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SUMMARY – CONCLUSIONS AND SUGGESTIONS
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Summary

In this thesis an attempt is made to give a complete report of the procedure adopted in the construction and standardisation of the Aptitude Test in Science for grade IX.

The Test

Out of a number of abilities that are supposed to be indicative of the 'scientific aptitude' the following seven have been selected on the basis of the analysis of a questionnaire issued to teachers and lecturers of science numbering 120.

1. Numerical ability
2. Spatial ability
3. Reasoning ability
4. Ability to inter-relate
5. Mechanical ability
6. Ability to give cause and effect relationship
7. Ability to infer from an experimental data.

Test items numbering 153 have been constructed based on the abilities listed out and the test battery consisted of seven sections. The test is translated into Telugu for administration in the secondary schools. After the pilot test is administered and the answer scripts valued, the test items have been rearranged in the light of the difficulty

and validity indices calculated, for each of the test items. Five items had to be delected in the final test in view of their low and negative validity indices. The final form of the test consisting of the seven sections is got prepared in a booklet form(appendix V). Separate printed answer sheets are supplied to the pupils to record their responses (appendix VI).

Sections included in the Test

Section	Ability tested	No.of test items included
I (1 - 27)	Numerical ability	27
II (28- 52)	Spatial ability	26
III (53- 70)	Reasoning ability	18
IV (71- 89)	Ability to inter-relate	19
V (90-112)	Mechanical ability	23
VI (113-134)	Ability to give cause and effect relationship.	22
VII (135-148)	Ability to infer from an experimental data	14
	Total	148

The Population

The population included all pupils of grade IX boys and girls from city, urban and rural areas of secondary schools in Andhra Pradesh.

A sample is drawn from the population for the standardisation of the 'Science Aptitude Test'.

The Sample

The total sample for the present test consisted of 2000 boys and girls from city, urban and rural secondary schools of Andhra Pradesh.

Mode of Administering the Test

The details of procedure involved in the administration of the test is given in Chapter VI. The necessary instructions to testees are given on the front page of the test booklet for the guidance of pupils before answering the test.

Time Limit

The total time fixed for the test is 120 minutes and the time limitation is strictly followed and the pupils answered the test items in the prescribed time.

Scoring

One mark is allotted for each of the test items and the maximum obtainable score in the test is 148. The key that has been prepared to facilitate the scoring is given in appendix VI

The Results

1. The difficulty values and internal consistency indices, of all the 148 test items included in the final test, are given in Table 1, page 8²

2. The total sample consisted of 2000 testees both boys and girls. Thus the value of N = 2000.

3. The highest score obtained in the test is '114' while the lowest score is '17'. The range between the highest and the lowest score is therefore equal to '98'.

4. The mean, the median and the standard deviation of the whole sample are

    Mean = 66.71

    Median = 66.37

    Standard deviation = 17.69

5. The nature of the frequency distribution is studied in three ways :

    (a) Through the measures of divergence

    The measures of divergence of the frequency distribution are the skewness and kurtosis. The values of these two are given below :

    Sk = + 0.0576 as per Formula I

    Sk = + 0.38 as per Formula II

The type of skewness in both the cases indicated a positive value.

The value of kurtosis is found to be 0.2628 and the value indicated that the kurtosis is slightly leptokurtic.

Both the measures of divergence are not significant and as such the distribution is taken to be nearly normal.

(b) Through CHI-SQUARE TEST

The value of chi-square in the test is calculated and is found to be 10.9435.

The x^2 value obtained is found to be not significant at 0.01 and 0.05 levels. This also testifies to the normality of the distribution.

(c) Through the best fitting normal distribution curve

The best fitting normal distribution curve for the test scores is drawn on page 133 and it showed that the distribution is much more nearly normal.

6. The reliability of the test is estimated by the following two methods :

(i) Split-Half Method

(ii) Kuder-Richardson Formula

The results obtained by the two methods are as follows:

Split-Half Method :

Reliability Coefficient	P.E.r
0.876	$\pm$ 0.0761

Kuder-Richardson Formula :

Reliability Coefficient

0.9014

The reliability of the test is fixed at 0.89 and is found to be quite satisfactory.

7. The validity of the test is estimated by correlating the standard test scores with the standard criterion scores. In the present test the annual examination marks in science of pupils in the previous grade are taken as criterion scores. This has given the predictive validity and is found to be 0.76 $\pm$ 0.021

The test scores are also compared with the teacher's estimation on a seven point scale. The correlation coefficient is found to be 0.72 $\pm$ 0.024. This again supports the validity of the test.

8. The norms for boys and girls have been separately determined and they are :

	Boys	Girls
Mean	73.6	73.98
Median	74.3	74.06

The standard deviations in both the frequency distributions are calculated for boys and girls.

	Standard Deviation of the frequency distribution
Boys :	17.03
Girls :	17.36

The mid-points of the class intervals in the two frequency distributions are expressed in standard scores and tabulated. (Tables 35 and 36). A perusal of the norms and standard scores in the two distributions

shows that there is no significant difference in the performance of boys and girls in aptitude test.

9. Thurstone's Centroid method of factor analysis is applied to the test data.The factor analysis revealed the presence of five factors but on the application of the formula given by Benjamin Fruchter, it is found that there are only four factors. It is concluded that there are only four major factors that could be identified which are :

    (1)   Numerical ability

    (2)   Spatial ability

    (3)   Reasoning ability

    (4)   Mechanical ability

The other variables included in the list in the beginning viz. (4) ability to inter-relate (6) ability to give cause and effect relationship and (7) ability to infer from an experimental data,could as well be included under the factor 'Reasoning'. Basically the 'reasoning' factor includes variables 4,6 and 7 mentioned above. Hence there is enough justification to conclude that there are only four factors that could be identified.

10. The following types of norms are established in the present test :

    (a) Grade Norms

    (b) Standard Score Norms

    (c) Percentile Norms

    (d) T-Score Norms

Conclusions

1. The test items included in the aptitude test battery
   numbering 148, based on the seven abilities comprising
   a scientific aptitude, measures the scientific aptitude
   to a considerable degree.

2. The information obtained about the pupil's scientific
   aptitude through the test is to be supplemented further
   with the information about his performance in the
   subject matter, interests, industry and health before a
   final decision is arrived at with regard to his
   possessing a real scientific aptitude.

3. The distribution of the scores obtained by pupils is
   normal and it suggests that a majority of the pupils
   coming under the average group do possess certain
   abilities that speak of ones 'scientific aptitude'.

4. The reliability and validity of the test are found to be
   quite satisfactory and the test serves a useful purpose
   of measuring scientific aptitude of pupils.

5. The final test battery might include all the seven
   sections. Even though only four major factors are identified
   as per the analysis made, the other remaining three
   factors may also be included as they have their own
   subtle and distinct contribution to make, to give
   evidence of having scientific aptitude in an individual.

6. The test may also help the Counsellor in the clinical studies of problem cases and in giving the right type of clinical service to maladjusted children wherever possible.

7. The test may also be used by the school authorities to select their own enrollment for science groups.

8. The test scores together with standard measures of achievement may help the authorities in coming to a 'clinical decision' who present a problem of conduct or scholarship.

9. For some pupils completion of the ninth grade signifies the end of their formal general education. Through choice or necessity, their next step is to secure some training in some trade which will lead to employment. They are entitled to sound counseling from the school before he can make a decision for the rather great psychological leap that he must take when he leaves the school to enter some field of employment. The aptitude test scores may help the authorities to have a correct appraisal of the individual for giving the necessary vocational guidance.

10. The aptitude test may also provide a satisfactory frame of reference for curricular planning in science with regard to the steps to be taken for its improvement.

Suggestions to test users

1. If the tests are to be applied and interpreted properly, the testers should acquaint themselves with the various

limitations, analyse them and understand the principles underlying thoroughly. If the testing is handled by skilled persons, it provides a far surer and more accurate tool for the assessment of abilities than do subjective impressions of the ordinary type examinations.

As Vernon puts it

Mental tests have been widely and often unfairly criticised. But the progress of testing is probably hindered to a great extent by its friends who are ignorant of its limitations than by its enemies.[1]

As such to achieve useful and better results it is necessary that the present test be used by skilled persons only. The test users should have at least elementary knowledge of mental testing.

The scores obtained on the test are comparable with the test norms only when the test is administered and scored in a standardised procedure.

It is of utmost necessity that the user of the test acquaints himself carefully with the test and the procedures of administering and scoring.

As Vernon opines

No mental test score should ever be accepted at its face value nor trusted in the same way as physical measurements are trusted. Even the best tests, it should be remembered only measure within a certain probable error.[2]

Even though the reliability and validity of the present test are reasonably satisfactory, the test user, however, should be careful in interpreting the test score. As mentioned earlier, besides the aptitude test scores, other information of the pupils'

[1]Vernon,P.E. _The Measurement of Abilities._ (London: University London Press Ltd.,1956),pp.195-196.

[2]Ibid.

achievement scores, interests, health and other traits like
sincerity, hardwork and industry are to be taken into account
before a final decision is taken about their possessing a
real scientific aptitude and to predict their future level of
attainments.