Cognitive Ability and Academic Achievement: A Correlational Study

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Abstract

The study investigates whether cognitive ability (CA) affects academic achievement (AA). AA scores were represented by the J&K Government higher secondary students' overall midterm test scores. The particular cognitive skills of interest were problem-solving, memory, awareness, and comprehension. The Madhugupta and Bindiyalakshmi Cognitive Ability Scale was used to test general CA. Correlation analyses were used to look at the link between these variables. A series of t-tests were employed to examine the effects of gender on CA and AA. There were 120 pupils in the sample, with a mean age of 17.1 years. AA and CA were found to be favourably associated by correlation analysis. The results add to our understanding of the roles that gender plays in research and how they affect CA & AA. The study concludes that understanding and improving AA can be aided by assessing the predictive value of CA.

Keywords: Cognitive Ability, Academic Achievement, Higher Secondary Students, Ganderbal District and Gender.

Introduction

The goal of education research and practice has been to understand better and improve academic attainment. Since AA is a topic of enormous societal and personal interest, many studies have been conducted on its explanation and prediction (Spinath, 2012). More than a century has passed since the problem of forecasting academic accomplishment first emerged. During that time, several psychological dimensions have been examined as potential indicators of AA (Verbitskaya L.A. et al., 2020). Among the myriad factors influencing academic success, CA is a fundamental predictor. CA, often characterised by awareness, understanding, reasoning, memory, and processing speed, is a cornerstone in shaping an individual's capacity to acquire, process, and apply knowledge within educational settings (Deary, 2012). Because of the significance of studying the relationship between CA and AA for educators, educational psychology is interested in finding the mechanisms underlying these inequalities.

Historically, CA has been linked to AA across various domains and educational levels (Strenze, 2007). The notion of intelligence as a predictor of AA traces its roots back to seminal

works such as Spearman's theory of general intelligence (g) and Binet's pioneering efforts in intelligence testing (Spearman, 1927; Binet & Simon, 1916). Generally, basic cognitive traits and intelligence explain up to 60% of the dispersion of academic success (Luo D. et al., 2006). However, contemporary research has extended beyond traditional conceptions of intelligence, acknowledging the multifaceted nature of CA and their differential impacts on academic outcomes (Deary et al., 2007).

Understanding the intricate interplay between CA and AA requires examining individual differences and contextual factors. While CA undoubtedly plays a significant role in shaping AA, its influence can be moderated by factors such as motivation, socio-economic status, and educational environment (Gottfredson & Deary, 2004). Moreover, recent advancements in cognitive neuroscience offer insights into the neural underpinnings of cognitive processes, shedding light on the mechanisms through which CA translate into academic success (Blakemore & Frith, 2005).

There are still several unsolved problems despite the abundance of data demonstrating the significance of CA in predicting AA. The fundamental challenge faced by previous research in obtaining a more differentiated and improved forecast of AA was to enhance the prediction of students' AA by identifying new criteria explaining incremental variance over general CA. Accordingly, "predictions of AA may be more accurate if they are based on assessment of a variety of individual differences, not just of past achievement and CA," according to Richardson et al. (2012, p. 353).

Credé and Kuncel (2008) also emphasised the significance of taking non-cognitive characteristics into account to improve admissions choices' accuracy, particularly at the higher education level, and lessen the harmful effects of significant group disparities in cognitive predictors. What part, for example, do environmental influences play in modulating the link between AA and CA? In order to advance theoretical knowledge and guide real-world interventions targeted at fostering AA for all students, these questions must be addressed.

An additional deficiency in earlier studies is the analysis of variations in gender in the predictive value for AA. Numerous studies (e.g., Schiefele et al., 2003) have demonstrated individual differences in functioning between male and female students. In order to comprehend gender differences in AA (e.g., Conger and Long, 2010) and account for evidence demonstrating different predictive values for males and females (e.g., Mellon et al., 1980), a gender-specific technique in AA prediction may be needed. To the best of our knowledge, little research has looked at the role that general CA plays in improving secondary students' academic progress while taking gender variations into account in the Ganderbal region in the recent past.

This research article seeks to contribute to the existing literature by synthesising findings from empirical studies and theoretical frameworks to elucidate the role of CA as a predicting

factor of AA. Moreover, it also examines whether gender difference significantly influences CA and AA. By examining the complex interplay between CA and individual differences in achievement, this study aims to provide insights that can inform educational policies and practices geared towards optimising learning outcomes.

Based on earlier research, we anticipated the following outcomes: no differences in general CA between genders (Ardila, A., 2011; Hypothesis 1). The literature review also suggests that there shouldn't be any gender variations in academic success (Hypothesis 2). Moreover, there are no associations between academic success and general CA at the higher secondary level (Follmer, D.J., 2017; see, for example, Tikhomirova, T., Malykh, A., & Malykh, S. (2020). Hypothesis 3).

Methods

Sample

At the time of the study, the participants were higher secondary students from the Ganderbal district's government and private schools, and they were all at least 16 years old on average. Data from 120 higher secondary students—60 men and 60 females—from three schools in the Ganderbal district served as the basis for the current study. The gender distribution in the current sample was typical of the district's population. The information provided to the participants included authorisation to view their academic records in the school database.

Measures

Academic Achievement

AA is the end outcome of education and measures how well a learner, instructor, or institution meets their learning objectives. Exams and continuing assessments are widely used to assess academic success. Still, disagreement exists on the most effective ways to measure it and whether to focus on declarative or procedural information, such as facts or abilities. The subjects' overall quarterly grades were used to gauge the participants' academic performance. Based on the results of their mid-year exams, students' AA is measured in the current study by their achievement scores. These tests are fundamental elements of the higher secondary education curriculum and are equivalent for all J&K state higher secondary students. The AA scores were collected from the administration to maintain authenticity, and finally, subject scores to statistical treatment for understanding and interpreting the findings.

Cognitive Ability

The brain uses CA to do important daily tasks. According to the American Psychological Association, perception, learning, memory, comprehension, reasoning, judgement, and

language are the talents required to do these activities. Although CA is innate, we can build and enhance them through training. Madhu Gupta and Bindiya Lakhani's CA scale (2018) was used to assess each student's level of CA among higher secondary pupils with a Cronbach's alpha of 0.701. Memory, alertness, comprehension, reasoning ability, and problem-solving ability were all tested on the CAS instrument. Participants were required to respond to all 40 items on this test by selecting the appropriate response type for each question. This paper-pencil test took the participants twelve to fifteen minutes to complete. The test score was determined by averaging the correctly answered items over all subtests, with item responses scoring dichotomously. The validated Standardised Cognitive Ability Scale (CAS) has demonstrated strong reliability estimations.

Data Screening and Analysis

We utilised the software package SPSS 16 for the statistical analysis. We thoroughly examined the data for missing values before beginning the study. For every item, the amount of missing data was less than 0.5%, making it insignificant (Kline, 2011). Our broad range of hypotheses was tested by combining several analytical techniques. We first conducted descriptive reliability assessments to characterise the underlying sample and look for prerequisite violations and anomalies in the data set. Subsequently, we employed t-tests to examine gender disparities in our dataset, and ultimately, we used a Pearson Correlation analysis to confirm the association between CA and scholastic success.

Procedure

This survey included all higher secondary pupils from the Ganderbal district. The study's research goals, which asked students to identify and analyse the distributions and correlations of specific cognitive perceptions, were best addressed through a descriptive study. Cognitive levels were tested using self-report tools, and achievement scores were gathered from school records. They were then split by gender, and total scores and subscales were generated for males and females.

The participant sample, which included girls and boys aged 17 to 19, is asked to answer during the regular course time. All participants received both written and oral instructions, and the subjects were prepared to address any impending questions in class. Significance tests were performed, and the data were analysed using the t-test and correlation. Participants completed the assessments by name or anonymously (whichever they chose). They got no compensation for their participation but were told they would receive information about their outcomes in the form of a self-referenced level of talent later. Scores from the CA scale were entered into the SPSS statistical programme.

Results

Descriptive Analysis

The results are shown in the Tables and Figures below. The data were analysed based on the association between male and female academic accomplishment and CA.

Table 1

Level of Cognitive Ability

Cognitive ability	Number of students	Percentage %
High	**04**	**3.33**
Above Average	**07**	**5.83**
Average	**45**	**37.5**
low	**64**	**53.33**

From Table 1, it has been found that 3.33% of the students have a high level of CA, about 5.83% of the sampled population have above average level of CA, about 37.5% of the students have an average level of CA and 53.33% higher secondary have low level of CA. Therefore, it has been clear that most students have low levels of CA.

Table 2

Level of Academic Achievement

Academic Achievement	Number of students	Percentage %
High (>75 %)	**40**	**33.3**
Average (50 – 75%)	**55**	**45.833**
Low (Less than 50%)	**25**	**20.83**
Total	**120**	**------**

Table 2 shows that 33.3% of the students have a high level of AA, about 45.833% of the sampled population have an above level of CA, and 20.83% higher secondary school students have a low level of AA. Therefore, it has been clear that most students have an average level of AA.

Table 3

Independent Sample t-test of Cognitive Ability and Gender of higher secondary students

Gender	N	M	S.D.	df	t-value	Inference
Male	**60**	**19.17**	**5.40**	**118**	**1.277**	**Not Significant**
Female	**60**	**20.45**	**5.61**			

*p <0.05.

It is evident from Table 3 that the t-value of male and female students' CA is 1.277, and df=118, which is statistically insignificant at 0.05 level. It reveals that the mean scores of male (19.17**)** CA and female (20.45) students do not differ significantly. So, there is no significant difference between gender and CA among higher secondary students.

Table 4

Independent Sample t-test of Academic Achievement and Gender of higher secondary students

Gender	N	M	S.D.	df	t-value	Inference
Male	60	**369.08**	**62.778**	**118**	**3.255**	**Significant**
Female	**60**	**403.60**	**52.987**			

**p<0.05.*

It is evident from Table 4 that the t-value of male and female students' AA is 3.255 and df=118, which is statistically significant at 0.05 level. It reveals that the mean scores of achievements of male (369.08) and female (403.60) students differ significantly. So, gender has a significant influence on AA among higher secondary students. Moreover, the mean scores of AA among female students are higher than those of male higher secondary students.

Pearson Correlation

The Pearson correlation analysis investigated the association between CA and AA at the upper secondary school level. The link between overall CA and AA is shown in Table 5.

Table 5

Correlation between Cognitive Ability and Academic Achievement at Higher Secondary Level

Variables	Correlation Coefficient "r"	p-value	Inference
Cognitive Ability & Achievement	**0.583**	**0.000***	**Significant**

*p <0.05.

From Table 5, the correlation coefficient between achievement and CA of higher secondary students is 0.583 and is statistically significant at 0.05 level. It reveals a significant positive correlation between CA and achievement (Richardson et al., 2012) among higher secondary students. Moreover, achievement and CA are having strong positive correlation ($r=0.583$; $p<0.05$). It can be inferred from Table 5 that students' CA significantly positively influences the AA of higher secondary students of Ganderbal district, Jammu & Kashmir.

Discussion

Predicting AA is a key goal in psychology and education research. The first half of this study looks at how gender differences affect CA and AA. Critical evaluation and literature studies reflect that gender difference does not significantly impact the higher secondary level CA. Male and female students had similar mean scores on overall CA (See. *Stephanie Ruffing 2015)*. This finding was also consistent with earlier studies, which found that male and female higher secondary students had equivalent CA (Halpernet et al., 2011). When analysing the relationship between gender and AA, research has found that female students use learning techniques more frequently, which may represent a distinct approach to academic studies. These findings are congruent with those from the current study. According to the results, male students' views suggested lower academic involvement (Noel Levitz, 2012). We verified the earlier results by demonstrating that gender variations exist in how learning is applied and in AA. According to Hassan N. and Hassan T. (2016), female students score higher on accomplishment tests than male pupils. The mean score results were small and consistent with specific literature from this geographical location. Contrary to the results, few studies point out that male students' achievement scores are higher (Mullis, Ina VS, et al. 2000).

The study's second main goal was to examine the relative contributions of CA and AA. This study examined scholastic achievement at the upper secondary level in connection to CA. General AA was determined by adding the language, math, science, and social sciences grades. These grades were used to predict measures of CA such as memory, awareness, comprehension, reasoning, and ability to solve problems.

It is concluded from the correlative study that CA is a promising predictor of AA (Lounsbury et al., 2003; Chamorro-Premuzic et al., 2006; Richardson et al., 2012) at the higher secondary level, especially when compared with the relatively stable and established construct of general CA. The examination of the relationship between CA and AA revealed results consistent with those of the literature (Rohde, T. E., & Thompson, L. A., 2006). This analysis confirms this global trend in Kashmir as well. Kashmiri culture and way of life place a high value on education. The current results are also significantly influenced by this cultural factor.

Limitations of the Current Study

Even if our study overcomes specific methodological difficulties, there are still some limits that should be mentioned. Pre-selection is a problem that always arises in samples of school children, mainly when performance-related characteristics like CA are emphasised. This variance constraint may limit the present findings' applicability to other populations, which may understate genuine connections. Future studies may, therefore, consider people other than those with higher secondary sampling. More reliable results will be produced if longitudinal research on gender disparities in CA and AA is thoroughly understood. One further weakness of the present study was its predominant emphasis on marks as the criteria variable, even though other constructs, such as retention, are also significant academic outcome variables. Therefore, expanding the parameters for evaluating AA may be crucial for future research (cf. Kunina et al., 2007).

Conclusion

The current investigation produced fresh insights into the roles that CA plays in AA among higher secondary students of the Ganderbal District. Our study has practical implications for how educational institutions support and counsel their students to maximise achievement and how students can maximise their AA, given that educational research and interventions aim to maximise the learner's AA according to their potential (Spinath, 2012). This study supports the empirical association between CA and AA. The results of the investigation into gender disparities in AA and CA indicate that there may be variations in this relationship. The results may change when various genders are studied using different measures of achievement and CA. Further study may also be required to examine the relative variations in AA and CA between male and female higher secondary pupils in the wider Kashmir area of J&K. To assess whether similar findings hold in other settings and contexts, more research is needed to confirm the nature of this link using multiple measures of CA and AA, as well as across districts and student levels. Lastly, our work broadens our understanding of the requirements for AA and encourages further research into alternate, incremental, and non-cognitive drivers of AA.

Summary

Research data indicates that gender differences in AA at the upper secondary level must be addressed (Reilly, D., 2012). However, it did not significantly affect CA; more research is helpful to understand this phenomenon fully. Girls consistently surpass males in AA, with both genders performing better overall in mean differences in achieving high AA. Additional analysis reveals no gender disparities in the higher secondary students CA of J&K's Ganderbal district. Finally, AA and CA are positively correlated; hence, developing and shaping CA among higher secondary students with a STEM curriculum will benefit higher secondary students' pursuit of AA.

Acknowledgement

We thank the School of Education, Central University of Kashmir, Jammu & Kashmir, Chief Education Officer, Ganderbal and School Principals for permitting this study. We also appreciate higher secondary students from Ganderbal for participating in this research and supporting us in collecting the necessary data for the study.

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