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Spatial and Numerical Abilities as Correlates of Academic Achievement in Economics

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ABSTRACT

The school system's primary concern and essential function are improving students' academic performance and producing a pool of skilled human resources to help grow and develop a nation. Despite how vital economics is to society, several factors determine students' choices and interests, among which spatial and numerical abilities are significant. This has led to students’ inability to cope with real-life situations, self-independent, and basic entrepreneurial skills. The paper examined spatial and numerical abilities as correlates of academic achievement in Economics. Four research questions guided the study with three instruments to collect data analyzed using mean, standard deviation, and regression analysis at a 0.05 significance level. The results revealed that the mean of all items is higher than the criterion mean of 0.50. Students had a high level of spatial ability (0.50 < 0.91), but performance in numerical ability was poor (0.50 > 0.43). The relationship between the independent variable revealed a significant positive relationship (r= 0.17, p<0.05(0.00)). There was a significant effect of independent variables on the dependent variable (F(2,997)= 41.093; p<0.05(0.000)). Teachers should be trained on how to incorporate spatial ability in economics classes.

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1. INTRODUCTION

Economics, one of the social science subjects, prepares students for topics like demand and supply, production, firm and government, and so on, which is put to use and contributes to a reasonable standard of living. The subject enables the individual to be valuable and efficient in society and creates rationality among human beings to help students develop analytical minds and critical thinking, making prudent provision of assets and other management tenacities. The economic syllabus at the senior secondary school level contains certain constructs such as the concept of demand and supply, the concept of cost, utility theory, essential tools for economic analysis, taxation, population, production, and others that require adequate knowledge of essential spatial ability as well as the numerical ability to ensure that students can cope with such topics.

Ideally, it is expected from the theoretical view that Economics students should have studied spatial ability before being exposed to the demand curve, change in demand, change in quantity demanded, the incidence of taxation and production, and possibility curve, to mention a few. Similarly, the students should have learned the concept of variation (direct, inverse, joint, and change) in formula subjects before being exposed to demand and supply functions, utility theory, etc. [1]. On that premise, it might be possible for the students to apply knowledge gained in essential spatial ability (picture smart) and basic mathematics (numerical ability) to solving related economic problems.

In earlier studies in this area, Roth et al. [2] have reported that acquiring knowledge of charts linked to scientific concepts is concomitant to skills of graphing, understanding, and interpretation, and attending tutorials before the teaching-learning process on relevant themes may enhance the level of their comprehension of scientific concepts and their school performance. From the literature, it has been discovered that the content influences those skillful in drawing and interpreting graphs in their data analysis. For instance, a learner's expertise in modules affects their ability to analyze, but those deficient in the knowledge of graphs may not be able to read between the lines. Zetland [3] viewed that illustration of cost-effective models in the identical symbol formula (direct-direct or inverse-inverse) enable learners to comprehend economic concepts than the established method found in textbooks, a mixed symbol (direct-inverse) found that the reversal intrinsic in economic philosophy is to a large extent a clog in the wheel of learning the basics of economics theory.

Furthermore, the observed relationship between the achievement made on a 3-D mental rotation task and mathematical word problem-solving also corroborates the prime position of spatial ability in mathematical learning [4], [5]. A mental representation of spatial ability in Mathematics could be represented by forming equations from the word problem. Significantly, coding and decoding in Mathematics concepts depend on spatial ability [6]–[8].

Students' spatial ability is the capacity to know diagrams or graphs that help them relate very well with some critical variable concepts in economics, including the theory of production, cost, market structures, etc. Manipulation and dexterity in using numbers in diverse manners, especially in scientific and practical administration, is regarded as Numerical ability. This is the proficiency demonstrated to appreciate and play with identical numbers. Mathematical skill is a human conjecture that is intellectually or logically described according to its use. Intellectual classification is used when relating to this paradigm from a theoretical viewpoint; mathematical ability can then be defined as the ability to obtain, process, and retain mathematical information [9], [10] or as the capacity to learn and master new mathematical ideas and skills [4]. Pragmatic definitions are used when looking at this construct from a perspective of evaluation, which focuses on identifying learners' potential or assessing learning outcomes. From this perspective, it is defined as the ability to perform mathematical tasks and solve mathematical problems accurately [11].

The correlation of students' performance in Mathematics showed a significant impact on their performance in Economics [12]. This result is not in agreement with the findings made by Cohn [13], that observed no significant effect of mathematical knowledge on learning the principles of Economics but supported the conclusion of Lagerlöf [14], who affirmed that the knowledge acquired in mathematics before gaining entrance into the University has a strong predictive power on students' performance in a range of Economics courses taken at the university level.

In another vein, a study by Kucian et al. [15] on the effects of mathematical problem-solving, mathematical reasoning, and spatial abilities on gifted students' mathematics achievement showed that their mathematics achievement was high, and their mathematical reasoning and problem-solving abilities were above average. A high and average significant correlation existed between gifted students' mathematical abilities and mathematics achievement. The sequence of the significance of gifted students' mathematical abilities on mathematics achievement is spatial thinking, mathematical reasoning, and problem-solving. These are found to be significant predictors of mathematics achievement [12]. There is inconsistency in the result of studies that focused on the impact of cognitive training rotation on specific mathematical skills beyond correlational studies, with some finding evidence of transfer [16], [17] and some not finding such evidence [18], [19]. There was little justification, as no empirical studies had validated the comparison of these cross-domain training studies or proven that spatial skills will improve the mathematical reasoning of the individual.

Besides, Gilligan et al. [12] assessed the contribution of spatial ability to mathematics achievement in middle childhood and associated differences in mathematical performance using their demographic factors. They found that learners from the high socio-economic class performed better than their counterparts from the low socio-economic class.

The main concern why schools are established is to increase the efficiency in the academic excellence of learners, which will enable them to function as skilled human resources to contribute meaningfully to grow and develop their nation. Despite the usefulness of economics to our society, the choice and interests of students are influenced by several factors and variables, among which spatial and numerical abilities stand out. It has led to students' inability to cope with real-life situations, self-independent, and basic entrepreneurial skills. Because of the gap created in the area of science and social sciences in particular, the paper examined spatial and numerical abilities as correlates of academic achievement in Economics as well as the influence of spatial and numerical abilities as means through which students' academic achievement in Economics among senior secondary schools could be enhanced. Against this background, four research questions guided the study which is:

1. What is the level of spatial ability on students' academic achievement in economics in Ibadan Metropolis?
2. What is the level of numerical ability on students' academic achievement in economics in Ibadan Metropolis?

3. What is the strength and direction of students’ spatial ability, numerical ability, and academic achievement in economics
4. To what extent will students' spatial and numerical abilities jointly predict students’ academic achievement in economics?

2. METHOD

The study adopted the ex-post facto design of survey type. The independent variables in the study are Spatial and Numerical abilities, while the dependent variable is Academic Achievement in Economics. The study population comprises Senior Secondary School 3 Economics Students in Ibadan North, Ibadan South East, Lagelu, and Oluyole Local Government Areas of Ibadan, Oyo State. Simple random sampling was used to select four local governments (Ibadan North, Ibadan South East, Lagelu, and Oluyole) from eleven LGAs in Ibadan and twelve public senior secondary schools from the four educational zones using Proportionate to size sampling (four from the forty-two in Ibadan North, four from the forty in Ibadan South West, two from twenty-six in Lagelu and two from twenty-seven in Oluyole) with an entire class from the arms of glasses of SSS 3 Economics students that are purposively selected from each school as participants for this study. Seven hundred thirty (730) students formed the study's sample size. Three instruments were used in this study. They are:

Spatial Ability Performance Test (SAPT). This instrument is 30 items achievement test used to quantify students' performance in identifying and grasping the basic notions required to learn and apply spatial concepts and procedures. The instrument consists of two sections, A and B. Section A sought the students' bio-data, while section B consisted of items that determined the extent of students’ knowledge of basic shapes. The internal consistency reliability of the items was estimated using Cronbach alpha which yielded r =0.79.

Numerical Ability Achievement Test (NAAT). This instrument is a 30 items achievement test used to quantify students' performance in identifying and grasping the fundamental notions required to learn and apply numerical ability concepts and procedures. The instrument consists of two sections, A and B. Section A sought the students' bio-data, while section B consisted of items that determined the extent of students’ knowledge of basic shapes. The internal consistency reliability of the items was estimated using Cronbach alpha which yielded r =0.81.

Economics Achievement Test (EAT). This instrument is an achievement test to quantify students' performance in identifying and grasping the fundamental notions required to learn and apply numerical ability concepts and procedures. The instrument consists of 20 items developed by the researchers with four options lettered A, B, C, and D, drawn from the SSS 3 mathematics curriculum topics. The reliability of the items was estimated using Cronbach alpha which yielded r =0.57.

Data collected were analyzed using descriptive statistics of frequency count, percentages, mean and standard deviation, and inferential statistical analysis of Pearson Product Moment Correlation and Multiple Regression at 0.05 significance level.

3. RESULTS AND DISCUSSION

Table 1. Performance of SSS 3 Students in Spatial Ability

Items	Can Identify	Cannot Identify	$\bar{x}$	σ^2
Item 1	715 *(97.90)*	15 *(2.10)*	0.98	0.14
Item 2	701 *(96.0)*	29 *(4.0)*	0.96	0.20
Item 3	688 *(94.2)*	42 *(5.8)*	0.94	0.20
Item 4	703. *(96.3)*	27 *(3.7)*	0.96	0.19
Item 5	709 *(97.1)*	21 *(2.9)*	0.97	0.17
Item 6	721 *(98.8)*	9 *(1.2)*	0.99	0.11
Item 7	718 *(98.4)*	12 *(1.6)*	0.98	0.13
Item 8	699 (95.8)	31 *(4.2)*	0.96	0.20
Item 9	640 *(87.7)*	90 *(12.3)*	0.88	0.33
Item 10	719 *(98.5)*	11 *(1.5)*	0.98	0.12
Item 11	721 *(98.8)*	9 *(1.2)*	0.99	0.11
Item 12	718 *(98.4)*	12 *(1.6)*	0.98	0.13
Item 13	640 *(87.7)*	90 *(12.3)*	0.88	0.33
Item 14	718 *(98.4)*	12 *(1.6)*	0.98	0.13
Item 15	689 *(94.4)*	41 *(5.6)*	0.94	0.23
Item 16	710 *(97.3)*	20 *(2.7)*	0.97	0.16
Item 17	672 *(92.1)*	58 *(7.9)*	0.92	0.27
Item 18	725 *(99.3)*	5 *(0.7)*	0.99	0.08
Item 19	640 *(87.7)*	90 *(12.3)*	0.88	0.33
Item 20	720 *(98.6)*	10 *(1.4)*	0.99	0.12
Item 21	642 *(87.9)*	88 *(12.1)*	0.88	0.33
Item 22	722 *(98.9)*	8 *(1.1)*	0.99	0.10
Item 23	711 *(97.4)*	19 *(12.6)*	0.97	0.16
Item 24	704 *(96.4)*	26 *(3.6)*	0.96	0.19
Item 25	724 *(99.2)*	8 *(0.8)*	0.99	0.09
Item 26	492 *(67.4)*	238 (32.6)	0.67	0.47
Item 27	618 *(84.7)*	112 (15.3)	0.85	0.36
Item 28	635 *(87.0)*	95 *(13.0)*	0.87	0.34
Item 29	283 *(38.8)*	447 *(61.2)*	0.39	0.49
Item 30	485 *(66.4)*	245 *(33.6)*	0.66	0.47

Criterion mean = 0.50; Weighted mean = 0.91; percentages in parenthesis

Table 1 presents the responses of student's performance on spatial ability, and the result showed that the students could identify items 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 20, 22, 23, 24, and 25. From the table, the weighted mean of 0.91 is lower than the response means. This explains the rate at which SSS 3 students' spatial ability reduced poor performance among economics students, while items 9, 13, 19, 21, 26, 27, 28, 29, and 30 were insignificant since their mean is less than the weighted mean of 0.91. Also, the mean values of only item 29 (39%) are lower than the criterion mean of 0.50, while the mean of all other items is higher than 0.50. It implies that most students could identify the particular shapes related to the simulated real-life problems of the items. Thus, this can be concluded that sampled senior secondary school students in Ibadan Metropolis had a high level of spatial ability (0.50 < 0.91).

Considering the input variable (Basic Shapes, Rectangle, Block arrows, and Flowchart) required the level of spatial ability of SS 3 students in Ibadan Metropolis. Many students performed well in the basic shape, rectangle, and block arrows levels but with a low percentage at the flowchart level about spatial ability. Most SS 3 students can correctly identify items 6, 7, 10, 12, 14, 20, and 25 in the first group compared to the rotated second group. That increased rate in the second group showed their conception of

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the proportion of variation of basic shape over time among the SS 3 students, which showed high mean values 99%, 98%, 98%, 98%, 98%, 99%, and 99% of the items, respectively while they could not identify correctly only item 9 with low mean value 88% less than weighted mean 91%.

Moreover, on indicator ‘rectangle,’ items 3, 4, 5, 15, and 17 showed high mean values of 94%, 96%, 97%, 94%, and 92%, respectively, and this implies that SS 3 students in Ibadan Metropolis can correctly identify those items as compared with the rate of change in the shapes while they could not correctly identify only item 21 with low mean value (88%) less than the weighted mean (91%). On the block arrows indicator, SS 3 students in Ibadan correctly identified all the items (items 1, 2, 8, and 22) with the means 98%, 96%, 96%, and 99%, respectively, more incredible than the weighted mean 91%. Besides, on flowchart indicators, SS 3 students could only correctly identify five items out of the twelve items, indicating that most SS 3 students had low mean values in the items. This indicates that SS 3 students understood basic shapes, rectangles, and block arrows well during their dearth of knowledge of flowcharts. Poor understanding of flowcharts may unavoidably lead to SS 3 students’ relatively poor identification of relevant diagrams in economics at the senior secondary school level.

The finding in Table 1 reveals that spatial ability has a high impact on the reduction of poor academic achievement in economics among senior secondary schools in the Ibadan Metropolis. This implies that economics teachers and experts in the field need to intensify efforts to revamp spatial ability in the flowchart (rotation of shape) in the economics class in senior secondary schools in Ibadan Metropolis. Thus, with aids of spatial ability, students could recognize basic shape models acquired from solving well-structured problems in the classroom to ill-structured problems faced outside the classroom. It could also be a great help to transfer the concepts learned from solving ill-structured problems, similar to those encountered in the real world, to solve well-structured problems encountered in the classroom.

The study aligns with the findings of Kucian et al. [15], who found an improvement in arithmetical skill when the number is considered in spatial terms in typically developing children and those with gradual calculation development. The study also supports Uttal [20] that spatial ability is a good predictor of achievement and attainment in the STEM disciplines. AlsoHarris et al. [21] found that deficiencies in spatial ability constitute an obstacle as a gateway for entry into STEM fields. The study also agrees with the findings that found a significant role of spatial ability in general mathematics achievement. In education, this has many effects on the mastery of essential spatial ability among secondary school economic students and it is an important factor for success in economics in secondary school. For this reason, there should be strong linkages between economics syllabus and spatial ability at secondary school level. Hence, there is the need for linkages between the curricula of economics and spatial ability at secondary school level. This will prevent the difficulty of proper understanding of diagrams in economics. Also, it will aid the students to transfer theories and ideas gained on shapes to a new acquired knowledge in economics.

Table 2. Achievement of SSS 3 Students in Numerical Ability

Items	Correct	Not Correct	$\bar{x}$	σ^2
Item 1	561 *(76.8)*	169 *(23.2)*	0.77	0.42
Item 2	420 *(57.5)*	310 *(42.5)*	0.58	0.50
Item 3	280 *(38.4)*	450 *(61.6)*	0.38	0.49
Item 4	279 *(38.2)*	451 *(61.8)*	0.38	0.49
Item 5	523 *(71.6)*	207 *(28.4)*	0.72	0.45
Item 6	360 *(49.3)*	370 *(50.7)*	0.49	0.50
Item 7	368 *(50.4)*	362 *(49.6)*	0.50	0.50
Item 8	210 (28.8)	520 *(71.2)*	0.29	0.45
Item 9	190 *(26.0)*	540 *(74.0)*	0.26	0.44
Item 10	197 *(27.0)*	533 *(73.0)*	0.27	0.44
Item 11	307 *(42.1)*	423 *(57.9)*	0.42	0.49
Item 12	336 *(46.0)*	394 *(54.0)*	0.46	0.50
Item 13	394 *(54.))*	336 *(46.0)*	0.54	0.50
Item 14	553 *(75.8)*	177 *((24.2)*	0.76	0.43
Item 15	164 *(22.5)*	566 *(77.5)*	0.22	0.42
Item 16	327 *(44.8)*	403 *(55.2)*	0.45	0.50
Item 17	258 *(35.3)*	472 *(64.7)*	0.35	0.48
Item 18	271 *(37.1)*	459 *(62.9)*	0.37	0.48
Item 19	215 *(29.5)*	515 *(70.5)*	0.29	0.46
Item 20	361 *(49.5)*	369 *(50.5)*	0.49	0.50
Item 21	215 *(29.5)*	515 *(70.5)*	0.29	0.46
Item 22	164 *(22.5)*	566 *(77.5)*	0.22	0.42
Item 23	427 *(58.5)*	303 *(41.5)*	0.58	0.49
Item 24	450 *(61.5)*	280 *(38.4)*	0.62	0.49
Item 25	279 *(38.2)*	451 *(61.8)*	0.38	0.49
Item 26	258 *(35.3)*	472 *(64.7)*	0.35	0.48
Item 27	273 *(37.4)*	457 *(62.6)*	0.37	0.48
Item 28	208 *(28.5)*	522 (71.5)	0.28	0.45
Item 29	227 *(31.1)*	503 *(68.9)*	0.31	0.46
Item 30	280 *(38.4)*	450 *(61.6)*	0.38	0.49

Criterion mean = 0.50; Weighted mean = 0.43; Percentages in parenthesis

From Table 2, the responses were analyzed, and the findings revealed that the students could correctly solve items 1, 2, 5, 6, 7, 12, 13, 14, 16, 20, 23, and 24. This explains the rate to which SSS 3 students' numerical ability reduced poor performance among economics students with a response means more remarkable than the weighted mean of 0.43, while items 3, 4, 8, 9, 10, 11, 15, 17, 18, 19, 21, 22, 25, 26, 27, 28, 29 and 30 were not significant. Since their mean is less than the weighted mean of 0.43. Also, item 1 has the highest mean of 0.77, while items 15 and 22 have the lowest mean of 0.22. It can be concluded that the sampled senior secondary school students' performance in numerical ability in Ibadan Metropolis is poor (0.50 > 0.43).

Research Question 2, required the level of numerical ability of SS 3 students in Ibadan Metropolis. The numerical ability had three indicators (Number and Numeration, Algebraic process, and Statistics). A relatively high proportion of students performed well in numbers and numeration but with a relatively low percentage in the algebraic process and statistics regarding numerical ability. To some extent, a large majority of SS 3 students were able to solve correctly items 1, 2, 5, 6, 7, 12, 13, 14, 20, 23, and 24, increasing the rate of their understanding of the number and numeration over time within the SS 3 Students who showed high mean values 77%, 58%, 72%, 49%, 50%, 46%,54%, 76%, 49%, 58% and 62%% of the items respectively while they could not solve correctly items

3, 4, 8, 21, 22, 26, 27, 28 and 29 with low mean value 38%, 38%, 29%, 29%, 22%, 35%, 37%, 28% and 31% less than weighted mean 43%. Moreover, on indicator 'algebraic process,' only item 16 showed a high mean value of 45%, and this implies that SS 3 students' in Ibadan Metropolis could correctly solve questions on the item while they could not correctly solve questions on item 11, 17, 18, 19 and 30 with low mean value 42%, 35%, 37%, 29%, and 38% respectively less than weighted mean 43%. On the statistic indicator, SS 3 students in Ibadan could not correctly solve all the items (items 9, 10, 15, and 25) with a mean of 26%, 27%, 22%, and 38%, accordingly lower than the weighted mean of 43%. This indicates that SS 3 economic students had a relative understanding of numbers and numeration and poor knowledge of algebraic processes and statistics.

Findings in Table 2 reveal that numerical ability shows a low impact on the reduction of poor performance amongst economics students in Ibadan Metropolis. This implies that economic teachers need to intensify efforts to improve the mathematical aspect of economics in class among senior secondary schools in Ibadan Metropolis. The study disagrees with Reilly [22], who found an inverse association between students' perception of mathematics and their performance in economics. The study does not corroborate the findings of Ademola [23], that reported no significant relationship between numerical ability and achievement. The study corroborates Yidana et al.[10], who found a positive relationship between students' mathematics achievement and economic performance. The educational implication of these is that mastery of numerical ability by economics students is among the most critical factors for success in economics in secondary school. Therefore, a need for coordination between economics curricula and numerical ability at the secondary school level is germane to avoid the difficulty of applying numerical ability (mathematics) in economics. This will help economic students transfer concepts, ideas and procedures learned in mathematics to a new and unanticipated economic situation.

Table 3. Intercorrelation Matrix of Spatial Ability, Numerical Ability, and Academic Achievement in Economics

Variables	Spat_Ability	Num_Ability	Eco_Achievement
Spat_Ability	1	0.165	0.226
Num_Ability		1	0.190
Eco_Achievement			1

Significance at the 0.05 level; N = 730

Table 3 presents the result of Pearson Product Moment Correlation Coefficients for the relationship among spatial ability, numerical ability, and academic achievement of SSS 3 students' in selected LGAs in Ibadan Metropolis. Regarding students' academic achievement by the two independent variables (spatial and numerical abilities), it was observed in Table 4.3 that, at $p<0.05$, there is no multi-collinearity ($r>0.90$) among the variables of the study. Also, the intercorrelation matrix showing the correlation coefficients between the independent variable: Spatial ability, and the criterion variable, academic achievement in economics, reveals a significant positive relationship between spatial ability and academic achievement in economics ($r= 0.23$, $p<0.05(0.00)$). This implies that the spatial ability of the sampled senior secondary school students has a direct but weak relationship with their academic achievement in economics.

However, the result shows that the correlation between the independent variable: spatial and numerical abilities reveals a significant positive relationship (r= 0.17, p<0.05(0.00)). This implies a weak positive relationship exists between the spatial and numerical abilities of the sampled senior secondary school students. Furthermore, the result shows that the correlation coefficient between the independent variables, numerical ability, and the criterion variable, academic achievement in economics, reveals a significant positive relationship between numerical ability and academic achievement in economics (r=0.19, p<0.05)(0.00)). This implies that the numerical ability of the sampled senior secondary school students has a weak positive relationship with their academic achievement in economics. It can therefore be concluded that there is a significant relationship between spatial ability, numerical ability, and academic achievement in economics among sampled senior secondary school students.

The inter-correction matrix in Table 3 presents the result of the relationship between all the study variables and shows no multi-collinearity among the variables. The intercorrelation matrix showing the correlation coefficients between spatial ability and academic achievement in economics reveals a significant positive relationship (r= 0.23, p<0.05 (0.00)). This finding agrees with Gültepe [24], who investigated the experience-language-pictorial-symbolic-application (ELPSA) pedagogical framework and found a significant difference in students' spatial reasoning and mathematics achievement across geometry, measurement, number, and algebra contents. Also, the result of the correlation coefficient between the numerical ability and students' academic achievement in economics shows a significant positive relationship between the numerical ability and students' academic achievement in economics (r = 0.17, p<0.05 (0.00)). This corroborates the findings of Santos [25] that the combination of numerical ability, verbal reasoning, and educational aptitudes significantly predict learners' performance in Limits and Continuity. He also believes that this will equally influence students' performance in mathematics.

Table 4. Regression Summary and ANOVA of how Spatial and Numerical Abilities Jointly Predict Students' Academic Achievement in Economics of SSS 3 Students in Ibadan Metropolis

Multiple R	= 0.276[a]				
R Square	= 0.076				
Adjusted R Square	= 0.074				
Standard Error	= 2.961				
Analysis of Variance					
Sources of Variance	Sum of Square	DF	Mean Square	F	Sig.
Regression	720.339	2	360.170		
Residual	8738.345	997	8.765	41.093	0.000[b]
Total	8458.684	999			

Dependent Variable: Academic Achievement in Economics

Predictors: (Constant) Numerical and Spatial Abilities

Significance at p<0.05; N = 730

Table 4 presents the combined effect of the independent variables, numerical and spatial abilities, on academic achievement in the economics of SSS 3 students in Ibadan

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Metropolis. From the table, the multiple correlation coefficient is R = 0.276a, R2 = 0.076, and Adj. R2 = 0.074. This implies that the multiple correlations of 0.276 indicate a positive relationship between numerical and spatial abilities to academic achievement in the economics of SSS 3 students in Ibadan Metropolis. This predictor variable helps predict the academic achievement in the economics of SSS 3 students in the sampled senior secondary schools in Ibadan Metropolis. Also, Table 4 reveals that the adjusted R2 accounted for 7.4% of the variance observed in academic achievement in economics among SSS 3 students in the sampled senior secondary schools in Ibadan Metropolis. The remaining 92.6% could be due to factors not considered in the study. Furthermore, there was a significant effect of the independent variables on the dependent variable ($F(2,997)= 41.093$; $p<0.05(0.000)$) in the regression analysis.

Findings in Table 4 show that the 0.276a found in the multiple regression correlation coefficients (R) indicates a linear relationship among spatial ability, numerical ability academic achievement in the economics of SSS 3 students in Ibadan Metropolis. The coefficient of determination (Adjusted R-Square 0.074) implies that spatial and numerical abilities in the study, when taken together, accounted for 7.4% of the total variance in the dependent variable (academic achievement in economics). In comparison, the remaining 92.6% is due to other factors not considered in the study. Furthermore, there was a significant effect of the independent variables on the dependent ($F(2,997) = 41.093$; $p<0.05(0.000)$). This means that the students' spatial and numerical abilities contribute significantly to their academic achievement in economics. The study supports Kucian [14], which found a significant relationship between gifted students' mathematical abilities and mathematics achievement. Precisely, spatial thinking, mathematical reasoning, and problem-solving significantly predict mathematics achievement.

4. CONCLUSION

This study investigated spatial and numerical abilities as correlates of students' academic achievement in economics in the Ibadan Metropolis. Based on the findings and discussion of the study, it could be concluded that the correlation coefficient between numerical ability and students' academic achievement in economics shows a significant positive relationship between numerical ability and academic achievement in economics. The students' spatial and numerical abilities contribute significantly to their academic achievement in economics; there is a weak positive association between spatial and numerical abilities on students' academic achievement in economics in Ibadan Metropolis. Also, spatial and numerical abilities significantly predict students' academic achievement in economics in Ibadan Metropolis. Because of the result of this study, it is therefore recommended that Teachers should be trained on how to incorporate the teaching of spatial ability in economics class, and Students should be made to understand the interrelationship between spatial and mathematical concepts and how they serve as the basis for further learning both within and outside the classroom.

REFERENCES

[1] P. M. Shrestha, "Examining the Factors Affecting the Profitability of Commercial Banks," *J. Math. Instr. Soc. Res. Opin.*, vol. 2, no. 2, pp. 105–114, May 2023, doi: 10.58421/misro.v2i2.86.

[2] W.-M. Roth and G. M. Bowen, "When Are Graphs Worth Ten Thousand Words? An Expert-Expert Study," *Cogn. Instr.*, vol. 21, no. 4, pp. 429–473, Mar. 2003, [Online]. Available: http://www.jstor.org/stable/3233806.

[3] D. Zetland, C. Russo, and N. Yavapolkul, "TEACHING ECONOMIC PRINCIPLES: ALGEBRA, GRAPH OR BOTH?," *Am. Econ.*, vol. 55, no. 1, pp. 123–131, Mar. 2010, [Online]. Available: http://www.jstor.org/stable/40657833.

[4] E. S. Johnson, "Sex differences in problem solving.," *J. Educ. Psychol.*, vol. 76, no. 6, pp. 1359–1371, Dec. 1984, doi: 10.1037/0022-0663.76.6.1359.

[5] D. van Garderen, "Spatial Visualization, Visual Imagery, and Mathematical Problem Solving of Students With Varying Abilities," *J. Learn. Disabil.*, vol. 39, no. 6, pp. 496–506, Nov. 2006, doi: 10.1177/00222194060390060201.

[6] L. M. Phillips, S. P. Norris, and J. S. Macnab, *Visualization in Mathematics, Reading and Science Education*, vol. 5. Dordrecht: Springer Netherlands, 2010.

[7] N. Shoresh and B. Wong, "Data exploration," *Nat. Methods*, vol. 9, no. 1, pp. 5–5, Jan. 2012, doi: 10.1038/nmeth.1829.

[8] E. Tufte, *Visual display of quantitative information*. Cheshire, CT: Graphics Press, 2001.

[9] V. A. Krutetskii, *The Psychology of Mathematical Abilities in Schoolchildren*. Chicago: University Of Chicago Press, 1976.

[10] T. Vilkomir and J. O'Donoghue, "Using components of mathematical ability for initial development and identification of mathematically promising students," *Int. J. Math. Educ. Sci. Technol.*, vol. 40, no. 2, pp. 183–199, Mar. 2009, doi: 10.1080/00207390802276200.

[11] V. Koshy, P. Ernest, and R. Casey, "Mathematically gifted and talented learners: theory and practice," *Int. J. Math. Educ. Sci. Technol.*, vol. 40, no. 2, pp. 213–228, Mar. 2009, doi: 10.1080/00207390802566907.

[12] K. A. Gilligan, E. Flouri, and E. K. Farran, "The contribution of spatial ability to mathematics achievement in middle childhood," *J. Exp. Child Psychol.*, vol. 163, pp. 107–125, Nov. 2017, doi: 10.1016/j.jecp.2017.04.016.

[13] E. Cohn, S. Cohn, D. C. Balch, and J. Bradley, "Do Graphs Promote Learning in Principles of Economics?," *J. Econ. Educ.*, vol. 32, no. 4, pp. 299–310, Mar. 2001, doi: 10.2307/1182879.

[14] J. N. M. Lagerlöf and A. J. Seltzer, "Effects of Remedial Mathematics on the Learning of Economics BT - Encyclopedia of the Sciences of Learning," N. M. Seel, Ed. Boston, MA: Springer US, 2012, pp. 1091–1093.

[15] K. Kucian *et al.*, "Mental number line training in children with developmental dyscalculia," *Neuroimage*, vol. 57, no. 3, pp. 782–795, Aug. 2011, doi: 10.1016/j.neuroimage.2011.01.070.

[16] Y.-L. Cheng and K. S. Mix, "Spatial Training Improves Children's Mathematics Ability," *J. Cogn. Dev.*, vol. 15, no. 1, pp. 2–11, Jan. 2014, doi: 10.1080/15248372.2012.725186.

[17] T. Lowrie, T. Logan, and A. Ramful, "Visuospatial training improves elementary students' mathematics performance," *Br. J. Educ. Psychol.*, vol. 87, no. 2, pp. 170–186, Jun. 2017, doi: 10.1111/bjep.12142.

[18] C. Xu and J.-A. LeFevre, "Training young children on sequential relations among numbers and spatial decomposition: Differential transfer to number line and mental transformation tasks.," *Dev. Psychol.*, vol. 52, no. 6, pp. 854–866, 2016, doi: 10.1037/dev0000124.

[19] Z. Hawes, J. Moss, B. Caswell, and D. Poliszczuk, "Effects of mental rotation training on children's spatial and mathematics performance: A randomized controlled study," *Trends Neurosci. Educ.*, vol. 4, no. 3, pp. 60–68, Sep. 2015, doi: 10.1016/j.tine.2015.05.001.

[20] D. H. Uttal and C. A. Cohen, "Chapter Four - Spatial Thinking and STEM Education: When, Why, and How?," in *The Psychology of Learning and Motivation*, vol. 57, B. H. B. T.-P. of L. and M. Ross, Ed. Academic Press, 2012, pp. 147–181.

[21] J. Harris, N. S. Newcombe, and K. Hirsh-Pasek, "A New Twist on Studying the Development of Dynamic Spatial Transformations: Mental Paper Folding in Young Children," *Mind, Brain, Educ.*, vol. 7, no. 1, pp. 49–55, Mar. 2013, doi: 10.1111/mbe.12007.

[22] B. Reilly and R. Bachan, "A comparison of A-level performance in economics and business studies: How much more difficult is economics?," *Educ. Econ.*, vol. 13, no. 1, pp. 85–108, Mar. 2005, doi: 10.1080/0964529042000325225.

[23] B. Ademola K, "Problem-Based Instructional Strategy and Numerical Ability as Determinants of Senior Secondary Achievement in Mathematics," *J. Educ. Pract.*, vol. 7, no. 13, pp. 89–95, 2016,

[Online]. Available: http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1102799&site=ehost-live.

[24] N. Gültepe, "Reflections on High School Students' Graphing Skills and Their Conceptual Understanding of Drawing Chemistry Graphs," *Educ. Sci. Theory Pract.*, vol. 16, no. 1, pp. 53–81, 2016, doi: 10.12738/estp.2016.1.2837.

[25] J. C. D. Santos and M. C. L. Boyon, "Numerical and Verbal Reasoning Aptitudes as Predictors of STEM Students' Performance on Limits and Continuity," *Educ. Meas. Eval. Rev.*, vol. 11, no. July, pp. 14–24, 2020.