.90 (HAUF), 182.24 (HARM), 185.80 (HARF), 112.01 (LAUM), 148.66 (LAUF), 85.49 (LARM) and 111.00 (LARF) were significant, χ^2 (7) = 113.692, *p* = .000, on **VRDP** between the mean rank of 189.61 (HAUM), 251.45 (HAUF), 175.08 (HARM), 221.16 (HARF), 117.04 (LAUM), 150.32 (LAUF), 79.70 (LARM) and 99.64 (LARF) were significant, χ^2 (7) = 120.190, *p* = .000, on **VR** between the mean rank of 200.34 (HAUM), 291.98 (HAUF), 175.94 (HARM), 201.66 (HARF), 144.63 (LAUM), 118.81 (LAUF), 31.01 (LARM) and 119.64 (LARF) were significant, χ^2 (7) = 200.237, *p* = .000, and on **RG** between the mean rank of 254.70 (HAUM), 222.80 (HAUF), 208.44 (HARM), 189.78 (HARF), 156.03 (LAUM), 114.55 (LAUF), 84.11 (LARM) and 53.60 (LARF) were significant, χ^2 (7) = 175.339, *p* = .000 respectively.

‘**Level of academic achievement**’, ‘**ecology**’, and ‘**gender**’ has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 53% on Mental Balance; 44% on Attention and Concentration; 29% on Delayed Recall; 67% on Immediate Recall; 34% on Verbal Retention for Similar Pairs; 36% on Verbal Retention for Dissimilar Pairs; 62% on Visual Retention; 54% on Recognition respectively which accept the Forth Hypothesis.

These findings proved the final hypothesis that there was a significant interaction effect of ‘**level of academic achievement**’, ‘**ecology**’, and ‘**gender**’ on the subscales of The PGIMS for the samples i.e. significant interaction effect of ‘**ecology** x **gender**’, ‘**gender** x **level of academic achievement**’, ‘**ecology** x **level of academic achievement**’ on the dependent variables (RM, REM, MB, A&C, IR, DR, RSP, RDP, VR, and RG) among the samples. The recent study is urgently needed for expanding the existing body of research and to help implement intervention programmes because there is a dearth of literature that supports the current findings.

The result of the present study may be summarized as follows concerning the theoretical expectation (hypothesis) set forth for the study:

1) The results revealed that in **levels of academic achievement**, high academic achiever scores were higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, and Verbal Retention for Similar Pairs, Verbal

Retention for Dissimilar Pairs, Visual Retention and Recognition respectively which accepts the first hypothesis.

2) The results revealed that in **ecology**, there was a difference between urban scores were higher in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition as compared to rural. However, there was no difference between urban and rural in Remote memory and Recent Memory. This proved the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students.

3) **Gender** differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no difference in Remote memory, Recent Memory, and Attention and Concentration compared between Males and Females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. This confirmed the first hypothesis "It was expected that (iii) higher scores in females than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males.

4) Results of the Spearman correlation revealed significant correlations among the dependent variables. The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of Remote Memory, which was shown to have no significant correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no significant correlation with Visual Retention or Dissimilar Pairs. This finding supported the second hypothesis, which stated that the study would reveal the significant relationship between the dependent variables (Remote, Recent Memory, Mental Balance, Digit Span-Attention and Concentration,

Immediate Recall, Delayed, Retention for Similar, Retention for Dissimilar Pairs, Visual Retention and Recognition on the Samples.

5) **Levels of academic achievement** has a significant independent effect with an effect size of 18% on Remote Memory, 23% on Recent Memory, 23% on Mental Balance, 58% on Attention and Concentration, 64% on Delayed Recall, 45% on Immediate Recall, 53% on Verbal Retention for Similar Pairs, 65% on Verbal Retention for Dissimilar Pairs, 63% on Visual Retention and 66% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**level of academic achievement**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. High academic achiever scores were significantly higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively.

6) **Ecology** has a significant independent effect with an effect size of 35% on Mental Balance, 17% on Attention and Concentration, 21% on Delayed Recall, 39% on Immediate Recall, 17% on Verbal Retention for Similar Pairs, 21% on Verbal Retention for Dissimilar Pairs, 30% on Visual Retention and 28% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**Ecology**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Urban scores were significantly higher as compared to rural in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition respectively. However, there was no significant difference between urban and rural in Remote memory and Recent Memory among the samples.

7) **Gender** has a significant independent effect with an effect size of 21% on Mental Balance, 19% on Delayed Recall, 14% on Immediate Recall, 15% on Verbal

Retention for Similar Pairs, 22% on Verbal Retention for Dissimilar Pairs, 25% on Visual Retention and 16% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**Gender'** on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Females were significantly higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were significantly higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females.

8) **Ecology** and **gender** has a significant interaction effect with an effect size of 16% on Mental Balance, 2% on Attention and Concentration, 8% on Delayed Recall, 18% on Immediate Recall, 7% on Verbal Retention for Similar Pairs, 7% on Verbal Retention for Dissimilar Pairs, 16% on Visual Retention and 11% on Recognition. This finding supported the fourth hypothesis set forth for the study.

9) **Gender** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 2% on Remote Memory, 4% on Recent Memory, 39% on Mental Balance, 42% on Attention and Concentration, 24% on Delayed Recall, 44% on Immediate Recall, 29% on Verbal Retention for Similar Pairs, 33% on Verbal Retention for Dissimilar Pairs, 46% on Visual Retention and 45% on Recognition. This finding supported the fourth hypothesis set forth for the study.

10) **Ecology** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 5% on Recent Memory, 46% on Mental Balance, 44% on Attention and Concentration, 25% on Delayed Recall, 61% on Immediate Recall, 32% on Verbal Retention for Similar Pairs, 31% on Verbal Retention for Dissimilar Pairs, 49% on Visual Retention and 51% on Recognition. This finding supported the fourth hypothesis set forth for the study.

11) **Levels of Academic Achievement, Ecology,** and **Gender** were used as independent variables in the memory tests. The findings indicate a statistically significant interaction effect of '**level of Academic Achievement, Ecology,** and

gender' on all the PGI-Memory sub-scales with an effect size of 2%, 4%, 53%, 44%, 29%, 67%, 34%, 36%, 62% and 54% respectively which accept the fourth hypothesis. The level of Academic Achievement had a clear effect on the test scores of PGIMS. participants with high academic achievers outperformed those with low academic achievers on all tests. The results also revealed gender effects, though these were small, with females outperforming males on verbal tests and the reverse pattern on recognition tests.

Limitation:

The study does have several limitations. First, as some participants were excluded for the higher control tasks which was a limitation and this reduced the number of participants. Only students attending high school level were studied which limits the diversity of the findings. The confounding variables from previous studies like age, school context, stress level, socio-economic status, and socio-psychological variables were under control which could also contribute to the factors of cognitive abilities. Due to lack of experimental control, this study does not attribute causality to the observed relationships. Therefore, it is suggested that future research should attempt to replicate these findings among a broader range of populations.

Suggestions for future research:

Based on the limitation of the present study, it was suggested that further extended studies illustrate the difference in memory abilities for a better understanding. The findings also suggested that the confounding variables from previous studies like age, school context, stress level, socio-economic status, and socio-psychological variables which were under control would enrich the finding on the factors of cognitive abilities on academic outcomes for making suggestions for intervention. The study also suggested that future research should attempt to replicate these findings among a broader range of populations among students attending all school levels for the diversity of the findings. Future research should attempt to conduct a longitudinal study and identifying early cognitive predictors of academic success at different levels of school education. With all of the limitations, the present study clearly highlighted the difference between level of academic achievement, gender and ecology on Memory abilities; the scale employed would find replicability in the selected population for further studies.

Significance of the study:

The study highlighted the potential academic achievement correlates to the differences in memory abilities. Poor memory ability may lead to failures in performing daily classroom activities such as remembering classroom instructions and in learning (Gathercole et al., 2006; Holmes et al., 2014; Cowan, 2014; Blankenship et al., 2015). Without early intervention, memory deficits cannot be made up over time and will continue to compromise a student's likelihood of academic success (Alloway, 2009).

Implications:

Based on the findings and recommendations made, memory components and capabilities should be assessed in order to offer a complete and accurate picture of the student's abilities and limitations. The government should prioritise early identification because it will allow occupational therapists and other professionals to create therapeutic activities and intervention goals for better academic outcomes. This is important as it will allow them to take into account the cognitive differences between students in urban and rural areas.

Overall, our research focused on the differences in cognitive abilities between urban and rural students as well as the crucial role that memory abilities play in academic achievement. Expanding our knowledge of how memory functions differ across urban and rural locations is still crucial to closing the gap and promoting better academic achievements. More programme interventions ought to be created and implemented as a result.

As Yuan and his colleagues (2006) highlight, improving working memory capacity holds the promise of providing students with more cognitive resources for both knowledge acquisition and application. It may not only improve student's current achievement but more importantly, also enhance their lifelong learning. To this end, new and motivating techniques are constantly being developed and include online quizzes that students can take to test their knowledge, or the use of clickers (remote control devices that allow students to communicate with their teacher in front via a computer system) with which students can answer multiple-choice questions during class and can give feedback to the teacher (Bruff, 2010; Miller et al., 2015).

Lastly, the addition of memory tests to the batteries of instruments usually employed in psycho-educational assessment may help to identify cases with high risk of academic failure among the individuals, as well as to implement preventive interventions.

Appendix-I

CONSENT FORM

Hriatturte:

1. He zirnaa i tel hian zawhna hrang hrang zawh i nih a, i lo chhan bak thildang engmah tih a ngailo ang.

2. Heta i chhanna ah hian i nihna thup vek a ni ang. He phek hmalam hi chu a hrana dahthat tur a nih avangin he chhanna hian i hming leh veng a tarlang dawn lo. Chuvangin i thiltawn te tlang taka chhang turin ka ngen a che.

3. Heta zawhna awm zawng zawng ah te hian, dik leh dik lo a awm lova, zawhna nena inhmeh ber a i hriat angin chhan zel mai tur a ni e.

4. He zirbingna in a tum tlangpui chu Hriatrengna (Memory) chungchanga zirna (research) tih hmasawn leh hriatrengna hi zirnaa hlawhtlinna (academic achievement) nen a inkungkaih dan hriat chian a ni.

5. He zirna atana i hun hlu tak sen i inhuam avangin ka lawm e.

He zirna, "**Memory Profiles of the High School Students in Mizoram** " ah hian kei ____________________________________ Veng/Khua________________, kum__________ hian ka remtihna ngei a telin, zawhna min pek te pawh ka chhang a ni tih he form hian a entir a, ka chhanna zawng zawng hi keimahin a ka hriat dan leh tawn dan vek a ni a. Ka chhanna te hi tlangzarh a nih pawhin ka nihna thup tlat a ni dawn tih ka hria a. Heta zawhna te hian keimahah harsatna a siam emaw, rilru hrehawmna a thlen a nih chuan ka duh hunah ka inhnukdawk thei a ni tih ka hre bawk e.

( )

Subject (Chhangtu)

(LALNUNPUII)

Research Scholar

Appendix-II

Demographic Questionnaire

1. **Your Father's Name:** ____
2. **Your Father's Occupation:** ____
3. **Your Mother's name:** ____
4. **Your Mother's Occupation:** ____
5. **Your Occupation:** ____
6. **Date of Birth:** ____
7. **Your Address:** ____
8. **Your Permanent Address:** ____
9. **Class reading:** ____
10. **Name of school:** ____
11. **Subject:** Arts / Science / Commerce
12. **Medium of teaching:** Mizo/ English/ Hindi
13. **Marks in percentage in class VII (last exams):** below 60/ 60-80 / above 80
14. **Marks in percentage in class VIII (last exams):** below 60/ 60-80 / above 80
15. **Marks in percentage in class IX (last exams):** below 60/ 60-80 / above 80
16. **Marks in percentage in class X (First/second termination exams):** below 60/ 60-80 / above 80
17. **Do you have any health problems?**
    Diabetes/ harts problem/sleep disorder/ Seizure/others
    If others____
18. **Are you currently under any medication?** ______________________
19. **If yes, which treatment you are taking:** _____________________
20. **What time your use to study:** Night/Morning/noon
21. **How many hours do you study in a day?**

1 hour / 2 hours/ 3 hours/ more than 4 hours

22. For you, what time is the best time for study: Night/Morning/noon

23. Do you have any history of substance abuse? Yes / No

24. If Yes, Specify which kind of substance:
Cannabis, Solvents, Tranquilizers, Hallucinogens, Alcohol, others.
If others____

25. At what age, did you start taking substances? _______________

Appendix-III

PGIMS-PW (English and Mizo)

Dwarka Prasad (Chandigarh)

N.N.Wig (Chandigarh)

A hnuaia awl te hi dahkhat rawh (Please fill up the following information)

Hming______________________________ Kum__________________

Zirlai pawl zat___________________________ Sex (Mipa/hmeichhia)_________

Occupation__________________________ Sr. No________________

Date_________________

SCORING TABLE/PROFILE

Sub-tests / P.Rank	Recent M	Mental Balance	Remote M	A &C	Delayed Recall	Immediate Recall	Retention for Similar parirs	Retention for Dissimilar pairs	Visual R	Recog.	Total Score

Clinical Test of Memory

I. Remote Memory		**Response**	**Scoring**
1.	How old are you ***(Kum engzat nge I nih?)***		
2.	Where were you born? ***(Khawi nge I pian na hmun?)***		
3.	a) When you were in first grade, who was your class teachers? ***(Class I I nih laiin, tunge in class teacher?)***		
	b) Have you ever experienced an accident when you were less than seven years old? ***(Kum sarih I tlin hmain tawhsual I tawk tawh em?)***		
	c) What were your final exam results in your 4th Grade? ***(Class 4 I nih lai in engxat na ah nge I pass?)***		
4.	When was your first school field trip? Mention how you spent that day. ***(In school field trip hmasa ber engtik nge? Hun in hman dan han sawi tel la.)***		
5.	How did you celebrate your 7th Birthday? ***(Engtin nge kum 7 I tlin birthday I lawm?)***		
6.	What was the name of the first storybook you read and tell me the story in brief? ***(Eng thawnthu bu nge I chhiar hmasak ber? A bu a in ziak tlangpui min lo hrilh)***		
II	**Recent Memory**	**Response**	**Scoring**
1.	What did you eat in your last dinner? ***(Zanriah I ei hnuhnun berah khan enge I ei?)***		
2.	What did you eat this morning? ***(Tukin ah enge I ei?)***		
3.	What is the name of this month? ***(Tun thla hi ege?)***		
4.	What day is today? ***(Ni engzat nge vawin?)***		
5.	What time did you wake up today? ***(Dar engzatah nge I thawh?)***		
III	**Mental Balance**	**Response**	**Scoring**

1.	Recite A to Z (Alphabet of any language) ***(A-Z sawi chhuah rawh le)***		
2.	Count backward from 20-1 ***(1 atanga 20 a let zawngin han sawi the le)***		
3.	Count backward by minusing 3s starting from 40. ***Sawmli (40) atanga pathum (3) paih eng nge?*** ***Chumi atanga pathum (3) paih chu engnge? Pathum han paih thla zel teh***		

IV Attention and Concentration

1. I am going to say some numbers. Listen them carefully, when I read them, you will repeat them in the same order.
(Nambar ka sawi anga. Ngun tak in lo ngaithla la, ka sawi zawh velah a in dawt in I lo sawi chhawng leh dawn ania)

		Response	**Scoring**
5-7-3	4-1-7		
5-3-8-7	6-1-5-8		
1-6-4-9-5	2-9-7-6-3		
3-4-1-7-9-6	6-1-5-8-3-9		
7-2-5-9-4-8-3	4-7-1-5-3-8-6		
4-7-2-9-1-6-8-5	9-2-8-8-3-1-7-4		

2. I am going to read some numbers but you will be required to repeat them backward. For example, I say 2,5 you will say 5,2
(Nambar ka sawi anga, a let zawng in I sawi ve thung ang. Entir nan, pahnih, panga ka tia nga panga, pahnih I ti thung ang)

		Response	**Scoring**
8-5	2-8		
4-3-7	8-5-1		
8-5-6-3	3-7-5-9		
4-7-2-9-1	9-2-5-8-4		
2-5-9-4-8-3	7-1-5-3-9-6		
3-5-8-6-1-9-2	6-3-7-1-4-8-5		
8-5-2-3-6-1-9-4	2-8-4-5-9-7-1-3		

V. Delayed Recall

I am going to read the name of some objects, listen carefully and when I ask you to repeat, you will do so. ***(Thil hming ka sawi anga, ngun takin lo ngaithla la, chuan sawi rawh le ka tih veleh I lo sawi zawm dawn nia)***

Read at the rate of one word per second and ask the subject to repeat it after an interval of one minute ***(thumal pakhat hi second khat zela rangin sawila, minute khat I chawlh hnu ah I sawi chhawn tir dawn nia)***

		Response	**Scoring**
1	**2**		
Umbrella ***(Nihliap)***	Fish ***(Thleng)***		
Flower ***(Pangpar)***	Lamp ***(Fian)***		

Clock ***(Hun)***	Rupee ***(Poisa)***		
Picture ***(Thlalak)***	Taj ***(In)***		
Pencil ***(Dawhkan)***	Toy ***(Bel)***		

VI. Immediate Recall

I am going to read a few small sentences one by one. Listen them carefully because when I am through I would like you to tell me the whole sentence as precisely as you can.

(Pakhat te te in thu ka sawi a nga, ngun tak in lo ngaithla la chipchhiar/kimchang thei ang ber in ka sawi zawh ah I sawi dawn ania)

	Scoring
1. Ram got up from the chair, opened the door and went to market. ***(Rama chu thuthleng atangin a tho a, khawgkar a hawnga chuan bazaar ah a kal)***	
2. Patient was asked to lie down on the table, he was seen, medicine was prescribed and was told to come next day. ***(Damlo chu dawhkan ah mu tur in a hrilh a, a endika, damdoi chu a chawh a chuan a tukah kal leh tur in a hrilh)***	
3. Mohan did not have water in his house, he picked-up the bucket, went to street well, filled it up and returned back. ***(Mohana chu an inah tui a nei lova, bucket a khai khanga, kawna tuikhur a pana, a dawh khata chuan a let ani)***	

VII. Verbal Retention for Similar Pairs

Now, I am going to read to you a list of pairs, i.e., two words at a time, Listen carefully, when I name one word of the pair you will tell the second word of the pair. ***(Tunah chuan thumal in kawp, entir nan, thumal pahnih arualin. Ngun takin lo ngaithlala, tichuan thumal pakhat ka sawi khan, a khawppui zawk zel I lo sawi dawn ania)***

1	**2**	**Response**	**Scoring**
Tree ***(Thing)***	Flower ***(Pangpar)***		
Sweet ***(Thlum)***	Sour ***(Thur)***		
Man ***(Pa)***	Woman ***(hmeichhia)***		
Day ***(Ni)***	Night ***(Zan)***		
Black ***(Dum)***	White ***(Var)***		

VIII. Verbal Retention for Dissimilar Pairs

					Response	**Scoring**
Table ***(Dawhkan)***	Black ***(Dum)***	**4**	**2**	**1**		
Tree ***(Thing)***	High **(Sang)**	**2**	**1**	**5**		
Lamp ***(Alh)***	Uneven ***(Inruallo)***	**1**	**5**	**3**		
Child ***(Nau)***	Bitter ***(khatak)***	**3**	**4**	**2**		
Dream **(Mang)**	Deep ***(Ril)***	**5**	**3**	**4**		

IX Visual Retention

I am going to show you a card, see it carefully. After some time (15 seconds) I will take it away and when I ask you to draw them, draw the things you saw in the card from your memory on this paper.
(Card ka hmuh che nga, ngun tak in en la. Ahnu reilo teah ka la sawn anga tichuan ziak rawh ka tih hun ah card a I hmuh kha he paper ah hian I ziak dawn ania)

Response	**Scoring**

X. Recognition

I am showing you a card containing pictures of many objects, see the whole card attentively. After some time I will place you another card. From this you will be required to identify and name the objects you saw in earlier card.
(He card ah hian thil lem hrang hrang awm ka hmuh che nga, card chhunga mi hi ngun takin en la, a hnu lawk ah card dang ka hmuh leh che nga, ti chuan a hma a I hmuh ho kha I thlang chhuak ang a, I sawi lang ang)

		Response			**scoring**

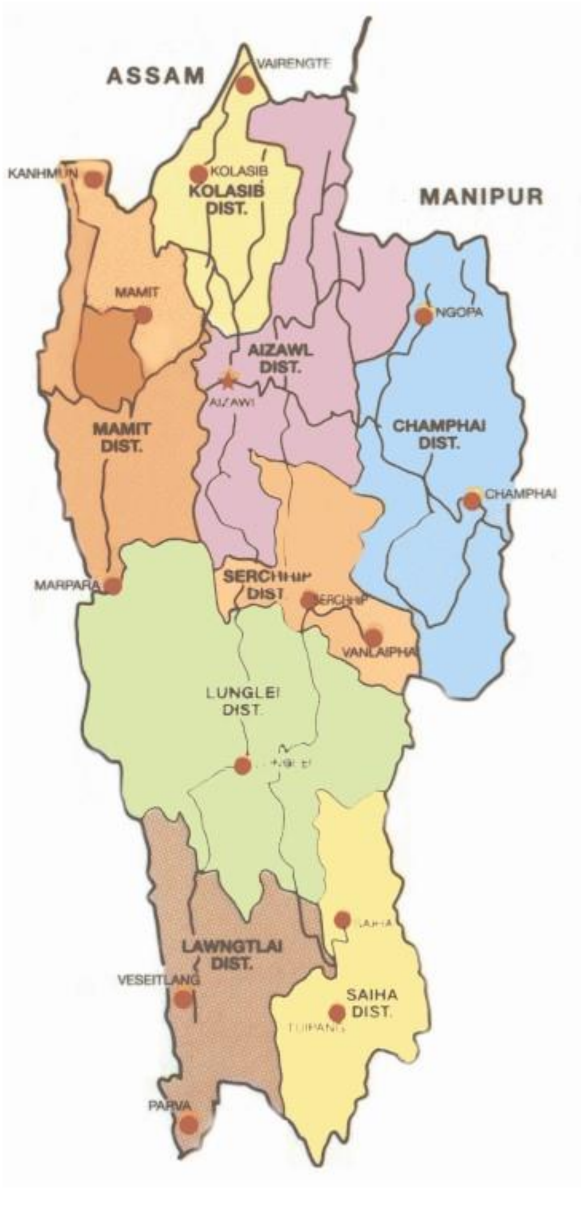
Appendix-IV

MAP OF INDIA

(Showing the location of Mizoram State)

Appendix-V

MAP OF MIZORAM STATE



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ABSTRACT

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In partial fulfillment of the requirement for the degree of

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Memory theories and research findings demonstrate the relevance of memory in everyday life, particularly in the field of education. First, memory is essential for most higher-level cognitive processes, such as recall, retention, decision-making, strategy utilisation, processing speed, and broad attention, all of which are commonly employed in daily life and in academic activities (McGrew & Woodcock, 2001; McNamara & Scott, 2001; Dehn, 2008). The importance of memory in students is mirrored in the huge quantity of relevant research concentrating on the teaching and learning process (Pantziara & Philippou, 2015). Previous research has revealed a contradictory result on the link between memory and academic success (Gathercole et al., 2003). Additionally, the results of previous research that examined different memory functions in connection to academic performance, either independently or combined, are also challenging to integrate.

Beginning in preschool and continuing through tertiary studies, working memory (WM) is considered to be an essential skill (Alloway et al., 2005; Alloway & Gregory, 2013). Poor arithmetic performance is also characterized by weak verbal working memory skills because people with these problems process information more slowly and struggle to keep up with timed tasks and fast presentation of information. Due to their frustration, some students decide to drop out of school or college (Alloway, 2006). According to previous studies, memory deficits likely contribute to difficulties in learning and poor academic progress among learners (Gathercole & Alloway, 2008). Researchers have reported that children who fail to perform adequately in academics without any apparent limitation had deficits in basic psychological processes. Defects in psychological processes which include cognitive abilities in perception, language, memory, attention, concept formation, problem-solving, and the like act as intrinsic limitations or deficiencies that interfere with the child’s learning (Carte et al., 1996).

Regarding the impact of short-term memory (STM) on academic achievement, it seems that children who have trouble reading have trouble with reading faces that need them to keep information in order of presentation for a brief period of time, including digit span and word span (McDougall et al., 1994; Swanson et al., 1998). This shortcoming might be related to deficits in the STM's rehearsal process (Henry & Millar, 1993). Another set of results demonstrated the critical role that short-term phonological storage plays in word recognition (Jorm, 1983). Additionally, some research showed that STM tasks like word and digit span allow one to discern between good and poor readers (Torgesen & Houck, 1980). This conclusion was supported by consistent findings showing the Wechsler IQ scale's digit span subtest is capable of identifying children who struggle with reading (Mishra et al., 1985).

El-Mir (2019) researched on how memory affects academic achievement. They examined how several memory functions, including working memory (WM), short-term memory (STM), and long-term memory (LTM), affect academic achievement. However, the relationships between WM and learning task performance were the main emphasis. Based on the findings that WM capacity conditioned achievement in word recognition and reading comprehension in language and concluded that measurements of WM might be used to predict performance in various cognitive tasks, such as reading.

WM capacity is considered to be able to predict performance in many cognitive tasks (Swanson, 1993; Engle, 2002), and it also significantly correlates with performance in word recognition, reading comprehension, spoken language comprehension, following directions, developing vocabulary, written expression, and reasoning (Engle, 1996; Engle et al.,1999; Dehn, 2008). WM span measures are intended to explain individual differences in learning (Gathercole et al., 2006; Swanson et al., 1990). Additionally, the research found that WM deficits lead to failures in various learning activities, including recalling and following instructions and mental arithmetic (Gathercole et al., 2006).

Furthermore, measurements of WM capacity correlate with reading performance (Daneman & Carpenter, 1980; Zahn et al., 2022). In addition, researchers found strong relationships between word recognition and several complicated memory span tests, such as WM span (Daneman & Carpenter, 1980; Gathercole & Pickering, 2000). More recent studies have revealed that WM capacity assessments are a better predictor of academic achievement than intelligence tests (Swanson, 2004; Alloway et al., 2005; Gathercole et al., 2006; DeMarie & Lopez, 2014). According to some evidence (Colom et al., 2004; Kane et al., 2005), a measure of working memory can provide an almost perfect prediction of performance on tests of general ability. Rinn and Plucker (2004) noted that further study of adolescents of high ability is of special interest to higher educational institutions and their attempts to improve both scholastic and non-scholastic opportunities. This age marks the beginning of a new milestone in a person's development, a transition out of childhood and into adulthood. Although some interest has been paid to the development of some of these dimensions of college students' memory ability (e.g., Dolgova et al., 2020, studied the relationship between memory properties and academic performance of college students), a review of the extant literature could find some contradicting relating this memory ability to academic achievement in this population. Therefore, the relationship between these constructs in younger (adolescent) populations is examined in the present study.

Additionally, the literature has revealed that there are gender differences in cognitive ability. There are several particular areas that are brought to mind rather immediately when thinking about the subject of whether there are differences in cognitive ability between males and females. Researchers have known for some time that the spatial and recognition domains are particularly important to the subject of cognitive gender differences as they produce noticeable differences in favour of males (Linn & Petersen, 1985; Benbow, 1988; Hyde et al., 1990; Hedges & Nowell, 1995; Voyer et al., 1995). Although verbal abilities used to be considered to favour women (Maccoby & Jacklin, 1974), more recent findings reveal that, depending on the task considered verbal abilities could indeed favour males (Hyde & Linn, 1988; Hedges & Nowell, 1995).

A previous review of the literature revealed gender differences in verbal recall, which indicates a clear pattern: It is assumed that men will have better memory for tasks requiring spatial information as compared to women (Loftus et al., 1987). Females often perform better on jobs requiring verbal information, whether they are adults or children. Lowe and colleagues (2003) Studied gender differences in short-term memory across 14 different measures in children and adolescents and revealed a profile of normal differences in patterns of memory test performance across gender, with women performing better on verbal tasks and men performing better on spatial tasks.

Similar to this, Herlitz and Rehnman's (2008) findings indicate that gender differences are produced during the course of verbal episodic memory tests. Women may have a little, overall episodic-memory advantage, which may be increased by their superior verbal output to men's disadvantage in visuospatial tasks. Pauls and colleagues (2013) investigated differences in episodic memory dependent on task type among 366 females and 330 males ranging in age from 16 to 69. Men performed better than women on tasks requiring auditory memory, whereas older men and male adolescents performed better on tasks requiring visual episodic and working memory. Working memory, executive functions, short-term memory, long-term memory, visuospatial and linguistic abilities, etc. were the major areas of attention in the previous studies (Margolin, 1984; Caramazza et al., 1987; Berninger & Swanson, 1994; Swanson & Sachse-Lee, 2001; DeStefano & LeFevre, 2004; Swanson et al., 2004; Alloway & Copello, 2013). Research examining the different memory components and the larger impact of memory on academic success is few. It seems likely that there are achievement differences between high and low performers that are associated with variations in memory profiles. This current study extends past findings by contrasting the performance of high and low academic achievers on a number of memory-related tasks.

Additionally, it is commonly assumed that rural schools are inferior to urban schools, and subsequent conclusions from this viewpoint indicate that student achievement levels differ between urban and rural areas. Researchers examined the academic performance of rural students to that of urban students in a number of crucial areas, and they found that more privileged family backgrounds—including those who come from families with greater socioeconomic status—are linked to higher academic achievement (Steinberg et al., 1996; Field et al., 2001). Strong evidence supports the notion that a child's familial socioeconomic status (SES) has a substantial impact on that individual, with cognitive ability being one of those effects (Hackman et al., 2010; Luby et al., 2013; Johnson et al., 2016; Brody et al., 2017). The study aims to contrast the memory profiles of urban and rural students. Research examining the different memory components and the larger impact of memory on academic success is few. It seems likely that based on the previous literature review there are differences in memory profiles based on the levels of academic achievement, gender and ecology. This current study extends past findings by contrasting the performance of academic achievement (**high and low academic achievers**), gender (**males and females**), and ecology (**urban and rural**) on a number of memory-related tasks.

The present study entitled "*Memory Profiles of High School Students in Mizoram*" aimed to study the memory profiles of the level of academic achievement (**high and low academic achievers**), ecology (**urban and rural**), and gender (**males and females**) among High school students in Mizoram. Hence, the study aims to create a memory profile for the population it is studying, and using a single battery of memory tests enables a more comprehensive assessment of memory performance. While considering ways to encourage academic achievement, it is essential to keep students' memory abilities in mind. Comparing different memory profiles of high achievers and low achievers might help identify memory profile elements that are particularly important for efficient learning and high-performance outcomes.

Objectives

The following Objectives were framed for the present study:

1) To examine the group difference in Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition among the groups

2) To identify the correlation between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) on the samples

3) To examine the independent effect of 'gender', 'ecology', and 'level of academic achievement 'on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

4) To study the interaction effect of 'ecology x gender', 'ecology and level of academic achievement', 'gender x level of academic achievement', and 'ecology x gender x level of academic achievement' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall,

Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) on the samples.

Hypothesis

The following hypotheses are framed to meet the objectives of the study:

1) There will be mean difference that (i) higher scores in high-level academic achievers than low-academic achievers, (ii) higher scores in Urban students than Rural students, (iii) and higher scores in Females than males on Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition with a significant difference level.

2) There will be a significant positive correlation between the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition).

3) There will be a significant independent effect of ‘level of academic achievement’, ‘ecology’, and ‘gender’ on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

4) There will be a significant interaction effect of ‘ecology x gender’, ‘ecology x level of academic achievement’, ‘gender x level of academic achievement’, and ‘ecology x gender x level of academic achievement’ on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples.

Sample

To achieve the objectives and hypothesis of the study 320 High School students of Mizoram a state in the northeast of India, (aged 16 years to 20 years) comprised equal representation of the **level of academic achievement**’ (High academic achiever and

Low academic achiever), '**ecology**' (urban and rural), and '**gender**' (male and female) were attempted comprising *160 High academic achievers {80 Urban (40 Male and 40 Female){ and 80 Rural (40 Male and 40 Female)} and 160 Low academic achievers{80 Urban (40 Male and 40 Female) and 80 Rural (40 Male and 40 Female)}* selected using a random method of sample selection, the extraneous variable which may include socio-demographic variables (SES status, types of school, substance use. etc.) was kept under control.

Designs

The design of this study was 2 x 2 x 2 factorial designs (2 gender x 2 ecology x 2 levels of academic achievement) having 8 groups under study, and each cell has equally matched its representation: 320 high school students [160 High academic achievers {80 Urban (40 male and 40 female) and 80 rural (40 male and 40 female)} and 160 Low academic achievers {Urban (40 male and 40 female) and 80 rural (40 male and 40female}] were served as the sample in the study.

Tool used

A demographic questionnaire was administered to all participants and assisted in the identification of confounding variables that could affect the data. The PGI-Memory Scale (PGIMS), constructed by Pershad and Wig (1977) was used for the evaluation of memory functions among the students. The PGIMS contained 10 sub-tests: Remote memory, Recent memory, Mental balance, Attention and Concentration, Mental Control, Immediate recall, Delayed recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual retention, and Recognition, all prescribed instructions are given in the manuals and APA guidelines for research were followed.

Procedure

The study starts with the identification and selection of samples as per objectives. Procurement of necessary permission from school authorities was taken for the study. After the samples were identified, necessary permission was taken, and oral and written informed consent was procured from each study sample. The purpose of the study was explained to all the study participants. Clearly explained that the participants may withdraw from the study at any time without any penalty. Assurance was given to the participants that confidentiality would be maintained throughout the study. The participants were clearly informed about what they had to perform during the conduction of the scale. The demographic questionnaire was administered to all participants and assisted in the identification of confounding variables that could affect the data. The administration of the PGI-MS was done to the selected samples with due care of instructions as given in the manual and APA Research Ethical Code (2002). To ascertain different types of memories, the P.G.I Memory Scale was used. It contains 10 subtests. Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed recall, Immediate recall, Verbal Retention for similar pairs, Verbal Retention for dissimilar pairs, Visual Retention, and Recognition. Each student was tested individually in a well-illuminated quiet room at the participating school. The essential items required for the test were placed on the table before calling the participants into the room. The participant was called in and was made comfortable and rapport was established. A casual conversation was started and also motivated to do their best without any unnecessary pressure for each participant. The researcher made sure that the participants understood the test and after the necessary instructions were given and understood by the participant, the test began. The procedure was repeated for each student.

Results and discussion

Sample Characteristics

The sample was categorized based on academic achievement, i.e., 160 High academic achievers were students who scored continuously higher than 80% marks, and 160 Low academic achievers scored lower than 50% marks in their last three years' examination results. Each of these two groups consisted of 80 rural students and 80 urban students, again equally categorised based on their gender into 40 males and 40 females for both urban and rural.

Subject-wise scores on subscales of the PGI-Memory Scales- remote, recent memory, mental balance, Attention and Concentration, Immediate Recall, Delayed Recall, Verbal retention for similar, Verbal retention for dissimilar pairs visual retention, and recognition were prepared for the whole samples High Academic Achiever Urban Male (HAUM), High Academic Achiever Urban Female (HAUF), High Academic Achiever Rural Male (HARM), High Academic Achiever Rural

Female (HARF), Low Academic Achiever Urban Male (LAUM), Low Academic Achiever Urban Female (LAUF), Low Academic Achiever Rural Male (LARM), Low Academic Achiever Rural Female (LARF).

Results Analysis of the present study was done in a phased manner:

1) Checking of missing raw data and outlier

The raw data set was checked for missing raw data and extreme outliers. Since there were outliers, further analysis was carried on.

2) Psychometric properties of PGI-Memory Scales/Subscales for the samples

Although the PGI-Memory Scale for Adults developed by Prashad and Wig (1977) was developed for adults with age norms for an age range from 20-69 years of age whereas the PGI-Memory Scale for Children developed by Kohli et al (1998) has age norms between 7-14 years of age, and no separate scale for adolescents in between the two scales. As such, PGI-Memory Scale for adults has been used for adolescents in earlier research to study memory functions (Gajre et al., 2008; Rajendran et al., 2016; Joshi & Arya, 2017; Chakravarty et al., 2019; Pandey et al., 2021). However, to ensure the applicability among adolescents of the targeted population pilot study was conducted and the results confirmed the applicability of the scale (Cronbach's Alpha $\geq$.60) on all the sub-scales of PGI-Memory Scales.

Psychometric analyses of the scales and subscales were done by employing Microsoft Office Excel 2013 and IBM's Statistical Package for the Social Sciences (SPSS 26). The psychological scales used in the present study were originally constructed for an adult population with age norms 20-69. Thus, before applying to the present study, it was thought needed to check the appropriateness and verify the trustworthiness of the scales for the population under study.

Accordingly, the reliabilities of all the subscales i.e., (i) Remote Memory, (ii) Recent Memory, (iii) Mental Balance, (iv) Attention and Concentration, (v) Delayed Recall, (vi) Immediate Recall (vii) Verbal Retention for Similar Pairs, (viii) Verbal Retention for Dissimilar Pairs (ix) Visual Retention and (x) Recognition in the present study were calculated using Cronbach's Alpha.

The internal consistency of the scales was calculated using Cronbach's Alpha and all the scales and subscales were found to be highly reliable where, Remote Memory consists of 6 items (α = .60), Recent Memory subscale consists of 5 items (α = .66), Mental Balance subscale consists of 3 items (α = .71), the Attention and Concentration subscale consists of 10 items (α = .71), Delayed Recall subscale consists of 10 items (α = .60), Immediate Recall subscale consists of 3 items (α = .76), Verbal Retention for Similar Pairs subscale consists of 5 items (α = .63), Verbal Retention for Dissimilar Pairs subscale consists of 15 items (α = .61), Visual Retention subscale consists of 5 items (α = .61), and Recognition subscale consists of 10 items (α = .73) respectively of the PGIMS appeared to have good internal consistency. The tool was considered reliable and hence, was used in the present study.

3) Mean comparison between the groups

High academic achievers and **low academic achievers** were calculated and high academic achievers are showing higher scores than low academic achievers on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition.

Results show that **high academic achievers** seem to have a higher level of memory performance than **low academic achievers**. These results corresponded to the findings of the previous researcher on the substantial association between memory and achievement (Dean, 2006; Kane et al, 2007; Lamba, 2014; Rabiner et al., 2016; Podila, 2019). Kane and his colleagues (2007) found that individuals with higher Working Memory Capacities performed better and strayed less during difficult tasks that required concentration and effort. The findings were thus consistent with Rabiner and colleagues' (2016) research into the relationship between attention problems and classroom learning to determine the relationship between academic achievement and attention difficulties, which suggests that attention issues frequently have a serious negative impact on students' academic achievement.

Short-term memory and academic achievement are strongly correlated in which Quilez-Robres and his colleagues (2021) and Jaquith (2007) discovered the effects of short-term memory on standardised achievement scores and provided additional support for the findings which shows that longer digit spans are associated with higher academic achievement. According to earlier studies, secondary school students who exhibit frequent inattention and poor concentration are unable to memorise without classroom concentration, thus impacting their academic achievement (Lamba, 2014; Podila, 2019). The current study confirms earlier findings by showing that low academic achievers have significantly lower attention and concentration than high academic achievers.

Previous studies suggested that weak verbal working memory skills are also characteristic of poor performance in arithmetic (Alloway, 2006). Working memory (WM) that has a positive relationship with academic achievement when possessed by students has an equally negative correlation when absent, according to another research. These findings imply that WM is a risk factor for academic failure for adolescents with attentional problems (Rogers et al, 2011).

According to Kulp and colleagues (2002), poor visual memory ability is significantly related to below-average reading decoding, math, and overall academic achievement. Also, Silver and his friends (2007) suggested that children with isolated arithmetic disabilities would have a memory profile indicative of short-term visual memory deficits. These findings are in accordance with our current findings in which high academic achiever scores significantly higher in Visual Retention and Recognition respectively as compared to low academic achiever.

As a result, the findings suggest that memory assessment in both visual and verbal modalities can be an informative tool when evaluating children with poor academic outcomes as memory deficits likely contribute to difficulties in learning and poor academic progress among learners (Gathercole & Alloway, 2008; Abraham et.al, 2016). From these findings, raising students' levels of academic achievement would need them to improve their auditory and visual processing. As a result, working memory is found to be crucial for verbal reasoning and literary comprehension by Baddeley and Hitch (Baddeley & Hitch, 1974). Baddeley and Hitch Model of working memory (1974) suggested that working memory plays a vital part in verbal reasoning and prose comprehension and in addition, Working Memory abilities predict academic success (Baddeley & Hitch, 1974). Earlier studies showed the correlation between

Working memory and academic performance (Benton, 2001; Baldwin et al., 2005; Gormley, 2009; Ishak et al., 2012). WM was found to be strongly related to academic success and to measures of reading, writing, spelling, mental arithmetic, measurement and spatial abilities, and computational scores in both typical and atypical school-going children (Caramazza et al., 1987; Margolin, 1984; Berninger & Swanson, 1994; Swanson & Sachse-Lee, 2001; DeStefano & LeFevre, 2004; Swanson et al., 2004; Alloway & Copello, 2013). In accordance with previous findings, overall memory performance was significantly higher among High academic achievers in the current study as compared to Low academic achievers, indicating that High academic achievers had better working memory capacity, attention, concentration, verbal and visual memory as compared to Low academic achievers. These findings also indicate that many children who struggle to pay attention will also struggle in academics. Thus, the results of this study found implications that individuals with memory deficits may show significantly lower academic performance. As a result, earlier comprehensive memory screenings are necessary to understand the strengths and weaknesses of children's memory skills that may assist professionals working with children to improve instructional planning, programming decisions, treatment recommendations, and accommodations to benefit their academic success.

Mean comparison between **urban** and **rural** was calculated and **urban** are showing higher scores on all the 10 sub-scales of PGIMS namely Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition than compared to their **rural** counterpart which was in supported by previous studies (Haller et al., 1993; Alspaugh & Harting, 1995; Jones & Ezeife, 2011; Wang et al., 2019; Sumi et al., 2021) which suggest that students in rural schools had lower scores in memory performance as compared to students in urban schools. Furthermore, the current study provides strong support for the hypothesis that students in **rural** performed lower in memory tasks than students in **urban**. The conclusions drawn from this perspective suggest that student achievement levels are significantly different with respect to **urban** and **rural**.

The possible explanation to the difference in memory ability between urban and rural students is that city life requires cognitive functions that are different from those necessary for daily life in remote rural villages. In the city, for example, individuals are frequently confronted with the need to read and to calculate. This is less likely to be the case in remote areas of the countryside, where communication occurs less frequently through the printed word and the economy relies on bartering rather than on monetary transactions. Depending upon parental expectations and the duties assigned to children, the demands made on cognitive abilities of boys and girls in the two environments may differ (Stevenson et al., 1990). Therefore, cognitive stimulation on cognitive may lead to improved memory ability (Bonnechère et al., 2021).

The current findings highlighted the significant role of memory abilities in academic performance and explored the differences in memory abilities between urban and rural students. Based on the aforementioned findings, it is proposed by prior research that early identification of cognitive deficits among students and the implementation of strategies to improve cognitive ability might improve students' overall development and hence support improved academic performance (Zhang et al., 2022). Therefore, the teachers, educators, and school authorities, especially at the High School level of Education; are suggested to offer more exposure and stimulating environments to students belonging to rural backgrounds. The study examined for the first time the rural-urban disparity among High school level school students on the dimensions of memory abilities, especially in north-east India.

Mean comparison between **males** and **females** on each dependent variable and **males** were showing higher scores than **females** on Recent Memory, Remote Memory, Attention and Concentration, and Recognition whereas, **females** were showing higher scores than their **male** counterparts on Mental Balance, Delayed Recall, Immediate Recall, Verbal retention for similar pairs, Verbal Retention for Dissimilar Pairs and Visual Retention on PGIMS.

Results suggested that Female seems to perform better on Verbal memory task as compared to Males in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first hypothesis "It was expected that **(iii) higher scores in Females than males**" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al., 2017). In contrast to our findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

The findings also revealed that there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between males and females and are in confirmatory to the statement that the principle for understanding gender differences in memory, males and females do not differ in overall memory ability (Maccoby and Jacklin, 1974). Likewise, previous studies found Working Memory and academic achievement were found to be equal in both males and females with no gender differences. (Aliotti & Rajabiun, 1991; Forrester & Geffen, 1991; Ullman et al.,1997; Tariq & Noor, 2012)

The current findings revealed that females perform better than males in the Verbal Retention task, which had interesting gender-related results. This was also consistent with the findings of Loftus and colleagues (1987) where gender differences in verbal memory suggest a clear pattern: Females, whether adults or children, appear to do better on tasks involving which is consistent with previous studies that female participants outperformed their male counterparts in the verbal test (Temple & Cornish, 1993; Huang, 1993; Murre et al., 2013; Chan & Abu Bakar, 2021). Likewise, Herlitz and Rehnman (2008) also suggest women may have a minor, general episodic-memory advantage, which can be augmented by the advantage women have over men in verbal production and negated by the male advantage in visuospatial tasks. The advantage that women have in auditory episodic memory may be explained by their advantage in verbal abilities and recall seems to be highly correlated with verbal ability (Daneman & Carpenter, 1983; Pauls et al., 2013). In addition, the potential sex differences in memory function, which extend to various memory domains, such as autobiographical memories, semantic memory, and memory recognition. Potential sex differences in memory are likely attributed to a multitude of factors, including various psychological (e.g., different processing strategies and learning strategies) and physiological parameters (e.g., brain structure, hormonal, and neurotransmitter differences) (Loprinzi & Frith, 2018). According to Adyalkar (2019), females have better short-term memory than men in terms of recall on the word recall test. In contrast to the current findings, Forrester and Geffen (1991) found no gender differences in verbal learning tasks.

These findings also revealed that males outperformed females on Recognition task which is consistent with earlier studies by Lowe (2003), and this may be due to that men's superior visual memory performance has been determined to be due to their better visuospatial abilities (Huang,1993; Loftus et al.,1987; Pauls et.al., 2013). However, according to Temple and Cornish's (1993) findings as well as Bridge's (2006) findings from two recognition experiments that used graphically presented travel photographs to test memory function, the results for both genders (males and females) are largely identical. In contrast, Heisz and his colleagues (2013) found that females outperformed males on recognition-memory tests, and this advantage was directly related to females' scanning behavior at encoding.

Whether there are gender differences in memory performance was one of the current key study topics. The findings from this study substantially indicate the presence of such variations. Nevertheless, females do not perform better than males in all of the PGI-Memory sales subscales. There were no statistically significant differences between males and females on the measures of remote memory, recent memory, and attention and concentration. Females did, however, perform better than males in most of the subscales in the areas of delayed recall, immediate recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, and Visual retention.

4) Mann Whitney *U* Test for measures of differences between the comparison groups on the dependent variables

Analysis of data was done to evaluate the independent effect of '**level of academic Achievement**', '**ecology**', and '**gender**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Verbal retention for similar pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition) among the sample.

The results revealed that **high academic achievers** had significantly higher scores than **low academic achievers** on all the 10 subscales of PGI-Memory Scales.

High academic achiever scores were significantly higher in the Remote memory (Mean Rank = 173.17) than low academic achiever (Mean Rank = 147.67) at $p < 0.01$ level with small effect ($U = 10760.00$; $z = -3.30$; $p < 0.01$; $r = 0.18$), High academic achiever scores were significantly higher in the Recent Memory (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with a small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; $r = 0.23$), High academic achiever scores were significantly higher in the Mental Balance (Mean Rank = 177.02) compared to low academic achiever (Mean Rank = 143.77) at $p < 0.01$ level with small effect ($U = 10139.00$; $z = - 4.09$; $p < 0.01$; r = 0.23), High academic achiever scores were significantly higher in the Attention and concentration (Mean Rank = 213.32) compared to low academic achiever (Mean Rank = 107.01) at $p < 0.01$ level with large effect ($U = 17015.00$; $z = -10.46$; $p < 0.01$; $r = 0.58$), High academic achiever scores were significantly higher in the Delayed Recall (Mean Rank = 219.26) compared to low academic achiever (Mean Rank = 101.00) at $p < 0.01$ level with large effect ($U = 3338.50$; $z = -11.45$; $p < 0.01$; $r = 0.64$), High academic achiever scores were significantly higher in the Immediate Recall (Mean Rank = 201.81) compared to low academic achiever (Mean Rank = 118.67) at $p < 0.01$ level with medium effect ($U = 6148.00$; $z = -8.20$; $p < 0.01$; $r = 0.45$), High academic achiever scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 209.27) compared to low academic achiever (Mean Rank = 111.12) at $p < 0.01$ level with large effect ($U = 4948.00$; $z = -9.58$; $p < 0.01$; $r = 0.65$), High academic achiever scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank = 219.51) compared to low academic achiever (Mean Rank = 100.75) at $p < 0.01$ level with large effect ($U = 3299.00$; $z = -11.66$; $p < 0.01$; $r = 0.53$), High academic achiever scores were significantly higher in the Visual Retention (Mean Rank = 217.71) compared to low academic achiever (Mean Rank = 102.57) at $p < 0.01$ level with large effect ($U = 3588.50$; $z = -11.35$; $p < 0.01$; $r = 0.63$), High academic achiever scores were significantly higher in the Recognition (Mean Rank = 219.19) compared to low academic achiever (Mean Rank = 101.07) at $p < 0.01$ level with large effect ($U = 3350.50$; $z = -11.77$; $p < 0.01$; $r = 0.66$).

From the current findings, in 'levels of academic achievement', high academic achiever scores were significantly higher as compared to low Academic Achiever in

Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively. This confirmed the First and third hypotheses set forth for the study that 'It was expected that (i) higher scores in high-level academic achievers than low-academic achievers' was in accordance with the study and was supported. This finding was supported by earlier studies that discovered a very substantial association between memory and achievement supported this conclusion (Dean, 2006; Rabiner et al., 2016; Quílez-Robres et al., 2021; Jaquith, 1996; Lamba, 2014; Podila, 2019; Kulp et al., 2002)

A Mann-Whitney U test was performed to evaluate whether **urban** and **rural** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **urban** and **rural** in which **urban** had significantly higher scores than **rural** on 8 subscales of PGI-Memory Scales. This confirmed the First and third hypotheses set forth for the study that (ii) higher scores in **urban** students than **rural** students. In Remote memory there was no significant difference between Urban (Mean Rank = 166.79) and Rural (Mean Rank = 154.29), (U = 11799.00; z = -1.62; p = 0.11; r = 0.09), and Recent Memory between Urban (Mean Rank= 167.00) compared to Rural (Mean Rank = 154.08), (U = 11766.00; z = -1.59; p = 0.11; r = 0.08). Urban scores were significantly higher in the Mental Balance (Mean Rank = 192.55) compared to Rural (Mean Rank = 128.85) at $p<0.01$ level with medium effect (U = 7704.00; z = -6.27; p <0.01; r = 0.35), Urban scores were significantly higher in the Attention and Concentration (Mean Rank = 177.03) compared to Rural (Mean Rank = 144.18) at $p < 0.01$ level with small effect (U = 10171.50; z = -3.18; p < 0.01; r = 0.17), Urban were significantly higher in the Delayed Recall (Mean Rank = 179.77) compared to Rural (Mean Rank = 141.47) at $p < 0.01$ level with small effect (U = 9735.50; z = -3.78; p < 0.01; r = 0.21), Urban scores were significantly higher in the Immediate Recall (Mean Rank = 196.81) compared to Rural (Mean Rank = 124.65) at $p < 0.01$ level with medium effect (U = 7027.00; z = -7.80; p < 0.01; r = 0.39), Urban scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 176.96) compared to Rural (Mean Rank = 144.24) at $p <$ 0.01 level with small effect (U = 10182.00; z = -3.19; p < 0.01; r = 0.17), Urban scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank =

179.36) compared to Rural (Mean Rank = 141.88) at $p < 0.01$ level with small effect ($U = 9801.00$; $z = -3.81$; $p < 0.01$; $r = 0.21$), Urban scores were significantly higher in the Visual Retention (Mean Rank = 188.52) compared to Rural (Mean Rank = 132.83) at $p < 0.01$ level with medium effect ($U = 8344.00$; $z = -11.35$; $p < 0.01$; $r = 0.30$), Urban scores were significantly higher in the Recognition (Mean Rank = 186.55) compared to Rural (Mean Rank = 134.77) at $p < 0.01$ level with small effect ($U = 8657.00$; $z = -5.16$; $p < 0.01$; $r = 0.28$).

In ecology, there was a significant difference between urban and rural in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition. However, there was no significant difference between urban and rural in Remote memory and Recent Memory. Thus, the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students' was in accordance with the study and was supported. The finding was supported by Alspaugh, (1992), Alspaugh and Harting (1995), and Haller and colleagues (1993) research and found that students in rural schools had lower scores in memory performance as compared to students in urban schools.

A Mann-Whitney U test was performed to evaluate whether **males** and **females** differed on the ten subscales of PGI-Memory Scales. The results indicated that there was a significant difference between **males** and **females** in which **females** had significantly higher scores than **males** on 6 subscales of PGI-Memory Scales. This confirmed the first and third hypotheses set forth for the study that (iii) higher scores in females than males students. There was no significant difference in Remote memory between males (Mean Rank = 165.79) and females (Mean Rank =155.28) at $p < 0.01$ level ($U = 11959.00$; $z = -1.36$; $p = 0.17$; $r = 0.07$). There was no significant difference in Recent Memory between males (Mean Rank = 163.78) compared to females (Mean Rank = 157.26) at $p < 0.01$ level ($U = 12278.00$; $z = -0.80$; $p = 0.42$; $r = 0.04$). There was no significant difference in Attention and concentration Between males (Mean Rank = 169.88) compared to females (Mean Rank = 151.24) at $p < 0.05$ level ($U = 11308.00$; $z = -1.81$; $p = 0.07$; $r = 0.10$). Females scores were significantly higher in the Mental Balance (Mean Rank = 180.23) compared to males (Mean Rank = 140.52) at $p < 0.01$ level with a small effect ($U = 9622.50$; $z = -3.91$; $p < 0.01$; $r = 0.21$), females were significantly higher in the Delayed Recall (Mean Rank = 178.05) compared to males (Mean Rank = 142.73) at $p < 0.01$ level with a small effect ($U = 9974.50$; $z = -3.48$; $p < 0.01$; $r = 0.19$), females scores were significantly higher in the Immediate Recall (Mean Rank = 174.04) compared to males (Mean Rank = 146.79) at $p < 0.01$ level with a small effect ($U = 10620.00$; $z = -2.67$; $p < 0.01$; $r = 0.14$), females scores were significantly higher in the Verbal Retention for Similar Pairs (Mean Rank = 174.38) compared to males (Mean Rank = 146.44) at $p < 0.01$ level with a small effect ($U = 10564.50$; $z = -2.84$; $p < 0.01$; $r = 0.15$), females scores were significantly higher in the Verbal Retention for Dissimilar Pairs (Mean Rank =180.76) compared to males (Mean Rank = 139.98) at $p < 0.01$ level with a small effect ($U = 9537.00$; $z = -3.98$; $p < 0.01$; $r = 0.22$), females scores were significantly higher in the Visual Retention (Mean Rank = 183.47) compared to males (Mean Rank = 137.24) at $p < 0.01$ level with a small effect ($U = 9101.50$; $z = -4.56$; $p < 0.01$; $r = 0.25$), males scores were significantly higher in the Recognition (Mean Rank = 175.28) compared to females (Mean Rank= 145.90) at $p < 0.01$ level with a small effect ($U = 10449.00$; $z = -2.93$; $p < 0.01$; $r = 0.16$).

Gender differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) significant differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 PGI-memory subscales. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between Males and Females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. Thus, the first and third hypothesis "It was expected that (iii) higher scores in Females than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males (Garg et al., 2017). In contrast to our findings, Koirala (2021) suggested that except for recent memory, the male significantly outperformed females in the other five subscales.

5) Relationship between the dependent variables

Analysis of data was done to examine the relationship between dependent variables. Spearman Correlation was employed to determine the significant relationship between the dependent variables.

Remote Memory shows a significant positive relationship with Recent Memory (r = .13, p < .05), Mental Balance (r = .13, p < .05), Attention and Concentration (r = .15, p < .01), Delayed Recall (r = .11, p < .05), Immediate Recall at .01 level (r = .16, p < .01) and Recognition (r = .17, p < .01).

Recent Memory shows a significant positive relationship with Mental Balance (r = .22, p < .01), Attention and Concentration (r = .26, p < .01), Delayed Recall (r = .14, p < .05), Immediate Recall (r = .18, p < .01), Verbal Retention for Similar Pairs *(r* = .12, p < .01), Visual Retention (r = .25, p < .01) and Recognition (r = .12, p < .05) respectively.

Mental Balance shows a significant positive relationship with Attention and Concentration (r = .46, p < .01), Delayed Recall (r =.45, p = <.01), Immediate Recall (r =.59, p < .01); Verbal Retention for Similar Pairs (r= .421, p < .01), Verbal Retention for Dissimilar Pairs (r = .44; p > .01), Visual Retention (r = .52, p < .01) and Recognition (r = .41, p < .01) respectively.

Attention and Concentration show a significant positive relationship with Delayed Recall (r = .34, p = < .01), Immediate Recall (r = .51, p < .01), Verbal Retention for Similar Pairs (r = .36, p < .01), Verbal Retention for Dissimilar Pairs (r = .43, p > .01), Visual Retention (r = .43, p > .01) and Recognition (r = .56, p > .01).

Delayed Recall showed a significant positive relationship with Immediate Recall (r = .50, p < .01), Verbal Retention for Similar Pairs (r = .32, p < .01), Verbal Retention for Dissimilar Pairs (r = .43, p < .01), Visual Retention (r = .41, p < .01) and Recognition (r = .33, p < .01) respectively.

Immediate Recall showed a significant positive relationship with Verbal Retention for Similar Pairs (r = .45, p < .01), Verbal Retention for Dissimilar Pairs (r = .48, p < .01), Visual Retention (r = .66, p < .01), and Recognition (r = .60, p < .01).

Verbal Retention for Similar Pairs showed a significant positive relationship with Verbal Retention for Dissimilar Pairs (r = .36, p < .01), Visual Retention (r = .47, p < .01), and Recognition (r = .35, p < .01).

Verbal Retention for Dissimilar Pairs showed a significant positive relationship with Visual Retention ($r = .43$, $p < .01$) and Recognition ($r = .46$, $p < .01$). Visual Retention showed a positive relationship with Recognition ($r = .46$, $p < .01$) respectively.

The highest significant positive correlation was found between Visual Retention and Immediate Recall ($r = .66$, $p < .01$)

The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of Remote Memory, which was shown to have no correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no correlation with Visual Retention or Dissimilar Pairs. In support, Dr. Subash Raj S (2016) examined the relationships between Hb Concentration and Remote Memory, Recent Memory, and Mental Balance, finding that it strongly affects Remote Memory and Mental Balance but not Recent Memory. Akhouri and Javed (2014) on the other hand, discovered a connection between the immediate, recent, and remote memories of patients with depression and anxiety and concluded that while immediate and recent memories are impaired in these individuals, remote memories are intact.

Yet according to Sreekanth and colleagues' (2015) research, there is a strong correlation between visual memory (Drishta Smriti) and auditory memory (Shruta Smriti) in various phenotypes (Prakriti). Sharma, however, observed that students' visual short-term memory (STM) has a higher mean reaction time than their auditory STM. Gupta and colleagues (2019) also discovered that alcoholics have significantly more cognitive impairment than controls in all PGI-Memory scale domains. According to Thapliyal and colleagues (2016), research on neurocognitive functioning, almost all memory-related functions—including mental balance, attention and concentration, delayed recall, verbal retention for dissimilar pairs, visual retention, and recognition, immediate recall, verbal retention for similar pairs, and visual retention—are dysfunctional among alcoholics, indicating that if one neurocognitive domain is impaired other domains are likely to be impaired.

6) Kruskal - Wallis H Test for measures of the interaction effect of 'ecology x gender', 'gender x level of academic achievement', 'ecology x level of academic achievement' on the dependent variables

Since the data violated assumptions for parametric tests, a non-parametric test i.e., Kruskal - Wallis H Test was calculated to examine any significant interaction effect of '**ecology x gender**', '**gender x level of academic achievement**', '**ecology x level of academic achievement**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention, and Recognition) among the samples.

The results showed that across '**ecology x gender**' there was a statistically significant difference on MB between the mean rank of 165.49 (Urban Males), 218.49 (Urban Females), 115.09 (Rural Males) and 142.93 (Rural females) were significant, $\chi2$ (3) = 55.783, p = .000, on A&C between the mean rank of 185.18 (Urban Males), 167.43 (Urban Females), 153.23 (Rural Males), and 136.17 (Rural females) were significant, $\chi2$ (3) = 12.211, p = .007, on DR between the mean rank score of 168.83 (Urban Males), 190.93 (Urban Females), 117.31 (Rural Males), and 164.94 (Rural females) were significant, $\chi2$ (3) = 28.041, p = .000, on IR between the mean rank score of 183.48 (Urban Males), 211.25 (Urban Females), 111.85 (Rural Males), and 135.43 (Rural females) were significant, $\chi2$ (3) = 58.747, p = .000, on VRSP among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 24.374, p = .000, with a mean rank score of 160.46 for Urban Males, 199.28 for Urban Females, 133.86 for Rural Males, and 148.40 for Rural females; on VRDP among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 26.470, p = .000, with a mean rank score of 153.32 for Urban Males, 200.89 for Urban Females, 127.39 for Rural Males, and 160.40 for Rural females; on VR among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 52.554, p = .000, with a mean rank score of 172.48 for Urban Males, 205.39 for Urban Females, 103.48 for Rural Males, and 160.65 for Rural females; on RG among Urban Males, Urban Females, Rural Males and Rural Females, $\chi2$ (3) = 37.629, p = .000, with a mean rank score of 205.36 for Urban Males, 168.68 for Urban Females, 146.28 for Rural Males, and 121.69 for Rural females.

'**Ecology**' and '**gender**' has a significant interaction effect with an effect size of 16% on Mental Balance; 2% on Attention and Concentration; 8% on Delayed Recall; 18% on Immediate Recall; 7% on Verbal Retention for Similar Pairs; 7% on Verbal Retention for Dissimilar Pairs; 16% on Visual Retention; 11% on Recognition respectively which accept the Forth Hypothesis.

(Note: HAM = High Academic Achiever Male, HAF = High Academic Achiever Female, LAM = Low Academic Achiever Male, LAF = Low Academic Achiever Female, RM = Remote Memory, REM = Recent Memory, MB = Mental Balance, AC = Attention and Concentration, DR = Delayed Recall, IR= Immediate Recall, VRSP = Verbal Retention for Similar Pairs, VRDP = Verbal Retention for Dissimilar Pairs, VRT = Visual Retention and RT = Recognition)

A Kruskal-Wallis H test showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across '**gender x level of academic achievement**' i.e on **RM** among HAM, HAF, LAM and LAF, χ^2 (3) = 12.516, p = .006, with a mean rank score of 178.00 for HAM, 168.00 for HAF, 154.00 for LAM, and 142.00 for LAF; **REM** among HAM, HAF, LAM and LAF, χ^2 (3) = 17.271, p = .001, with a mean rank score of 182.68 for HAM, 171.01 for HAF, 145.41 for LAM, and 142.90 for LAF; **MB** among HAM, HAF, LAM and LAF, χ^2 (3) = 128.321, p = .000, with a mean rank score of 200.19 for HAM, 227.83 for HAF, 80.39 for LAM, and 133.59 for LAF; on **A&C** among HAM, HAF, LAM and LAF, χ2 (3) = 136.800, p = .000, with a mean rank score of 229.27 for HAM, 211.24 for HAF, 109.13 for LAM, and 92.36 for LAF, on **DR** among HAM, HAF, LAM and LAF, χ^2 (3) = 80.524, p = .000, with a mean rank score of 191.77 for HAM, 211.93 for HAF, 94.37 for LAM, and 143.94 for LAF; **IM** among HAM, HAF, LAM and LAF, χ^2 (3) = 142.564, p = .000, with a mean rank score of 196.15 for HAM, 242.04 for HAF, 99.18 for LAM, and 104.64 for LAF; **VRSP** among HAM, HAF, LAM and LAF, χ^2 (3) = 95.768, p = .000, with a mean rank score of 195.57 for HAM, 217.85 for HAF, 98.75 for LAM, and 129.83 for LAF; **VRDP** among HAM, HAF, LAM and LAF, χ^2 (3) = 108.065, p = .000, with a mean rank score of 182.34 for HAM, 236.31 for HAF, 98.37 for LAM, and 124.98 for LAF; **VR** among HAM, HAF, LAM and LAF, χ^2 (3) = 147.642, p = .000, with a mean rank score of 188.14 for HAM, 246.82 for HAF, 87.82 for LAM, and 199.23 for LAF; **RG** among HAM, HAF, LAM and LAF, χ^2 (3) =

145.248, p = .000, with a mean rank score of 231.57 for HAM, 206.29 for HAF, 120.07 for LAM, and 84.08 for LAF respectively.

'**Gender**' and '**level of academic achievement**' has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 39% on Mental Balance; 42% on Attention and Concentration; 24% on Delayed Recall; 44% on Immediate Recall; 29% on Verbal Retention for Similar Pairs; 33% on Verbal Retention for Dissimilar Pairs; 46% on Visual Retention; 45% on Recognition respectively which accept the Forth Hypothesis.

(Note: HAU= High Academic Achiever Urban, HAR= High Academic Achiever Rural, LAU= Low Academic Achiever Urban, LAR= Low Academic Achiever Rural, RM= Remote Memory, REM= Recent Memory, MB= Mental Balance, AC= Attention and Concentration, DR= Delayed Recall, IR= Immediate Recall, VRSP= Verbal Retention for Similar Pairs, VRDP= Verbal Retention for Dissimilar Pairs, VRT= Visual Retention and RT= Recognition)

A Kruskal-Wallis H test showed that there was a statistically significant difference on all of the ten sub-scales of PGI-memory Scales across '**ecology x level of academic achievement**' i.e on **RM** among HAU, HAR, LAU and LAR, χ^2 (3) = 13.722, p = .003, with a mean rank score of 182.00 for HAU, 164.00 for HAR, 152.00 for LAU, and 144.00 for LAR; **REM** among HAU, HAR, LAU and LAR, χ^2 (3) = 19.486, p = .000, with a mean rank score of 186.56 for HAU, 167.13 for HAR, 147.93 for LAU, and 140.39 for LAR; **MB** among HAU, HAR, LAU and LAR, χ^2 (3) = 149.379, p = .000, with a mean rank score of 246.46 for HAU, 181.55 for HAR, 137.53 for LAU, and 76.46 for LAR; **A&C** among HAU, HAR, LAU and LAR, χ^2 (3) = 143.446, p = .000, with a mean rank score of 234.27 for HAU, 206.24 for HAR, 118.34 for LAU, and 83.16 for LAR; **DR** among HAU, HAR, LAU and LAR, χ^2 (3) = 81.348, p = .000, with a mean rank score of 223.14 for HAU, 180.55 for HAR, 136.61 for LAU, and 101.70 for LAR; **IR** among HAU, HAR, LAU and LAR, χ^2 (3) = 196.257, p = .000, with a mean rank score of 238.59 for HAU, 199.60 for HAR, 156.14 for LAU, and 47.68 for LAR; **VRSP** among HAU, HAR, LAU and LAR, χ^2 (3) = 104.170, p = .000, with a mean rank score of 229.40 for HAU, 184.02 for HAR, 130.34 for LAU, and 98.24 for LAR; **VRDP** among HAU, HAR, LAU and LAR, χ^2 (3) = 102.442, p = .000, with a mean rank score of 220.53 for HAU, 198.12 for HAR, 133.68 for

LAU, and 89.67 for LAR; **VR** among HAU, HAR, LAU and LAR, χ^2 (3) = 157.550, *p* = .000, with a mean rank score of 246.16 for HAU, 188.80 for HAR, 131.72 for LAU, and 75.33 for LAR; **RG** among HAU, HAR, LAU and LAR, χ^2 (3) = 165.363, *p* = .000, with a mean rank score of 238.75 for HAU, 199.11 for HAR, 135.29 for LAU, and 68.86 for LAR respectively.

'**Ecology**' and '**level of academic achievement** has a significant interaction effect with an effect size of 3% on Remote Memory; 5% on Recent Memory; 46% on Mental Balance; 44% on Attention and Concentration; 25% on Delayed Recall; 61% on Immediate Recall; 32%
on Verbal Retention for Similar Pairs; 31% on Verbal Retention for Dissimilar Pairs; 49% on Visual Retention; 51% on Recognition respectively which accept the Forth Hypothesis.

These findings proved the final hypothesis that there was a significant interaction effect of '**level of academic achievement**', '**ecology**', and '**gender**' on the subscales of The PGIMS for the samples i.e. significant interaction effect of '**ecology** x **gender**', '**gender** x **level of academic achievement**', '**ecology** x **level of academic achievement**' on the dependent variables (RM, REM, MB, A&C, IR, DR, RSP, RDP, VR, and RG) among the samples. The research suggested that there is an interaction effect between the level of academic achiever, ecology, and gender among the samples. The recent study is urgently needed for expanding the existing body of research and to help implement intervention programmes because there is not enough literature that supports the current findings.

(Note: HAUM = High Academic Achiever Urban Male, HAUF = High Academic Achiever Urban Female, HARM = High Academic Achiever Rural Male, HARF = High Academic Achiever Rural Female, LAUM = Low Academic Achiever Urban Male, LAUF = Low Academic Achiever Urban Female, LARM = Low Academic Achiever Rural Male, LARF = Low Academic Achiever Rural Female, RM = Remote Memory, REM = Recent Memory, MB = Mental Balance, AC = Attention and Concentration, DR = Delayed Recall, IR = Immediate Recall, VRSP = Verbal Retention for Similar Pairs, VRDP = Verbal Retention for Dissimilar Pairs, VRT = Visual Retention and RT= Recognition)

A Kruskal-Wallis H test showed that across '**level of academic achievement** x **ecology** x **gender'** there was a statistically significant difference on **REM** between the mean rank of 194.34 (HAUM), 178.79 (HAUF), 171.01 (HARM), 163.24 (HARF), 154.32 (LAUM), 141.53 (LAUF), 136.50 (LARM) and 144.28 (LARF) were significant, χ^2 (7) = 21.481, *p* = .003, on **MB** between the mean rank of 215.43 (HAUM), 277.50 (HAUF), 184.95 (HARM), 178.15 (HARF), 115.56 (LAUM), 159.49 (LAUF), 45.23 (LARM) and 107.70 (LARF) were significant, χ^2 (7) = 172.944, *p* = .000, on **A&C** between the mean rank of 246.99 (HAUM), 221.55 (HAUF), 211.55 (HARM), 200.93 (HARF), 123.36 (LAUM), 113.31 (LAUF), 94.90 (LARM) and 71.41 (LARF) were significant, χ^2 (7) = 146.758, *p* = .000, on **DR** between the mean rank of 218.31 (HAUM), 227.98 (HAUF), 165.23 (HARM), 195.88 (HARF), 119.34 (LAUM), 153.88 (LAUF), 69.40 (LARM) and 134.00 (LARF) were significant, χ^2 (7) = 96.925, *p* = .000, on **IR** between the mean rank of 199.66 (HAUM), 277.51 (HAUF), 192.64 (HARM), 206.56 (HARF), 167.29 (LAUM), 144.99 (LAUF), 31.06 (LARM) and 64.29 (LARF) were significant, χ^2 (7) = 215.174, *p* = .000, on **VRSP** between the mean rank of 208.90 (HAUM), 249.90 (HAUF), 182.24 (HARM), 185.80 (HARF), 112.01 (LAUM), 148.66 (LAUF), 85.49 (LARM) and 111.00 (LARF) were significant, χ^2 (7) = 113.692, *p* = .000, on **VRDP** between the mean rank of 189.61 (HAUM), 251.45 (HAUF), 175.08 (HARM), 221.16 (HARF), 117.04 (LAUM), 150.32 (LAUF), 79.70 (LARM) and 99.64 (LARF) were significant, χ^2 (7) = 120.190, *p* = .000, on **VR** between the mean rank of 200.34 (HAUM), 291.98 (HAUF), 175.94 (HARM), 201.66 (HARF), 144.63 (LAUM), 118.81 (LAUF), 31.01 (LARM) and 119.64 (LARF) were significant, χ^2 (7) = 200.237, *p* = .000, and on **RG** between the mean rank of 254.70 (HAUM), 222.80 (HAUF), 208.44 (HARM), 189.78 (HARF), 156.03 (LAUM), 114.55 (LAUF), 84.11 (LARM) and 53.60 (LARF) were significant, χ^2 (7) = 175.339, *p* = .000 respectively.

'**Level of academic achievement**', '**ecology**', and '**gender**' has a significant interaction effect with an effect size of 2% on Remote Memory; 4% on Recent Memory; 53% on Mental Balance; 44% on Attention and Concentration; 29% on Delayed Recall; 67% on Immediate Recall; 34% on Verbal Retention for Similar Pairs; 36% on Verbal Retention for Dissimilar Pairs; 62% on Visual Retention; 54% on Recognition respectively which accept the Forth Hypothesis.

The result of the present study may be summarized as follows concerning the theoretical expectation (hypothesis) set forth for the study:

1) The results revealed that in **levels of academic achievement**, high academic achiever scores were higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively which accepts the first hypothesis.

2) The results revealed that in **ecology**, there was a difference between urban scores were higher in Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition as compared to Rural. However, there was no difference between urban and rural in Remote memory and Recent Memory. This proved the first hypothesis 'It was expected that (ii) higher scores in Urban students than Rural students.

3) **Gender** differences were assessed on the 10 (ten) subscales of the PGI-Memory Scale and revealed 6 (six) differences between males and females in 'Delayed Recall', 'Immediate Recall', 'Verbal Retention for Similar Pairs', 'Verbal Retention for Dissimilar Pairs', 'Visual Retention', and 'Recognition' in which females' mean scores were higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no difference in Remote memory, Recent Memory, and Attention and Concentration compared between Males and Females. A profile of normal variations in patterns of memory test performance across gender revealed relative strengths for females on verbal tasks and males on recognition tasks. This confirmed the first hypothesis "It was expected that (iii) higher scores in females than males" was accepted and the findings revealed that females scored significantly higher on most of the "Memory Tests" than males.

4) Results of the Spearman correlation revealed significant correlations among the dependent variables. The results revealed a significant positive correlation among the dependent variables, PGI-Memory Scales Sub-scales with the exception of

Remote Memory, which was shown to have no significant correlation with Verbal Retention for both Similar and Dissimilar Pairs, and Visual Retention along with Recent Memory, which also showed no significant correlation with Visual Retention or Dissimilar Pairs. These findings supported the second hypothesis, which stated that the study would reveal the significant relationship between the dependent variables (Remote, Recent Memory, Mental Balance, Digit Span-Attention and Concentration, Immediate Recall, Delayed, Retention for Similar, Retention for Dissimilar Pairs, Visual Retention and Recognition on the Samples.

5) **Levels of Academic Achievement** has a significant independent effect with an effect size of 18% on Remote Memory, 23% on Recent Memory, 23% on Mental Balance, 58% on Attention and Concentration, 64% on Delayed Recall, 45% on Immediate Recall, 53% on Verbal Retention for Similar Pairs, 65% on Verbal Retention for Dissimilar Pairs, 63% on Visual Retention and 66% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**level of academic achievement**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. High academic achiever scores were significantly higher as compared to low academic achievers in Remote memory, Recent Memory, Mental Balance, Attention and concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and Recognition respectively.

6) **Ecology** has a significant independent effect with an effect size of 35% on Mental Balance, 17% on Attention and Concentration, 21% on Delayed Recall, 39% on Immediate Recall, 17% on Verbal Retention for Similar Pairs, 21% on Verbal Retention for Dissimilar Pairs, 30% on Visual Retention and 28% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**Ecology**' on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Urban scores were significantly higher as compared to Rural in Remote memory, Recent Memory, Mental Balance, Attention and

concentration, Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention, and Recognition respectively. However, there was no significant difference between urban and rural in Remote memory and Recent Memory among the samples.

7) **Gender** has a significant independent effect with an effect size of 21% on Mental Balance, 19% on Delayed Recall, 14% on Immediate Recall, 15% on Verbal Retention for Similar Pairs, 22% on Verbal Retention for Dissimilar Pairs, 25% on Visual Retention and 16% on Recognition. This finding supported the third hypothesis that there will be a significant independent effect of '**Gender'** on the dependent variables (Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Delayed Recall, Retention for Similar Pairs, Retention for Dissimilar Pairs, Visual Retention and Recognition) among the samples. Females were significantly higher than males in Delayed Recall, Immediate Recall, Verbal Retention for Similar Pairs, Verbal Retention for Dissimilar Pairs, Visual Retention and males' mean score were significantly higher in Recognition in absolute scores across gender on the 10 subscales of PGIMS. However, there was no significant difference in Remote memory, Recent Memory, and Attention and Concentration compared between Males and Females.

8) **Ecology** and **gender** have a significant interaction effect with an effect size of 16% on Mental Balance, 2% on Attention and Concentration, 8% on Delayed Recall, 18% on Immediate Recall, 7% on Verbal Retention for Similar Pairs, 7% on Verbal Retention for Dissimilar Pairs, 16% on Visual Retention and 11% on Recognition. This finding supported the fourth hypothesis set forth for the study.

9) **Gender** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 2% on Remote Memory, 4% on Recent Memory, 39% on Mental Balance, 42% on Attention and Concentration, 24% on Delayed Recall, 44% on Immediate Recall, 29% on Verbal Retention for Similar Pairs, 33% on Verbal Retention for Dissimilar Pairs, 46% on Visual Retention and 45% on Recognition. This finding supported the fourth hypothesis set forth for the study.

10) **Ecology** and **levels of Academic Achievement** have a significant interaction effect with an effect size of 5% on Recent Memory, 46% on Mental Balance, 44% on Attention and Concentration, 25% on Delayed Recall, 61% on

Immediate Recall, 32% on Verbal Retention for Similar Pairs, 31% on Verbal Retention for Dissimilar Pairs, 49% on Visual Retention and 51% on Recognition. This finding supported the fourth hypothesis set forth for the study.

11) **Levels of Academic Achievement, Ecology,** and **Gender** were used as independent variables in the memory tests. The findings indicate a statistically significant interaction effect of '**level of Academic Achievement, Ecology,** and **gender**' on all the PGI-Memory sub-scales with an effect size 2%, 4%, 53%, 44%, 29%, 67%, 34%, 36%, 62% and 54% respectively which accept the fourth hypothesis. Level of Academic Achievement had a clear effect on the test scores of PGIMS. participants with high academic achievers outperformed those with low academic achievers on all tests. The results also revealed gender effects, though these were small, with Females outperforming males on verbal tests and the reverse pattern on recognition tests.

Limitation:

The study does have several limitations. Firstly, some participants were excluded for the higher control tasks which was a limitation and this reduced the number of participants. Only students attending high school level were studied which limits the diversity of the findings. The confounding variables from previous studies like age, school context, stress level, socio-economic status, and socio-psychological variables were under control which could also contribute to the factors of academic outcomes. Due to lack of experimental control, this study does not attribute causality to the observed relationships.

Suggestions for future research:

Based on the limitation of the present study, it was suggested that future research should attempt to replicate these findings among a broader range of populations among students attending all school levels for the diversity of the findings. Future research should attempt to conduct a longitudinal study and identifying early cognitive predictors of academic success and failure at different levels of school education. It suggests that a deeper exploration of these findings using the Quality Questionnaire can aid memory researchers in refining theories, developing targeted interventions, and improving memory-related strategies for better academic success. With all of the limitations, the present study clearly highlighted the difference between level of academic achievement, gender and ecology on Memory abilities; the scale employed would find replicability in the selected population for further studies.

Significance of the study:

The study confirms that memory plays a pivotal role in education along with ecology and gender. This is likely to be true even in the context of Mizo students according to the findings. The research emphasizes poor auditory and visual processing in slow learners, prompting an investigation into causes and methods to enhance these areas. From these findings, it shows that earlier comprehensive memory screenings are necessary to understand the strengths and weaknesses of children's memory skills that may assist professionals working with children to improve instructional planning, programming decisions, treatment recommendations, and accommodations to benefit their academic success. Lastly, it stresses the urgency of addressing memory-related academic challenges by examining potential long-term consequences like increased dropout rates or negative societal behaviours.

Implications:

Based on the findings and recommendations made, memory components and capabilities should be assessed to offer a complete and accurate picture of the student's abilities and limitations. The Ministry of Education (MOE) should consider implementing policies tailored for slow learners/potential learners, such as Training Modalities and Remedial Teaching Policy. Improving instructional efficiency can bridge the academic skills gap for slow learners. Also, Tailored Teaching Approaches wherein slow learners can progress in the classroom if teaching materials and methods match their appropriate level of learning. Teachers need more techniques and ideas to effectively meet the needs of slow learners. Implementing Grouping Strategies in which separate groups for fast learners and slow/potential learners can positively impact classroom learning. Previous studies suggest that grouping based on performance has improved slow learners' participation in active learning methods and boosted their confidence. The addition of memory tests to the batteries of instruments usually employed in psycho-educational assessment may help to identify cases with high risk of academic failure among the individuals, as well as to implement preventive interventions.

Lastly, overall, our research focused on the differences in cognitive abilities between urban and rural students as well as the crucial role that memory abilities play in academic achievement. Expanding our knowledge of how memory functions differ across urban and rural locations is still crucial to closing the gap and promoting better academic achievements. More programme interventions ought to be created and implemented as a result.

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