

Influences of Gender and Age on the Performance of Secondary School Students in Differential Aptitude Test in Southwest, Nigeria.

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Abstract

The study investigated the influences of gender and age on the performance of Senior Secondary School One (SSS1) students in Differential Aptitude Test (DAT). Eight hundred and sixteen SSS1 students formed the sample. A-62 item DAT was developed to collect data for the study. The items in DAT have discriminating power of 0.42 and above, and also with difficulty levels between 0.40 and 0.69. The students were tested in Spelling (SP), Verbal ability (VA), Numerical reasoning (NR), Mechanical knowledge (MK), Abstract reasoning (AR), Comprehension (CO) and Spatial ability (SA) with construct validity coefficients ranging from 0.69 to 0.83 and reliability coefficients were between 0.50 and 0.79. The overall reliability of DAT was 0.74. The result showed that there were significant differences in the performance of male and female students in SP, VA, NR, CO and SA while their performance were not significantly different in MK and AR. The result also revealed that there were significant differences in the performance of students in SP, VA, NR and MK in respect to students' age group while the age groups did not significantly influence the performance of the students in AR, CO and SA. In conclusion, gender and age of SSS1 influence their performance in DAT. It is recommended that gender and age of the students should be considered while allocating SSS1 to subject areas.

Keywords: Gender, age, differential aptitude test, subject combination, performance

Introduction

The Nigeria National Policy on Education (Federal Ministry of Education, 2014) requires students after primary education to go through six-year secondary education which consists of three years in junior secondary school and another three years in senior secondary level, students are require to choose their subject areas (Arts, Commercial and Science). The careers of the students depend on the chosen subject areas at the secondary school level. In view of the numerous careers that are available, career selection is one of the major careful decision SSS1 students will have to make. This decision has a great impact in the life of an individual and the consequence could be felt throughout the life time. It is observed that career selections are usually done directly or indirectly on behalf of SSS1 students by their parents, relatives, school authority and school counsellors without taking into cognizance the innate ability of the SSS1 students to cope with chosen careers. According to Eyo and Edet (2011), choosing an

career or job is one of the difficult decisions that every student must face and the outcome of such decision would likely determine the kind of life the student will live in future.

It is obvious that the DAT is indispensable in assisting students to choose the right career since neither aptitude test nor achievement test could measure all the inherent abilities and traits embedded in an individual. According to Brian (2011), aptitude test is used to predict how well a person might perform in school or in an employment, hence it is used for educational and vocational counselling. According to Kagan (2019) an aptitude test is used to determine an individual propensity to succeed in a given activity. It reveals the inherent strengths and weaknesses and have natural inclination toward success or failure in specific areas based on their innate characteristics. She stated further that school use aptitude test to determine if students are inclined toward advanced placement in classes or certain areas of study. Aptitude test is a form of career assessment test to know a chosen career where individual could excel in life.

Many schools use achievement test to choose careers for their SSS1 students. Alnahdi (2015) suggested that both aptitude and achievement tests should be used in admitting students into higher institutions. However, aptitude test are not tied to curriculum as different individuals have varying levels of interest and intelligence in different areas of endeavour. The total score of general aptitude tests cannot make a true calculation of different kinds of aptitude hence DAT measures all kinds of aptitude separately. DAT covers several areas like SP, VA, NR, MK, AR, CO and SA. The SP measures how a student can spell common English words, the ability to spell is basic skill necessary in many academic and vocational pursuits. The VA measures ability to infer the relationship between the first pair of the words and apply the relationship to the second pair of words. The NR measures the ability to perform mathematical tasks and computational tasks, it is important for success in courses that use figures. The MK measures the ability to understand basic mechanical principles of machineries, tools and motion. The AR is non-verbal measure of reasoning ability. It assesses how well individuals can reason geometric shapes or design. AR is a measure of logical, analytical and conceptual skills. The CO is the understanding and interpretation of what is read, the ability to understand materials read. While SA is capacity to understand reason and remember the spatial relations among objects when turn at different orientations [3-dimension (3D)] in space. SA is important for success in field such as architectural design and engineering (Mankar & Chavan, 2013).

Many factors influence the selection of vocation/career and choice of subjects among secondary school students which include, parental influence, students' gender, socio-economic status among others (Alordiah, Akpadaka & Oviogbodu, 2015). Eyo and Edet (2011) submitted that gender plays a major role in career choice of the students, gender has a significant influence on the occupational preference among counselled and non-counselled students. Adebule and Ibitoba (2015) asserted that stereotypic belief that boys perform better than girls in core natural sciences and mathematics could influence students' choice of career.

Age is also a factor that could influence students' career choices as decisions making increase with age, skills in making decision increase with age (Jones, 2008). Marunic & Glazar (2014) submitted that age played significant role in students' spatial aptitude. Also, Ocal and Ehri (2017) reported that age of students was a function of their innate abilities meaning that the learning abilities of students could have impact on their age.

Petros, Vukica and Mildred (2014) emphasised that out of seven components that made up human intelligence, spatial visualisation takes three components; S_1 is ability to recognise object when rotated at different angle; S_2 this is ability to imagine movement or displacement within an objects and; S_3 is ability to subject the observer into motion while observation is in progress. Mental rotation is sequel to success in technical and engineering professions.

Petros, Vukica and Mildred concluded that spatial visualisation skills demonstrated greater correlation to numerical ability among students.

Ahmad, Khairul and Aznial (2006) agreed with Petros, Vukica and Mildred that spatial ability is an integral part of human intelligence and that there is a high correlation between spatial ability and mechanical aptitude but

spatial ability could not be used to successfully predict abstract reasoning abilities in student. Ahmad, Khairu and Azniah's work covered the factors influencing development of spatial ability; it was concluded that there is no significant difference in spatial ability of both sexes and also, that students in secondary schools have developed formal operational thinking tendencies hence their individual spatial ability tends to increase at adolescence stage and gradually reduce at age 25 and above. Marunic and Glazar (2014) also agreed that age and experience play significant role in spatial ability of student. This assertion was in consonant with the submission of Sipus and Cizmesija (2012) that older students tend to perform better than young students. In the same vein, gender of the students determines the scores in spatial ability.

Lowerie, Logan and Ramful (2016) in their research work titled "Spatial Reasoning Influences Students' Performance on Mathematics Task" disagreed with other authors mentioned above concerning this topic under discussion by submitting that there is no gender differences in terms of performance of students in spatial ability test but there was a high correlation between scores in spatial abilities and numerical abilities. It was agreed that spatial thinking is positively related to numerical reasoning meaning that those students that are good at spatial abilities are also tend to be good at numerical calculation tasks.

Kanimozhi and Ganesan (2017) declared that students in secondary schools tend to have average level of quantitative aptitude. Also, the male students usually performed better than their female counterparts in quantitative aptitude. In the same vein, Sipus and Cizmesija's (2012) findings supported the school of thought that says male students perform better than female students in spatial abilities, but female students are better than male students in numerical abilities, This submission was simply put by Olatoye and Aderogba (2011) that there is no statistically significant difference between the performance of students with respect to gender in numerical aptitude, this is in contrast to Kanimozhi and Ganesan's (2017) claimed that male students are better than female students in numerical aptitude exercises.

The aptitude of male and female students on mechanical aptitude was studied by Ringby (2008) in an article titled "Sex Differences in Mechanical Aptitude: An investigation of Sex Differences in Mechanical Aptitude and its Relation to Nonverbal" it was found that male students outperformed their female counterparts; this assertion was also supported by many authors like (Fortson, 1991; Chapman, 1998; Wiesen, 1999).

Sarsani's (2008) study gave three types of reasoning, namely: sequential reasoning (deductive and logical reasoning); inductive reasoning (identification of peculiarities in a pattern); quantitative reasoning (required either deductive or inductive reasoning). Sarsani also revealed that boys in both government and private secondary schools performed better in abstract reasoning aptitude test than their female counterparts in Hyderabad, capital city of Andhra Pradesh, India.

Datta and Roy's (2015) study was based on piagetian theory they submitted that abstract reasoning involves conceptual knowledge and spatial visualisation ability in students because the "reasoner" has to classify the objects or events into problem categories based on the relevant properties available. The findings of Datta and Roy also indicated that age (either early or late adolescents) plays significant role in results of both abstract reasoning and spatial ability tests. The study also revealed high correlational co-efficient between abstract reasoning and spatial ability.

Reading comprehension is the process of creating meaning from written words. The aim is to obtain the understanding of the written document instead of deriving meaning from individual words or sentences. The outcome of reading comprehension is the mental representation of a text meaning that is combined with the readers' previous knowledge. The findings of the study showed that reading strategies have a great impact on the students' reading comprehension ability (Gilakjam, 2016). The implication of this is that a student with low reading comprehension is likely to perform poorly in other scholastic activities. It was affirmed by Ronneberg and Torrance (2017) that high word reading performance enhances comprehension which has a high correlation with spelling ability.

Sadoski, Willson, Holcomb, Boulware-Gooden (2005) carried out a study on verbal and nonverbal predictor of spelling performance among 9th -12th grade students; it was observed that students made use of phonological and orthographic strategies in spelling exercise and the older students performed better than younger ones because the older students added the use of orthographic strategies (a method that involved sound, spelling pattern and semantics). This was also agreed by Ocal and Ehri (2017) that age and experience boost spelling marks, Ocal and Ehri also submitted that spelling and level of vocabulary (verbal aptitude) are highly correlated. Results of Daffen, Mackenzie and Hermmings (2017) indicated that spelling, grammar and punctuation jointly predict written Composition and Comprehension achievement but spelling was the major predictor. Implications for the educational practice of writing in the contemporary context emphasised the importance of spelling in relation to writing and comprehension in senior primary school. Johnson (2013) also attested to the great value of spelling in elementary students by saying that students that are struggling with spellings will definitely have difficulties in reading fluently and invariably it would negatively affect comprehensive ability of the students due to incessant stumbling over unknown words. Also, Chiper (2015) unequivocally affirmed that female students displayed superiority in spelling and in verbal ability, also that age difference is a factor to consider in spelling ability students. In the light of the above, this study could help to find out if gender and age influence students' performance in DAT in order to guide and counsel senior secondary school students on appropriate subject combination which translate to wise choices of careers.

Statement of the Problem

Allocation of SSS1 students into various three major classes (Art, Commercial and Science) in Nigeria are usually based on students' performance in promotional achievement examinations which relegates the duties and functions of school Counsellors to the background. Career Counselling especially at secondary school level is fundamental to the students' success and in making wise choice of subjects' combination which will translate to wise choices of career that could maximize their potentialities. The essence of inclusion of guidance and counselling into school system especially at secondary school level is to address ignorance among students on the choices of career and personality maladjustment. However, some of the counsellors do not abreast themselves with the use of psychometric test like DAT and its interpretation in case such aptitude test are available. It is against this background that students just choose any course without undergoing necessary career guidance counselling which has made some of the students not succeeding in their chosen careers.

In view of the above, this study examined the influence of gender and age on the performance of SSS1 students on DAT for career counselling of the students.

Hypotheses

The following hypotheses were generated and tested at 0.05 level of significance:

1. There are no significant differences between the mean scores of the female and male students in numerical ability, verbal reasoning, spatial ability, spelling, comprehension, mechanical aptitude and abstract reasoning on DAT.
2. There are no significant differences among mean scores of students in numerical ability, verbal reasoning, spatial ability, mechanical aptitude, spelling, comprehension, mechanical aptitude and abstract reasoning on DAT with respect to students' ages.

Methodology

The study employed descriptive research design of survey type. The population of the study consisted of all the SSS1 students in southwest, Nigeria. A total sample of 816 students comprising of 388 male and 428 female SSS1 students were randomly selected for the study using multistage sampling procedure and stratified random sampling technique. The research instrument for the study was 62-item DAT developed by the researchers for use in Nigerian secondary schools. The DAT consists of seven different segments which are: Spelling (SP), Verbal ability (VA), Numerical reasoning (NR), Mechanical knowledge (MK), Abstract reasoning (AR), Comprehension (CO) and Spatial ability (SA) with construct validity coefficients of 0.77, 0.81, 0.79, 0.81, 0.69, 0.70 and 0.83 respectively using convergence method and reliability coefficients of 0.43, 0.79, 0.63, 0.60, 0.57,

0.50, 0.63, and 0.50 respectively using Cronbach’s Alpha reliability method while overall of DAT was 0.74. The items in DAT have discriminating power of 0.42 and above, and also with difficulty levels between 0.40 and 0.69. Hypothesis one was tested using student’s t-test while hypothesis two was tested using Analysis of variance (ANOVA). Scheffe Post Hoc test was performed on pairs of students’ age group where the significant difference occurred. Data collected were analysed using Statistical Package for Social Science (SPSS 23 IBM); Student’s t-test and Analysis of Variance.

Results

Hypothesis One: There are no significant differences between the mean scores of the female and male students in numerical ability, verbal reasoning, spatial ability, spelling, comprehension, mechanical aptitude and abstract reasoning on DAT.

Table 1

t –test Analysis of Scores of Male and Female SSS1 Students in DAT

Variable	Sex	N	Mean	SD	Df	t	P	Remark
Spelling	Male	388	3.6289	1.60310	814	7.646*	0.000	Sig
	Female	428	4.4696	1.53690				
Verbal ability	Male	387	7.5039	3.24267	814	5.467*	0.000	Sig
	Female	428	8.7500	3.25578				
Numeric	Male	388	3.5464	1.86090	814	3.500*	0.000	Sig
	Female	428	4.0047	1.87426				
Mech	Male	388	3.5284	1.59674	814	1.148	0.251	Not Sig
	Female	428	3.6612	1.69989				
Abstract	Male	388	3.8840	1.63598	814	0.056	0.955	Not Sig
	Female	428	3.8902	1.51173				
Comp.	Male	388	2.0593	1.27553	814	2.615*	0.009	Sig
	Female	428	2.2804	1.13941				
Spatial	Male	388	3.7861	2.08925	814	3.773*	0.000	Sig
	Female	428	4.3318	2.03993				

* p<0.05
N=816

In Table 1, 388 males and 428 females were tested, with degree of freedom (Df) of 814. In Spelling, the t-test value equal to 7.646, the alpha value (0.05) was greater than P-value of 0.000, hence, it was significant, and therefore hypothesis was rejected.

In Verbal Aptitude, the male and female have mean scores of 7.5039 and 8.7500 respectively, the t-test value was 5.467, the P-value (0.000) was less than alpha level value hence, it was significant. Therefore, the hypothesis was also rejected.

In numerical ability, the males had mean score of 3.5465 while the females had mean of 4.0047, the t-test value calculated was 3.500 and the P-value equal to 0.000 which was less than alpha value of 0.05. Therefore, it was significant, hence, the hypothesis was consequently rejected.

In the Mechanical knowledge, males students had mean score of 3.5464 while the female students had mean score of 3.6612. The calculated value for t-test was 1.148 and the P-value was 0.251 which was greater than 0.05 level of significance. Therefore, it was not significant. The hypothesis was not rejected.

In the Abstract reasoning for male SSS1 students, the mean score of 3.8840, the female SSS1 students had mean score of 3.8902. The calculated value for t-test and P-value were 0.056 and 0.955 respectively. It was also not

significant, the hypothesis was not rejected.

In Comprehension, the males and females had mean scores of 2.0593 and 2.2804 respectively, the t-test value was 2.615 and the P-value was 0.009 which was less than 0.05 level of significance. It was significant therefore the hypothesis was rejected.

In Spatial ability test, male SSS1 students had mean score of 3.7861, the female SSS1 students had mean score of 4.3318. The calculated value for t-test was 3.773 and the P-value was 0.000, this was less than 0.05 alpha value. Therefore, it was significant. The hypothesis was therefore rejected.

Hypothesis Two: There are no significant differences among mean scores of students in numerical ability, verbal reasoning, spatial ability, mechanical aptitude, spelling, comprehension, mechanical aptitude and abstract reasoning in the differential aptitude test with respect to students' ages.

Table 2

Analysis of Variance in DAT Showing the Performance of SSS1 Students in Terms of Ages.

Variables	Source	Sum of Squares	Df	Mean Square	F	P	Remark
Spelling	Between Groups	68.978	2	34.489	13.493*	.000	Sig
	Within Groups	2078.040	813	2.556			
	Total	2147.018	815				
Verbal ability	Between Groups	216.488	2	108.244	10.121*	.000	Sig
	Within Groups	8684.093	812	10.695			
	Total	8900.582	814				
Numerical	Between Groups	53.655	2	26.828	7.709*	.000	Sig
	Within Groups	2829.242	813	3.480			
	Total	2882.897	815				
Mech	Between Groups	38.612	2	19.306	7.182*	.001	Sig
	Within Groups	2185.545	813	2.688			
	Total	2224.157	815				
Abstract	Between Groups	8.205	2	4.102	1.665	.190	Not Sig
	Within Groups	2003.423	813	2.464			
	Total	2011.627	815				
Compre-hension	Between Groups	5.827	2	2.914	1.994	.137	Not Sig
	Within Groups	1188.113	813	1.461			
	Total	1193.940	815				
Spatial	Between Groups	7.017	2	3.509	.810	.445	Not Sig
	Within Groups	3519.717	813	4.329			
	Total	3526.734	815				

***p<0.05**

Table 2 shows that F values of Spelling, Verbal Aptitude, numeric ability, and Mechanical Aptitude were $F_c = 13.493, 10.121, 7.709,$ and 7.182 at 0.05 level of significance. There was enough strong piece of evidence to reject all the null hypotheses, meaning that there were significant differences among the mean scores of the three age groups that sat for DAT.

In the same Table 2, Abstract Reasoning, Comprehension and Spatial Aptitude indicated that F_c were 1.665, 1.994 and 0.810 respectively. The values were not significant hence; the hypotheses were not rejected at 0.05 level of significance.

Table 3

Scheffe Post Hoc Analysis for SSS1 students' Age Groups

Variables	Age	1	2	3	N	Mean	SD
Spelling	10-12 (1)		*		56	3.3393	1.43053
	13-15 (2)			*	653	4.2129	1.62958
	16& above(3)				107	3.5794	1.48602
Verbal ability	10-12(1)		*		56	6.6250	3.20546
	13-15(2)			*	653	8.3982	3.30655
	16& above(3)				107	7.4906	3.07136
Numerical	10-12(1)		*	*	56	2.8750	1.85925
	13-15(2)				653	3.8821	1.83938
	16&above (3)				107	3.6822	2.02157
Mech	10-12(1)		*		56	2.8750	1.76905
	13-15(2)				653	3.6907	1.63621
	16& above(3)				107	3.4112	1.58979
Abstract	10-12(1)				56	3.5179	1.76832
	13-15(2)				653	3.9142	1.52041
	16& above(3)				107	3.9159	1.74897
Comp	10-12(1)				56	1.8750	1.37593
	13-15(2)				653	2.2067	1.19501
	16& above (3)				107	2.1402	1.20101
Spatial	10-12(1)				56	3.8393	1.97048
	13-15 (2)				653	4.1179	2.10605
	16& above (3)				107	3.9159	1.97685

N=816

In Table 3 above, Spelling and Verbal Aptitude had significant difference between age group of 10-12 and 13-15 and also there was a significant difference between age group 13-15 and 16 & above.

In Numerical Aptitude, there were significant difference between age group 10-12 and other age groups. This means that students in age group 13-15 performed better than students in other two groups. In Mechanical Aptitude, the significant difference lies between age groups 10-12 and 13-15.

Discussion

The result of the t-test revealed that there were significant differences in the performance of male and female testees in Spelling, Verbal Aptitude, Numerical Aptitude, Mechanical Aptitude, Abstract Reasoning and Spatial Aptitude. This finding disagreed with Lowerie, Logan and Ramful (2016) and Ahmad, Khairul and Aznial

(2006) which concluded that there was no gender differences in performance of students in spatial abilities but Sipus and Cizmesija (2012) report contradicted this assertion by vehemently pronouncing that male students are statistically significantly better than female students in Spatial Aptitude. Kanimozhi and Ganesan (2017) revealed that males are better in Numerical Aptitude exercises than females but Olatoye and Aderogba (2011) said that there was no significant difference between the performances between them. Also, many authors agreed that male students outperformed female students in Mechanical Aptitude (Fortson, 1991; Chapman, 1998; Wiesen, 1999) but the finding of this study negated the long-time erroneous belief by revealing that there was no significant difference between performances of testees in Mechanical Aptitude irrespective of gender. Chiper (2015) affirmed that female students displayed superiority in Spelling and Verbal Aptitude and this was in line with the findings of this study. Sarsani (2008) study in Hyderabad showed that boys are better than girls in Abstract Reasoning but this study disagrees with Sarsani's submission. The difference in the performance of male and female students might be due to the stereotypic believe that numerical and mechanical oriented careers belongs to male domain thereby reducing the interest of females especially in numerical and mechanical areas of knowledge.

The study indicated that there were significant differences in the ages of the testees in Spelling, Verbal Aptitude, Numerical Aptitude, and Mechanical aptitude but vice versa in Abstract Reasoning, Comprehension and spatial. Marunic and Glazar (2014) with Sipus and Cizmesija (2012) agreed that age played significant role in Spatial Aptitude by saying that older students tend to perform better than young students. This was not in line with the finding of this study. Also, Datta and Roy (2015) opined that age played significant role in scores of students in Abstract Reasoning and spatial aptitude. This finding also negated the finding of Datta and Roy. The findings of Ocal and Ehri (2017); Daffen, Mackenzie and Hermmings (2017); Johnson (2013); Sadoski et al (2005) all agreed that age of the students was a function of scores in Spelling, Verbal Aptitude, composition and Comprehension. The reason for the difference in the performance of students of different age group might due to the fact that learning increases with experience. Older students are expected to perform better than younger students as intelligence normally grow with age

Conclusion

The study discovered that gender and age variables are contributory factors that could influence SSS1 students' choice of subject combination/career. The performance of male and female students in DAT are significantly different in spelling, verbal ability, numerical reasoning, comprehension and spatial ability. Also the study revealed that age group of the students significantly influence their DAT performance in spelling, verbal ability, numerical reasoning and mechanical reasoning.

Recommendations

Based on the findings of this study, it was recommended that:

1. DAT should be used by school guidance counsellor for allocating Senior Secondary School students to subject combinations since it would show clearly different areas of abilities that relate to their career potentialities.
2. Gender of the students should be taken into consideration while allocating them into subject combinations especially when required potentialities in spelling, verbal ability, numerical reasoning, and spatial ability.
3. Age of the students should be considered while allocating them into subject combinations especially when it requires potentialities in spelling, verbal ability, numerical reasoning and mechanical knowledge.

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