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An Investigation of the Swing from Arts

An Investigation of the Swing from Arts to Sciences in Sri Lanka

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Sri Lanka has given a very prominent place to education especially since the inauguration of the Free Education Scheme in 1945. However, as education is an agent of social mobility, it grew mainly under the impetus of social justice and equality of educational opportunity¹. At first the pressure for more education was absorbed by the rapid expansion of Arts studies. This type of education imparted in the schools soon became ineffective in relation to national needs, thus creating grave socio-economic problems.

The government that came into power in 1956 took some firm measures with the intention of rectifying this situation. Steps were taken to popularise the study of science in the secondary schools. A policy decision was taken to teach General Science to all pupils in the Junior Secondary Schools². Further, the provision of more opportunities to study specialised sciences at the Senior Secondary Level, the introduction of science scholarships, the establishment of laboratories in rural areas, the granting of special posts to science graduate teachers, and the introduction of new science curricula were some of the far reaching measures taken to encourage more and more students to study science³.

These efforts had their impact in the student enrolment for science. The early sixties saw a slow but steady growth in the enrolment for science studies especially at the Senior Secondary level. Statistics⁴ reveal that, from 1960 onwards, there was a very sharp rise in the enrolment for science at the G.C.E. (A.L.) classes. Today more and more students join the science classes irrespective of whether they have the aptitude to study science or not.

It is also possible to observe that a large majority who are committed to science fail at the G.C.E. (A.L.) Examination⁵. However these failures sit the G.C.E. (A.L.) Examination again and again with the intention of gaining admission to the universities. Tuition in Science Education is now a booming business and private tutories are reaping rich benefits by catering to the G.C.E. (A.L.) failures. It is true to say that more and more students join the science classes to end up as early school leavers. Apparently, there is a severe loss of potential scholars in the field of Arts.

Using the G.C.E. (A.L.) enrolment as the criterion, one can observe a steadily growing swing away from the Arts to the Sciences. This is in sharp contrast to the situation in Western countries where there is a swing from the Sciences to the Arts⁶. The present study attempts to analyse and interpret this swing away from the Arts to the Sciences in Sri Lanka.

Method of Study.

Barnard and McCreath⁷ have suggested a method of studying such a situation. "What actually happens to any particular pupil depends not only on his motivation and ability, but also on the opportunities offered to him at different stages during the time at particular schools and the particular entry requirements for courses at any higher education institutions to which he may apply".⁸ In specific terms, they suggest that such a study "starts from the pupil and traces his progress through the system, through particular schools and higher education institutions".⁹

To sharpen the foci of investigation, one can put forward a hypothesis relevant to the situation. This hypothesis could be that the system of education in Sri Lanka does not select the correct type of student and it may also be said that the system has imposed almost insurmountable obstacles as the student progresses through the education system. To test this hypothesis, one can pose questions such as the following. Are the aspirations of the students high? Do they aim to go to the university or leave school at 16 or 18? Are they all academically oriented to follow a science course leading to the university? What obstacles, if any, stand in their way as they go through the system?

Experiments were conducted to find the answers to these questions. Educational psychologists agree that any selection for a course should be based on the children's ability, aptitude, interests and motivations. In order to assess these and to answer the above questions the writer —

- (1) Obtained measures of aspirations, general interests and motivations of students by means of:
 - (a) their ratings of 15 careers
 - (b) their ratings of 8 school subjects
 - (c) two separate questionnaires were administered to
 - (i) G.C.E. (O.L.) students (Pre-specialization group)
 - (ii) science students in G.C.E. (A.L.) classes (Specialization group)
 - (d) an essay on "What I expect to be doing in 5 years time".
- (2) Made use of a battery of intelligence tests designed for use in Sri Lanka.
- (3) Obtained teachers' estimates of ability of students to enter the university.

Selection of the samples.

The samples were selected from among the schools in the Western Province. To draw these samples the schools in the Western Province were classified into three categories on the basis of availability of laboratories.

These are:

- (1) Schools with laboratories to teach science up to G.C.E. (A.L.) classes.
- (2) Schools with laboratories to teach science up to G.C.E. (O.L.) classes.
- (3) Schools with science rooms only.

The pre-specialization group of 450 students was drawn from G.C.E. (O.L.) students by randomly selecting 150 students from each category of schools mentioned above.

The G.C.E. (A.L.) sample of 302 students was selected at random from 15 schools that taught G.C.E. (A.L.) science.

Aspirations and preferences of the pre-specialization group.

It is relevant to study the aspirations and the degree of preference for science among the students who are not yet committed to science. The main aim of such a study is to find out how their aspirations and preferences are influenced by their home and school environment.

R. G. Rowlands¹⁰ has conducted some experiments to find out the influence of the type of school and the home background on the aspirations and preferences of the students for science studies. He administered a questionnaire to find out the aspirations, preferences and goals of the students studying in different types of schools in England. He classified the sample into three groups on the basis of their responses. These three groups are the scientists (S), non-scientists (N) and the early leavers (E). The science group (S) was further divided into two groups S_u and S_o where.

S_u — represents those who intended to go to the universities and

S_o — represents others in the group.

He devised three mathematical formulae to indicate —

- (1) the level of aspiration,
- (2) the preference for science, and
- (3) university preference.

These formulae are given in the Appendix.

The writer drew up a questionnaire based on that drawn up by Rowlands and administered it to the pre-specialization group.

The questionnaire was designed to bring out the aspirations, preferences and goals in the field of science. The Table below gives the three ratios for the three types of schools.

TABLE 1

Level of aspiration, university and preference ratios for the pre-specialization group classified according to type of school

	<i>Level of aspiration ratio</i>	<i>University ratio</i>	<i>Preference ratio</i>
Schools with science rooms	75	42	48
Schools with G.C.E. (O.L.) laboratories	80	68	64
Schools with G.C.E. (A.L.) laboratories	87	75	72

It can be seen that the level of aspiration ratio for science is quite high for all three types of schools. The minimum value of 75 is for schools without laboratories to teach science. In Rowland's study only two types of schools exceeded this value. This shows that, in Sri Lanka, the aspirations of the students are relatively high even if adequate facilities are not available in the schools. It is interesting to note that in the two types of schools with science facilities, the preference ratio and university ratio are relatively high. This shows that the students are realistic although all the students have the aspiration to take to science. The students in the schools without science facilities seem to be aware that their chance of studying science and gaining admission to the university are relatively low. The low preference ratio for those in schools without facilities is indicative of this realistic attitude. When the preference and university ratios are compared with those for England, it is seen that on the average these two ratios are higher for England but compare very favourably with those schools in Sri Lanka with science facilities.

TABLE 2

Level of aspiration, university and preference ratios classified according to urban and rural sectors in Sri Lanka

	<i>Level of aspiration ratio</i>	<i>University ratio</i>	<i>Preference ratio</i>
Urban	... 86	74	64
Rural	... 72	53	58

Table 2 brings out the fact that although the rural students had a fairly high aspiration ratio, the university and preference ratios were comparatively low. The schools without adequate facilities for teaching science are situated in rural areas and it is seen that the preference and university ratios are low in comparison with those for other schools. This again is a reflection of the realistic attitude of the students in the rural areas. They appear to be aware that even if the aspirations are there, the chances of studying science and then entering a university are very remote.

Fathers' occupational status is closely linked with the aspirations and preferences of students. The occupation of the father is a crude but reliable index of the socio-economic status as he is the sole breadwinner in the majority of the families. Table 3 below indicates that the children of professional and administrative officers have the highest level of aspiration and university ratios but the preference ratio is highest for the office and non-manual category. If not for this, the values for the three ratios drop successively along the occupational scale.

TABLE 3

Level of aspiration, university and preference ratios classified according to the occupation of the father

	<i>Level of aspiration ratio</i>	<i>University ratio</i>	<i>Preference ratio</i>
1. Professional and administrative	93	88	64
2. Office and non-manual	91	76	71
3. Skilled manual	81	60	51
4. Unskilled manual	73	56	43

The relatively low preference ratio for the professional and administrative category could be attributed to the fact that the students may have other interests in business, law or in the administrative service.

The results of this survey show that the aspirations and preferences of the students are highest in the students who study in developed urban schools and whose fathers' occupational status and, therefore, the income, are high. The occupational scale is generally connected to the degree of education. It could, therefore, be said that the aspirations and preferences are greatest for those children whose parents are well educated with a reasonably good income.

Decision to take to science

A questionnaire was administered to 302 students in G.C.E. (A.L.) science classes. This group consisted of 160 boys and 142 girls drawn from the first and second year classes. As all are science students, they have taken the irreversible decision of remaining in the field of science for the rest of their educational career.

The most influential factor in their decision to study science was the father or the mother. 36% said that the father was influential but only 7% said that the mother was influential. Thus for 43% the parents had taken the decision for them. 27% said that they took the decision themselves while 18% expressed that their reading led them to take to science. A noteworthy feature that emerges is that the encouragement given by the school staff is very low. The teachers and the principals have been influential only to a very small extent and only 8% had taken to science as a result.

It is heartening to find that the aim of 81% of the students was to take to higher studies. Nearly 2% wanted to give up studies. Although the reasons for giving up studies were not given, this minority could be those who will inherit property and businesses from the parents. 17% said that they would go in search of jobs after the G.C.E. (A.L.) examination. This indicates that nearly a fifth of the students would definitely give up studies after the G.C.E. (A.L.).

Out of the students who wished to go for higher studies as much as 84% aimed to join the university. The teacher training colleges were preferred by 15.34%. Only 0.66% stated that they hoped to pursue higher education in a foreign university.

A startling revelation is that the ambitions of these students are not stable. In their essay on "What I expect to be doing in 5 years' time" they expressed the concern that they may not be able to achieve their aims. The writer structured the essay with the intention of guiding their responses. Some had suggested alternative ambitions in the event of their failing to get through the examinations. They were aware that it was very difficult to get through the G.C.E. (A.L.) examination and then qualify to enter the university.

As much as 58% said that in the event of their failing to gain admission to the university, they would seek employment. The rest aimed to continue studies in other tertiary institutions. It is quite clear that the G.C.E. (A.L.) examination hinder their interests and motivations. They face this examination with utmost uncertainty and dread. This has to be expected as only 12.46% of the total number who qualified at the G.C.E. (A.L.) examination in 1980 were in fact admitted to the universities.

The questionnaire also aimed at bringing out the other obstacles to their education. Almost 51% of the sample expressed the desire to change their school if they were offered a school of their choice. All of them wished to go to developed schools in urban areas.

They appear to have a good knowledge of a 'developed school' in science and where these are situated in Sri Lanka. While 23% said that they would like schools in Colombo, another 16% wished to go to schools outside their educational region. The rest (12%) expressed the desire to go to the nearest urban school in the same educational region. It is interesting to note that as much as 49% wished to remain in the same school. However 13% felt that although they wished to go to developed schools, they were forced to remain in the same school as their parents could not afford to send them to schools outside their area. None wanted to go from an urban school to a rural school.

The reasons given for their decisions were many. As requested in the questionnaire, they gave three reasons on order of importance. Judging only from their first preference, their decision rested mostly on the availability of resources for science teaching. 13% said that they wanted to go to other schools in the urban areas as the facilities were better. 17% said they preferred the urban schools because of the availability of better and experienced teachers. 10% preferred the schools mentioned as they were 'popular' schools. Only 11% of the sample felt that they should go to urban schools as they produced better examination results. The students are aware that better facilities and better teachers are the most important factors to achieve success. The concept of a 'popular' school is linked with success at public examinations. They were indirectly referring to the same factors when they said that they wanted to go to 'popular' schools.

Influence of socio-economic status on the education of students

It is true to say that the socio-economic status of the parent contributes to education of the children to a great extent. A Departmental survey that investigated educational wastage in Sri Lanka schools showed that 48.79% of those who gave up schooling did so because of poverty. Another major reason given for non-attendance was that the poor parents "would not wish their children to be the subject of scornful comment of other children or teachers".¹²

According to the socio-economic survey conducted in 1969—70; it is found that the general level of household income of the urban sector is much higher than that of the rural sector. Table 4 gives the statistics.

TABLE 4

Average income of household for one month in Sri Lanka

	<i>All island</i>	<i>Urban</i>	<i>Rural</i>
Average income in rupees	289	453	264

Source: Report of the preliminary survey, 1969—70, Department of Census and Statistics, Sri Lanka.

The same survey shows that the general level of education of the urban sector is higher than that of the rural sector. Table 5 below shows that the disparity is very great indeed.

TABLE 5

Level of education according to urban and rural sectors, Sri Lanka.

<i>Level of Education</i>	<i>Urban</i>			<i>Rural</i>		
	<i>Male</i>	<i>Female</i>	<i>Total</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
1. No schooling ...	7.2%	15.7%	11.4%	10.4%	21.2%	15.8%
2. Primary ...	39.1	36.5	37.8	48.3	42.4	45.4
3. Middle school ...	38.4	37.3	37.9	34.0	29.0	31.7
4. Passed G.C.E. (O.L.) ...	12.9	9.1	11.0	6.5	6.2	6.3
5. Passed G.C.E. (A.L.) and over ...	2.4	1.4	1.9	0.8	0.8	0.8

Source: Report of the preliminary survey, 1969—70; Dept. of Census and Statistics, Sri Lanka.

This shows that, economically, the urban child is better placed than the rural child. Moreover, the general level of education of those who live in urban areas is higher than that for the rural sector. As the parents in the urban sector are better educated and have better financial resources, they take more interest in the education of the children. This fact is amply demonstrated from the responses to the questionnaire given to the pre-specialization group. The urban child lives in an educationally better environment created both by the school and the more educated parent. It is an accepted fact that the urban schools have better facilities and

produce better results. Therefore, it is true to say that the urban schools serve the social elite of the nation. The poor child is handicapped and he is deprived culturally, socially and economically.

Interests and motivations for science among science students.

It is an accepted fact that interests and motivations towards science are basic to success in any field of science. To assess the students' interests and motivations the writer conducted an experiment which consisted of:

- (1) ratings of 15 careers
- (2) ratings of 8 school subjects
- (3) an essay on "What I expect to be doing in five years' time".

The writer used the following 15 careers

- (1) Research scientist
- (2) Engineer
- (3) Journalist
- (4) Lawyer
- (5) Doctor
- (6) Science teacher
- (7) Priest
- (8) Bank clerk
- (9) Personnel Manager
- (10) Craftsman
- (11) Factory worker
- (12) Social worker
- (13) Secondary school teacher (other than science)
- (14) Farmer
- (15) Government clerk.

The students were asked to rate the careers using six different criteria.

These criteria are:

- (1) How much they like such a career.
- (2) How interesting each career would be.
- (3) How high an initial salary would each career draw
- (4) The prestige each career would bestow.
- (5) How high would be the qualifications needed
- (6) The usefulness of each career to the society.

A five point scale was used to rate the careers. The following guidance was given to indicate the direction and meaning of the ratings.

I would like it very much.....	4 points
I like it but not to a great extent.....	3 points
I like it a little.....	2 points
I don't think I like it.....	1 point
I don't like it at all.....	0 points

The teachers who conducted this experiment saw to it that the students rated all careers on one criterion before they proceeded to the next.

Table below shows the ratings of the 15 careers on the six criteria.

TABLE 6
Ratings of 15 careers

		C R I T E R I A					
		Liking	Interest	Initial salary	Prestige	Qualifications	Usefulness
1.	Research Scientist						
	Boys	3	5	3	10	4	10
	Girls	4	8	4	9	3	11
2.	Engineer						
	Boys	1	2	4	3	2	3
	Girls	5	9	5	3	2	2
3.	Journalist						
	Boys	7	8	6	12	7	11
	Girls	8	10	6	10	6	13
4.	Lawyer						
	Boys	5	3	1	1	1	2
	Girls	9	2	1	2	4	3
5.	Doctor						
	Boys	2	1	2	2	3	1
	Girls	1	1	2	1	1	1
6.	Science teacher						
	Boys	6	6	7	4	5	4
	Girls	2	3	8	4	5	4
7.	Priest						
	Boys	15	15	15	6	15	8
	Girls	15	15	15	7	15	6
8.	Bank clerk						
	Boys	4	11	5	13	9	12
	Girls	3	5	5	12	9	10
9.	Personnel Manager						
	Boys	8	4	8	11	10	14
	Girls	11	12	3	13	10	12

10. Craftsman	Boys	11	13	12	15	13	15
	Girls	13	13	14	14	14	14
11. Factory worker	Boys	14	12	11	14	12	9
	Girls	14	14	10	15	13	15
12. Social worker	Boys	12	14	13	5	11	7
	Girls	6	7	12	8	12	5
13. Secondary school teacher	Boys	10	9	9	8	6	5
	Girls	7	4	9	5	7	8
14. Farmer	Boys	13	7	14	7	14	6
	Girls	12	11	13	6	11	7
15. Government clerk	Boys	9	10	10	9	8	13
	Girls	10	6	11	11	8	9

Among the boys, the careers of engineer, doctor, lawyer, research scientist and personnel manager rank high in all six criteria. The place given to the research scientist is relatively high except under the 'prestige' and 'usefulness' criteria. This is because of the absence of a research tradition in Sri Lanka and the few discoveries made by the researchers are not known to the boys. The ratings indicate that boys are more interested in science-based occupations than girls. It is obvious that occupations with less remunerative attractions and prestige and those that involve manual work such as farmer, factory worker, craftsman are disliked by the boys as well as the girls. The boys and girls have ranked high the occupations of science teacher and secondary school teacher.

The girls like the occupations of doctor, science teacher, bank clerk and research scientist but they do not like and show no interest in becoming personnel managers. It could well be that they feel they are temperamentally not suited for this post and it could be attributed to their culture.

The writer checked the initial salary scales of the above careers with the rank order indicated by both boys and girls. Their rank order is remarkably accurate. However, the salary scale of the lawyer is ranked first by both groups. A lawyer is in general a private practitioner and his income varies with his regularity. Well established lawyers in fact draw a very large income. Students' awareness of this fact may have prompted them to rank it first.

This study reveals that the careers of engineer, doctor, lawyer and science teacher are liked by the students and they agree that these are not only more useful than the others to the society but also carry prestigious value.

This is reflected in the rank ordering of the school subjects. The students have rank ordered the eight subjects in the following manner.

Subject	Rank
Mathematics	1
Chemistry	2
Physics	3
Biology	4
Sinhala Language	5
English Language	6
Religion	7
Agriculture	8

It is seen that the students like science subjects more than the others. Although Sri Lanka is an agricultural country, agriculture is disliked by the students. It is partly a reflection of a dislike for manual work. This lack of interest is in fact reflected in the number of agriculture graduates produced by the universities in Sri Lanka.

Analysis of the essay

The students were restricted in their freedom of expression in the ratings of careers and school subjects. An open-ended essay was given to the students so that their interests and aspirations would come out freely as they were allowed free expression. The students, however, were guided in the essay by structuring it in order to bring out their interests, aspirations and likely obstacles.

The essay reveals the same sort of interests and ambitions discussed earlier. The essay was analysed by finding the frequency of reporting a career as a first choice or second choice. The frequency distribution of the careers is shown in the Appendix. The results are very similar to those obtained under the rating of 15 careers. Students' ambitions are centred around the professions of doctor and engineer. As remarked earlier, their aims are not stable and they have indicated alternative careers in the event of failing to gain admission to the university. Some had even commented that "I am even prepared to face failure at the G.C.E. (A.L.) examination as I feel that the chances of getting a permanent job are greater".

It is now possible to interpret the observations on careers and school subjects in the Sri Lankan context. Vocational attitudes and ambitions not only reflect the interests but also reflect the social structure which is moulded by the past history. It is obviously true that the economic

returns play a very important part in determining vocational ambitions and attitudes. Out of the 15 careers, the first ten, except that of lawyer and bank clerk, selected by both boys and girls are government jobs. These careers carry relatively high salaries and therefore the society identifies these with security and prestige. The ratings under the 'prestige' criterion support this theory. Among the non-government jobs, the prestige of the farmer is regarded more than the others such as craftsman and factory worker. The farmer belongs to a high caste than the craftsman and hence occupies a higher place in the social scale. However, both are not liked by the students as the economic returns are comparatively low. According to the traditional caste system the manual work is done by the low caste people. The productive occupations bring low economic returns and also enjoy low prestige. The traditional value system is amply demonstrated by the ratings of the careers. All careers involving manual work are rated low. Thus it can be concluded that the aspirations and interests of the students are moulded not only by their interest in science but also by economic rewards, historical and cultural forces that are alien to the country's needs. Therefore aspirations and interests give prestige to a narrow band of occupations. All students aim for these careers. Hence their education is channeled along narrow lines with the intention of achieving them. The ranking of school subjects offers evidence in support of this view. The older generation and especially the parents are influential in perpetuating this social pattern and the fact that 43% of the parents influenced the choice of science is evidence in support of this fact.

Abilities and aptitudes of the students.

It is true that aspirations and motivations play a very important part in the success in education. Of equal importance or more are the abilities and aptitudes of the children for science. Especially in an underdeveloped country like Sri Lanka, only those who have the ability and aptitude should take to science and it is the duty of the school to guide and direct the students based on objective criteria. If students who are unfit for science are chosen, then they will not be able to cope with the education and will end up as failures. Further, if such a system exists, it is injurious to the education of the children and to the development of manpower resources of the country.

To date, the Department of Education has not issued a clear cut circular governing the selection of students for various courses. Selection is in the hands of the heads of schools and the various methods of selection vary from school to school. In general there are outside pressures, parental and political, to get children admitted to the science stream. Although the Department of Education expects the students to have a specific number of credit passes at the G.C.E. (O.L.) for various courses, there is provision to collect them at subsequent sittings. The heads of schools misuse this privilege and allow those who are academically unfit, to join the G.C.E. (A.L.) class. T.L. Green¹³ highlighted this as follows: "Uncontrolled educational expansion is of limited value and Sri Lanka has suffered from the lack of clear directional basis in

education whereby pupils were guided in terms of aptitudes and abilities. The result, in relation to social needs, is well known. To overcome this situation education needs to be controlled, organised and given direction in the light of national needs, not sectional interests”.

It is therefore quite clear that Sri Lanka has suffered due to the lack of adequate and sound criteria of selection into various courses. It is quite possible that large numbers of students without the aptitude and ability for science are specializing in this field in the schools of Sri Lanka today.

From an educationist's point of view, economic, social and other factors are irrelevancies and selection should be based on individual ability and aptitude. Dempster¹⁴ put it thus: “Throughout the child has been kept in the forefront, for it is the child that matters, not any system or theory and it is upon the happiness and progress of every child that all selection must ultimately be judged”. It is in the best interests of the child and the country that we should select those few who have the aptitude and ability for science.

This brings us to the theoretical aspects of the selection procedures adopted to select students for science studies. Such a study will enable us to estimate what proportion of the science students without the necessary aptitude and ability are in the G.C.E. (A.L.) science classes today.

The Schools Council Curriculum Bulletin¹⁵ No. 3 devotes a whole section to discuss the intellectual differences and science ability. The findings of research workers such as Berridge, Khan, Jog, Lewis and Larwood are analysed and it arrives at the conclusion that “A clearly defined association emerges between scientific aptitude and the general verbal-factor of intelligence and reasoning factors, but the evidence for practical and social factors is rather inconsistent and the case for factors of imagination and memory also needs to be verified further”.¹⁶ The overall conclusions reached from this brief survey supports Vernon's¹⁷ interpretation of mental factors for science. He suggests that factors of scientific ability cut across the verbal-educational and kinaesthetic-motor classification and in his diagrammatic scheme ‘science’ ability is represented as being linked across the verbal-educational, kinaesthetic motor, and numerical group factors.

A recent study by Liam Hudson¹⁸ on the relation of psychological test scores to academic bias gave the following qualitative summary. This is in agreement with Vernon's findings.

Qualitative summary of test scores

	<i>General intelligence</i>	<i>Accuracy</i>	<i>Spatial ability</i>	<i>Vocabulary</i>	<i>General knowledge</i>	<i>Cognitive bias</i>
Arts specialists	poor	poor	poor	good	fair	verbal
Science specialists	very good	good	very good	good	good	numerical and spatial

He concludes that "academic bias of clever school boys does reflect itself in test scores with surprising clarity".¹⁹ This study shows that 'verbal', 'non-verbal', and 'combined' intelligence tests can be used to predict the science aptitudes of students. Research conducted in the U.S.A. by Brandwein²⁰, Roe,²¹ too support this view.

It is found that those who get high scores in the intelligence tests do not necessarily take to science. This is because they have no interest for science and they are not motivated. Therefore research workers point out that high intelligence alone should not be the criterion for selection. Students' interests, aspirations and motivations should also be taken into consideration.

Research work carried out in the U.S.A. points out that "high ability will be expressed most favourably in the most favourable environment"²² In order to gain an insight into the most favourable environment, research workers have studied research scientists at work and also their early life, especially that period when they were in the schools. They have thus delineated two other factors for success in science. These are classified as 'predisposing factor' and 'activating factor'. The predisposing factor is linked with the personality traits of the individual scientist. These traits consist of attitudes and characteristics such as persistence, diligence and an inquiring mind. The activating factor is "concerned with opportunities for advanced training and contact with an inspirational teacher".²³ "Without activation, potentialities may be lost or turned to other areas".²⁴ To sum up, high ability in science is dependent on the interaction of three factors—'intellectual', 'predisposing' and 'activating'. All three factors are necessary but no factor in itself is sufficient to develop high ability in science. In this context, the findings of Margaret Mead and Rhoda Metraux on the image of the scientist, reinforce the importance of the above mentioned factors. "He is a very intelligent man.....He has long years of expensive training.....during which he studied very hard. He is interested in his work and takes it seriously. He is careful, patient, devoted, courageous, open-minded. He knows his subject. He records his experiments carefully, does not jump to conclusions, and stands up for his ideas even when attacked".²⁵

From this brief survey it is clear that several validated instruments are necessary to assess the ability and aptitude for science. Among these are the intelligence tests to measure above mentioned mental abilities, a personality questionnaire and other means of measuring interests, aspirations and motivations. The writer used an intelligence test battery specially validated for Sri Lanka. The writer devised means to measure interests, aspirations and motivations. These have already been discussed. He was handicapped to some degree due to the lack of a validated instrument for Sri Lanka to measure personality characteristics like the one designed by Cattell.

This was overcome to some degree by the use of teachers' estimates of ability in science. The teacher's estimate is based on day to day work in the classroom and gives to some extent a subjective but fair picture of the students' abilities in science. The teachers were instructed to take into consideration such factors as persistence, questioning attitude, diligence, in their estimate.

No doubt the main weakness in such scores is the wide variation of the standards of assessment from teacher to teacher but the statistical analysis shows that there is a high correlation between those estimates and intelligence test scores.

As pointed out earlier, the teachers were asked to assess the chances of each child gaining admission to the university. This was expressed as a percentage. It is clear that their estimate is mainly based on the students' present achievement in the science subjects. If we assume that only those who score more than 50% are likely to gain admission to the universities, then these estimates predict that only 31% will be successful. However, the teachers were told that a pass at the G.C.E. (A.L.) was around 40%. On taking 40% as the 'cut-off point', they estimated that only 46% would pass the G.C.E. (A.L.) examination. These estimates show that teachers admit the fact that a large number of those who do not have the aptitude for science have taken to science. According to the teachers estimate as much as 54% would be unsuccessful at the G.C.E. (A.L.) examination. The teachers' estimates when correlated with intelligence test scores give the following correlation coefficients.

Correlation of intelligence test scores with teachers' estimates.

	<i>Correlation coefficient</i>
Verbal with teacher's estimates	+0.812*
Non-verbal with teachers' estimates	+0.613*
Combined with teachers' estimates	+0.724*

*p < .05

These correlation coefficients show that the teachers' estimates, although subjective, correspond to a great extent with the intelligence test scores.

The teachers' estimates showed that at least 54% who are unfit for science are in the G.C.E. (A.L.) science classes. A more objective figure could be arrived at by using the intelligence test scores. To get this figure the writer used the Combined Intelligence test scores. The writer decided to use this combined test score as this test includes items under 'verbal', 'spatial', 'reasoning', and 'numerical' factors. The norms of the intelligence test for this class of students are a mean score of 59.89 and a standard deviation of 17.25.²⁶

As a characteristic feature of science prone students is high intelligence, the writer wished to select only those students who had a score of more than one standard deviation above the mean. This is undoubtedly an arbitrary but a valid 'cut-off point'. According to the American norm, the 'cut-off point is higher.'²⁷ Thus, those who score below 59.89 belong to the average and below average group. According to our assumption those who score 77.14 (one standard deviation above the mean) and above can be considered as the students who have the ability to study science. As much as 62% score below 77.14 and 34% score below the mean. Therefore out of the students studying science only 38% have the aptitude for science and 34% too receive the same academic education that the others receive and compete for the same examination. An academically biased education is not suitable for the average and below average students. It is almost certain that these students will not be able to pass the G.C.E. (A.L.) examination. Undoubtedly, it is a colossal waste of valuable resources.

All the students who are to sit the G.C.E. (A.L.) examination have to reach a certain standard with a minimum number of credit passes earned at the G.C.E. (O.L.) examination. It is an accepted fact that a very large number of science students fail the G.C.E. (A.L.) examination. In some science subjects as much as 45% fail this examination. This study too shows that 38% of the G.C.E. (A.L.) science students belong to the average and below average category. This fact is a very bad reflection on the validity of the G.C.E. (O.L.) examination as an instrument of selection for further studies. We may safely conclude that the G.C.E. (O.L.) examination has a low predictive validity.

As remarked earlier, university admissions are based on the results of the G.C.E. (A.L.) examination. Every year an increasing number of students sit this examination and a large number obtain passes in all four subjects. The number of students who qualify for admission to the universities shows a steady increase but an ever increasing number of students fail to gain admission due to the limited number of places available in the universities. Although the statistics for 'science' are not given separately, the progressively worsening situation can be assessed from the Table given below. Today, as much as 88% of the students who qualify for admission are shut out from the universities.

TABLE 7
University admissions 1972-1980

Examination Year (G. C. E.—A. L.)	Admission Year	Number Eligible	Number Admitted	Percentage Admitted
1972	1973	10747	3420	31.82
1973	1974	12961	3532	27.25
1974	1975	15446	3789	24.53
1975	1976	15023	3942	26.23
1976	1977	19045	4150	21.79
1977	1978	27582	4996	18.11
1978	1979	26918	4661	18.42
1979	1980	29698	4857	16.35
1980	1981	40300	5020	12.46

Source: U.G.C. Annual Report, 1981.

The problem of gaining admission to the universities gets still more aggravated, especially from the point of view of the science prone student, as the University Grants Commission selects only 55% of the students on merit as the sole criterion. Table 8 below compares the actual university admissions for 1975 with the hypothetical situation when students are selected on merit.

TABLE 8

University admissions 1975

Distribution of students by their Districts of origin

District	Population Percentage	Medicine & Dental Surgery		Engineering and Sciences	
		Actual selection on District basis	Hypothetical selection according to merit	Actual selection on District basis	Hypothetical selection according to merit
Colombo	21.03	110	132	70	129
Kalutara	5.76	15	11	20	16
Kandy	9.34	24	17	31	11
Matale	2.49	8	3	8	3
Nuwara Eliya	3.57	2	2	6	—
Galle	5.80	29	18	20	24
Matara	4.63	8	5	15	20
Hambantota	2.68	1	—	8	—
Jaffna	5.54	29	61	20	56
Mannar	0.61	1	1	1	—
Vavuniya	0.75	—	—	—	—
Batticaloa	2.03	6	4	7	2
Amparai	2.14	—	—	1	1
Trincomalee	1.51	3	1	5	5
Kurunegala	8.09	12	3	26	9
Puttalam	2.99	3	2	10	2
Anuradhapura	3.06	2	1	4	1
Polonnaruwa	1.29	1	—	1	—
Badulla	4.84	2	1	7	2
Moneragala	1.51	—	—	2	1
Ratnapura	5.21	11	7	10	5
Kegalla	5.13	8	6	18	3
SRI LANKA	100.00	275	275	290	290

Source: Planning and Research Unit, University of Sri Lanka.

We may therefore conclude that the limited number of places available in the universities has so far not served as an adequate warning to those who take to science. Today the G.C.E.(A.L.) Examination acts as an almost insurmountable barrier built into the system to stem the ever increasing flow of students who seek to gain admission to the universities. At present there aren't sufficient institutions at the tertiary level to absorb even a part of those who qualify for admission to the universities but are rejected. Further, the rejected cannot find employment easily. Their future is very bleak indeed. Thus an ever increasing number of students take to science to join the ranks of unemployed and frustrated. Needless to say, such a situation must also be considered a colossal waste of national resources.

The government will have to recognize very soon that concrete action will have to be initiated to absorb all those who qualify but fail to gain admission to the universities. Further, this study clearly shows that selection for science will have to be based on adequate and sound criteria. The G.C.E. (O.L.) Examination has failed miserably as an instrument of selection for further study in the sciences. The students will have to be given adequate direction and guidance based on the latest techniques in psychometrics so successfully adopted in other countries. If this problem is neglected indefinitely it might lead to social chaos even exceeding the proportions experienced in 1971.

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1. R. G. Rowlands's formulae

$$1. \frac{S+N}{S+N+E} \times 100 = \text{Level of aspiration ratio}$$

$$2. \frac{S}{S+N} \times 100 = \text{Preference ratio}$$

$$3. \frac{S^u}{S} \times 100 = \text{University ratio}$$

Where S denotes scientists

„ N	„	non-scientists
„ E	„	early school leavers
„ S ^u	„	those who intend to go to the universities
„ S _o	„	others in the science group.

2. Career choices reported in the essay

BOYS		GIRLS	
<i>Career</i>	<i>No. of times reported</i>	<i>Career</i>	<i>No. of times reported</i>
1. Engineer	80	1. Doctor	75
2. Doctor	73	2. Science teacher	40
3. Research Scientist	23	3. Bank clerk	40
4. Bank clerk	20	4. Engineer	28
5. Graduate Scientist	15	5. Lawyer	23
6. Lawyer	14	6. Hospital nurse	20
7. Veterinary scientist	14	7. Teacher-not science	15
8. Science teacher	13	8. Clerk	13
9. Administrative Officer	12	9. Graduate scientist	12
10. Businessman	10	10. Stenographer	12
11. Dentist	10	11. Air Hostess	6
12. Architect	6		
13. Clerk	6		
14. Apothecary	6		
15. Technician	5		
16. Engine Driver (Railway)	5		
17. Motor Mechanic	4		
18. Pilot	4		