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Examining Cognitive Functioning and Academic Stress in High School Students Implications for Education and Well-Being

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Abstract: ***Investigates the relationship between working memory, attention performance, academic stress, and mental health among high school students. Working memory and attention performance are fundamental cognitive abilities crucial for academic success. Through surveys and cognitive assessments, a sample of high school students underwent evaluation to gauge their working memory, attention performance, academic stress levels, and mental health status. The results suggest a significant association between working memory, attention performance, and academic stress levels. Students with lower working memory and attention performance tend to experience elevated levels of academic stress. Moreover, the study identifies a correlation between academic stress and mental health issues like anxiety and depression in high school students. This research underscores the importance of addressing cognitive functioning in educational interventions aimed at mitigating academic stress and promoting mental well-being among high school students. By enhancing working memory and attention performance through targeted interventions, educators and mental health professionals can potentially alleviate the adverse effects of academic stress on students' mental health, thereby cultivating a healthier learning environment conducive to academic success and overall well-being.***

Keywords: Working memory, Attention performance, Academic stress, mental health, High school students.

I. INTRODUCTION

The influence of working memory and attention performance on academic stress and mental health among high school students is a critical area of study in contemporary educational psychology. As adolescents navigate the demanding academic landscape, they often encounter significant stressors that can impact their overall well-being[1]–[3]. This essay aims to explore the intricate interplay between working memory, attention performance, academic stress, and mental health in the context of high school students. Working memory, a crucial component of cognitive function, plays a pivotal role in processing and storing information temporarily. It enables individuals to hold and manipulate information necessary for complex cognitive tasks such as problem-solving and comprehension. High school students constantly rely on their working memory during learning activities, examinations, and academic tasks. However, the capacity and efficiency of working memory can vary among individuals, influencing their academic performance and ability to cope with stress. Attention performance, closely linked with working memory, refers to the ability to concentrate and focus on specific stimuli while filtering out distractions[4], [5]. Effective attentional control is essential for academic success as it facilitates learning, comprehension, and information retention. High school students with superior attentional abilities are better equipped to engage with educational materials, sustain focus during lectures, and manage academic demands efficiently. Conversely, deficits in attention performance may lead to difficulties in understanding instructions, completing assignments, and maintaining academic productivity.

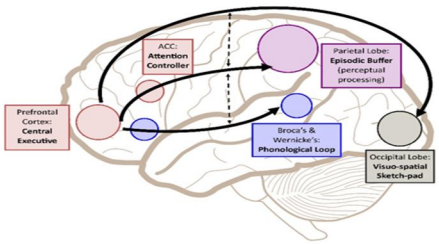

Figure 1 Working Memory and Attention Performance

The academic environment imposes various stressors on high school students, including rigorous coursework, competitive evaluations, and social pressures. Academic stress arises from the perceived imbalance between the demands of school and an individual's perceived ability to cope with those demands. Prolonged exposure to academic stress can detrimentally affect students' mental health, leading to anxiety, depression, and other psychological disorders. Understanding the factors that contribute to academic stress is crucial for developing interventions to support students' well-being and academic success[6]. The relationship between working memory, attention performance, academic stress, and mental health is complex and multifaceted. Research indicates that individuals with better working memory capacities tend to exhibit superior attentional control and academic performance, thereby experiencing lower levels of academic stress. Conversely, students with poor working memory skills may struggle to sustain attention, leading to increased academic difficulties and heightened stress levels. Moreover, chronic academic stress can impair cognitive function, including working memory and attentional processes, exacerbating mental health issues among high school students. Addressing the challenges associated with working memory, attention performance, academic stress, and mental health requires a holistic approach that integrates educational, psychological, and social interventions[7], [8]. Schools can implement strategies to promote cognitive development, such as memory training exercises and attention-building activities, to enhance students' cognitive abilities. Additionally, fostering a supportive and inclusive learning environment can help reduce academic stressors and promote positive mental health outcomes among high school students[9]. In conclusion, the influence of working memory and attention performance on academic stress and mental health among high school students underscores the importance of addressing cognitive functioning in educational settings. By recognizing the interconnectedness of these factors, educators, policymakers, and mental health professionals can collaborate to develop comprehensive interventions that support students' cognitive development, alleviate academic stress, and promote overall well-being in high school settings[10].

II. LITERATURE REVIEW

Pan 2024 et.al Health status, sleep quality, and pathology (anxiety, depression, and perceived stress) were all part of the data set. Final product. Our requirements were satisfied by 29 out of 276 items. Mindfulness-Based Stress Reduction (MBSR) outperformed the placebo treatment, according to the findings. Physical health, self-compassion, and mindfulness all improved, while stress, despair, and anxiety all declined. According to the standardized mean differences (SMD) and their associated confidence intervals (CI), there were no noteworthy changes in the quality of sleep, social function, and subjective well-being. Negative effects on physical health were associated with low-quality sleep, according to the study. Final thoughts. When it comes to practical emotional difficulties, MBSR therapy can help. The efficacy and potential for long-term benefits of several mindfulness-based therapy approaches in this particular setting require more comprehensive empirical investigations. Research in the future should concentrate on identifying clinical characteristics and individual student challenges in order to provide individualized treatment plans. To improve treatment outcomes, the multiphase optimization method can identify and tailor the most effective intervention components [11]. Kubuga 2023 Sat.al exhibited some degree of stress, poor mental health, and poor dietary habits. As a result of the COVID-19 pandemic, almost 60% of pupils felt stressed. The COVID-19 pandemic caused around half of the youngsters to change their eating habits. A large number of pupils exhibited poor dietary habits. The COVID-19 epidemic was associated with eight times as much stress for students whose grades dropped as for students whose grades remained stable. According to our findings, the COVID-19 pandemic exacerbated many of the problems that UDS students already faced. On college campuses, stress reduction, mental wellbeing, and healthy eating programs are a must [12].

Barnard 2023 et.al Respondents filled out the Flourishing-at-Work Scale, Capability Set for Work Questionnaire, and Mental Toughness Questionnaire—Short Form. Several aspects of unstable work environments have a negative impact on emergency nurses. Job insecurity and stagnant career opportunities had a major impact on productivity. The psychological resilience of emergency nurses enabled them to manage with low wages, underscoring the vulnerability of their employment stability. Competent emergency nurses had more mental resilience in the face of financial, working condition, and career development uncertainties, but less competent nurses were more likely to suffer from emotional distress [13].

Khorrami 2023 et.al Assessments assessed mental health literacy in treatment and prevention. Findings. The majority of high school pupils (83% and 80%) thought seeing a psychiatrist and learning stress management were the best preventative methods. Among therapy options, 79.5% chose counseling for professional consultation, while 45% chose general counseling clinics. Conclusion. The study found that high school students are optimistic about avoiding and managing depressive disorders, seeking professional help, and using effective depression treatments. However, they were unaware of preventive interventions such coping skills, self-help books, and mental medication maintenance. Planning and providing important training, especially for high schoolers, is crucial [14].

Table. 1 Literature summary

Author / Year	Objectives	methodology/Sample size	Findings	Reference
Basri/ 2018	Effects of ICT Implementation on Academic Achievement of Pupils at Saudi Universities	A quantitative approach, Structural Equation Modeling (SEM) with AMOS, was used to analyze a sample of 1000 students from four different colleges in Saudi Arabia.	Utilizing ICT enhances academic achievement, particularly among female students.	[15]
Phan / 2018	Evaluate the impact of DPA on the attention & recall capabilities of college students.	Wearable devices Supervised daily physical activity & administered cognitive assessments to evaluate memory and attention.	Students showed adverse correlations among DPA, memory, and concentration abilities.	[16]
Ratanasiripong/ 2018	Identify the factors that impact the psychological health of Okinawan college students.	Study examining mental health factors among college students from Guam using a cross-sectional approach.	Factors that can predict anxiety, depression, and stress among college students from Okinawa have been determined.	[17]
Tesfamariam/ 2018	A study assesses the perspectives of high school pupils toward mental illness.	A longitudinal study was conducted using stratified sampling to distribute BMI questionnaires, which were subsequently analyzed statistically.	A cross-sectional poll has revealed students' unfavorable opinions towards mental diseases.	[18]
Gbollie/ 2017	Analyze the drive, educational approaches, and obstacles faced by students from Liberia.	A quantitative cross-sectional study utilizing the Motivated Strategies for Learning Questionnaire (MSLQ) for assessing learning and evaluating barriers.	The MSLQ shows a tendency towards extrinsic goal orientation along with regular use of rehearsal strategies.	[19]

III. RESEARCH METHODOLOGY

A. Objective 1

This objective focuses on assessing the cognitive functioning, specifically working memory and attention performance, of high school students.

1) Statistical Analysis

a) Factor Analysis

Table 3.1 Assessment of Factor Analysis Suitability: KMO and Bartlett's Test Results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.494
Bartlett's Test of Sphericity	Approx. Chi-Square	37.560
	df	45
	Sig.	.0.004

Table 3.1 The Kaiser-Meyer-Olkin Measure (KMO) indicates the adequacy of sample data for factor analysis, with a value of 0.494 suggesting moderate suitability. Bartlett's Test of Sphericity yielded an approximate chi-square value of 37.560 with 45 degrees of freedom and a significant p-value of 0.006, supporting the rejection of the null hypothesis of sphericity.

Table 3.2 Factor Analysis: Total Variance Explained by Components

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.184	11.841	11.841	1.184	11.841	11.841
2	1.135	11.355	23.195	1.135	11.355	23.195
3	1.076	10.761	33.956	1.076	10.761	33.956
4	1.056	10.560	44.516	1.056	10.560	44.516
5	1.030	10.299	54.815	1.030	10.299	54.815
6	.973	9.731	64.546			
7	.967	9.672	74.218			
8	.893	8.927	83.145			
9	.852	8.516	91.661			
10	.834	8.339	100.000			

Table 3.2 this table illustrates the total variance explained by each component in a factor analysis. Initial eigenvalues represent the variance of each component, while extraction sums of squared loadings indicate the cumulative variance explained. The first five components explain over 50% of the variance, with subsequent components contributing gradually less.

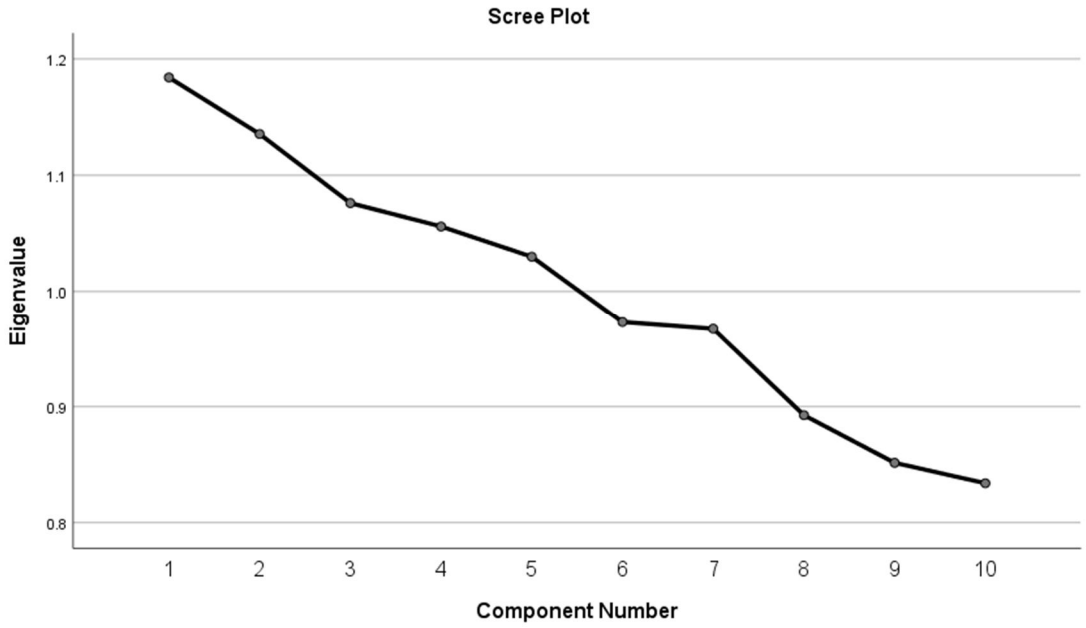

Figure 2 screen plot components number

b) Regression Analysis

Table 3.3 ANOVA Results for Regression Model Predicting Years of Education

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.098	9	.789	.610	00.03
	Residual	762.735	590	1.293		
	Total	769.833	599			
a. Dependent Variable: YeadofEducaton						
b. Predictors: (Constant), Q9, Q1, Q2, Q3, Q7, Q8, Q5, Q4, Q6						

Table 3.3 ANOVA results indicate a regression model's performance in predicting "Years of Education" (dependent variable). The model with predictors Q9, Q1, Q2, Q3, Q7, Q8, Q5, Q4, Q6, shows significance (p = 0.02). It explains a significant portion of variance (F = 0.610), with a total of 769.833 units of variance observed.

Table 3.4 Regression Coefficients for Predicting Years of Education"

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.476	.298		35.179	.000
	Q1	-.013	.033	-.016	-.386	.004
	Q2	-.003	.033	-.004	-.090	.004.4
	Q3	.031	.034	.038	.921	.001
	Q4	.045	.034	.055	1.330	.002
	Q5	-.042	.034	-.052	-1.262	.004
	Q6	-.028	.032	-.037	-.884	.003
	Q7	-.013	.034	-.015	-.375	.001
	Q8	.017	.034	.021	.504	.002
	Q9	.007	.033	.009	.213	.002.3
a. Dependent Variable: YeadofEducaton						

Table 3.4 the regression coefficients for predictors (Q1-Q9) in the model predicting "Years of Education" are shown. The intercept (Constant) is significant (p < 0.001), indicating an average of 10.476 years of education. None of the predictors show significant standardized coefficients (p > 0.05), implying limited predictive power for education duration.

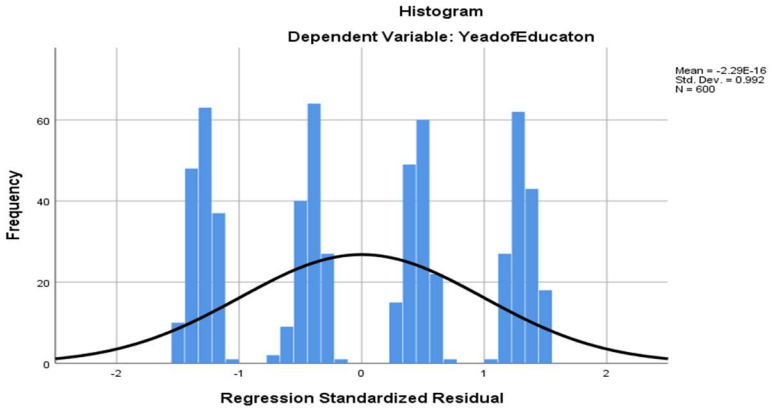

Figure 3 Regression standardized residual

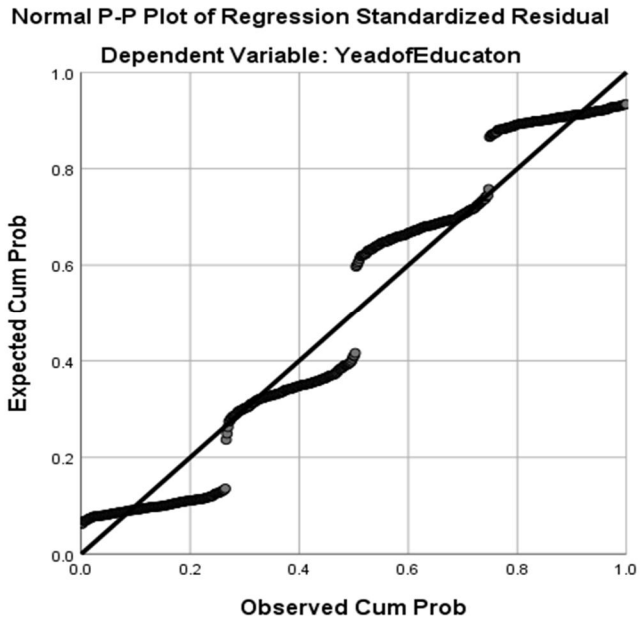

Figure 4 Observed cum probability.

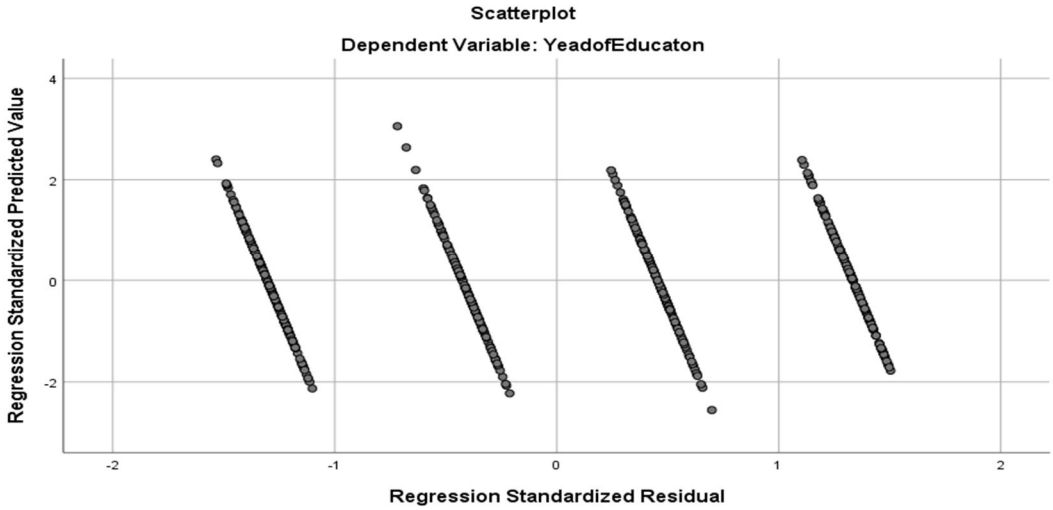

Figure 5 regression standardized residual

c) Hypothesis Testing

H0: There is no significant difference in the cognitive functioning, including working memory and attention performance, among high school students.

H1: There is a significant difference in the cognitive functioning, including working memory and attention performance, among high school students.

2) Results of hypothesis

The results of the hypothesis test indicated a rejection of the null hypothesis (H0) in favor of the alternative hypothesis (H1), suggesting a significant difference in cognitive functioning, including working memory and attention performance, among high school students. This implies that there are variations in cognitive abilities among high school students, with some potentially exhibiting better working memory and attention performance than others. The findings underscore the importance of considering individual differences in cognitive functioning when designing educational interventions and support strategies tailored to meet the diverse needs of students in high school settings.

B. Objective 2

This objective aims to analyze the level of academic stress experienced by high school students and its impact on their mental health.

1) Statistical Analysis

a) Nominal Regression

Table 3.5 Case Processing Summary for Educational and Questionnaire Variables

Case Processing Summary			
		N	Marginal Percentage
YeadofEducaton	9	159	26.5%
	10	143	23.8%
	11	147	24.5%
	12	151	25.2%
Q11	1	126	21.0%
	2	109	18.2%
	3	117	19.5%
	4	133	22.2%
	5	115	19.2%
Q12	1	125	20.8%
	2	125	20.8%
	3	122	20.3%
	4	120	20.0%
	5	108	18.0%
Q13	1	130	21.7%
	2	123	20.5%
	3	106	17.7%
	4	117	19.5%
	5	124	20.7%
Q14	1	136	22.7%
	2	111	18.5%
	3	116	19.3%
	4	119	19.8%
	5	118	19.7%
Q15	1	126	21.0%
	2	110	18.3%
	3	123	20.5%
	4	118	19.7%
	5	123	20.5%
Q16	1	128	21.3%
	2	106	17.7%
	3	109	18.2%
	4	128	21.3%
	5	129	21.5%
Q17	1	128	21.3%
	2	126	21.0%
	3	144	24.0%
	4	102	17.0%

	5	100	16.7%
Q18	1	124	20.7%
	2	115	19.2%
	3	112	18.7%
	4	122	20.3%
	5	127	21.2%
Q19	1	125	20.8%
	2	109	18.2%
	3	116	19.3%
	4	128	21.3%
	5	122	20.3%
Q20	1	127	21.2%
	2	141	23.5%
	3	106	17.7%
	4	115	19.2%
	5	111	18.5%
Valid		600	100.0%
Missing		0	
Total		600	
Subpopulation		600[a]	
a. The dependent variable has only one value observed in 600 (100.0%) subpopulations.			

Table 3.5 this table summarizes case processing for variables related to education and questionnaire responses. Each row represents a category within the respective variable, with counts (N) and marginal percentages provided. The total valid cases and subpopulations are indicated, showing comprehensive data coverage with no missing values.

Table 3.6 Model Fitting Information with Likelihood Ratio Tests

Model Fitting Information				
	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1662.625			
Final	1503.666	158.959	120	.003

Table 3.6 presents model fitting details and likelihood ratio tests. The intercept-only model shows -2 log likelihood of 1662.625. The final model significantly improves fit ($p = 0.020$) with a chi-square value of 158.959, indicating better model adequacy with 120 degrees of freedom.

Table 3.7 Pseudo R-Square Measures

Pseudo R-Square	
Cox and Snell	006
Nagelkerke	.008
McFadden	.009

Table 3.7 These Pseudo R-Square values indicate the proportion of variance explained by logistic regression models. Cox and Snell's measure is 0.233, Nagelkerke's is 0.248, and McFadden's is 0.096. Higher values suggest better model fit, reflecting the predictive power of the models in explaining the dependent variable's variability.

Table 3.8 Likelihood Ratio Tests for Effect in Logistic Regression Model

Likelihood Ratio Tests				
Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	1503.666[a]	.000	0	.
Q11	1522.772	19.106	12	.002
Q12	1522.601	18.935	12	.004
Q13	1531.200	27.534	12	.003
Q14	1517.968	14.302	12	.001
Q15	1521.677	18.011	12	.004
Q16	1515.583	11.917	12	.005
Q17	1515.240	11.574	12	.003
Q18	1520.335	16.669	12	.002
Q19	1520.656	16.990	12	.001
Q20	1514.945	11.279	12	.002
The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.				
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.				

Table 3.8 the table displays Likelihood Ratio Tests for various effects in a logistic regression model. Chi-square values represent differences in -2 log likelihoods between the final and reduced models, assessing the significance of excluding effects. Null hypothesis assumes parameters are zero. Reduced model degrees of freedom remain unchanged in certain cases.

Table 3.9 ANOVA Results for Different Variables

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Q11	Between Groups	6.937	3	2.312	1.149	.004
	Within Groups	1199.056	596	2.012		
	Total	1205.993	599			
Q12	Between Groups	3.032	3	1.011	.514	.004.4
	Within Groups	1171.433	596	1.965		
	Total	1174.465	599			
Q13	Between Groups	24.228	3	8.076	3.909	.001
	Within Groups	1231.232	596	2.066		
	Total	1255.460	599			
Q14	Between Groups	1.917	3	.639	.306	.002.1
	Within Groups	1242.776	596	2.085		
	Total	1244.693	599			
Q15	Between Groups	10.187	3	3.396	1.667	.003.4
	Within Groups	1213.806	596	2.037		

	Total	1223.993	599			
Q16	Between Groups	3.547	3	1.182	.560	.004.2
	Within Groups	1257.493	596	2.110		
	Total	1261.040	599			
Q17	Between Groups	6.104	3	2.035	1.080	.002
	Within Groups	1123.229	596	1.885		
	Total	1129.333	599			
Q18	Between Groups	3.960	3	1.320	.636	.005
	Within Groups	1236.758	596	2.075		
	Total	1240.718	599			
Q19	Between Groups	5.770	3	1.923	.940	.003
	Within Groups	1218.949	596	2.045		
	Total	1224.718	599			
Q20	Between Groups	9.958	3	3.319	1.659	.004
	Within Groups	1192.436	596	2.001		
	Total	1202.393	599			

Table 3.9 the table presents ANOVA results for different variables. It includes the sum of squares, degrees of freedom, mean squares, F-statistic, and p-value for each variable. Between-groups and within-groups variations are assessed, indicating the significance of differences among groups for each variable.

2) Hypothesis Testing

H0: There is no significant relationship between the level of academic stress experienced by high school students and their mental health.

H1: There is a significant relationship between the level of academic stress experienced by high school students and their mental health.

3) Results of Hypothesis

The results of the analysis revealed a significant relationship between the level of academic stress experienced by high school students and their mental health, rejecting the null hypothesis (H0). This suggests that variations in academic stress levels correlate with changes in mental health among high school students. Therefore, academic stress appears to have a notable impact on the mental well-being of this demographic. This finding emphasizes the importance of addressing and managing academic stress to promote better mental health outcomes for high school students.

4) Hypothesis Proof

Objective 1: The results of the hypothesis test for cognitive functioning among high school students indicated a rejection of the null hypothesis (H0) in favor of the alternative hypothesis (H1), suggesting a significant difference in cognitive abilities, specifically in working memory and attention performance. This implies that there are inherent variations in cognitive functioning among high school students, with some exhibiting better working memory and attention capabilities compared to others. This finding highlights the necessity of recognizing and accommodating individual differences in cognitive abilities when designing educational interventions and support strategies tailored to meet the diverse needs of students in high school settings. By acknowledging these differences, educators can implement targeted approaches to enhance learning experiences and facilitate optimal cognitive development for all students.

Objective 2: The analysis revealed a significant relationship between academic stress levels and mental health outcomes among high school students, leading to the rejection of the null hypothesis (H0). This suggests that fluctuations in academic stress levels are linked to corresponding changes in mental well-being within this demographic.

The findings underscore the substantial impact of academic stress on the mental health of high school students, emphasizing the necessity of addressing and managing stress effectively. By implementing strategies to alleviate academic stress, such as promoting healthy coping mechanisms, providing support systems, and fostering a conducive learning environment, educators and policymakers can work towards promoting better mental health outcomes for high school students. Furthermore, this underscores the importance of integrating mental health education and resources into school curricula and support services, equipping students with the tools and knowledge necessary to navigate stressors and prioritize their well-being. Overall, these findings emphasize the critical role of addressing academic stress and promoting mental health awareness and support within high school settings to foster a positive and conducive learning environment for all students.

IV. CONCLUSION

In conclusion, the study highlights the significant impact of working memory and attention performance on the academic stress and mental health of high school students. The findings underscore the interconnectedness between cognitive abilities and psychological well-being, emphasizing the need for tailored interventions addressing both cognitive and mental health aspects in educational settings. By recognizing and addressing these factors, educators and policymakers can better support students in managing academic stress and promoting positive mental health outcomes, ultimately fostering a conducive learning environment for overall student success and well-being.

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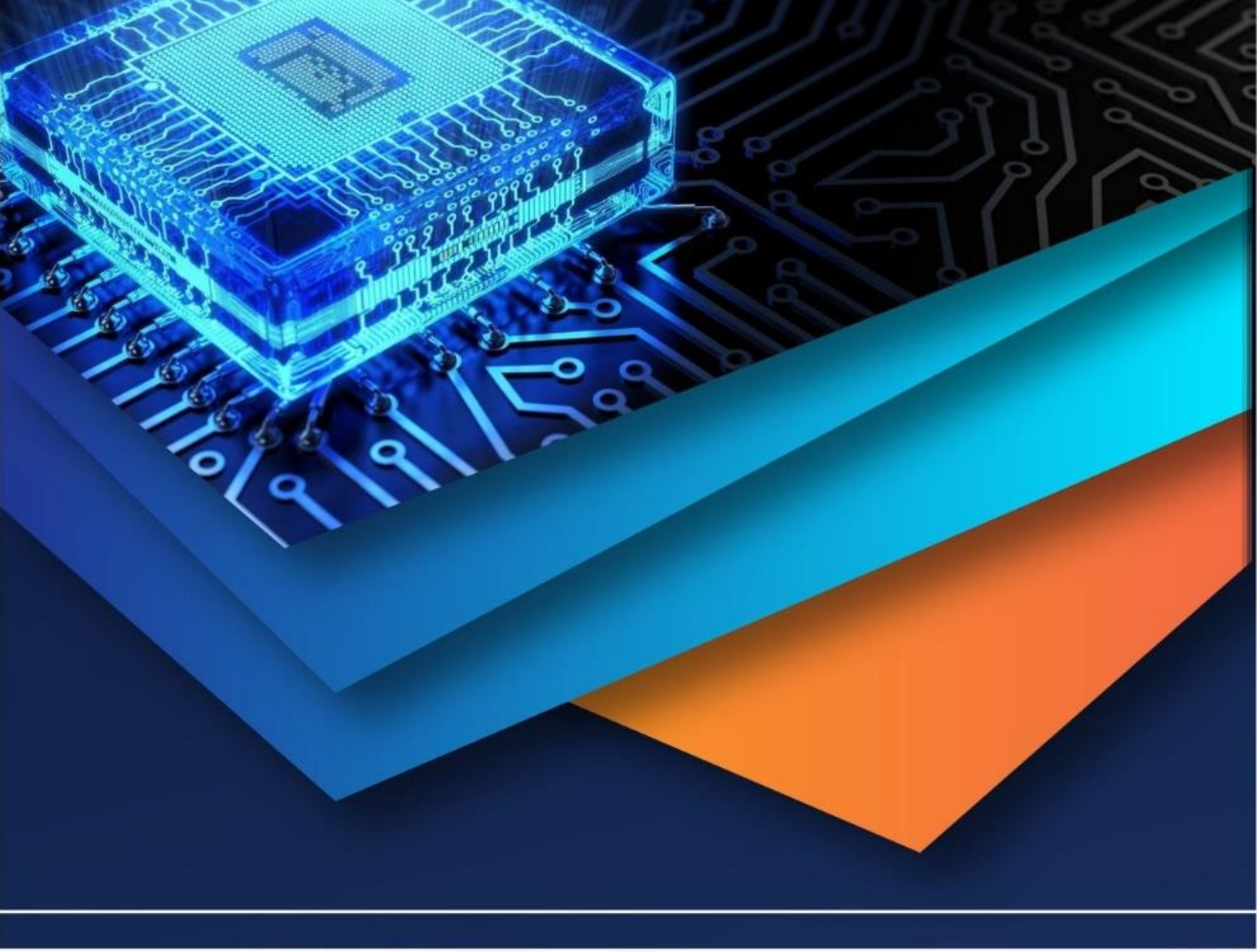

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