FACTORS RELATED TO THE PERFORMANCE OF THIRD YEAR STUDENTS IN MATHEMATICS IN JAMAICAN POST PRIMARY SCHOOLS

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Studies done on the academic achievement (Reid, 1964) and the cognitive abilities (Vernon, 1969) of primary school children in Jamaica have suggested that environmental factors greatly affect the academic performance of these children. Mathematics is usually regarded as the school subject which is least affected by social and cultural factors. The writer decided to investigate which of the following variables had the greatest effect on the mathematical performance of secondary school students: psychological variables (affective and cognitive); environmental variables (location, size, and type of school); teacher related variables (experience, qualification, sex, and effectiveness); and other pupil related variables (sex, socio-economic status, and teacher rated performance in mathematics).

THE SAMPLE

A stratified random sample of 457 pupils in their third year of secondary schooling in 16 post primary Jamaican schools was selected from all streams in 7 All-Age Schools, 4 Junior Secondary Schools, 2 Private Secondary Schools, and 3 government aided High Schools. Questionnaires were also administered to the 33 teachers of these pupils to gather data on relevant teacher attributes. The teachers were rated for their effectiveness by their principals, or an education officer if the principal also taught mathematics at the grade nine level.

THE INSTRUMENTS

The criterion, Mathematics Achievement ("Math. Achv."), was measured by a 70 item test designed by the writer which is similar to the Grade Nine Achievement Test in Mathematics (1970), Ministry of Education, Kingston (Isaacs, 1971). The following variables were examined to see if they are related to mathematics achievement:

English Language Achievement ("Eng. Achv."), measured by a modified form of the Ministry of Education's Grade Nine Achievement Test in English (1970);

Verbal Mental Ability ("Verb. M.A."), measured by L.H.E. Reid's Mental Ability Test 11-J6, Part I;

Non-Verbal Mental Ability ("N-V M.A."), measured by L.H.E. Reid's Mental Ability Test 11-J6, Part II;

Self-Concept of Mathematical Ability, ("S-C"), measured by a modified form of the Brookover (1965) Self-Concept of Ability - Specific Subjects (Form B) scale;

Attitudes to Mathematics ("Att."), measured by an instrument based on items from the three attitude scales used in the International Study of Achievement in Mathematics (Husen, 1967);

Socio-Economic Status ("SES"), measured by a rating scale based on Miller's (1967) Occupational Coding Scheme;

Teacher Assigned School Marks/Grades ("Grade") were obtained from the school records;

Teacher Qualification ("Tch. Qual."), Teacher Experience ("Tch. Exp.") and Teacher Sex were determined from the teachers' responses on a questionnaire;

Teacher Effectiveness ("Tch. Eff."), measured by a rating scale based on Ryan's (Remmers, 1963) Assessment Blank;

School Size ("Sch. Size") and School Type ("Sch. Typ.") were determined from the Ministry of Education's Directory of Government and Government-Aided Educational Institutions, 1967-1968;

Importance of School Location ("Sch. Loc.") was rated on a scale based on Levert's (1968) Inventory and Classification of Urban Settlements in Jamaica.

ANALYSIS OF THE DATA

A number of hypotheses were formulated and tested and the following inferences drawn:

That Mathematics Achievement is significantly related (at the .01 level) to:

a) English Language Achievement (r = .786);
b) Verbal Mental Ability (r = .801);
c) Non-Verbal Mental Ability (r = .630);
d) Self-Concept of Mathematical Ability (r = .360);
e) Attitudes to Mathematics (r = .240);
f) Teacher Assigned School Grades/Marks (r = .625);
g) Teacher Experience (r = .321);
h) Teacher Effectiveness (r = .331);
i) Importance of School Location (r = .438);

that, for this population, there is:

j) no significant relationship between teacher qualification and mathematics achievement;
k) no significant difference between the mathematical performance of subjects taught by men and those taught by women;
l) no significant difference between the mathematical performance of boys and girls;
m) a significant difference between the mathematical performance of subjects in the upper and lower social classes.

A 14 x 14 correlation matrix for the 13 independent variables and mathematics achievement was prepared by calculating the product moment correlations between each pair of variables (see Table 1). This matrix was factor analysed to produce a preliminary components solution of 9 components which accounted for 91% of the variance in the mathematics achievement test. The first four components all had eigen values greater than one (and accounted for 67% of the variance) while the remaining 5 components had eigen values less than one. An examination of the components by the writer showed that the first four components were easily interpreted in terms of the variables whilst the remaining components could not be so easily interpreted because of the very low loadings of the variables on them. The writer therefore decided to limit the principal factor solution to four factors.

TABLE 1: CORRELATION MATRIX OF FOURTEEN ENVIRONMENTAL AND PSYCHOLOGICAL VARIABLES*

	Eng. Achv.	Verb. M.A.	N-V. M.A.	S-C.	Att.	SES	Grade	Tch. Qual.	Tch. Exp.	Tch. Eff.	Sch. Typ.	Sch. Size	Sch. Loc.
Math. Achv.	7753	7747	5285	3037	2397	-3998	6252	1035	3212	3313	3867	2615	4379
Eng. Achv.		7930	4996	1536	1725	-3746	4423	1311	3180	4328	4131	1863	4344
Verb. M.A.			5979	1687	1624	-4556	4439	1201	1988	2991	4403	2605	4413
N-V M.A.				1631	2126	-2614	3551	0666	1283	2594	2064	3850	4402
S-C					5022	0333	4039	-1226	-0003	-0010	0184	-0250	-0399
Att.						0821	2669	-0303	-0092	0485	0222	0218	0691
SES							-1769	-1948	-1337	-0848	-5408	-1891	-4312
Grade								-0377	1926	2043	0944	0805	1890
Tch. Qual.									-0853	-1173	2791	-0938	1075
Tch. Exp.										2659	-0224	0528	3242
Tch. Eff.											0168	3787	4326
Sch. Typ.												-2649	3912
Sch. Size													5516

* Decimal Points omitted

The correlation matrix was used to produce a principal axes factor solution. The principal factor pattern for the first four factors is shown in Table 2. This factor matrix shows the usual principal axes pattern of a first factor which is a general factor followed by secondary bipolar factors. No attempt was made to interpret it. This pattern was used to produce a rotated factor solution by the Varimax method. The rotated factor pattern is shown in Table 3.

TABLE 2: MATRIX OF (UNROTATED) FACTOR LOADINGS FOR FOURTEEN PSYCHOLOGICAL AND ENVIRONMENTAL VARIABLES*

Variables	Factors			
	A	B	C	D
Math. Achv.	8828	1158	-1316	1143
Eng. Achv.	8494	-0288	-0784	1785
Verb. M.A.	8608	-0576	-1217	-0116
N-V M.A.	6928	-0859	0914	-3107
S-C	2589	6916	-3638	-1045
Att.	2606	6139	-2782	-2814
SES	-5504	4943	1444	0577
Grade	5889	4298	-1857	1710
Tch. Qual.	1276	-4623	-3698	-2699
Tch. Exp.	3608	0310	2837	6931
Tch. Eff.	4847	0780	5283	1451
Sch. Typ.	4749	-4984	-5291	0300
Sch. Size	3941	0504	7046	-4740
Sch. Loc.	6801	-2737	3558	-1606
Variance	33.8%	13.3%	12.2%	7.8%

* Decimal points omitted

TABLE 3: MATRIX OF ROTATED FACTOR LOADINGS FOR FOURTEEN PSYCHOLOGICAL AND ENVIRONMENTAL VARIABLES*

Variables	Factors				
	I	II	III	IV	h^2
Math. Achv.	5224	4864	3133	4642	823
Eng. Achv.	5574	3245	3031	5025	760
Ver. M.A.	6178	3589	3729	3313	759
N-V M.A.	3411	3682	5784	0766	593
S-C	-0654	8239	-0748	0032	689
Att.	-0491	7592	0737	-1315	602
SES	-7089	0948	-2229	-1012	571
Grade	1796	6270	0897	4022	595
Tch. Qual.	5664	-1089	-0512	-3230	440
Tch. Exp.	0024	-0727	0445	8275	692
Tch. Eff.	-0383	0110	5487	4884	541
Sch. Type	8584	0171	-1271	0380	755
Sch. Size	-1229	-0102	9288	-0324	879
Sch. Loc.	4029	-0594	6863	2303	690

*Decimal points omitted

DISCUSSION

Following guidelines laid down by Thurstone (1938) for determining the significant factor loadings, the writer considered only those variables which have loadings of .40 or higher on the factor. The first factor of the rotated factor pattern was loaded mainly on School Type and Social Class. (The negative sign for Social Class arose as a result of the inverse order in coding social class: 1 for the highest, 6 for the lowest.) The factor was loaded to a lesser extent on Teacher Qualification, and the variables measuring academic achievement and ability, as well as School Location. This factor was designated the "Social Environment of the School and Home". It accounted for approximately 27% of the variation in performance of the students on the mathematics achievement test.

The factor seems to represent that syndrome of social and cultural factors which affects motivational levels, learning styles, attitudes to learning and hence level of academic performance. This factor is partly

determined by the tone and climate of the school and the home. As the more highly qualified teachers tend to be found in, and gravitate to, the schools with higher social status it is not surprising to find that Teacher Qualification has a significant loading on this first factor.

The second factor was loaded mainly on the affective variables related to mathematics achievement and school grades in mathematics. This factor was designated "Perception of Mathematics and Mathematical Ability". It accounted for about 24% of the variation in mathematical performance on the achievement test. The second factor probably includes those personality characteristics of the subjects which determine attitudes, interest, self-confidence, as well as those subjective perceptions of mathematics, the teachers of mathematics, and the doing of mathematics which make up the emotive component of learning school mathematics.

The third factor was loaded mainly on School Size and Location. This factor was designated the "School and its Environs". It accounted for a further 10% in the variation of the mathematical performance of the students. This factor is best described in terms of the physical attributes of the school as well as the demographic features of, and the civic and social importance of the community in which the school is located. Factor III shows a significant loading on the non-verbal mental ability test. This suggests that non-verbal mental ability is probably stimulated by physically and socially more complex surroundings and so students living in such surroundings tend to perform better than those from simpler (i.e. more rural) communities.

The fourth factor was loaded on "Teacher Experience" and "Effectiveness". It was designated the "Teacher". This factor accounted for approximately 21.5% of the variation in the mathematical performance of the students. It is interesting to note that "Teacher Qualification" was negatively loaded on this factor. This probably occurred because for this sample the most experienced and effective teachers were mainly those trained in teachers' colleges. The majority of the graduates in this sample were relatively inexperienced and not rated as highly, by their principals, as the older and less qualified teachers. The significant loading of English Achievement on this factor probably arose from the fact that in the All-Age schools in this sample the teachers of mathematics were also the teachers of English. This was also the case in some classes in the Junior Secondary Schools.

Three of the factors identified in this survey (Factors I, III, & IV) are environmental or situational type factors. Which leads one to conclude that these extrinsic factors tend to mask the variation in mathematics achievement which are due to the developed cognitive abilities of the students. The findings of this exploratory study lead one to suggest that research into the academic aptitude and ability of Jamaican children must carefully control for variation in environmental and social factors.

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