A STUDY OF THE RELATIONSHIP BETWEEN SOME ASPECTS OF INTELLECT AND ACADEMIC PERFORMANCES OF GENERAL SENIOR HIGH SCHOOL STUDENTS IN INDONESIA

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University for the Degree of

Doctor of Philosophy

by

Setijadi

September 1964

SUMMARY

This was a study based on Guilford's model of the "structure of intellect" . In this model factors of intellect were categorized along three dimensions. The categories within a dimension were called aspects of intellect. The purpose of this study was to find the relationship between performances on pure factor tests of intellect and school grades, and to infer from the results whether different aspects of intellect play significantly different roles in academic performances.

The subjects participating in the study were 308 students from general senior high schools in two places in Central Java, Indonesia.

Two out of the three dimensions of Guilford's structure of intellect were selected for study, the Operations and Contents dimension. The effect of different working time was also studied.

Criteria for academic performances were eleven course grades. These grades were given about three months after the tests were administered to the subjects.

It was found that the reliabilities of the test were around zero. The other tests have moderate to rather high reliabilities.

The correlations between the test scores and course grades, the validities, were rather low. Analyses of variance for validities of the tests with each grade were computed, yielding no significant differences of the main effects. The interaction of Speed with Contents was significant at the .05 level for the validities of the tests to predict three course grades. When working time was increased, Figural tests validities tend to increase, and Semantic tests validities tend to decrease.

The results of this study did not support Guilford's theory and model as a useful construct for predictive purposes

VITA

The author was born in Kudus, Central Java, Indonesia, in April 18, 1929. He obtained the Baccalaurate in Education from the Gadjah Mada University, Indonesia, in 1954, and the Master of Arts degree, majoring in secondary education, from the University of Colorado in 1958.

He joined the Indonesian National Army in November 1945, and resigned from the army in January 1951, in order to pursue his college education.

From 1954 to 1957 he was teaching assistant at the Gadjah Mada University, before his transfer to the Teachers College, Airlangga University, where he became Assistant Specialist and later Junior Lecturer.

ACKNOWLEDGEMENTS

For the completion of this work, the author extends grateful acknowledgements to the following:

Members of his Special Committee: Dr. Jason Millman, Chairman, Doctors William T. Lowe and Robert R. Zimmermann, Members, for their assistance, suggestions,and criticisms of the work.

Miss Sajarti Soetopo, for her tireless efforts of administering the tests and collecting other data for this study in Indonesia. Without her help it would be impossible for the author to do this study.

Mr. Foster L. Brown, Mr. Richard Granda, Dr. S. R. Searle, and other members of the Cornell Computing Center, for their valuable ...ce in the electronic computations employed in the study.

The Ford Foundation,through the State University of New York, for the all inclusive scholarship which made it possible for the author to study at Cornell and have his family with him.

The Teachers College, Airlangga University, and the Department of Higher Education, Republic of Indonesia, for granting the author a leave of absence for over two years.

The Perwakilan SMA in Semarang, the SMA Negeri I and II Surakarta, the SMA Negeri Bojolali, for giving their permission for administering the tests to their students. The teachers and students who participated in this study.

Setijadi

Ithaca, New York

August 1964

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Standardized aptitude tests were not generally available for use in Indonesian high schools. Aptitude tests from foreign countries could not be used because of language differences. The need for such tests to improve standards of admission and guidance seemed to have been felt for a long time. However, attempts to develop and standardize aptitude tests for use in these schools have been made only recently.[1] The results have not been published yet.

I. THE PROBLEM

Aptitude tests may be grouped into two categories. There were general aptitude tests and multi-aptitude tests. The former tests were supposed to measure a general intellectual factor while the latter tests were supposed to measure different aptitudes or factors of intellect.

According to Guilford[2] the factors of intellect could be categorized along different dimensions (see figure 1). In this study the categories within each dimension were called aspects.

---

[1] Attempts have been made by the College of Psychology, the University of Indonesia. This knowledge was obtained through private communications.

[2] J.P. Guilford, Three Faces of Intellect. American Psychologists, 14 (August, 1959), pp. 469-479.

This study was concerned with the relationship of some of these aspects of intellect to academic success in high schools in Indonesia.

Purposes of the study. The purpose of this study was:

1. To translate and adapt existing American tests, and construct a new test which supposedly measure certain aspects of intellect and which look promising as predictors of academic success of general senior high school students in Indonesia.

2. To determine the relationship between the performances on these tests and various school grades of general senior high school students in Indonesia.

3. To infer from the results of (2) whether different aspects of intellect within a dimension play significantly different roles in the academic performances of these students.

Importance of the study. It was hoped that the results of this study might be used to construct new aptitude tests in Indonesia which attempt to measure those aspects of intellect which were significantly related to academic success. This included the possibility that some of the tests used might become perfected and standardized.

Background of the problem. Secondary schools in Indonesia were divided into two levels, the junior high school level (grade seven through nine) and the senior high school level (grades ten through twelve). The senior high schools were of different types. There were the technical high schools, professional high schools, and general high schools. The majority of the students attended the general senior high

schools where students were prepared for college. Within the framework of these schools the curriculum was divided into four streams after the tenth grade. Each stream emphasized one of the following areas: Language and History, Social Studies, Mathematics, and Sciences.

In each of the schools the curriculum was relatively fixed and uniform throughout the nation. Thus, students remained in the same class unit throughout the year for instruction in all subjects. The Department of Basic Education and Cultural Affairs was the highest authority in school affairs through the high school level.[3]

Reports of grades were issued quarterly on the basis of examinations made by the teachers of the subjects. Toward the end of the school year the schools could give promotion examinations which were uniform throughout the school for each equivalent subject. Before graduation from junior and senior high schools nationwide examinations were given by the Department of Basic Education. A certificate was given to each student who passed the examinations. Students graduated from junior high school could enroll either in a general senior high school or in a technical or professional school.

Most of the graduates of the general senior high school applied for admission in a college. The problems of admission and placement became more important due to the rapid increase in the number of schools and colleges. Grades alone seemed to be less satisfactory as predictors

---

[3]Colleges and Universities were under the supervision of the Department of Higher Education and Sciences.

for future performances when the range of ability of the students increased. A significant increase in predictive validity could be obtained by using aptitude tests in conjunction with school grades.

It was hoped that the results of this study would contribute toward the development and standardization of aptitude tests to be used in the Indonesian high schools.

II. DEFINITION OF TERMS

General senior high school (Sekolah Menengah bagian Atas). Grade ten through twelve emphasizing college preparatory training.

Factors of intellect. Individual characteristics of the mind inferred from factor analytic studies using different tests. According to Guilford there were 120 factors of intellect.

Aspects of intellect. Categories of factors of intellect along a certain dimension of intellect (see below). Examples of aspects of intellect were: evaluation, convergent production and memory along operations dimension; relations, systems, implications along the products dimension; and figural, semantic contents along the contents dimension (see figure 1).

Dimensions of intellect. Higher order categories of factors of intellect. There were three dimensions of intellect according to Guilford: operations, products, and contents. In this study another dimension was added: time.

III. ASSUMPTIONS AND LIMITATIONS

Assumptions. The following assumptions were made:

1. The tests used were pure measures of the respective factors for the population of subjects of this study. This assumption was necessary to make inferences about the relationship between various aspects of intellect and academic performances.

2. The predictive criteria were equivalent for all schools.

Limitations of the study. The study was limited by the nature of the student sample and the factors of intellect investigated and the specific measures of the factors employed. The nature of the student sample might not be crucial since this study dealed with correlations between test scores rather than with the mean scores. That is, it was anticipated that the correlations, compared to means, were less subject to changes in student populations.

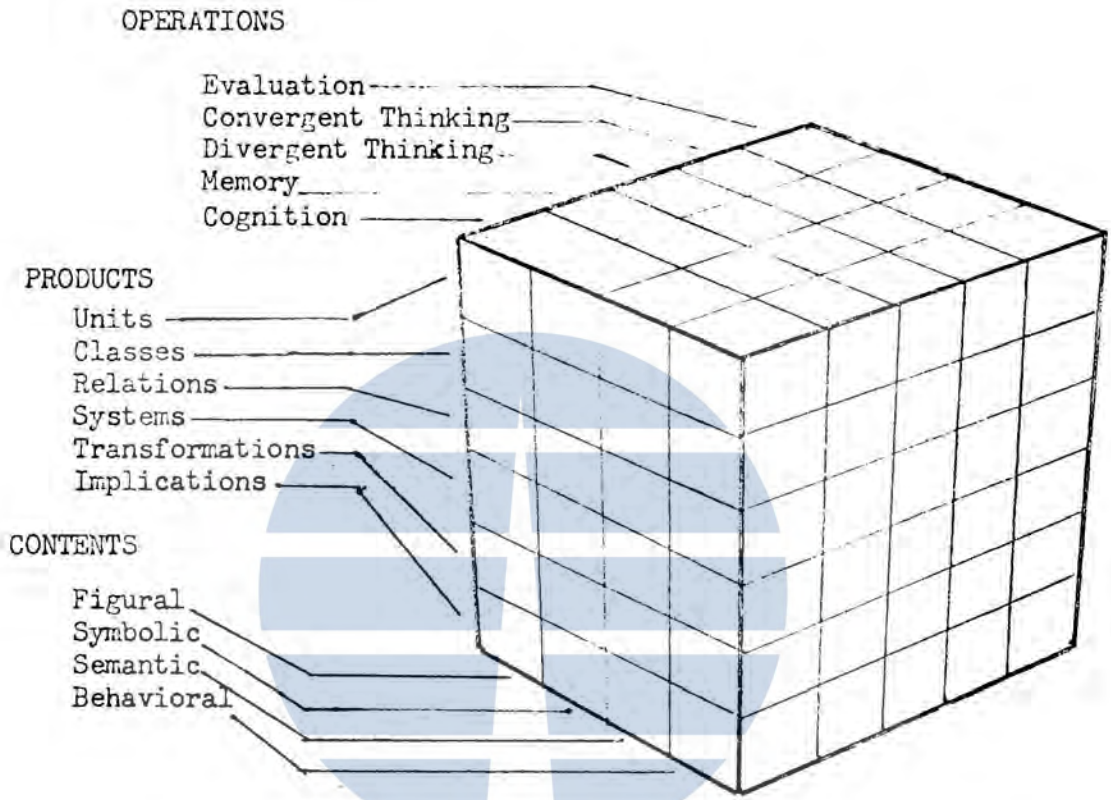


FIGURE 1: GUILFORD'S THEORETICAL MODEL FOR THE COMPLETE "STRUCTURE OF INTELLECT"

The dimensions according which the factors were arranged were: Operations, Contents, and Products. The aspects were the categories within each dimension. The factors were the small cubicles divided by the lines in 3 dimensional space. There were 5 x 4 x 6 = 120 factors.

CHAPTER II

REVIEW OF RELATED LITERATURE

I. LITERATURE ON SOME PROBLEMS RELATING TO INTELLIGENCE TESTING

In many American high schools multi-aptitude test batteries were used in conjunction with general intelligence tests, achievement tests, and school grades for the purpose of admission and guidance. The advantage of using a combination of tests over a single type of test seemed obvious. When a choice has to be made between the various types of tests to be used with school grades for admission and guidance, there were several criteria to be considered for the choice.

Predictive validity seemed to be one important criterion. Multipotentiality, descriptiveness, and timelessness were other criteria which should seriously be taken into account.[1] The choice of tests investigated in this study was based upon these four criteria. Since Indonesian senior high schools did not have any standardized test which could be used for admission and guidance multipotentiality and differential predictive validity[2] seemed to be the most important criteria for selection. Multipotentiality meant that the tests were

---

[1] Donald E. Super, "The Use of Multifactor Test Batteries in Guidance." Personnel and Guidance Journal, 35 (September 1956), pp. 9-15.

[2] W. G. Mollenkopf, "Some Aspects of the Problem of Differential Prediction". Educational and Psychological Measurements, XII (Spring 1952), pp. 39-44.

useful in many situations, for example, tests results could be used as standards for admission as well as for placement. Differential predictive validity meant that the tests should be able to predict whether the chance of success in one situation would be significantly different than the chance of success in another situation. It should be remembered that Indonesian general senior high schools consisted of a variety of streams, therefore differential prediction was important.

The purpose of the first section of this chapter was to justify the choice of factorially pure multi-aptitude tests for eventual use in Indonesian high schools. Interest inventories and other non-intellectual tests were left out of discussion since this study was only concerned with tests of intellect.

General intelligence versus special aptitude tests.

Controversies about the nature of intelligence seemed to have been more apparent than real, according to a review made by Warrington and Saupe.[3] General intelligence tests continued to be used despite claims of superiority by special aptitude tests such as the Differential Aptitude Tests (DAT). The Psychological Corporation, publishers of the DAT even provided evidence of predictive validity of a single measure of scholastic aptitude in the form of the sum of DAT scores Verbal Reasoning and Numerical Ability.

---

[3]W.G. Warrington and J.L. Saupe, "Development and Applications of tests of General Mental Ability". Review of Educational Research, 29 (1959), pp. 15-25.

Millholland and Fricke[4] indicated that the most damaging criticism that can be made of special aptitude tests is that the high regard for these tests was mostly due to their general validity. Many studies show that a measure of linguistic aptitude predicted grades in English and social studies hardly better than it predicted grades in mathematics and science. Similarly, numerical tests often did not predict English, foreign languages, and social studies grades.[5] Therefore no real advantage has been gained by adding or substituting general intelligence tests with special aptitude tests.

Differences in opinions regarding whether intelligence was composed of a general or several group factors depended in part on the particular approach to factor analysis.[6] However, the high intercorrelations which were usually found among tests used for differentiating aptitude seemed to add more weight to the point of view that intelligence was composed of a factor. Guilford, Fruchter, and Kelley have indicated that when tests were varied sufficiently in kind, zero correlations were numerous.[7] The variety of tests could be increased by a willingness to utilize completion tests that require some

---

[4] J. E. Millholland and B. G. Fricke, "Development and Applications of Tests of Special Aptitudes". Review of Educational Research, 32 (1962), pp. 25-39.

[5] Ibid., p. 29.

[6] Warrington and Saupe, op. cit., p.15.

[7] J. P. Guilford, B. J. Fruchter, and H. P. Kelley, "Development and Applications of Tests of Intellectual and Special Aptitudes". Review of Educational Research, 29 (1959), p. 26.

subjective judgment in scoring.[8] If tests were used which have low intercorrelations among themselves differential predictive validity may be significant.[9]

The above discussions indicated one possible important advantage of multi-aptitude tests over general aptitude tests.[10] If intercorrelations between multi-aptitude tests could be made low, the tests could be used for differential prediction. These tests were at least equal to general aptitude tests in that a combination of multi-aptitude test scores could be used as a measure of general intelligence.

Aptitude tests versus standardized achievement tests.

Aptitude test and achievement test scores were sometimes hard to be interpreted differently. Especially when aptitude tests were constructed for predictive purposes within a rather limited area. An example of these kinds of tests were the School and College Ability Tests.[11] These tests required a high degree of achievement in schools, that is, they were similar in contents with achievement tests. Achievement

---

[8] Ibid., p. 27.

[9] John W. French, "Comparative Prediction of College Major Field Grades by Pure Factor Aptitude, Interest, and Personality Measures". Educational and Psychological Measurements, 23 (Winter 1963), pp. 767-774.

[10] F. E. Wellman, "Differential Prediction of High School Achievement using Single Score and Multiple Factor Tests of Mental Maturity". Personnel and Guidance Journal, 35 (April 1957), pp. 512-517.

[11] Cooperative School and College Ability Tests. (Princeton, N. J.: Educational Testing Service, 1955), Form 5A and others.

tests have indeed been found to be generally better predictors for future achievement than aptitude tests.[12] This might be the reason why aptitude tests should resemble achievement tests to have greater predictive validity.

Preference for using aptitude or achievement tests depended upon the purpose for the test. With reference to college testing programs the topic has been discussed by Ebel[13] and Wesman[14]. Ebel preferred specific achievement tests because these tests had high predictive validity for future achievements in the same area.[15] On the other hand Wesman indicated that aptitude tests could help in identifying potentially good students who did poorly in high school. Achievement tests could only reveal the degree of achievement of these students. Since school grades were available there was no need for achievement tests.[16] Apparently the possible increase of predictive validity of standardized achievement tests over school grades seemed not to have made the effort of developing achievement tests worthwhile.

Thus it seemed obvious that if high predictive validity was desired achievement tests should be used. However, school grades were already available which would give about the same measures as achievement test scores. Other measures could be obtained by using aptitude

---

[12]Milholland and Fricke, op. cit., p. 25.

[13]R. L. Ebel, "What Kinds of Tests for College Admission and Scholarship Programs?" Proceedings, Invitational Conference on Testing Problems, (Princeton, N.J.: Educational Testing Service, 1959), pp. 88-97.

[14]A.G. Wesman, "What Kinds of Tests for College Admission and Scholarship Program?" Proceedings, Invitational Conference on Testing Problems, (Princeton, N.J.:Educational Testing Service, 1959), pp. 114-120.

[15]Ebel, op. cit., p. 96.

[16]Wesman, op. cit., p. 116.

tests which did not resemble achievement tests. These tests seemed useful to identify underachievers and contribute toward differential prediction.

Development of factorial pure tests.[17] Studies using shorter batteries of relatively unique tests, that is, tests with low intercorrelations among themselves, have been done by Meranda[18], and Meranda and others[19]. These studies found that a short battery of relatively unique tests, the Measurements of Skills, could produce as valid predictions as could a substantially longer battery,the Differential Aptitude Tests.

Uniqueness could be obtained by using factorial pure tests. French used very short pure tests of aptitude factors to predict college major-field grades.[20] The median intercorrelation among the tests was only .14. The tests have been found to have low absolute validity, however, differential prediction was made possible by these low intercorrelations.[21]

---

[17]Pure Factor test was here defined as a test with a high loading on one factor and low loadings on other factors.

[18]P.F. Meranda, "Relative Predictive Efficiency of a Short Versus a Long Test Battery for High School Students". Psychological Reports, 8 (February 1961), p. 62.

[19]P.F. Meranda and others, "Relative Predictive Efficiency of the DAT and a Short Multifactor Battery of Tests". Psychological Reports, 11 (August 1962), pp. 71-81.

[20]French, loc. cit.

[21]Ibid., p. 770.

An early example of a battery of factorial pure tests is the Primary Mental Abilities Tests (PMA)[22] developed by the Thurstones. Wolking[23] found that for absolute prediction of school grades the PMA was inferior to the DAT. However, it was not due to this fact that the PMA was not regarded as suitable for use in an educational and guidance program[24]. Rather, it was because of the lack of refinement and empirical validation[25]. There was evidence the test might still prove to be useful for differential prediction of high school grades[26] even if the absolute predictive validity was inferior.

According to Super[27] factorial pure tests were likely to meet his criteria of multipotentiality, descriptiveness, and timelesness. The lessened absolute predictive validity of these type of tests seemed to be the price for multipotentiality because academic performance was likely to involve a great variety of aptitudes.

---

[22] SRA Primary Mental Abilities. Third edition. Chicago: Science Research Associates, 1958, Intermediate form.

[23] William D. Wolking, "Predicting Academic Achievement with the Differential Aptitude and the Primary Mental Abilities Tests". Journal of Applied Psychology, (April 1955), pp. 115-118.

[24] Ralph F. Berdie, (Review of the SRA Primary Mental Abilities Tests), The Fourth Mental Measurements Yearbook, Oscar K. Buros, editor (Highland Park, N. J.: The Gryphon Press, 1953, pp. 703-704.

[25] Anne Anastasi, (Review of the SRA Primary Mental Abilities Tests) Ibid., pp. 700-703.

[26] F. E. Wellman, loc. cit.

[27] Super, op. cit., p. 12.

There were thus several advantages in using factorial pure tests. These tests tended to meet the criteria of multipotentiality, descriptiveness, and timelessness. Although each of the tests had low predictive validity, together they could form a battery with a relatively high absolute as well as differential predictive validity. Testing time could also be reduced because a comparatively short form of these tests could be used with equal predictive validity as a longer form of factorial less-pure tests.

II. LITERATURE ON ISOLATION OF SPECIFIC INTELLECTUAL FACTORS USING FACTOR ANALYSIS

Studies by John W. French. Modern multifactor theory of intellect or aptitudes were based upon factor analytical studies following the lead of Thurstone[28]. Theories so developed were deductive in nature at the earlier stages. No hypothesis were made and tested, and no comprehensive structure was developed relating to the various factors discovered. At later stages there seemed to be a need to establish the factors found by conducting other studies using different subjects and different tests.

John W. French[29] has made a review of 69 comparable factor analytic studies of aptitude and achievement tests. The purpose was to interpret and crossidentify the factors found in these studies.

---

[28] L. L. Thurstone, Primary Mental Abilities. (Psychometric Monograph No. 1, Chicago: University of Chicago Press, 1938.).

[29] John W. French, Aptitude and Achievement Tests in Terms of Rotated Factors. (Psychometric Monograph No. 5, Chicago: University of Chicago Press, 1951.)

Interpretation of factors were based on the characteristics of the tests which had a significant loading on the factor. Factors found in one study may be reconfirmed by other independent studies. He found a number of factors which were relatively established, and a number of others of which interpretation and "existence" were still doubtful.

Guilford's Structure of Intellect. After a substantial number of factors had been found and established, there seemed to be a need to arrange these factors in some systematic order. A theory of intellect could thus be developed. Several models had been proposed to meet the need, including Burt[30], Guttman[31], and Lazarsfeld[32]. Guilford[33] mentioned three of these models: the dimensional model, the hierarchical model, and the matrix model.

The dimensional model was a space of n dimensions, each dimension representing a unique factor or trait. The hierarchical model which emphasized the structure of a typical personality, represented factors at several distinct levels of generality, one of the levels being

---

[30] C. Burt, "The Structure of Mind: A Review of the Results of Factor Analysis." British Journal of Educational Psychology, 19 (June-November 1947), pp. 100-111, 176-199.

[31] L. Guttman, "A New Approach to Factor Analysis: The Radex", Mathematical Thinking in Social Science, P. F. Lazarsfeld, editor.

[32] P. F. Lazarsfeld, "A Conceptual Introduction to Latent Structure Analysis", Ibid., pp. 349-387.

[33] J. P. Guilford, "Factorial Angles to Psychology", Psychological Review, 68 (January, 1961), p. 6.

devoted to primary traits. The third model, with which this study was concerned, arose from the logical classification of known primary traits in columns and rows to form a three dimensonal matrix.

The matrix model was an attempt to classify known factors in certain areas of personality, in this case the intellectual abilities. Guilford called this model "structure of intellect"[34].

The structure of intellect was represented by means of a three dimensional, rectangualr solid (FIGURE 1). According to this model the factors of intellect were classified on three bases or dimensions: Operations, Contents, and Products. Within the Operations dimension the intellectual aptitudes were classified into five major groups: factors of Cognition (C), Memory (M), Convergent Production (N), Divergent Production (D), and Evaluation (E). The Contents classification involved four categories: Figural (F), Symbolic (S), Semantic (M), and Behavioral (B). The Products dimension was divided into six categories: Units (U), Classes (C), Relations (R), Systems (S), Transformations (T), and Implications (I).

Guilford and Merrifield have given the following definitions of the above categories or aspects of intellect:

Operations: Major kinds of intellectual activities or processes; things that the organism does with the raw materials of information.

Cognition: Discovery, awareness, rediscovery, or recognition of information in various forms; comprehension or understanding.

Memory: Retention of information in any form.

Divergent Production: Generation of information from given information, where the emphasis is upon variety of output from the same source.

Convergent Production: Generation of information from given information, where the emphasis is upon achieving unique or conventional accepted or best outcomes.

Evaluation: Reaching decisions or making judgments concerning the goodness (correctness, suitability, adequacy, desirability) of information in terms of criteria of identity, consistency, and goal satisfaction.

Contents: General varieties of information.

Figural content: Information in concrete form, as perceived or as recalled in the form of images. The term "figural" implies some degree of organization or structuring.

Symbolic content: Information in the form of signs, having no significance in and of themselves, such as letters, numbers, musical notations, etc.

Semantic content: Information in the form of meanings to which words commonly become attached, hence most notable in verbal thinking; involved in doing verbal tests, where the things signified by words must be known.

Behavioral content: Information, essentially non-verbal, involved in human interactions, where awareness of the attitudes,needs, desires, intentions, thoughts, etc. of other persons and of ourselves is important.

Products: Results of the organism's processing of information.

Units: Relatively segregated or circumscribed items of information having "thing" character.

Classes: Aggregates of items of information grouped because of their common properties.

Relations: Recognized connections between units of information based upon variables that apply to them.

Systems: Organized or structured aggregates of items of information; complexes of interrelated or interacting parts.

Transformations: Changes in existing or known information or in its use, as in production.

Implications: Extrapolations of information, in the form of expectancies, predictions, antecedents, and consequences.[35]

Guilford also made a distinction between model and theory. When connections between the model's constructs and the empirical world was hypothesized a model became a theory. He did not elaborate on the meaning of model, but seemingly he used the term model to emphasize the unconfirmed nature of the hypothesis in question.[36] To support the structure of intellect as a theory two types of verifications were necessary. First, previously found factors must be confirmed as distinct from each other, when interpreted in terms of their location in the model. Second, new factors must be hypothesized from the model and their independent existence verified.[37] These types of verifications

---

[35] J. P. Guilford and P. R. Merrifield, The Structure of Intellect Model: Its Uses and Implications. (Report of the Psychological Laboratory, No. 24, 1960).

[36] The meaning of model has been discussed in May Brodbeck, "Logic and Scientific Method in Research on Teaching", Handbook of Research on Teaching, N. L. Gage, editor. (Chicago: Rand McNally and Company, 1963), pp. 88-89.

[37] J. P. Guilford, P. R. Merrifield, op. cit., p. 3..

had actually been sought by Guilford and others[38], Merrifield and others[39], and Gershon and others[40]. The results seemed satisfactory as support for the usefulness of theory. So far, the structure of intellect had been used as a basis for consideration of problems of curriculum[41], in relation to teaching of reading[42], and as a basis for systematic orientation with respect to psychological tests[43]. Some of Guilford's tests for factors within the structure of intellect had been used for predictive purposes[44]. According to the authors:

> These results indicate that creativity tests in this battery do have considerable validity as predictors for academic performance,and the criterion variance accounted for by creativity tests is to a substantial degree independent of the variance accounted for by the I.Q. tests[45].

The predictive criterion used was grade point average.

---

[38]J. P. Guilford, et al., An Investigation of Symbolic Factors of Cognition and Convergent Production. (Report of the Psychological Laboratory, University of Southern California, No. 22, 1960).

[39]P. R. Merrifield, et al., "The Role of Intellectual Factors in Problem Solving." Psychological Monographs, 76, No. 10 Whole No. 529, 1962).

[40]A. Gershon, J.P. Guilford, and P.R. Merrifield, Figural and Symbolic Divergent-Production Abilities in Adolescent and Adult Populations. (Reports from the Psychological Laboratory, The University of Southern California, No. 29, 1963.)

[41]J.P. Guilford, "Human Abilities in Education," California Journal of Instructional Improvement, 1 (December, 1958), pp. 3-6.

[42]J. P. Guilford, "The Natural of Intelligence", Proceedings, Annual Summer Conference (Bellingham, Washington: Western Washington College, 1960), pp. 3-16.

[43]J.P. Guilford, B.J. Fruchter, and H.P. Kelley, op.cit., pp. 26-41.

[44]Victor B. Cline, J. M. Richards, and Clifford Abe, "The Validity of a Battery of Creativity Tests in a High School Sample", Educational and Psychological Measurements, 22 (Winter, 1962), pp. 781-784.

[45]Ibid., p. 789.

To the author's knowledge the structure of intellect as a whole had never been used as a basis for differential prediction of academic performances.

To summarize, there seemed to be two kinds of theories of factors of intellect. The first type of theory indicated only what factors were found in studies using factor analysis. Later studies were conducted which might result in creating new factors, and reinterpret, confirm or question old factors. The second, more elaborate, type of theory tried to incorporate the discovered factors in a comprehensive model or theory of intellect. Studies were conducted not only to support or question old factors, but also to discover new factors predicted by the theory. French's work illustrated the first type and Guilford's work the second type.

Development of pure tests for the factors seemed to be the logical consequence of these studies. Usefulness of the theory were sometimes judged by the ability of these pure factor tests to predict future performances differentially. Guilford's theory seemed never to have been tested for its usefulness in differential prediction. Favorable results of such studies may have far reaching effects for test construction.

III. LITERATURE ON THE EFFECTS OF TIME LIMITS ON TEST SCORES

Different working time limits given to a test might affect the predictive validity of the test. Walters reported that a slight improvement for prediction of school work were detected as a result of extension

of the standard working time for the tests[46]. Speed, or rate of work, could be a factor quite distinct from other factors. If this was true, another dimension to categorize factors of intellect the dimension of time, could be added to the three dimensions already mentioned by Guilford[47].

Lord[48] has investigated the existence and interrelations of various speed factors, and their relation to academic course grade. Using speeded and unspeeded tests of vocabulary, spatial ability, arithmetic reasoning, scores on certain regular admissions examination, scores on specially prepared reference tests, and end of the year course grade at the U. S. Naval Academy at Annapolis, he could identify number speed, perceptual speed, verbal speed, and spatial speed factors. The results indicated also the existence of a general speed factor at the second order level. He found that all correlations between course grades and the four speed factors, with one small exception, were positive, although not large. However, he indicated that tests on which 50 to 75 percent of the examinees reached the last item did not involve the speed factors needed.

Morrison related speed with the individuals' preferred average time per item[49]. His study showed that no difference in percentage of

---

[46]Fred C. Walters, A Statistical Study of Certain Aspects of the Time Factor in Intelligence (New York: Bureau of Publications, Teachers College, Columbia University, 1927).

[47]J.P. Guilford and P.R. Merrifield, loc. cit.

[48]Frederic M. Lord, "A Study of Speed Factors in Tests and Academic Grades", Psychometrika, 21(March 1956), pp. 31-50.

[49]Edward J. Morrison, "On Test Variance and the Dimensions of the Measurement Situation," Educational and Psychological Measurements, 20 (Summer, 1960), pp. 231-250.

correct items could be detected between tests with time limit and tests without time limit, when time limit was more than 40 percent of the subjects' average preferred rate of responses. Thus, his study did not contradict Lord's findings that only very highly speeded tests involved the speed factors to any appreciable extent.[50]

The studies of Lord and Morrison seemed to justify the addition of the time dimension to Guilford's structure of intellect. The aspects within the time dimension would be Speededness and Unspeededness. Relationship between Speededness and academic performances could be significantly different from the relationship between Unspeededness with the same performances.

On the other hand, Speededness as defined above was not the concern of Walter's study. He merely tested two different working time for the tests, one was the standard working time, and the other an extension of the standard time such that every subject had the opportunity to complete the test.

---

[50] Lord, op. cit., p. 49.

CHAPTER III

PROCEDURE AND METHOD OF ANALYSIS

I. DESIGN TO OBTAIN TEST SCORES

It seemed important to know how test scores measuring Operations and Contents relate to subject matter performance. However, due to limitations in time and resources this study was only concerned with four aspects of Operations and two aspects of Contents, all at the Transformations (T) Products. The four aspects of Operations investigated were Cognition (C), Divergent Production (D), Evaluation (E), and Convergent Production (N). The two aspects of Contents selected for study were Figural (F), and Semantic (N) Contents. Figure 2 illustrates the factors of Guilford's structure of intellect investigated in this study.

Another dimension was introduced in this study: the dimension of Time. The total factors investigated are thus illustrated in figure 3.

There were two important variables to be controlled in the design. One variable was the school and the other was the class. The first variable was partially controlled by replicating each measure with parts of another school. To increase generalization of results the two schools were selected from two different localities. One school was selected from a place which might be characterized as rural (R) and the other school was selected from a place which might be characterized as urban (U). There were in fact two schools selected from the urban area

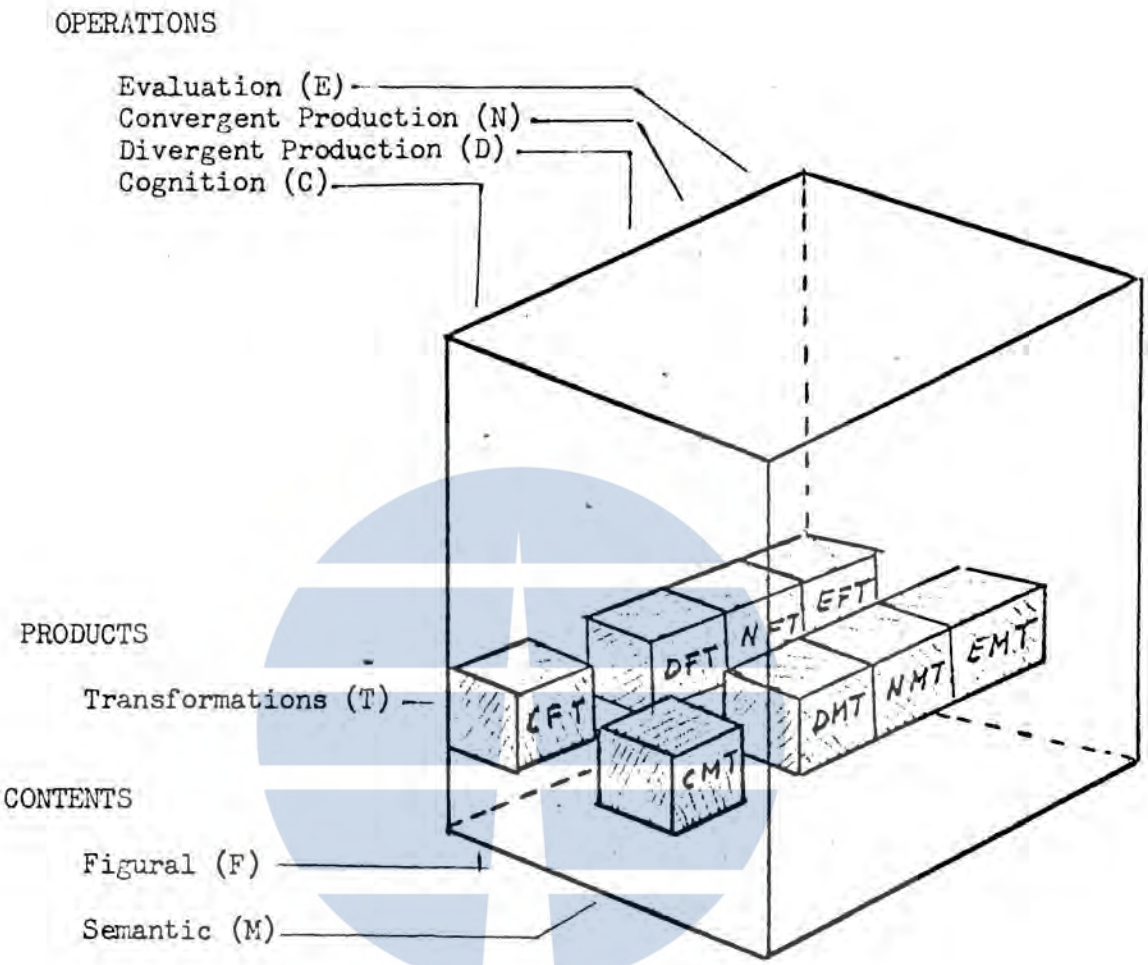


FIGURE 2: GUILFORD'S FACTORS INVESTIGATED IN THIS STUDY

The dark small blocks are the factors of Guilford's Structure of Intellect investigated in this study. The letters on these blocks refer to aspects of Operations, Contents, and Products respectively. Thus the factor CMT is in the Cognition block, Semantic Column, and Transformations row.

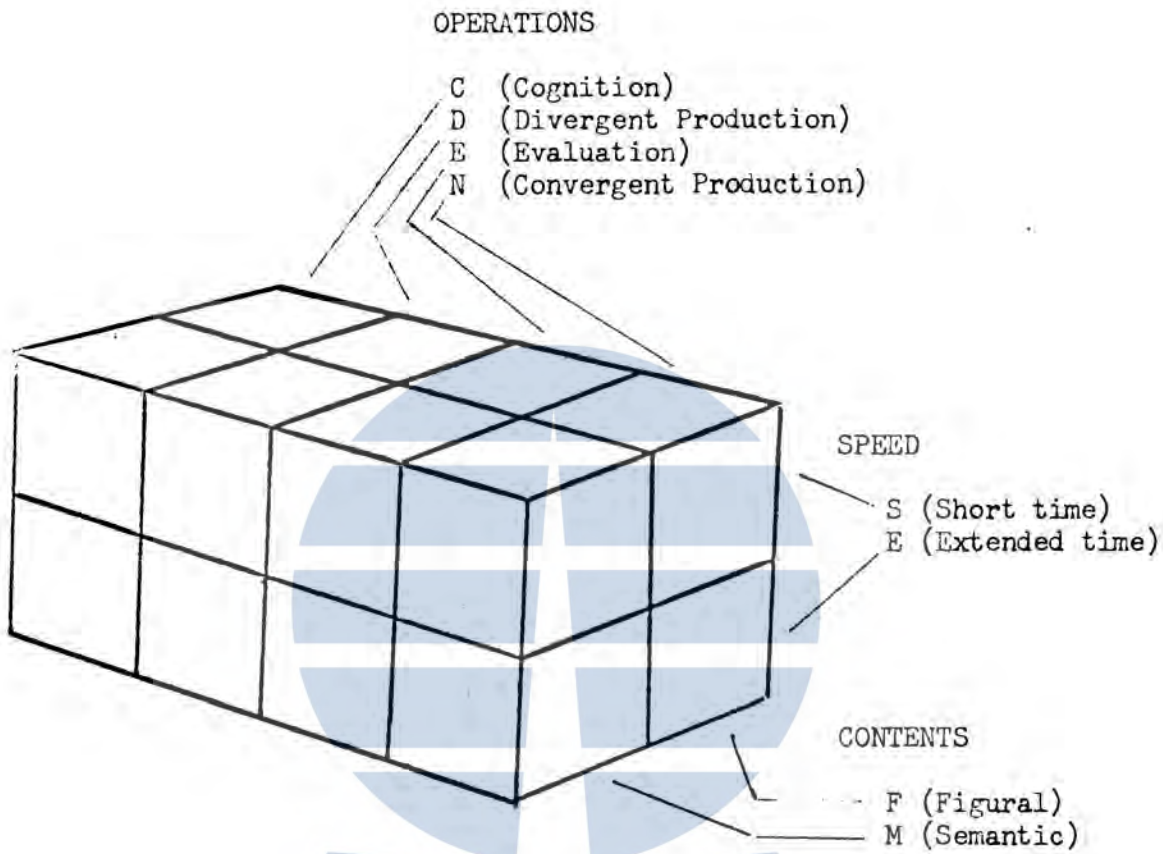


FIGURE 3: A COMPLETE PICTURE OF THE ASPECTS INVESTIGATED IN THIS STUDY

The dimension of Speed is added in this picture. The cells investigated become 16.

as will be explained in the next section. Class was partially controlled by replicating each measure with parts of three other class units.

TABLE I illustrates the design used in obtaining the test scores from a school in a rural and from a school in an urban area. Four class units participated from each of the two schools. Each class was randomly divided into two groups of approximately the same size. One group was administered tests having figural content; the other group in the class was administered tests having semantic content.

II. SELECTION OF THE SAMPLE

To improve translation and adaptation, especially translation of the test directions, and cultural adaptation of test contents, a pretest group of sixteen Indonesian graduate students was selected. Due to limitations in time no pretest group comparable in ability to the student population under study could be selected. It was thought to be better, however, to use a pretest group which was different in many respects than without using one. This difference became apparent when estimation of working time limits based on the pretest group were far from applicable to the actual subjects. This pretest group was also used to improve the new constructed test. In the next sections these topics will be further discussed.

The schools were selected from available general high schools in the vicinity of the test administrator's place of residence. The two places from which the sample was selected were Surakarta (U) and

TABLE I

ILLUSTRATION OF THE DESIGN USED IN OBTAINING THE TEST SCORES*)

School	Speed	Contents	Group**)	Cognition	Divergent Thinking	Convergent Thinking	Evaluation
Urban	Extended time	Figural	1	$C_{11}, C_{12}, \ldots \ldots \ldots, C_{1n_1}$	$D_{11}, D_{12}, \ldots \ldots \ldots, D_{1n_1}$	$N_{11}, N_{12}, \ldots \ldots \ldots, N_{1n_1}$	$E_{11}, E_{12}, \ldots \ldots \ldots E_{1n_1}$
			2	$C_{21}, C_{22}, \ldots \ldots \ldots, C_{2n_1}$	$D_{21}, D_{22}, \ldots \ldots \ldots, D_{2n_2}$	$N_{21}, N_{22}, \ldots \ldots \ldots, N_{2n_2}$	$E_{21}, E_{22}, \ldots \ldots \ldots E_{2n_2}$
		Semantic	3	. . .	. . .	. . .	. . .
			4	. . .	. . .	. . .	. . .
	Short time	Figural	5	. . .	. . .	. . .	. . .
			6	. . .	. . .	. . .	. . .
		Semantic	7	. . .	. . .	. . .	. . .
			8	. . .	. . .	. . .	. . .

C_{11} = the score of individual number one in group one
C_{12} = the score of individual number two in group one who took the test for CFT with an extended working time, etc.
n_1 = the number of cases in group one, etc.

*) This is an illustration of the design to get the scores from the urban locality; the same design was repeated for the rural locality.

**) Group 1 and 3 represent students from the same class. Similarly, groups 2 and 4; 5 and 7; and 6 and 8 contain students from the same class.

Bojolali(R), both in Central Java. Two public general senior high schools were selected from Surakarta and one public general senior high school from Bojolali. Two schools would have been selected from Bojolali,but, there was only one public school available. Two tenth grade classes were selected from each school in Surakarta and four tenth grade classes from the school in Bojolali. The two schools in Surakarta were housed in the same building and, for the purposes of this study, were regarded as one school.

III. SELECTION AND ADAPTATION OF THE TEST

Guilford and Merrifield[1] have collected sets of two to four tests which seemed most representative of each of the 50 factors identified. Each factor was identified with three letters, representing categories of Operations, Contents, and Products respecitvely. For example, the test for factor NMT was a test for the factor in the Convergent Production block, Semantic column and Transformation row (see FIGURE 1, page 6). All tests, except one, were adaptations of tests mentioned in the Guilford-Merrifield report. No test for EFT was available, therefore a test for this factor was constructed. The process of adaptation and test construction will be discussed below.

Thus, the following tests were assembled. Tests for the factors (CFT, DFT, EFT, NFT, and for the factors CMT, DMT, EMT, NMT.[2] The first

---

[1]J.P. Guilford and P.R. Merrifield, The Structure of Intellect Model: Its Uses and Implications. Los Angeles: Report of the Psychological Laboratory, University of Southern California, 24 (1960).

[2]To repeat, the three letters of each factor referred to categories of Operations, Contents, and Products respectively. Thus the

four tests were grouped into one battery, and the other four tests into a second battery. The first battery was called the MT or Semantic battery and the second the FT or Figural battery.

The two batteries were given either with a Short time limit (P) or with an Extended time limit (L). The Extended time limit was twice the Short time limit. There were thus two batteries used, each administered two ways. There were the Short time FT, the Extended time FT; the Short time MT, and the Extended time MT battery.

The order of the tests within a battery was changed each time a battery was given to another class. The order was predetermined by randomly assigning a test to the first, second, third, and fourth place with the restriction that no three tests should appear in the same order (see APPENDIX A).

An answer sheet was provided for each test so that the test could be used repeatedly. The first one or two pages of each test were used for the test directions, sample items, and one or more exercise problems in some cases. The Indonesian text of each test can be found in the appendix, together with English translations of the test directions. References to the locations of the English versions can be found in the descriptions of the tests below. The exception was the EFT test constructed by the author. It should be recalled that because of the

---

first four factors were factors in the Cognition, Divergent Production (N), Evaluation (E), and Convergent Production (N) categories of Operations, all in the Figural Contents (F) and Transformations Products (T). The latter four were factors in the same categories of Operations, but all were in the Semantic Contents (M) and Transformation Products (T) (see FIGURE 2 page 26).

culture boundedness of some items, the tests used were not identical to the English version.

Procedure of translation and adaptation of the American tests.

As mentioned before, the eight tests were pretested with 16 Indonesian students. All were graduate students studying various fields at Universities in New York State. Each of these graduate students were asked to comment on the clarity of the test directions and con-tents, and to comment on the familiarity of test items when applied to the population of subjects. Words and sentences which seemed strange to these students were changed. Their comments on the familiarity of test items were used for adapting the American tests to the Indonesian culture. The working time used for the pretest group was the same as Short working time.

In translating and adapting the tests for use with Indonesian students the following steps were made:

a. The test items were translated literally whenever possible.

b. If a word, usually a noun, seemed unfamiliar to the subjects because of different cultural background, the word was changed into another word which resembled the original English word as closely as possible. For example, "bowling ball" was changed into "soccer ball".

c. If an item was difficult to translate because it dealt with problems which seemed too unfamiliar for the subjects, a new item was constructed for Transformation of Use[3]. In another test, Practical Estimation[3], two items were omitted because of this difficulty, only one

[3]The names refer to the tests which will be described later.

new item was constructed. An example of a newly constructed item in Transformation of Use was: To remove dry oil paint from a floor. The original item was: To remove old wallpaper from a wall. The alternatives were of course also different.

d. The administration of the tests were simplified whenever possible. Tests consisting of two parts were changed into one part, with the exception of Story Titles which remained a two part test. Except for Practical Estimation, the total number of items remained the same (see point c above).

e. Marking the "wrong" alternatives in true-false problems was not required in the case of Concealed Figures. Thus omitted alternatives and alternatives considered wrong could no longer be distinguished. This was decided to prevent accidental forgetting to mark the wrong answers, which occurred with the pretest group. This forgetting might have been due to the relatively rapid pace with which these tests were to be finished. This change should not affect the scores significantly since ommitting an item was very likely a rare occasion with the subjects. It had never occurred with the pretest subjects. Alternatives in rows not containing any "correct" marking were ignored in scoring (see the description of Concealed Figures below).

f. Additional directions to use the answer sheets were given. The directions for marking the answers on the answer sheets were made consistent: a circle indicated a "correct" alternative.

g. The original standard time was altered for some tests to enable the administration of two tests concurrently to one class. The testing time for the following tests were altered to match a test in

other (FT or MT) batter (see Guide for the Administration of the Tests in Appendix A).

Name of test	Original time	Altered time
Story Titles (DMT)	6 minutes	8 minutes
Practical Estimation (EMT)	12 minutes	14 minutes
Paper Form Board (CFT)	7 minutes	8 minutes

g. Time estimation was very difficult because of the unavailability of a pretest group similar in all respects to the actual test group. Since only one out of the sixteen subjects was able to complete some of the tests given to him within the Short time working limits, it was concluded that the Short time for all tests used were speeded when applied to the population of subjects. This conclusion proved to be true only for three Figural tests and one Semantic test (see TABLE II). To make the percent of students completing a Figural test more like the percent completing the Semantic counterpart, some of the last items of the tests were not scored (see page 37).

Extreme cautiousness might be one reason why the pretest subjects, who were all graduate students, most of them 30 years and older, were in general slower in their rate of responses than the actual subjects, who were tenth grade high school students. Tests such as Practical Estimation, Area Estimation, Gestalt Transformation, or, for that matter, all multiple choice tests with relatively few items, could be finished in a relatively short time because a person could resort to

TABLE II

PERCENTS OF STUDENTS COMPLETING THE TESTS AFTER ADJUSTMENT IN SCORING*

WORKING TIME	TEST FOR FACTOR			
	CMT (Similarities)	DMT** (Story Titles)	EMT (Practical Estimation)	NMT (Gestalt Transformation)
Extended	75	--	97	100
Short	25	--	82	97

WORKING TIME	TEST FOR FACTOR			
	CFT (Paper Form Board)	DFT (Matches)	EFT (Area Estimation)	NFT (Concealed Figures)
Extended	77 (35)	80 (30)	87	77 (22)
Short	28 (0)	46 (7)	78	22 (1)

*Numbers between brackets were percentages of students completeing the tests before adjustments in scoring. Where these numbers do not appear the scoring was not adjusted.

**No maximum number of answers were required for Story Titles.

guessing when the items became too difficult. This might be another reason why these tests were finished by almost all subjects within the Short working time given.

Procedure of construction of the new test.

The new test was intended to measure the EFT factor, that is the factor in the Evaluation, Figural Contents, and Transformations cubicle (see FIGURE 2 page 26). The new test was constructed on the basis of definitions of Evaluation, Figural Contents, and Transformations mentioned in CHAPTER II (page 17 and 18). This new test, with the name of Area Estimation, will be described later. The time limit of ten minutes was given so that the test will match the remaining unmatched test in the MT batter, namely Similarities (see point g on page 34 and GUIDE FOR ADMINISTRATION OF THE TESTS in APPENDIX A). This test was also given to the pretest group. Only one out of the six pre-test subjects finished the test within the given Short time limit. Again, it was erroneously concluded that the time limit would make the test Speeded for the population of subjects.

Method of scoring.

The key for the tests were not given with the tests solicited for this study. A certain amount of subjective judgment was used by the author to provide the answers for scoring Practical Estimation and Transformation of Use. An example of this judgment can be found in the sample item, for which the "correct" answer is given, described

in Transformation of Use as shown on page 39. To the author answer D (light bulb) seemed to be equally "correct" with answer C (pocket watch), which was the "correct" answer. Perhaps answer D was better because the wire in the bulb could give more instant fire with electricity than the lens could give with sun power. The sample item with the given "correct" answer was translated literally except for the final alternative which was "bowling ball" in the original text. The given "correct" answer was left unchanged in this sample problem because it did not seem relevant for completing the actual test items.

A substantial amount of subjective judgment was involved in scoring Story Titles and Similarities because they were of the open-ended type. Almost no subjective judgment seemed to be involved in scoring the other tests.

Corrections for guessing was applied only for the scoring of true-false items (Concealed Figures and Area Estimation) and not for the scoring of multiple choice items which had four or more alternatives.

It should be recalled that the estimations of time limits for the tests were difficult. The percentage of the subjects completing the tests varied widely for the Short as well as for the Extended working time. These results have made it necessary to make adjustments in scoring. The number of items scored in the tests which were completed by only a small percentage of the subjects within the Extended time limits was reduced to such an extent that over 75 percent of the subjects finished the reduced tests. In this way the advantage that a student might have by finishing the tests with a rapid pace was minimized. The results of this adjustment are shown in TABLE II on page 35).

IV. DESCRIPTION OF THE TESTS

The test for factor CMT (Penetration)[4]

1. Name of test: Similarities

2. Essence of directions: "Write six ways in which common objects are alike. The similarities listed should concern real characteristics of objects such as structure (form), use, or operation. Statements such as 'bought in stores', 'cost money', and 'liked by children' are not acceptable."

"Answers should be written on a separate answer form which is provided."

"Questions should be raised before the test begins."

"Do not begin before instructed to do so."[5]

3. Sample item:"Djambu bidji (Indonesian fruit) and orange are alike:

A. sweet

B. round

C. have seeds

D. fruit

E. have skins

F. grow on trees "

4. Number of problems: 12

---

[4]The names between the parantheses were names of the factors given by Guilford.

[5]The last three sentences in the directions applied to all tests, therefore these sentences will not be repeated.

5. Working time: Short, 10 minutes; Extended, 20 minutes.

6. Scoring: The score was the number of items judged correctly. If similar answers were given only one counted as right answer. The maximum possible score was 72.

7. Origin of test: The Aptitude Project at the University of Southern California. The test was an experimental form of the name: Similarities --RCSO1A. This test, in turn, was an adaptation of a United States Air Force test of the same name.

Test for factor NMT (Semantic Redefinition)

1. Name of test: Transformation of Use.

2. Essence of direction: "Indicate which of the five listed objects has a part that will serve a specified purpose. The answer should be given by making a circle around the letter that goes with the correct alternative."

"Answers should be given on a separate answer form .....and so forth."

3. Sample item: "TO START A FIRE"

A. Fountain Pen B. Onion (C) Pocket Watch D. Light Bulb E. Soccer Ball.

"Best answer is C. Reason: You could use the crystal of a pocket watch as a burning glass to start a fire."

4. Number of problems: 20.

5. Working time: Short, 10 minutes; Extended, 20 minutes.

6. Scoring: The score was the number of items judged correctly. The maximum score was 20.

7. Origin of test: The Aptitude Project at the University of Southern California. The test was an experimental form of the name: Gestalt Transformation--CRO3A.

Test for factor DMT (Originality)

1. Name of test: Story Titles.

2. Essence of directions: "Write as many appropriate titles for story plots as possible. The titles need not be clever but they should clearly relate to the plot."

"Answers should be given on a separate answer form.....", and so forth.

3. Sample item: none.

4. Number of plots: 2.

5. Working time for each plot: Short, 4 minutes; Extended, 8 minutes. Subjects were instructed to stop with the first plot and continue with the next plot after the time for one plot has expired.

6. Scoring: The score was the number of different responses that were judged clearly related to the plot. No maximum score was determined.

7. Origin of test: The Aptitude Project at the University of Southern California. The test was an experimental form of the name: Plot Titles--DMTO1D.

Test for factor EMT (Judgment)

1. Name of test: Practical Estimation.

2. Essence of directions: "Make quantitative estimates based upon common experience. The answer should be given by making a circle around the letter that goes with the correct alternative."

"Answers should be given on a separate answer form"...., and so forth.

3. Sample item: "Using a shovel, with which material could you fill a box most quickly?"

(A) Soft Dirt B. Loose Sand C. Loose Gravel D. Sand and Gravel Mixed.

"Best answer given is A. Reason given: The more you can pick up every time you load the shovel,the faster you will be able to fill the box."

4. Number of problems: 28.

5. Working time: Short, 14 minutes; Extended, 28 minutes.

6. Scoring: The score was the number of answers judged correctly. Maximum possible score was 28.

7. Origin of test: The Aptitude Project at the University of Southern California. In turn, this test was adapted from an Aviation Cadet Classification test.

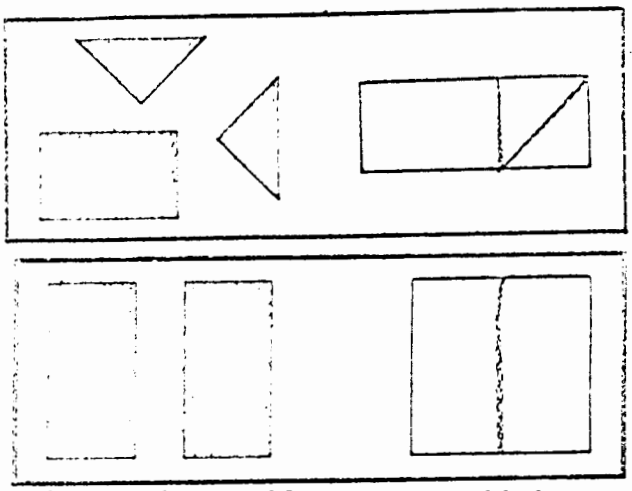
Test for factor CFT (Visualization).

1. Name of test: Paper Form Board

2. Essence of directions: "Draw lines on outline showing how striped pieces will fit together to form a figure presented."

"Answer should be given on a separate answer form ...., and so forth."

3. Sample item:



"A horizontal line through the center of the square would also be a correct answer."

"The drawing at right shows only one of the possible arrangements of the striped pieces."

Six exercise problems were given. One problem was provided with an answer.

4. Number of problems: 28.

5. Working time: Short, 8 minutes; Extended, 16 minutes

6. Scoring: The score was the number of correct answers. Maximum possible score was 42.

7. Origin of test: L.L. Thurstone, the University of Chicago. The original name of the test was Paper Form Board—Vz-1.

Test for factor DFT (Figural Adaptive Flexibility)

1. Name of test: Matches.

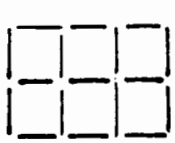
2. Essence of directions: "Indicate three different patterns of a specified number of matches that can be removed to leave a specified number of triangles and squares such that only complete triangles and squares are left. Use different principles for each pattern. To indicate solution, mark through the matches you want to remove."

"Answers should be given on a separate answer form.....", and so forth.

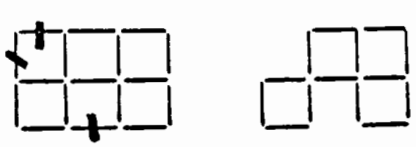
3. Sample item:

"TAKE AWAY 3 MATCHES LEAVING 4 SQUARES"

Given

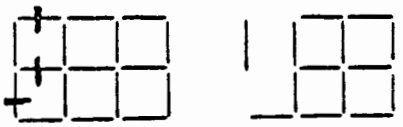


Solution A

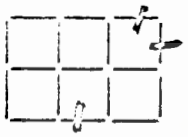


"TAKE AWAY 3 MATCHES LEAVING 4 SQUARES"

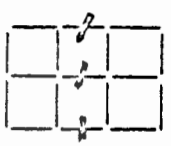
Given 

Wrong 

"The solution is wrong because two matches are left that are not parts of the squares."

B 

C 

D 

"Solution B and C would not be counted because these solutions use the same principle as A. Solution D uses a principle different from that of A, so D is counted as a second acceptable solution."

One practice problem with answer was given.

4. Number of problems: 10.

5. Working time: Short, 14 minutes; Extended, 28 minutes.

6. Scoring: The score was the number of correct solutions. Maximum possible score was 30.

7. Origin of test: The Aptitude Project at the University of Southern California. This test was an experimental form of the name Match Problem II--DFT02B.

Test for factor NFT (Figural Redefinition)

1. Name of test: Concealed Figures.

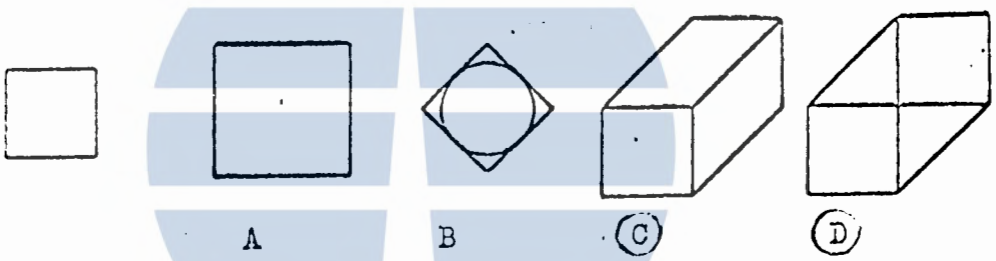
2. Essence of directions: "Indicate which of the four complex

geometrical figures contain a given geometrical figure. Indicate the answer by making a circle around the letter that goes with the drawings which contain the given figure. Circle only the letters that go with the drawings which contain the given figure of exactly the same size and in exactly the same position."

"Answers should be given on a separate answer form....", and so forth.

3. Sample item:

Figure Drawings



"Drawing B. contains the figure having exactly the same size but it has been turned, therefore B was not circled. At least one of the four drawings in each row contains the given figure."

One exercise problem with answer was given.

4. Number of rows of drawings: 49.

5. Working time: Short, 10 minutes; Extended, 20 minutes.

6. Scoring: The number of correct answers minus the number of incorrect answers. Maximum possible score was 196. The letters not circled were counted as correct if these letters went with the drawings not containing the given figure. Rows without at least one circle was ignored.

7. Origin of test: L. L. Thurstone, The Psychometric Laboratory, University of North Carolina.

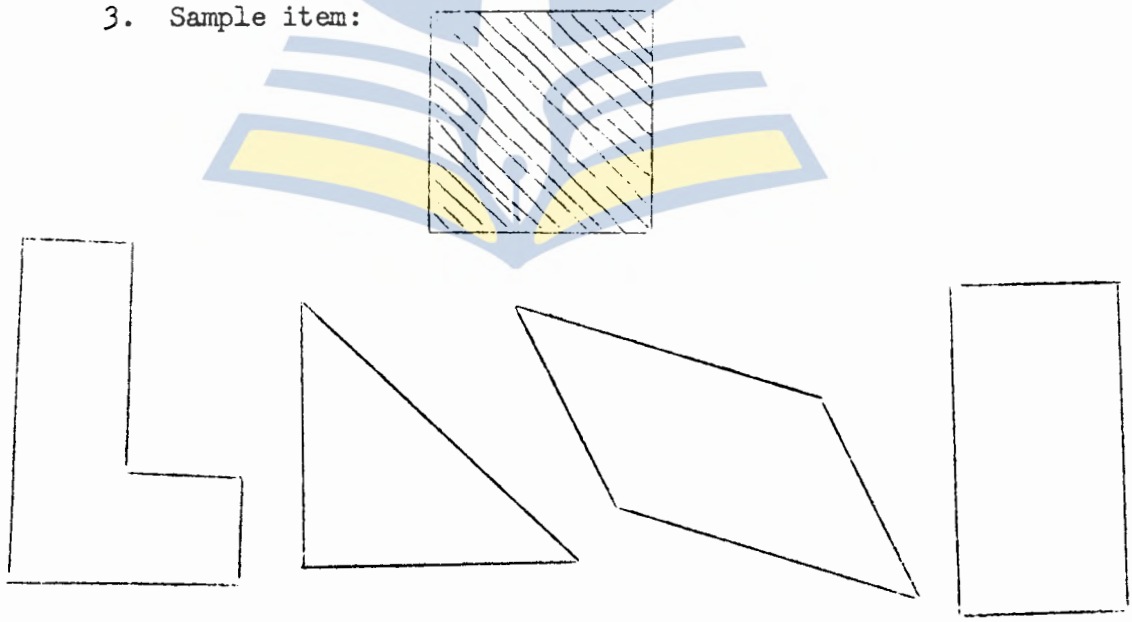
Test for factor EFT (No factor name)

1. Name of test: Area Estimation.

2. Essence of directions: "Indicate which of the drawings on a page have the same area as a given geometrical figure at the top of the page. The drawings are arranged in rows of four. At least one drawing in each row has the same area as the given figure. Indicate answer by making a circle around the letters that go with the drawings which have the same area as the given figure, and by crossing the letters that go with the drawings which have a different area as the given figure. A ruler may be used as an aid for estimating the areas, however, since time is short do not try to make accurate measurements."

"Answers should be given on a separate answer form"....., and so forth.

3. Sample item:



"If measured accurately figure A and figure C will have the same area as the striped figure at the top, therefore, circles are drawn around A and C, and B and D are crossed."

4. Number of rows of drawings: 16.

5. Working time: Short, 10 minutes, Extended, 20 minutes.

6. Scoring: The score was the number of correct responses minus the number of wrong responses. Letters not marked were ignored. Maximum possible score was 64.

7. Origin of test: the author. It was though that the test would measure Evaluation (E) in the Operations dimension because within the time limits given only approximations of the area could be attempted, there would be no time for accurate measurements. It was also thought that the test would measure Figural contents (F) since the figures did not represent something beyond themselves, that is they were not Symbolic. And the figures could obviously not be regarded as either Semantic or Behavioral. It was more difficult to justify the test as measuring Transformations (T) in the Products dimension. It seemed that this test was analogous with Practical Estimation which required the subjects to estimate sizes, weights, and so forth. Therefore, Area Estimation was though to measure the same aspects as Practical Estimation, except for the Contents which was Figural instead of Semantic.

V. ADMINISTRATION OF THE TESTS

Detailed steps for the administration of the tests were provided. The English translation of these steps can be found in APPENDIX A. The tests were administered to all subjects in this study by a single high school teacher. She was helped in the supervision of the classes by one or two teachers of the schools involved.

The two batteries with the same time limit, that is Short time or Extended time, were given to each class. TABLE I on page 29 illustrates the design. Within a class the subjects were assigned randomly by the administrator to either an FT or an MT battery. To avoid serial position effect the order of the four tests were changed for each class. How these changes were made are described on page 31. .

Intelligence testing was relatively new for senior high school students in Indonesia, therefore a considerable amount of time was devoted to explaining the directions. Subjects from the Bojolali (rural) high school needed more time for explanation than subjects from the Surakarta (urban) high schools. The actual testing time, including explanations of directions, was two class periods for the Short time batteries and three class periods for the Extended time batteries at the Surakarta high schools, and two and one half and four class periods respectively at the Bojolali high schools. One class period lasted 45 minutes. According to the reports from the test administrator the rural high school students were generally slower in understanding the directions than the urban high school students.

VI. THE PREDICTIVE CRITERIA

Out of the 15 school subjects for which course grades were available for the first quarter 11 grades were selected which seemed important for determining academic achievements at the general senior high schools. These subjects were:

1. Civics
2. Indonesian Language and Literature
3. History of Indonesia
4. Geography of Indonesia
5. Mathematics
6. Physics
7. Chemsitry
8. Biology
9. World History
10. English
11. Economics and Cooperatives

The school subjects not included were:

1. Religion and Ethics
2. Physical and Health Education
3. German
4. Drawing (Arts)

These four courses were excluded for the following reasons. Religion and ethics was an elective course, that is students could select the course with different teachers depending upon their religion. A student may also be exempted from taking the course if his or her religion

was not taught at school. Physical and health educatinn, and drawing seemed to involve non-intellectual abilities. German was an elective course in the curriculum. This course was regarded as of minor importance in grade eleven and grade twelve. It would be placed in the group of subjects termed the accompanying subjects (kelompok penjerta).

Civics, history of Indonesia, geography of Indonesia, and Indonesian language and literature were given throughout the entire high school years and were officially termed the fundamental subjects (kelompok dasar). The other subjects were given different emphases at the eleventh or twelfth grade depending upon the stream within which those subjects were to be taught. These subjects were officially termed the specific subjects.

VII. METHOD OF ANALYSIS

Statistics for each group or one half class unit were computed. These included the correlations between each test and each criterion. These correlations were then converted into Fisher's z scores. Using factorial analysis of variance with one replication differences in mean z's for the main effects and interactions were tested. Details of these analyses are discussed in CHAPTER IV.

CHAPTER IV

RESULTS

I. RELIABILITY COEFFICIENTS OF THE TESTS

To discover how reliable the tests were, these tests were divided in odd and even numbered halfs. The product moment correlations between the half-test scores were computed for each group. These correlations were averaged using z-transformations of the r's, weighted by the number of cases of each group.[1] These average correlations were then corrected by the Brown-Spearman formula. The results are presented in TABLE III.

The reliabilities of the Figural tests were generally higher than the reliabilities of the Semantic tests. The exception was the reliabilities of the short-time Matches (DFT). When the reliabilities were examined along the Operations dimension significant differences could be expected. The Cognition tests have generally the highest reliabilities; on the average the tests for Divergent Production and for Convergent Production were about the same; the tests for Evaluation had the lowest reliabilities, particularly the Semantic Evaluation test (Practical Estimation)had very low reliabilities. Along the Speed dimension the increase in working time seemed not to increase reliabilities significantly.

---

[1]Quinn McNemar, Psychological Statistics (third edition; New York: John Wiley and Sons, 1962), p. 140.

TABLE III

AVERAGE SPLIT-HALF RELIABILITIES OF THE TESTS CORRECTED BY THE SPEARMAN-BROWN FORMULA*

WORKING TIME	TEST FOR FACTOR CMT (similarities)	DMT (Story Titles)	EMT (Practical Estimation)	NMT (Gestalt Transformation)
Extended	.77	.64	-.09	.49
Short	.56	.74	.14	.48

WORKING TIME	TEST FOR FACTOR CFT (Paper form Board)	DFT (Matches)	EFT (Area Estimation)	NFT (Concealed Figures)
Extended	.87	.75	.59	.89
Short	.90	.69	.42	.79

*The formula was $r_{tt} = \frac{2r_{hh}}{1 + r_{hh}}$,

where

r_{tt} = reliability of the total test

r_{hh} = correlation of the two halves of the test

The above results were substantiated by an analysis of variance for the z-transformations of the reliabilities. The design and expectations of mean square were the same as the analysis of variance for the validities described in section V of this chapter. The results are shown in TABLE XIII in APPENDIX C.

II. INTERCORRELATIONS OF THE TESTS

TABLE IV shows the average test intercorrelations[2]. It was anticipated that the tests intercorrelations would be low, since the factors supposedly measured by the tests were hypothesized to be independent. Although some of these intercorrelations were as high as .70 or more, the median intercorrelation was only .25. This median was not as low as the median intercorrelation of the tests used in French's study[3], however, it looked low enough to be somewhat consistent with Guilford's claim of independence.

III. MEAN, STANDARD DEVIATION, AND RANGE OF THE TEST SCORES AND COURSE GRADES

Course grades may range from ten (superior) to one (very unsatisfactory). However, extreme grades were almost never given. TABLE V, VI, VII, AND VIII show the means,standard deviations and range of the grades and test scores. No one received a ten or a one. Only one student received a nine (for English), and only a few students received a two (all for mathematics). On the average the grades ranged from eight to three

---

[2]The same averaging method by way of z-transformation, weighted by the number of cases in each group was used (see footnote 1). When correlations were averaged in the next sections the same method was used.

[3]John W. French, "Comparative Prediction of College Major Field Grades by Pure Factor Aptitude, Interest, and Personality Measures". Educational and Psychological Measurements, 23 (Winter 1963), p. 770.

TABLE IV

AVERAGE INTERCORRELATIONS OF THE TESTS*

	Figural tests			
Figural tests	1	2	3	4
1. Paper Form Board	1.00	0.33	0.01	0.36
2. Matches	0.38	1.00	0.14	0.30
3. Area Estimation	0.14	0.04	1.00	0.22
4. Concealed Figures	0.46	0.27	0.19	1.00
	Semantic tests			
Semantic tests	1	2	3	4
1. Similarities	1.00	0.27	0.25	0.27
2. Story Titles	0.38	1.00	0.40	0.13
3. Practical Estimation	0.15	0.18	1.00	0.25
4. Gestalt Transformation	0.22	-0.02	0.13	1.00

*The figures at the upper right hand side of the diagonal are the intercorrelations of the Extended time forms. The figures at the lower left hand side of the diagonal are the intercorrelations of the Short time forms.

TABLE V

AVERAGE MEAN, STANDARD DEVIATION, MINIMUM AND MAXIMUM OF GRADE TEST SCORES OF THE FOUR GROUPS THAT TOOK THE EXTENDED TIME FIGURAL TESTS

COURSES AND TESTS	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
Civics	6.46	0.63	7.25	5.75
Indonesian Language and Literature	5.81	0.62	6.75	4.75
History of Indonesia	5.86	0.80	7.50	4.50
Geography of Indonesia	5.99	0.64	7.25	5.00
Mathematics	4.55	1.28	7.50	3.00
Physics	4.49	1.11	6.50	3.50
Chemistry	5.24	0.96	7.00	3.50
Biology	5.59	1.03	7.25	4.00
World History	5.57	0.74	6.75	4.25
English	5.07	1.19	7.50	3.25
Economics and Cooperatives	6.09	0.73	7.25	4.75
Paper Form Board (CFT)	22.91	5.15	29.75	12.75
Matches (DFT)	11.67	3.67	17.75	3.50
Area Estimation (EFT)	16.66	9.96	33.25	1.00
Concealed Figures (NFT)	62.66	25.92	101.00	2.25

TABLE VI

AVERAGE MEAN, STANDARD DEVIATION, MINIMUM AND MAXIMUM OF GRADES AND TEST SCORES OF THE FOUR GROUPS THAT TOOK THE SHORT TIME FIGURAL TESTS

COURSES AND TESTS	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
Civics	6.27	0.74	7.50	5.25
Indonesian Language and Literature	6.20	0.64	7.00	5.00
History of Indonesia	6.08	0.87	7.50	4.75
Geography of Indonesia	6.05	0.75	7.50	4.50
Mathematics	4.44	0.99	6.25	2.75
Physics	4.80	1.20	7.25	3.25
Chemistry	5.20	0.95	6.50	3.75
Biology	5.93	0.88	7.25	4.50
World History	5.89	0.79	6.75	4.25
English	5.63	1.16	7.50	3.75
Economics and Cooperatives	6.19	0.75	7.50	3.75
Paper Form Board (CFT)	18.86	5.24	26.75	9.25
Matches (DFT)	8.34	3.05	13.75	3.75
Area Estimation (EFT)	14.18	7.63	27.50	-3.75
Concealed Figures (NFT)	40.52	17.73	77.50	7.25

TABLE VII

AVERAGE MEAN, STANDARD DEVIATION, MINIMUM AND MAXIMUM OF GRADES AND TEST SCORES OF THE FOUR GROUPS THAT TOOK THE EXTENDED TIME SEMANTIC TESTS

COURSES AND TESTS	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
Civics	6.26	0.64	7.00	5.25
Indonesian Language and Literature	5.82	0.68	7.00	4.75
History of Indonesia	5.86	0.86	7.50	4.25
Geography of Indonesia	5.91	0.80	7.25	4.75
Mathematics	4.30	1.35	7.25	2.75
Physics	4.37	1.11	6.66	3.00
Chemistry	5.26	1.16	6.75	3.25
Biology	5.91	1.03	7.25	4.25
World History	5.57	1.00	7.25	3.50
English	5.19	1.16	7.50	3.75
Economics and Cooperatives	6.16	0.58	7.00	5.25
Similarities (CMT)	30.71	6.86	43.75	17.00
Story Titles (DMT)	16.67	5.76	27.75	9.00
Practical Estimation (EMT)	11.25	2.30	15.75	7.00
Transformation of Use (NMT)	9.18	2.90	15.00	4.25

TABLE VIII

AVERAGE MEAN, STANDARD DEVIATION, MINIMUM AND MAXIMUM OF GRADES AND TEST SCORES OF THE FOUR GROUPS THAT TOOK THE SHORT TIME SEMANTIC TESTS

COURSES AND TESTS	MEAN	DEVIATION	MAXIMUM	MINIMUM
Civics	6.01	0.67	7.25	5.50
Indonesian Language and Literature	5.86	0.81	7.25	4.50
History of Indonesia	5.87	0.85	7.00	4.00
Geography of Indonesia	5.86	0.64	6.75	5.25
Mathematics	4.08	1.14	7.00	3.00
Physics	4.66	0.97	6.75	4.00
Chemistry	5.03	1.15	7.00	4.00
Biology	5.77	0.95	7.25	4.00
World History	5.58	0.68	6.50	4.25
English	5.37	1.19	7.50	3.50
Economics and Cooperatives	6.20	0.80	7.25	4.50
Similarities (CMT)	21.43	4.87	31.25	17.50
Story Titles (DMT)	10.69	3.74	21.00	6.25
Practical Estimation (EMT)	10.29	2.44	15.25	5.75
Transformation of Use (NMT)	17.44	2.65	12.50	3.25

with an average mean of less than 6. Mathematics and physics had the lowest average mean of less than 4.5. The average standard deviation for all course grades was less than one (.80). Actually, almost 90 percent of the grades were four through seven. The highest average standard deviation was 1.19 for mathematics and the lowest was .67 for civics.

The average mean, standard deviation, and maximum and minimum scores are also given in TABLES V-VIII. None of the subjects received a maximum score. Theoretically the minimum score for each test was zero, however, a few of the subjects received a minus score on some tests because of the correction for guessing (see CHAPTER III). Increase in working time generally increased the mean scores by about one standard deviation. Only the average mean score for the NFT test decreased with a longer working time. With an increase in working time the standard deviations of the tests for CFT and EMT decreased, the standard deviations of the other tests increased.

IV. CORRELATIONS BETWEEN THE TEST SCORES AND COURSE GRADES

TABLE IX and TABLE X show the average correlations between the test scores and course grades. These correlations were, in general, rather low. Many of these were negative. There were some course grades which tended to correlate higher with the tests scores in general. These grades were for Indonesian language and literature, history of Indonesia, mathematics, biology, and English.

TABLE IX

AVERAGE CORRELATIONS OF TEST SCORES AND SCHOOL GRADES FOR THE FIGURAL TESTS

	Civics	Indonesian Lang. and Lit.	History of I Indonesia	Geography of Indonesia	Mathematics	Physics	Chemistry	Biology	World History	English	Economics and Cooperatives	Test halves correlations
EXTENDED WORKING TIME												
Paper Form Board (CFT)	.12	.17	.29	.12	.31	.14	.13	.38	.13	.20	-.06	.73
Matches (DFT)	.01	.17	.09	.34	.26	.09	.20	.49	.06	.12	.17	.65
Area Estimation (EFT)	.02	.27	.28	.24	.17	.26	-.06	.31	.19	.29	.12	.45
Concealed Figures (NFT)	.21	.20	.03	.09	.36	.29	.33	.26	.14	.46	-.12	.80
SHORT WORKING TIME												
Paper Form Board (CFT)	-.02	-.05	-.11	.15	.23	.19	.16	.16	-.04	.23	-.06	.83
Matches (DFT)	-.03	.00	-.19	.07	-.14	.19	.02	.06	-.03	-.04	.05	.53
Area Estimation (EFT)	-.21	-.28	-.27	.03	.07	-.01	-.04	.03	-.09	-.03	-.07	.26
Concealed Figures (NFT)	.03	.05	-.16	-.07	.19	.07	.18	.19	-.15	.08	-.02	.69

TABLE X

AVERAGE CORRELATIONS OF TEST SCORES AND SCHOOL GRADES FOR THE SEMANTIC TESTS

EXTENDED WORKING TIME	Civics	Indonesian Lang. and Lit.	History of Indonesia	Geography of Indonesia	Mathematics	Physics	Chemsitry	Biology	World History	English	Economic and Cooperatives	Test halves correlations
Similarities (CMT)	.03	.24	.14	.10	-.08	.01	.01	.10	.08	-.36	-.05	.61
Story Titles (DMT)	-.04	.08	-.05	-.01	-.04	.13	.02	-.16	-.10	.00	.13	.56
Practical Estimation (EMT)	.01	.28	.08	.02	-.11	.00	-.01	.04	-.01	.19	.23	-.09
Transformation of Use (NMT)	.07	.05	.15	.08	.21	.34	.36	.14	-.01	.17	.05	.29
SHORT WORKING TIME												
Similarities (CMT)	.09	.34	.16	.13	.35	.22	.29	.24	-.05	.22	.10	.36
Story Titles (DMT)	-.01	.21	.07	.08	.18	.05	.15	.10	-.03	.19	.06	.49
Practical Estimation (EMT)	-.01	.14	.16	.11	.23	.16	.14	.09	.20	.24	.25	.06
Transformation of Use (NMT)	.12	.17	.28	.13	.19	.14	.09	.21	.17	.16	.00	.27

Thosw were generally the grades with relatively high standard deviations. The grades with relatively low standard deviations tended also to have very low correlations with the tests, and had several minus correlations. Exceptions were the correlations between history of Indonesia and the short time Figural tests. These were all relatively high negative correlations.

V. ANALYSES OF VARIANCE FOR RELATIONSHIP BETWEEN ASPECTS OF INTELLECT AND COURSE GRADES

TABLE I on page 29 shows how the data were obtained. The correlations of the test scores and school grades were computed for each group. These correlations were transformed into Fisher's z-scores. The analysis of variance was computed with these z-scores.[4] TABLE XI shows the design of the analysis of variance (ANOVA) for the relationship between the test scores and each course grade.

TABLE XII shows the expected mean squares for each line of the ANOVA, assuming all variables fixed except group (R). School is not a random variable since the two schools were selected to represent an urban and a rural school population respectively. The error term used for the F-tests was the estimated mean square for group within school, contents, and speed (R:ABC) for testing the effects of A, B, AB, C, AC, BC, ABC; the error term for testing the effects of D, AD, BD, ABD,

---

[4]The analysis of variance was computed using an IBM 1604 Computer. The program followed was: Factorial Analysis of Variance (FANOV), P. L. Primer, programmer; S. R. Searle, documentation (first issue, Ithaca: Cornell Computing Center, February 1964).

TABLE XI

ILLUSTRATION OF THE DESIGN FOR ANALYSIS OF VARIANCE

School	Contents	Speed	Operations: Cognition	Divergent Thinking	Convergent Thinking	Evaluation
Urban	Figural	Sht.	z_{C1} , z_{C2}	z_{D1} , z_{D2}	z_{N1} , z_{N2}	z_{E1} , z_{E2}
		Ext.	z_{C3} , z_{C4}	z_{D3} , z_{D4}	z_{N3} , z_{N4}	z_{E3} , z_{E4}
	Semantic	Sht.	.	.	.	.
		Ext.	.	.	.	.
Rural	Figural	Sht.	.	.	.	.
		Ext.	.	.	.	.
	Semantic	Sht.	.	.	.	.
		Ext.	z_{C15} , z_{C16}	z_{D15} , z_{D16}	z_{N15} , z_{N16}	z_{E15} , z_{E16}

NOTE: the z's were the z-transformations of the correlations of the test scores with the course grades. Since there were 11 courses, 11 of such z-transformation tables were made.

z_{C1} = z-transformation of the correlation of the test for CFT (Paper Form Board) scores with course grades for group 1.

z_{D2} = z-transformation of the correlation of the test for DFT (Matches) scores with course grades for group 2, etc.

TABLE XII

EXPECTATION OF MEAN SQUARE FOR THE ANALYSIS OF VARIANCE
FOR RELATIONSHIPS OF SEVERAL ASPECTS OF INTELLECT WITH COURSE GRADES

Source	df	Expectation of Mean Square
School (A)	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 16\sigma_a^2$
Contents (B)	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 32\sigma_b^2$
Speed (C)	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 32\sigma_c^2$
Operations (D)	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 32\sigma_d^2$
A X B	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 8\sigma_{ab}^2$
A X C	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 8\sigma_{ac}^2$
A X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 8\sigma_{ad}^2$
B X C	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 16\sigma_{bc}^2$
B X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 16\sigma_{bd}^2$
C X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 16\sigma_{cd}^2$
A X B X C	1	$\sigma_w^2 + 4\sigma_{r:abc}^2 + 4\sigma_{abc}^2$
A X B X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 4\sigma_{abd}^2$
A X C X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 4\sigma_{acd}^2$
B X C X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 8\sigma_{bcd}^2$
A X B X C X D	3	$\sigma_w^2 + \sigma_{dr:abc}^2 + 2\sigma_{abcd}^2$
Group (R): A X B X C	8	$\sigma_w^2 + 4\sigma_{r:abc}^2$
D X R : A X B X C	24	$\sigma_w^2 + \sigma_{dr:abc}^2$

A, B, C, D = fixed ; R = random

CD, ACD, BCD, ABCD, was operations by group within school, contents, and speed (DR:ABC).

Since there were eleven course grades, eleven ANOVA's were computed. The results of each ANOVA may be found in APPENDIX C. In general the F-tests for the main effects and interactions between the variables were not significant. Only three F-tests were found to be significant at the .05 level. All three were for the interactions of Speed with Contents and were for the relationship between the tests and grades in history of Indonesia, mathematics, and world history. FIGURE 4 illustrates the interaction of Speed with Contents for the relationship between the tests and grades in mathematics.

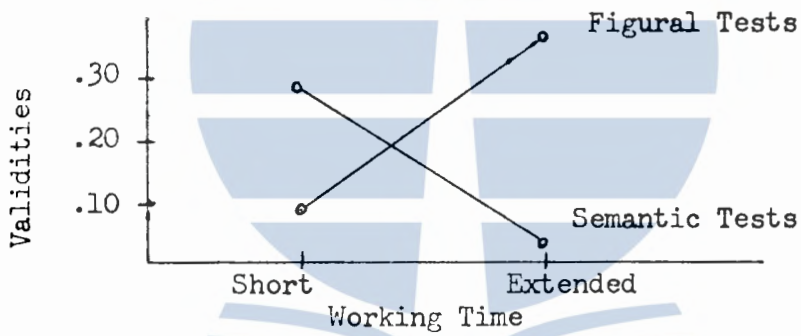


FIGURE 4: INTERACTION OF SPEED WITH CONTENTS FOR THE RELATIONSHIP BETWEEN THE TESTS AND GRADES IN MATHEMATICS

The interaction of speed with contents for the relationship between the tests and history of Indonesia and world history followed the same pattern. Thus, increase in working time seemed to increase the validity of Figural tests, while increase in working time seemed to decrease the validity of Semantic tests to predict grades in history of Indonesia, mathematics, and world history.

VI. SUMMARY OF RESULTS

The results may be summarised as follows:

1. Reliabilities for the Evaluation tests were low. Practical Estimation had very low and negative reliabilities. This may be due to the difficulty of the items. It should be recalled that with this test the subjects were asked to make comparisons involving length, weight, speed, and so forth. The "wrong" alternatives may be so close to the "correct" answers that, at least for these subjects, the choice could be no more than just guessing. With such low reliabilities, the relationship of this test with the school grades was expected to be negligible.

Reliabilities of the specially constructed Area Estimation, the other Evaluation test, seemed to improve with increase in working time. There seemed to be a possibility that the reliability of this test could be improved by increasing the difference between the areas of the correct figure and the incorrect alternative. The choice of the correct alternative would thus be easier. The Extended time Area Estimation had relatively high validity to predict all course grades except civics and chemistry (TABLE IX). This test seemed to be best to predict languages (Indonesian and English), history (Indonesian and world), and geography. It was interesting that this test also had good promise for predicting biology (31).

2. The reliabilities of the Cognition tests were generally satisfactory except the Short time Similarities, which was rather low. The Short time Similarities had better promise to predict course grades than the Extended time version. The Short time form of this test seemed

to be good for predicting languages, and more "exact" courses such as mathematics, physics, chemistry, and biology.

The Extended time Paper Form Board, the Figural Cognition test, was generally a better predictor of school grades than the Short time form of the test. The former seemed to be a relatively good predictor of history of Indonesia, mathematics and biology.

3. The Divergent Production tests had moderate reliabilities. The Semantic forms of this test were generally poor predictors of grades. The Short time form of this test could perhaps be used to predict Indonesian, and English (validities .21 and .19). The Figural forms of the Divergent Production tests were on the average better predictors than the Semantic forms. Again the Extended time Figural form (Extended time Matches) were generally better predictors than the Short time Matches. The Extended time form was a relatively good predictor for geography of Indonesia, mathematics and biology.

4. The Convergent Production tests had on the average moderate reliabilities. The Semantic form had rather low but the Figural forms had rather high reliabilities. For predictive purposes the Figural forms were, in general, also better than the Semantic forms. Extended time Concealed Figures (the Figural form) seemed to be rather good predictors of languages, civics, and the "exact" courses.

5. The intercorrelations between the tests were, in general, rather low. These results did not contradict the expectations that the tests were relatively unique.

6. Lower relationship of tests and courses were generally associated with lower variabilities in grading. Thus the test were

generally poor predictors for course grades such as civics, geography of Indonesia, economics and cooperatives, which have low standard deviations. Relationship between some tests with these courses might have been significantly improved if more variability in grading could be given.

7. There were no differences in relationship between the various aspects within a dimension and academic performance, assuming the tests used were measuring the intellectual aspects they were supposed to measure, and when course grades used in this study were used as criteria for academic achievements.

8. The interaction between Speed and Contents were found significant for relationship between the tests and history of Indonesia, mathematics, and world history. Validities of the Figural tests were increasing when working time was doubled, on the contrary validities of the Semantic tests were decreasing when working time was doubled, on the contrary validities of the Semantic tests were decreasing when working time was doubled. When the percentages of the subjects completing the tests within the given time were taken as an index of speed, it was obvious that the Figural tests were speeded even with Extended working time. On the contrary, the Semantic tests were generally not speeded, even with the Short working time. This might be the reason for the interaction. Thus, if Figural and Semantic tests were compared with both speeded and unspeeded working time, interaction of Speed with Contents might not be significant.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

This was a study based on Guilford's model of the "structure of intellect"[1]. In this model factors of intellect were categorized along three dimensions. The categories within a dimension were called aspects of intellect. The purpose of this study was to find the relationship between performances on pure factor tests of intellect and school grades, and to infer from the results whether different aspects of intellect play significantly different roles in academic performances.

The subjects participating in the study were 308 students from general senior high schools in two places in Central Java, Indonesia. Two high schools were selected from Surakarta, a city, and one high school was selected from Bojolali, a small town. Eight tenth grade classes participated, four from the city schools and four from the town school.

Two out of the three dimensions of Guilford's structure of intellect were selected for study, the Operations and Contents dimension. Within the Operations dimension four aspects were selected, Cognition (C), Divergent Production (D), Evaluation (E), and Convergent Production (N). Within the Contents dimension two aspects were studied,

---

[1]J. P. Guilford, "Three Faces of Intellect". American Psychologists, 14 (1959), pp. 469-479).

Figural (F) and Semantic (M) contents. The third dimension, Products, was fixed at the Transformation (T) aspect. Thus, the factors being studied were CFT, that is the factor at the Cognition, Figural contents, and Transformation levels, DFT, EFT, NFT, CMT, DMT, EMT, and NMT. Seven available American tests were translated and culturally adapted to measure seven of the eight factors. No test was available to measure EFT, therefore, a test was constructed by the author to measure this factor. This test was constructed on the basis of descriptions of the aspects Evaluation, Figural contents, and Transformations[2].

The effect of different working time was also studied. Each test was given with a Short (usually standard), and an Extended (double the Short) working time.

The eight tests were grouped into two batteries, the Figural (tests for CFT, DFT, EFT, and NFT) and the Semantic (tests for CMT, DMT, EMT, and NMT) battery. Each subject was given one battery of tests with a Short or an Extended working time. There were thus two batteries each administered with two working times.

Each participating class was divided into two groups, one group taking a Figural and the other group taking a Semantic battery. Eight groups took a Figural and another eight groups a Semantic battery. The Figural and the Semantic batteries were given each to four groups with a Short and to the other four groups with an Extended working time.

---

[2]J. P. Guilford and P. R.Merrifield, The Structure of Intellect Model: Its Uses and Implications (Reports of the Psychological Laboratory, University of Southern California No. 24. Los Angeles; University of Southern California, 1960), p.

Criteria for academic performances were eleven course grades. These grades were given about three months after the tests were administered to the subjects.

It was found that the reliabilities of the test for EMT were around zero. The other tests have moderate to rather high reliabilities.

The correlations between the test scores and course grades, the validities, were rather low. Analyses of variance for validities of the tests with each grade were computed, yielding no significant differences of the main effects. The interaction of Speed with Contents was significant at the .05 level for the validities of the tests to predict three course grades. When working time was increased, Figural tests validities tend to increase, and Semantic tests validities tend to decrease.

II. CONCLUSIONS

The theoretical problem underlying this study was to see whether multi-factor theory of intellect, developed on the basis of factor analysis, has practical uses for predicting academic performances. The theory was that a complex behavior, such as school performance, could be analyzed into different, relatively simple factors. If this was true, the problem was to find what factors were involved in each performance. If these aptitudes or factors were known, each could be measured in each individual to determine whether an individual had the necessary aptitudes to have a good chance to complete certain performances successfully.

When the factors were arranged in several dimensions, as in Guilford's model, the model could be used as an integrated structure. That is, instead of dealing with each factor separately, one could deal with the categories in each dimension. These categories were the aspects of intellect in this study. Each dimension was thus regarded as a different variable in an experiment, and each aspect a different treatment.

The problem, then, was to find what aspects of intellect play a significant role in each academic performance. If Guilford's theoretical model was useful, the tests developed to measure the aspects which play a significant role in one academic performance should have high predictive value for this performance. This assumes, that the aptitudes did not change through education.

This study attempted to find out which factors relate significantly to school performances, and whether the aspects within each dimension relate significantly different to school performances. The purpose of the first attempt was self-evident. The second problem could provide an answer to support Guilford's structural model. When the aspects within each dimension were found to be differently related to academic performances,the arrangements of factors into a multi-dimensional structure could be useful for predictive purposes.

The results of this study did not support Guilford's theory and model as a useful construct for predictive purposes for the following reasons:

First, the predictive validities of the tests were generally very low,and many were negative.

Second, the analysis of variance did not show any significant difference in the relationship between the aspects within each dimension, and each school performance as indicated by the school grades.

The first result might be an indication that, in general, the factors of intellect did not play a significant role in academic performances, therefore the tests used to measure the factors had no predictive value. The second result might be an indication that arrangements of factors in a multi-dimensional structure did not have any practical value for predicting academic performance.

French reported that aptitude scores were less differentially valid than interest scores, which meant that the former had more equal validities for most of study fields.[3] French's results and the results of this study might also be an indication that the aptitudes investigated play an equal role in all fields of study. In other words, the supposedly different aptitudes might very well be just a reflection of a general intellectual factor.

However, there were other factors that could affect these results. It was already anticipated that the validities were generally rather low since pure factor tests were used. Extreme shortness of the tests and restriction of range of abilities in terms of school grades add to the lowering of the validities. It was indicated in the results

---

[3]John W. French, "Comparative Prediction of College Major-Field Grades by Pure-Factor Aptitude, Interest, and Personality Measures," Educational and Psychological Measurements, 23 (Winter, 1963), p. 772.

that the lower and negative validities were generally associated with more restriction of range of grading. The general picture of these validities was not much different than the validities reported by French[4]. It was very likely that the validities would be higher if the tests were given when the students were still in the junior high schools. This would be due to the greater variability in the students' abilities.

It might very well be that these validities were, in general, too low to indicate any significant difference, if there was any at all, in the relationship between the aspects of intellect and the school grades.

Only further research could show which of the above mentioned possibilities were true.

For the purpose of actually predicting general senior high school performance this study could privde some useful information. The results had indicated that some of the tests had moderate validities to predict certain course grades. These tests, separately or in combination, could be improved and eventually standardized and used to predict grades in these courses.

As should be recalled the general senior high schools were divided into different streams after the tenth grade. When the students, who were participating in this study, reach the eleventh and twelfth grade their course grades at this level could be used as predictive criteria. However, instead of each grade separately, a grade point

---

[4] Ibid., p. 770-771.

average for the specific subjects[5] should be used. Differential predictive validities could then be computed using the grade point average of each stream.[6] Should these tests show promise for differential prediction, these could also be improved to predict whether a student's likelihood of success is better in one stream than in another.

III. NEED FOR FURTHER RESEARCH

1. The validities of the tests may have been low because of the shortness of the tests. A similar study using longer tests should be carried out in order to improve the reliabilities and possibly the validities of the tests.

2. It was assumed that the tests used were measuring the factors they were supposed to measure. Another study using more than one test for each factor could strengthen this assumption. Especially the test for EFT developed by the author, which was never factor analyzed, and the test for EMT, which disappeared in Guilford's second summary of suggested tests for factors[7], should be more carefully scrutinized.

---

[5]The specific subjects were the major subjects which were given different emphasis for each stream.

[6]For computational formulas see John W. French, Comparative Prediction of Success and Satisfaction in College Major Fields. Part II: Pooling and Analysis of Results and Conclusions. Research Bulletin RB-61-7. Princeton, N. J.: Educational Testing Service, 1961.

[7]J. P. Guilford and R.Hoepfner, Current Summary of Structure-of-Intellect Factors and Suggested Tests. (Reports from the Psychological Laboratory, The University of Southern California, No. 30, 1963).

3. The inclusion of other factors in a similar study was desirable. The factors investigated in the present study might be selected from those which did not have a significant role in academic performance.

4. Another type of research, recently conducted by Peterson and others[8], might be desirable. This study tried to discover what factors played a significant role in algebra and general mathematics. However, this type of research did not question the usefulness of Guilford's structural model. The study only dealt with the factors without reference to their structural arrangements.

---

[8] H. Peterson, et al., Determination of "Structure-of-Intellect" abilities involved in Ninth-Grade Algebra and General Mathematics. (Reports from the Psychological Laboratory, The University of Southern California, No. 31, 1963).

APPENDIX A

GUIDE FOR ADMINISTRATION OF THE TESTS

APPENDIX A

GARIS-GARIS BESAR PENJELENGGARAAN PEMBERIAN TEST PADA MURID-MURID KL. I S.M.A.

I. Nama dan pembagian test.

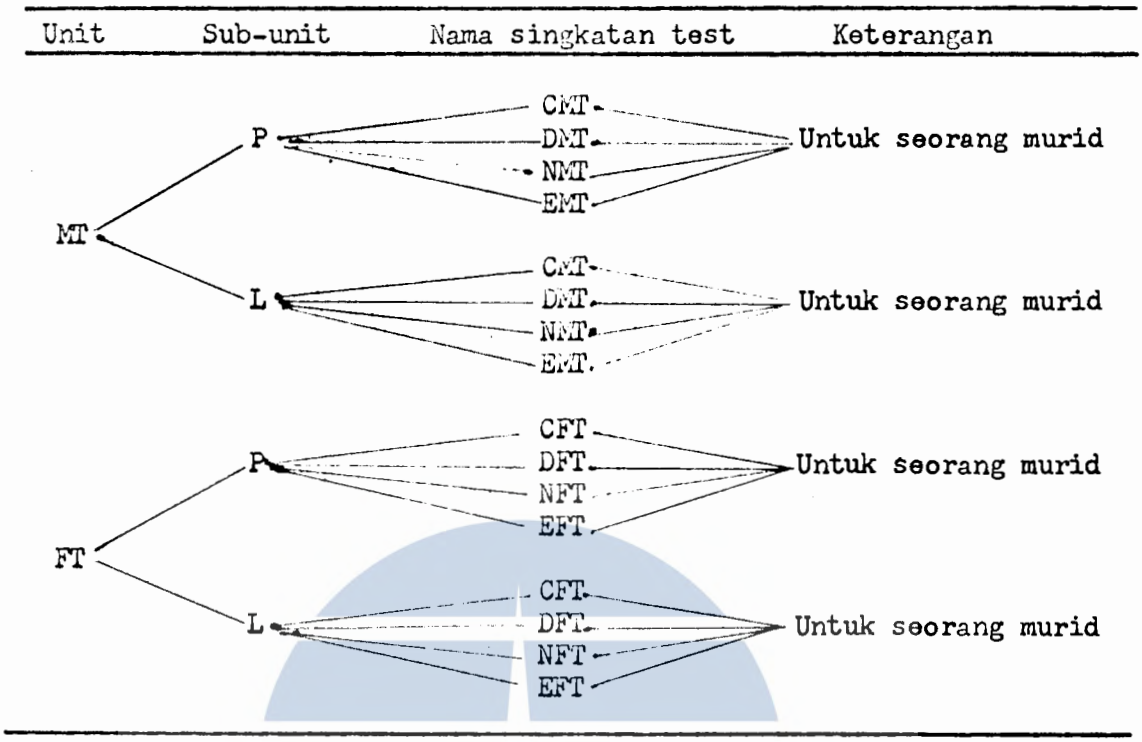
Test jang dipergunakan seluruhnja ada 8 matjam. Test-test itu disusun dalam 2 unit: Unit MT dan Unit FT. Setiap unit terdiri dari 4 matjam test. Test-test tersebut diberi nama:

Unit MT: Kesamaan (CMT)
Kepala2 Karangan (DMT)
Perobahan Guna (NMT)
Taksiran Praktis (EMT)

Unit FT: Potongan Kertas (CFT)
Batang Korek Api (DFT)
Pola2 Tersamar (NFT)
Taksiran Luas (EFT)

Setiap unit dibagi dalam 2 sub-unit. Setiap sub-unit terdiri dari keempat test dalam unit itu, tetapi sub-unit jang satu mempunjai batas waktu kerdja jang lebih pendek dari batas waktu kerdja sub-unit jang lain. Untuk mudahnja, maka sub-unit jang mempunjai batas waktu kerdja jang pendek kita sebut sub-unit P (pendek) dan sub-unit jang mempunjai waktu kerdja pandjang kita sebut sub-unit L (longgar).

Setiap anak hanja ditugaskan untuk membuat satu sub-unit (4 test). Untuk djelasnja, maka dibawah ini diberikan suatu ichtisar:



II. Urut-urutan dan pasangan test jang diberikan dalam satu kelas.

Sub-unit MT-P dan Sub-unit FT-P hendaknja diberikan bersama-sama dalam satu kelas. Kelas lainnja diberi Sub-unit MT-L dan FT-L. Supaja waktu bagi 2 test jang diberikan bersama-sama dalam satu kelas tidak berbeda, maka penjelenggaraan test diatur demikian: setiap kali memberi satu test jang termasuk unit MT diberikan pula kepada separo kelas lainnja satu test dari unit FT jang mempunjai batas waktu kerdja jang sama. Dengan demikian maka pasangan test unit MT dan unit FT adalah sebagai berikut:

UNIT MT		UNIT FT	
Test	Batas Waktu	Test	Batas Waktu
MT-P-NMT	10 menit	FT-P-NFT	10 menit
MT-P-EMT	14 menit	FT-P-DFT	14 menit
MT-P-CMT	10 menit	FT-P-EFT	10 menit
MT-P-DMT	8 menit	FT-P-CFT	8 menit
MT-L-NMT	20 menit	FT-L-NFT	20 menit
MT-L-EMT	28 menit	FT-L-DFT	28 menit
MT-L-CMT	20 menit	FT-L-EFT	20 menit
MT-L-DMT	16 menit	FT-L-CFT	16 menit

Pemberian test tidak perlu menurut urut-urutan seperti tersebut diatas. Tetapi hendaknja setiap kali memberikan test kepada kelas berikutnja, urut-urutan dirobah. Dengan sendirinja pasangan harus tetap sama supaja waktu untuk mendjawab pertanjaan2, memberhentikan pekerdjaan, dan memberi tahu mulai bekerdja, djatuh pada waktu jang bersamaan untuk unit FT dan untuk unit MT jang diberikan dalam satu kelas. Untuk memudahkan pekerdjaan sipemberi test, maka dibawah ini diberikan daftar urut-urutan test untuk setiap kelasnja:

DAFTAR URUT-URUTAN TEST UNTUK SETIAP KELAS

No. Kelas	No. urut Test	Sub-unit MT-P	(Waktu kerdja pendek)	Sub-unit FT-P
I.	1.	NMT	diberikan bersama dengan	NFT
	2.	DMT	,,	CFT
	3.	EMT	,,	DFT
	4.	CMT	,,	EFT
II.	1.	NMT	,,	NFT
	2.	CMT	,,	EFT
	3.	EMT	,,	DFT
	4.	DMT	,,	CFT
III.	1.	DMT	,,	CFT
	2.	EMT	,,	DFT
	3.	NMT	,,	NFT
	4.	CMT	,,	CFT
IV.	1.	CMT	,,	EFT
	2.	EMT	,,	DFT
	3.	NMT	,,	NFT
	4.	DMT	,,	CFT
V.	1.	NMT	,,	NFT
	2.	EMT	,,	EFT
	3.	CMT	,,	DFT
	4.	DMT	,,	CFT
VI.	1.	EMT	,,	DFT
	2.	CMT	,,	EFT
	3.	NMT	,,	NFT
	4.	DMT	,,	CFT

No. Kelas	No. urut Test	Sub-unit MT-P	(Waktu kerdja pandjang, 2 kali w.k. pendek)	Sub-unit FT-P
VII.	1.	DMT	diberikan bersama dengan	CFT
	2.	NMT	,,	NFT
	3.	CMT	,,	EFT
	4.	EMT	,,	DFT
VIII.	1.	CMT	,,	EFT
	2.	NMT	,,	NFT
	3.	DMT	,,	CFT
	4.	EMT	,,	DFT
IX.	1.	EMT	,,	DFT
	2.	DMT	,,	CFT
	3.	CMT	,,	EFT
	4.	NMT	,,	NFT
X.	1.	EMT	,,	DFT
	2.	NMT	,,	NFT
	3.	DMT	,,	CFT
	4.	CMT	,,	EFT
XI	1.	CMT	,,	EFT
	2.	NMT	,,	NFT
	3.	DMT	,,	CFT
	4.	EMT	,,	DFT
XII.	1.	NMT	,,	NFT
	2.	EMT	,,	DFT
	3.	DMT	,,	CFT
	4.	CMT	,,	EFT

III. Prosedur penjelenggaraan test didalam kelas.

N.B. Untuk setiap murid disediakan formulir djawaban untuk menjelesaikan 4 test dari salah satu sub-unit. Dengan djalan ini maka test-test tersebut dapat dipakai untuk beberapa kali, karena murid-murid sama sekali tidak diperbolehkan untuk menulis, memberi tanda atau mentjoret pada kertas-kertas test itu sendiri. Segala djawaban dan tjoret-tjoretan bila perlu harus dikerdjakan pada formulir djawaban.

A. Test-test dan formulir-formulir djawaban dibagikan kepada murid-murid. Setiap murid mendapat satu sub-unit (4 test) sekaligus dan formulirnja jang chusus dibuat untuk menjelesaikan sub-unit tersebut. Test-test tersebut ditumpuk dalam satu tumpukan dan diletakkan terbalik dan dalam susunan seperti terdapat dalam paragrap II diatas. Formulir djawabannja diletakkan disamping tumpukan test itu dan tidak perlu dibalik.

B. Pemberitahuan untuk mulai menulis nama dan nama sekolah, dan mulai membatja petundjuk-petundjuk test jang pertama, diberikan dengan mengatakan: "Anak-anak, dimukamu terletak tumpukan test jang terbalik dan formulir djawabannja. Ambillah formulir djawaban tersebut dan tulislah namamu dan nama sekolahmu disebelah atas halaman pertama" ..... (untuk memberi tanda apakah kelas ini membuat test-test itu dengan waktu jang pendek atau waktu jang pandjang (longgar), maka perlu ditambahkan:) ....."dan berilah tanda P (atau L) disudut atas sebelah kanan halaman pertama itu" ..... (lihat tjontoh) ..... "Kerdjakanlah semua itu sekarang djuga." ..... (tunggu sedjenak) ....."Semua sudah menulis nama dan sekolahnja? Dan sudah pula menu-

lis P (atau L) disebelah atas kanan? Sekarang balikkanlah tumpukan test itu. Tumpukan itu sudah dalam urut-urutan jang betul, djadi djangan dirobah-robah. Ambillah test jang ada diatas sendiri. Sebagian kelas membuat test ..... (nama test golongan MT) dan sebagian lagi membuat test ..... (nama test golongan FT)."

"Batjalah sekarang petundjuk-petundjuk untuk test itu dengan teliti. Djanganlah membuat atau melihat test itu sendiri sebelum diberitahukan."

"PERHATIAN: DJANGANLAH MENULIS ATAU MEMBERI TANDA APAPUN DIHALAMAN-HALAMAN TEST ITU SENDIRI. UNTUK MENTJOBA TJONTOH DAN MENDJAWAB TESTNJA SUDAH DISEDIAKAN FORMULIR DJAWABAN JANG ADA DIMUKAMU ITU. BUKALAH HALAMAN PADA FORMULIR DJAWABAN TERSEBUT JANG CHUSUS DISEDIAKAN UNTUK MEMBUAT TEST INI."

"Bila masih ada jang kurang djelas pada petundjuk-petundjuk itu bertanjalah dengan segera. Mulailah sekarang membatja" ..... (tjukup waktu diberikan untuk membatja dan tanja djawab) ....."Semua sudah djelas?" ..... "Sudah pula membuka halaman pada formulir djawaban jang disediakan untuk membuat testmu itu?" ..... "Mulailah sekarang membuka halaman berikut dan mulai mengerdjakan testnja. DJANGAN LUPA MEMBUAT TEST ITU PADA FORMULIR DJAWABAN."

N.B. Bila kelas sedang mengerdjakan sub-unit P (waktu kerdja pendek) maka ditambahkan keterangan sebagai berikut: "Waktu jang diberikan hanja sebentar sadja, jaitu sesuai dengan apa jang tertjantum dibagian achir petundjuk test itu. Djadi bekerdjalah dengan setjepat mungkin, supaja mendapat angka jang setinggi-tingginja."

Bila kelas sedang mengerdjakan sub-unit L (waktu kerdja pandjang) maka ditambahkan keterangan sebagai berikut: "Waktu jang diberikan untuk menjelesaikan test agak banjak, jaitu duakali waktu jang tertjantum dibagian achir petundjuk test itu. Bekerdjalah dengan teliti tetapi tjepat, supaja mendapatkan angka jang setinggi-tingginja." .....

..... (stopwatch mulai didjalankan) ..... (Chusus untuk test KEPALA-KEPALA KARANGAN jang mempunjai 2 bagian, sesudah lewat waktu jang diberikan untuk setiap bagiannja :) ....."Waktu jang diberikan untuk bagian pertama dari test KEPALA-KEPALA KARANGAN sudah lewat. Mulailah sekarang dengan membuat bagian jang kedua" ..... (sesudah lewat waktunja untuk seluruh test:) ..... " Waktu sudah habis. Letakkan pinsilmu" ..... "Sekarang segeralah mulai dengan membatja petundjuk-petundjuk untuk test kedua, jaitu test ..... (nama test golongan MT) untuk sebagian kelas, dan test ..... (nama test golongan FT) untuk separo kelas lainnja."

"PERHATIAN SEKALI LAGI: DJUGA UNTUK TEST INI TELAH DISEDIAKAN FORMULIR DJAWABANNJA, DJADI DJANGANLAH MENTJORET TESTNJA, AKAN TETAPI SEGALA DJAWABAN TJONTOH MAUPUN TEST ITU SENDIRI HARAP DIKERDJAKAN PADA FORMULIR DJAWABAN." ..... "Sekarang mulai membatja" ..... (tjukup waktu diberikan untuk membatja petundjuk-petundjuk dan tanja djawab) ..... "Semua sudah djelas?" ..... "Mulailah sekarang membuka halaman berikut dan mulai mengerdjakan testnja " .....

Kemudian prosedur diulangi, sehingga keempat test selesai dikerdjakan.

Translation of: GARIS-GARIS BESAR PENJELENGGARAAN PEMBERIAN TEST PADA MURID-MURID KL. I S.M.A.

GUIDE FOR ADMINISTRATION OF THE TESTS TO BE GIVEN TO 10th GRADE GENERAL SENIOR HIGH SCHOOL STUDENTS

1. Names and classification of the tests

There are altogether 8 kinds of tests. These tests are arranged in two units: the MT unit and the FT unit. Each unit consists of 4 kinds of tests. These tests are given the following names:

The MT unit consists of: Similarities (CMT)
Story Titles (DMT)
Transformation of Use (NMT)
Practical Estimation (EMT)

The FT unit consists of: Paper Form Boards (CFT)
Matches (DFT)
Concealed Figures (NFT)
Area Estimation (EFT)

Each unit is divided into two sub-units. Each sub-unit consists of all 4 tests in the unit, but one sub-unit has a shorter working time than the other sub-unit. For convenience the sub-unit with the short working time will be called sub-unit P, and the sub-unit with the longer working time sub-unit L.

OUTLINE

Each student is required to take one sub-unit of tests (4 tests). The following table may clarify the situation.

UNIT	SUB-UNIT	ABBREVIATED NAME OF TEST	INSTRUCTIONS
MT	P	CMT, DMT, NMT, EMT	To be given to a student
	L	CMT, DMT, NMT, EMT	To be given to a student
FT	P	CFT, DFT, NFT, EFT	To be given to a student
	L	CFT, DFT, NFT, EFT	To be given to a student

II. Order of testing and pairing of the tests within a class

Sub-units FT-P and MT-P should be given together in one class. Another class should be given sub-units MT-L and FT-l. In order to maintain the same working time for two tests given at the same time, the tests should be arranged in pairs with the same working time. Every time a test from an MT unit is given to one half of the class the other half should be given a test from an FT unit which has the same working time. Thus the tests should be paired according to the following arrangements.

OUTLINE

MT UNIT TEST	WORKING TIME	TEST	WORKING TIME
MT-P-NMT	10 minutes	FT-P-NFT	10 minutes
MT-P-EMT	14 minutes	FT-P-DFT	14 minutes
MT-P-CMT	10 minutes	FT-P-EFT	10 minutes
MT-P-DMT	8 minutes	FT-P-CFT	8 minutes
MT-L-NMT	20 minutes	FT-L-NFT	20 minutes
MT-L-EMT	28 minutes	FT-L-DFT	28 minutes
MT-L-CMT	20 minutes	FT-L-EFT	20 minutes
MT-L-DMT	16 minutes	FT-L-CFT	16 minutes

The order of administration of the tests does not have to follow the above sequence. But the sequence should be changed each time time the tests are given to another class. Naturally the pairing should be maintained to enable the tester to start the test, to stop the test, and to explain the directions at the same time for both MT and FT units given in the same class.

To simplify the matter the following table of change of sequences are given for each class.

TABLE OF TEST SEQUENCES FOR EACH CLASS

Class No.	Order of tests	Short working time Sub-unit MT-P		Sub-unit FT-P
I.	1.	NMT	should be given together with	NFT
	2.	DMT	should be given together with	CFT
	3.	EMT	should be given together with	DFT
	4.	CMT	should be given together with	EFT
II.	1.	NMT	should be given together with	NFT
	2.	CMT	should be given together with	EFT
	3.	EMT	should be given together with	DFT
	4.	DMT	should be given together with	CFT

OUTLINE

Class No.	Order of Tests	Short working time Sub-unit MT-P		Sub-unit FT-P
III.	1.	DMT	should be given together with	CFT
	2.	EMT	should be given together with	DFT
	3.	NMT	should be given together with	NFT
	4.	CMT	should be given together with	CFT
IV.	1.	CMT	should be given together with	EFT
	2.	EMT	should be given together with	DFT
	3.	NMT	should be given together with	NFT
	4.	DMT	should be given together with	CFT
V.	1.	NMT	should be given together with	NFT
	2.	EMT	should be given together with	EFT
	3.	CMT	should be given together with	DFT
	4.	DMT	should be given together with	CFT
VI.	1.	EMT	should be given together with	DFT
	2.	CMT	should be given together with	EFT
	3.	NMT	should be given together with	NFT
	4.	DMT	should be given together with	CFT

Class No.	Order of tests	Long working time (2 times short w.t.) Sub-unit MT-P		Sub-unit FT-P
VII.	1.	DMT	should be given together with	CFT
	2.	NMT	should be given together with	NFT
	3.	CMT	should be given together with	EFT
	4.	EMT	should be given together with	DFT
VIII.	1.	CMT	should be given together with	EFT
	2.	NMT	should be given together with	NFT
	3.	DMT	should be given together with	CFT
	4.	EMT	should be given together with	DFT
IX.	1.	EMT	should be given together with	DFT
	2.	DMT	should be given together with	CFT
	3.	CMT	should be given together with	EFT
	4.	NMT	should be given together with	NFT
X.	1.	EMT	should be given together with	DFT
	2.	NMT	should be given together with	NFT
	3.	DMT	should be given together with	CFT
	4.	CMT	should be given together with	EFT

OUTLINE

Class No.	Order of tests	Sub-unit MT-P	Long working time	Sub-unit FT-P
XI.	1.	CMT	should be given together with	EFT
	2.	NMT	should be given together with	NFT
	3.	DMT	should be given together with	CFT
	4.	EMT	should be given together with	DFT
XII.	1.	NMT	should be given together with	NFT
	2.	EMT	should be given together with	DFT
	3.	DMT	should be given together with	CFT
	4.	CMT	should be given together with	EFT

III. Procedure of testing

N.B. Answer sheets are provided for each sub-unit. Thus, the tests could be used repeatedly. The students are not allowed to mark or write anything on the tests themselves. All answers or markings if necessary should be made on the answer forms.

A. The tests and the answer forms should be distributed to the students. Each student should receive one sub-unit (4 tests) and the appropriate answer forms. The tests should be stacked according to the sequence mentioned in section II for each class. These tests should be placed face down in front of each student. The answer forms should be placed besides the tests. It is not necessary to put the answer forms face down.

B. Instructions to write the names and the name of the school, and to start reading the directions should be given by saying: "Boys and girls, in front of each of you lay a stack of tests with face down and a stack of answer forms for those tests. Take the answer sheets and write your name and the name of your school at the top of the first

page." ..... (to indicate whether the class is taking the tests with the short or long working time, the following should be added).... "Write a P (or L, which ever is appropriate) on the top right hand corner of the first page" (see enclosed example)" and do all those things now" .....(pause, to allow the students to finish their task)....."Has everybody finished writing the names and the name of the school? Has everybody also written a P (or L) on the top right hand corner of the answer form? Now, take the stack of tests and turn it over, face up. The stacks are already arranged in the right order, so do not change it. Take the top test. Half of the class will take.....(name of the test from the MT group) and the other half will take.....(name of the test from the FT group)" ....."Read all the directions carefully. Do not begin with the actual test before you are told to do so."

"ATTENTION: DO NOT WRITE OR MAKE ANY NOTES ON THE TEST ITSELF. DO THE PRACTICE PROBLEMS, AND MARK YOUR ANSWERS ON THE ANSWER FORMS. TURN THE PAGES OF YOUR ANSWER FORMS UNTIL YOU FIND THE RIGHT PAGE FOR YOUR TEST."

"If you have some doubts about the directions please ask about them immediately. Now you may begin to read.".....(allow sufficient time for reading the directions and answer their questions) ..... "Is everybody clear now?"....."Did everybody find the correct page in your answer form for this test?"..... "Turn to the next page. You may begin now. Don't forget to write your answer on the answer forms."

N.B. If the class is taking sub-unit(short working time) the following should be added: "You have only a very short time to finish your test. Therefore, work as fast as you can so that you will receive as high a score as possible."

If the class is taking sub-unit L (long working time) the following should be added: "The time given to finish the test is quite long, that is 2 times the working time stated at the end of your test directions. Work accurately but fast so that you will receive as high a score as possible".....(stopwatch should be started)..... (Special instructions for the "Story Titles" test. This test has two parts. After the time has expired to do one part, the following should be said): "Time is up to do the first part of the "Story Titles". Start now with the second part.").....(After the time has expired to do the whole test:) ....."Time is up, lay your pencils down"....."Begin immediately with reading the directions for your second test. This test will be (name of test in the MT group) for one half of the class, and (name of test in the FT group) for the other half of the class. "..... "Attention once again: an answer form is also provided for this test. All the answers for the practice problems should be given on the answer form"....."Begin to read now".....(sufficient time is allowed to read the directions and answer any questions)..... "Is everybody clear now?"....."Open the next page and start doing your test"..... (The procedure is then repeated again until all 4 tests has been finished).

APPENDIX B

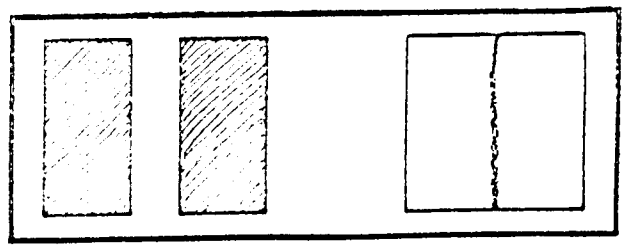
This appendix contains the tests used in the study and the English translation of the tests directions. Some of the tests contents are exact reproductions of the original American tests, only the tests directions were translated and modified. These tests are Paper Form Board, Matches, and Concealed Figures. Since these tests are available elsewhere the tests contents are not reproduced here. Page 38 and the following pages contain information about the origin of the tests.

The translated and adapted tests, and the newly constructed test are fully reproduced in this appendix.

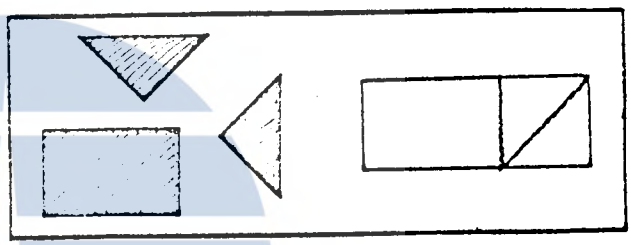
CFT

POTONGAN KERTAS

Kedua potongan abu2 ini dapat disusun mendjadi budjur sangkar seperti ternjata dalam gambar sebelah kanan sendiri. Garis pinsil dibuat untuk menundjukkan bagaimana rupa susunan tadi sehingga tepat menjamai budjur sangkar jang ada disebelah kanan. Memberi garis horisontal melalui tengah2 budjur sangkar djuga dianggap djawaban jang benar.



Tiga potongan abu2 ini dapat disusun mendjadi persegi pandjang. Garis2 pensil dibuat untuk menggambarkan salah satu susunan jang mungkin dibuat.

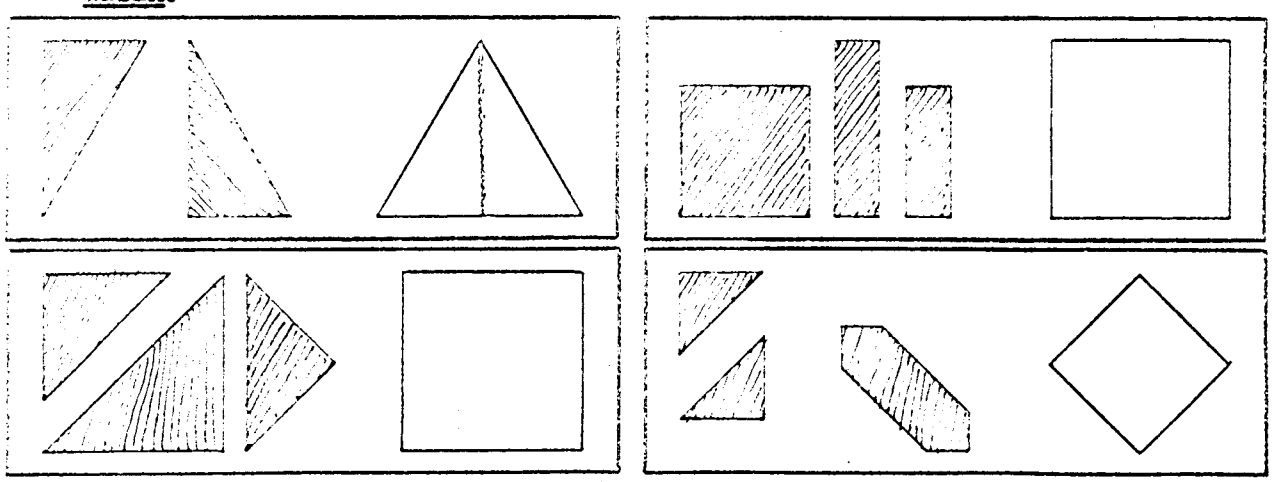


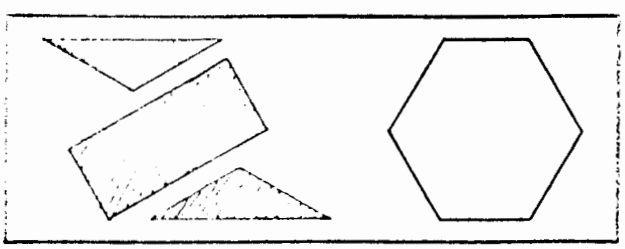
PERHATIAN: DJANGANLAH MEMBERI GARIS-GARIS ITU PADA HALAMAN-HALAMAN TEST INI. FORMULIR DJAWABAN TELAH DISEDIAKAN UNTUK MENJELESAIKAN PERSOALAN JANG DIMINTA. LIHATLAH HALAMAN 1-3 DALAM FORMULIR ITU. TJONTOH-TJONTOH DIBAWAH INI HARUS DJUGA DISELESAIKAN PADA FORMULIR DJAWABAN TERSEBUT.

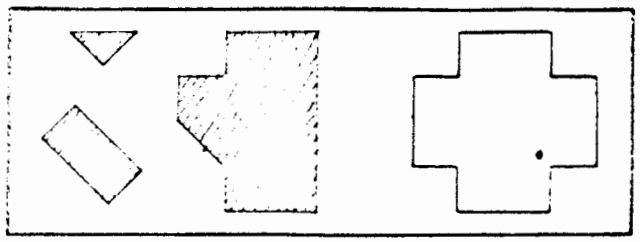
Pada soal2 latihan berikut ini, soal pertama telah diberi garis djawabannja.

Tjobalah sekarang memberi garis2 pinsil pada gambar2 putih jang ada disebelah kanan untuk menundjukkan bagaimana potongan2 abu2 itu dapat disusun mendjadi gambaran putih dikanannja. Djanganlah membuang-buang waktu dengan membuat garis jang terlampau baik dan lurus. Jang diminta hanjalah garis2 jang tjukup djelas menundjukkan susunan tersebut.

Buatlah tjontoh2 dibawah ini dengan segera, pada formulir djawaban.







Bila pemberitahuan sudah diberikan (sekarang belum) bukalah halaman berikut dan mulailah bekerdja membuat garis2 seperti pada tjontoh2 diatas.

Test ini terdiri dari 42 soal. Waktu jang diberikan hanja 8 menit, djadi bekerdjalah dengan setjepat mungkin.

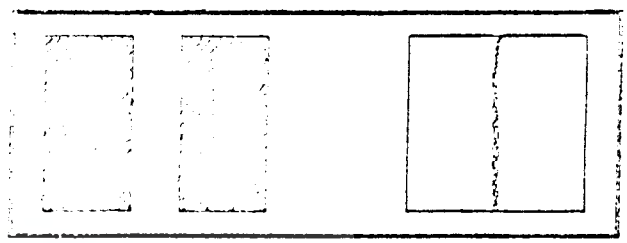
Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBALIK HALAMAN SEBELUM DIBERITAHUKAN

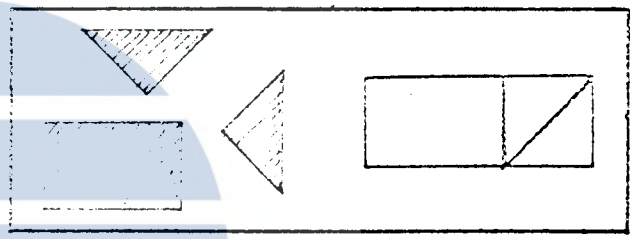
Translation of: POTONGAN KERTAS

PAPER FORM BOARD

The two striped figures can be placed together to form a square as the figure at right. A pencil line has been drawn to show how the two pieces can be placed together so as to form exactly a square like the figure at right. A horizontal line through the center of the square would also be a correct answer.



The three striped figures can be placed so as to form a rectangle. Pencil lines have been drawn to show one possible arrangement.

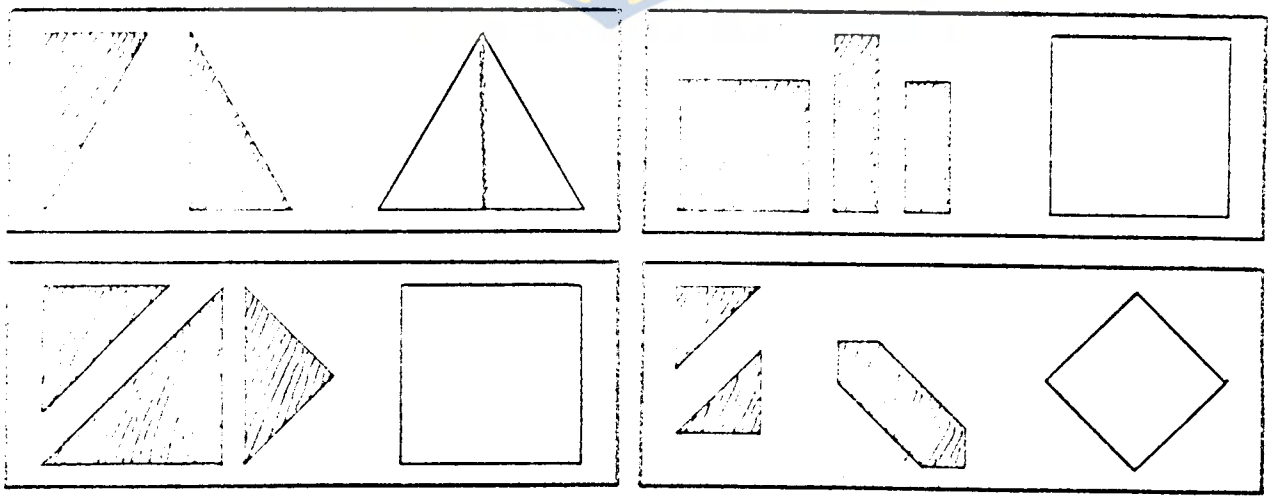


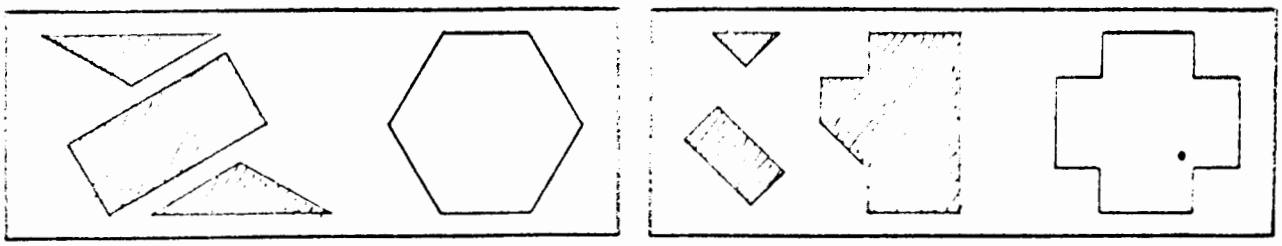
NOTICE: DO NOT PUT THE LINES ON THE TEST. AN ANSWER FORM TO INDICATE YOUR ANSWERS IS PROVIDED. SEE PAGES 1-3 IN THE ANSWER FORM. THE EXAMPLES BELOW SHOULD ALSO BE COMPLETED ON THE ANSWER FORM.

In the following practice problems the first one has already been marked.

Now draw pencil lines in the white drawings at the right side to show how the striped pieces can be placed to form the drawing at right. Do not waste time by drawing extreme straight lines. You are only asked to draw lines just clear enough to indicate the arrangement of the pieces.

Go right ahead. Put your answers on the answer form.





When the signal is given (not yet) turn the page and start to draw the lines as in the examples above.

This test consists of 42 problems. The time given is only eight minutes. Therefore, work as fast as possible.

If there are any questions, please ask it now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

DFT

BATANG KOREK API

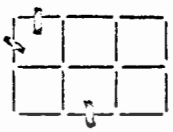
Dalam test ini akan diperlihatkan gambar2 batang korek api jang tersusun dalam pola2. Sdr. diminta untuk menjelesaikan persoalan dengan menjisihkan beberapa batang sedemikian rupa sehingga batang2 korek api jang tertinggal merupakan pola2 baru.

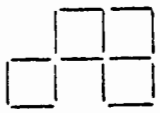
Perhatikanlah tjontoh ini:

Ketentuan

AMBILLAH 3 BATANG SEHINGGA POLA TINGGAL 4 BUDJUR SANGKAR

Penjelesaian A





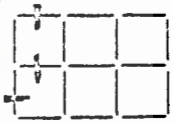
Dalam tjontoh ini, petundjuk2 ditulis disebelah kiri. Gambar dibawah "ketentuan" adalah sama dengan jang akan sdr. lihat pada test. Untuk menjatakan penjelesaian sdr. tjoretlah garis jang hendak sdr. sisihkan. Dalam tjontoh diatas penjelesaian dengan tjoretan2 itu sebetulnja sama dengan gambar disebelah kanan sekali bila batang2 itu sungguh2 diambil. Perhatikanlah, bahwa hanja budjur -sangkar2 jang lengkap jang tinggal.

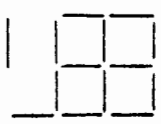
Penjelesaian dibawah ini tidak dapat diterima.

Ketentuan

AMBILLAH 3 BATANG SEHINGGA POLA TINGGAL 4 BUDJUR SANGKAR

Salah

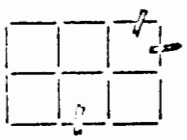




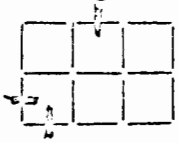
Penjelesaian ini salah karena ada 2 batang jang tidak merupakan bagian dari 4 budjur sangkar jang diminta. Sdr. harus mengambil batang2 korek api itu sedemikian rupa sehingga hanja djumlah budjur sangkar jang diminta sadja jang tinggal, tanpa ada batang2 lain jang tinggal terlepas.

Dalam test ini sdr. akan mendapatkan angka lebih banjak bila sdr. dapat menundjukkan penjelesaian tambahan jang lain. Dibawah ini ada beberapa kemungkinan penjelesaian soal jang sama.

B

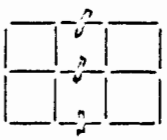


C



Perhatikanlah, bahwa B dan C mempergunakan prinsip jang sama dengan A dalam tjontoh jang pertama: 2 batang sudut dan satu batang tengah dari segi jang ber-

D



D memakai prinsip jang lain daripada A, dan djuga memenuhi sjarat bahwa batang2 jang tinggal semua merupakan bagian dari

hadapan. Untuk mendapatkan penjelesaian jang sungguh2 berlainan, sdr. harus memakai prinsip2 jang lain. B dan C disini tidak dihitung untuk tambahan angka.

budjur sangkar jang diminta. Djadi D dihitung sebagai penjelesaian lain jang dapat diterima.

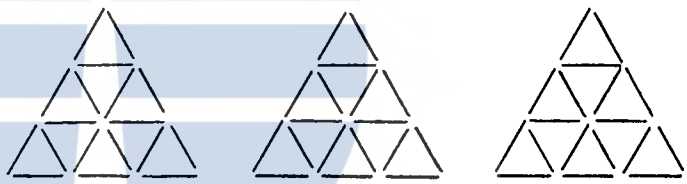
PERHATIAN: BERIKANLAH SEMUA DJAWABAN PADA FORMULIR DJAWABAN HALAMAN 4 DAN 5. DJANGANLAH SEKALI-KALI MENTJORET ATAU MEMBERI TANDA APAPUN LAINNJA PADA TEST INI. BUATLAH TJONTOH-TJONTOH PADA FORMULIR DJAWABAN DJUGA.

BUKALAH HALAMAN BERIKUT UNTUK MENDAPATKAN PETUNDJUK2 LEBIH LANDJUT.

BATANG KOREK API (landjutan petundjuk2)

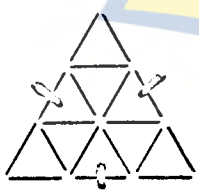
Dibawah ini ada soal jang lain, kali ini dipergunakan segi-tiga2. Tjobalah menemukan tiga penjelesaian jang berlain-lainan. Buatlah ini pada formulir djawaban, (halaman 3 disebelah kanan bawah).

AMBILLAH 3 BATANG SEHINGGA POLA TINGGAL 6 SEGITIGA



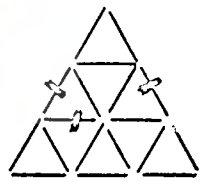
Dibawah ini diberikan tiga tjontoh penjelesaian. Perhatikanlah dengan sungguh2 bahwa setiap penjelesaian itu selalu berlainan dalam beberapa hal dengan penjelesaian lain2nja. Semua segitiga lengkap, tidak ada sebatangpun jang tinggal terlepas.

A

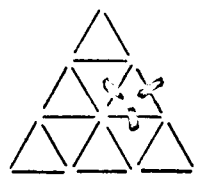


B

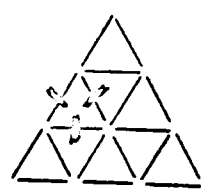
C



Seandainja disamping penjelesaian B sdr. djuga memberikan penjelesaian ini:



atau



Saudara tidak akan diberi tambahan angka untuk penjelesaian2 terachir ini, karena pola penjelesaiannja sama dengan B. Pola penjelesaian harus berlainan supaja mendapat tambahan angka.

Test ini terdiri dari 10 soal. Beberapa soal didasarakan pada segiempat, lain-lainnja didasarkan pada segi-tiga. Sdr. diminta menemukan 3 (tiga) penjelesaian jang sungguh2 berlainan bagi setiap soal. Satu tambahan gambar diberikan untuk tiap-tiap soal. Gaubar ke-empat ini dapat sdr. pergunakan bila salah satu penjelesaian sebelumnja merupakan penjelesaian ulangan dari jang lainnja, atau bila sdr. membuat suatu kesalahan. Angka maksimum untuk setiap soal adalah tiga.

Waktu jang diberikan seluruhnja hanja 14 menit. Djadi, bekerdjalah setjepat mungkin. Bila terdapat kesukaran pada satu soal, tinggalkanlah soal itu untuk sementara. Bila kemudian masih ada waktu, soal itu dapat diulangi kembali.

Bila ada pertanjaan2, harap dikemukakannja sekarang.

DJANGANLAH MEMBALIK HALAMAN SEBELUM DIBERITAHUKAN.

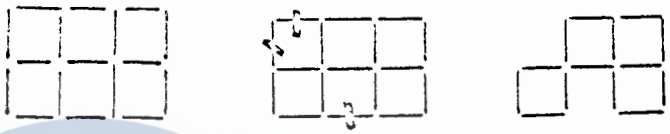
Translation of: BATANG KOREK API

MATCHES

In this test you will see drawings of matches laid out in patterns. You are to remove some of the matches so that the matches left form new patterns.

Look at this example: Given Solution A

TAKE AWAY 3 MATCHES
LEAVING 4 SQUARES



In this example, your instructions appear at the left. The drawing under "given" is like those you will see in the test. To indicate a solution, you would mark through the matches you want removed. In the example, the solution marked would look like the pattern at the right if the matches were actually removed. Note that only complete squares are left.

The solution below is <u>not</u> acceptable:

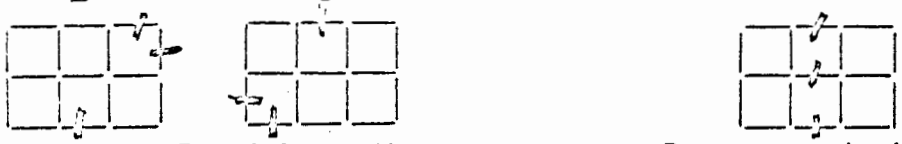
Given Wrong

TAKE AWAY 3 MATCHES
LEAVING 4 SQUARES

This solution is wrong, because it leaves two matches that are not parts of the required four squares. You must remove matches so that exactly the required number of complete squares remain, with no matches left over.

In this test you will add to your score by giving additional different solutions to each problem. Below are some other possible ways of doing the same problem.

B C D



Notice that B and C use the same principle as A in the first example: Two matches from a corner and the middle match from the opposite side.

D uses a principle different from that in A, and also meets the rules that all

In getting really different solutions you apply different principles. Here B and C would not be counted.

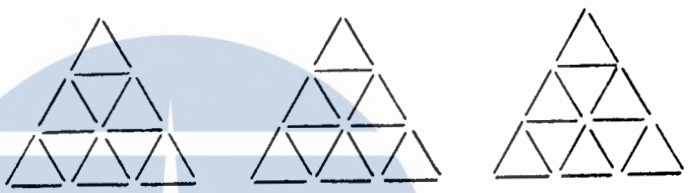
matches remaining are parts of remaining squares, so D is counted as another acceptable solution

NOTICE: PUT ALL YOUR ANSWERS ON PAGES 4 AND 5 OF THE ANSWER FORM. DO NOT MARK ANYTHING ON THIS TEST. COMPLETE EXAMPLES ALSO ON THE ANSWER FORM.

GO TO THE NEXT PAGE FOR FURTHER INSTRUCTIONS

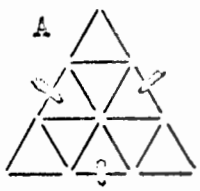
Below is another problem, this time using triangles. Try to find three different solutions. Complete this problem on the answer form (page 4).

TAKE AWAY 3 MATCHES
LEAVING 6 TRIANGLES

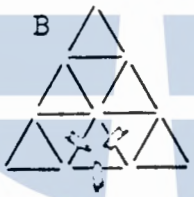


Three solutions are shown below. Notice especially that each solution is in some way a different pattern than the others. All the triangles are complete, no matches being left over.

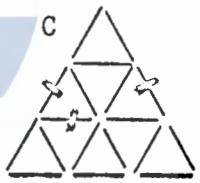
A



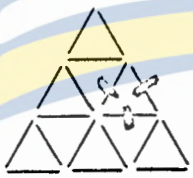
B



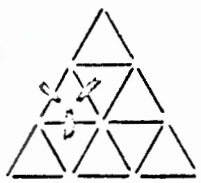
C



Suppose you had given solution B and also:



or



You would not be given credit for the additional solution since the pattern is the same as for B. Patterns must be different in order to receive full credit.

This test consists of 10 items. Some items are based on squares, others on triangles. You are to find three different solutions to each problem. One extra figure is provided for each problem. You may use this

fourth figure in case you think one of your previous solutions is a duplicate or if you make an error. The maximum score on each problem is three points.

The time given to complete the whole test is 14 minutes. Therefore, work as fast as possible. If you have difficulty with one problem, go on to the others. If time permits you could return to these problems.

If there are any questions, please ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

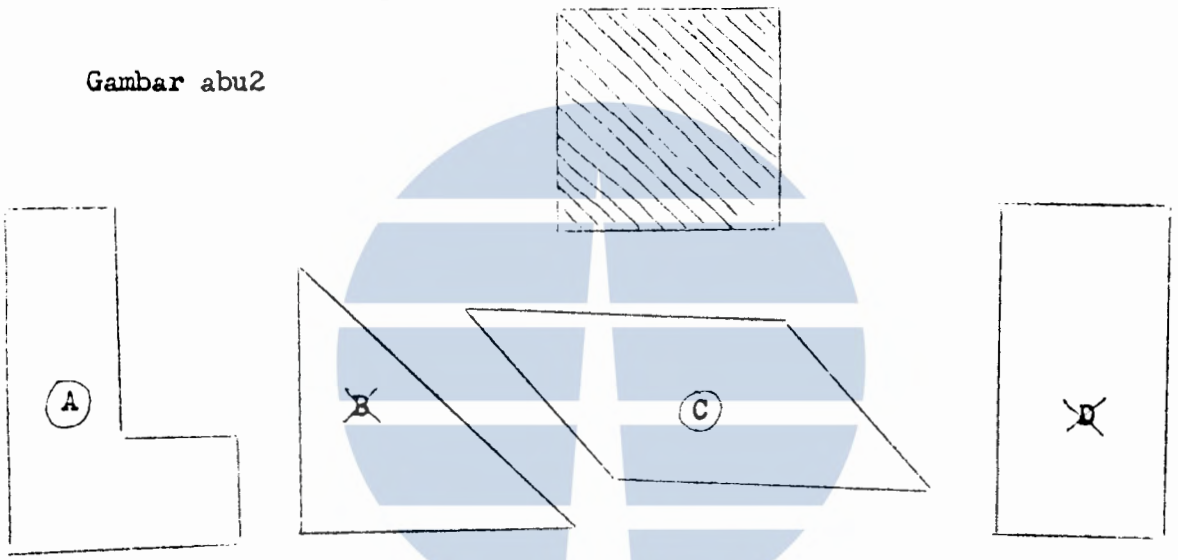
EFT

TAKSIRAN LUAS

Test ini terdiri dari satu gambar geometris abu2 disebelah atas setiap halaman dan deretan2 bermatjam-matjam gambar geometris lainnja jang putih dibawahnja. Setiap gambar dalam deretan diberi huruf A, B, C, dan D. Tugas sdr. adalah menaksir mana sadja diantara 4 gambar: A, B, C dan D itu jang mempunjai luas jang sama dengan luas gambar geometris abu2 disebelah atas.

Lihatlah tjontoh dibawah ini:

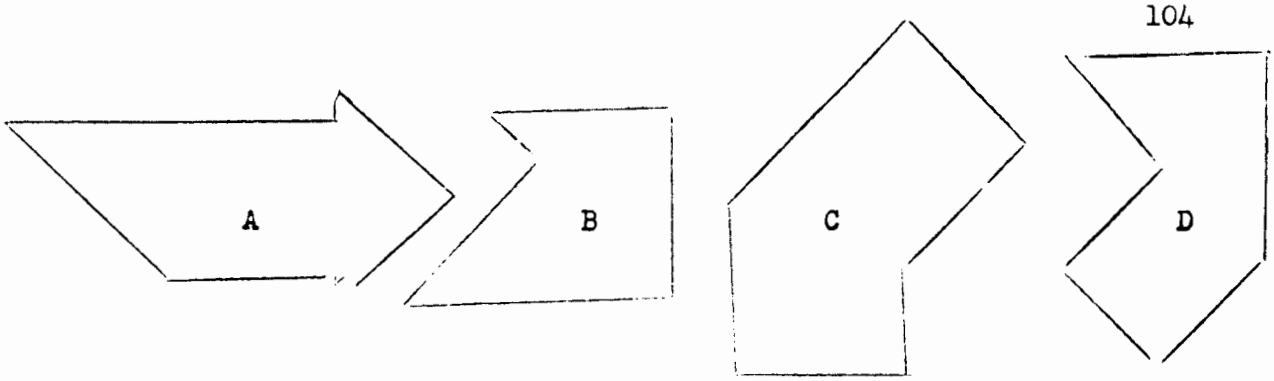
Gambar abu2



Bila diukur dengan teliti maka gambar A dan gambar C tepat sama luasnja dengan gambar abu2 diatas. Maka dari itu A dan C diberi lingkaran, dan B dan D ditjoret. Akan tetapi sdr. tidak diminta mengukur gambar2 itu dengan teliti, tjukup hanja menafsir setjara kasar sadja. Sdr. boleh mempergunakan mistar atau alat lainnja untuk membantu membandingkan luas gambar2 dalam deretan dengan luas gambar abu2 diatas, tetapi karena waktunja terlalu terbatas, sebaiknja sdr. djangan mengukur dengan teliti.

PERHATIAN: BERIKANLAH SEMUA DJAWABANMU PADA FORMULIR DJAWABAN HALAMAN 6. DJANGAN SEKALI-KALI MEMBERI TANDA APAPUN DJUGA PADA TEST INI.

Buatlah tjontoh dibawah ini dengan membandingkan gambar2 geometris ini dengan budjur-sangkar abu2 jang ada pada tjontoh pertama diatas ini. Tuliskanlah djawabanmu pada formulir djawaban djuga.



TERUSKANLAH DENGAN HALAMAN BERIKUT INI UNTUK MENDAPAT PETUNDJUK-PETUNDJUK LAGI

TAKSIRAN LUAS (landjutan petundjuk2)

Sdr. seharusnja melingkari A dan mentjoret B, C, dan D, karena A sama luasnja dengan budjur-sangkar abu2 diatas tjontoh pertama, dan B, C, dan D tidak sama luasnja.

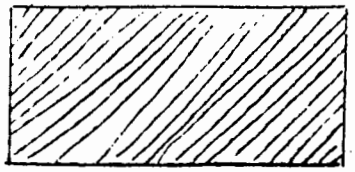
Pada setiap halaman berikut hanja akan ada satu gambar geometris abu2 dan 4 deretan gambar geometris putih. Luas gambar2 putih itu harus dibandingkan dengan luas gambar abu2 diatas setiap halaman.

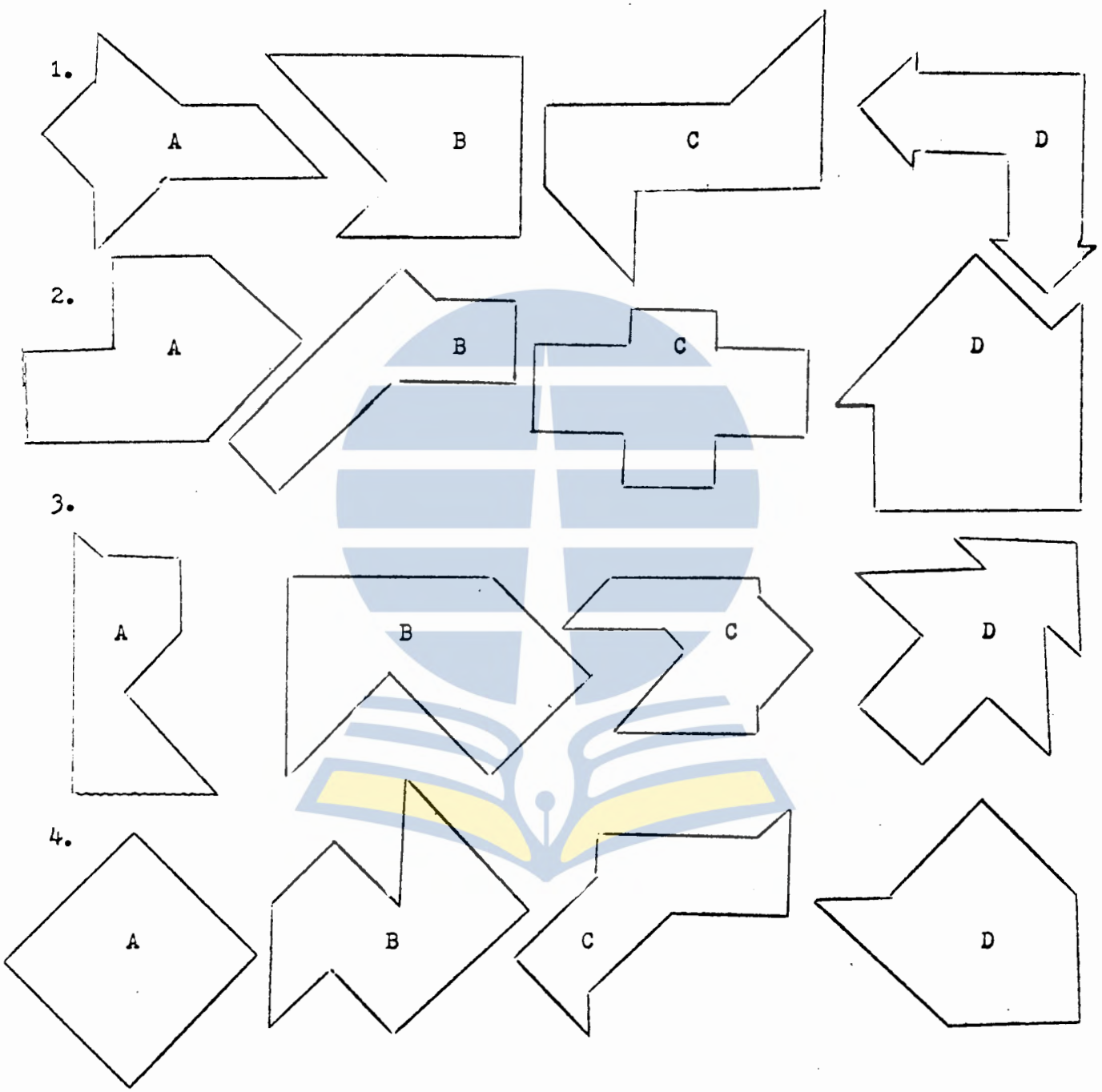
PERHATIAN: DALAM TIAP-TIAP DERETAN PALING SEDIKIT TERDAPAT SATU GAMBAR JANG SAMA LUASNJA DENGAN GAMBAR ABU-ABU JANG ADA DISEBELAH ATAS SETIAP HALAMAN, TETAPI DAPAT PULA TERDJADI BAHWA DUA, TIGA, ATAU EMAPAT GAMBAR DALAM SATU DERETAN JANG SAMA DENGAN GAMBAR ABU-ABU.

Test ini terdiri dari 4 halaman soal2. Waktu jang diberikan hanja 10 menit untuk menjelesaikan soal2nja. Bekerdjalah dengan setjepat mungkin.

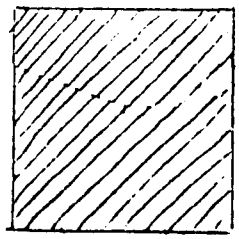
Bila ada pertanjaan2 silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBUKA HALAMAN BERIKUT SEBELUM DIBERITAHUKAN.

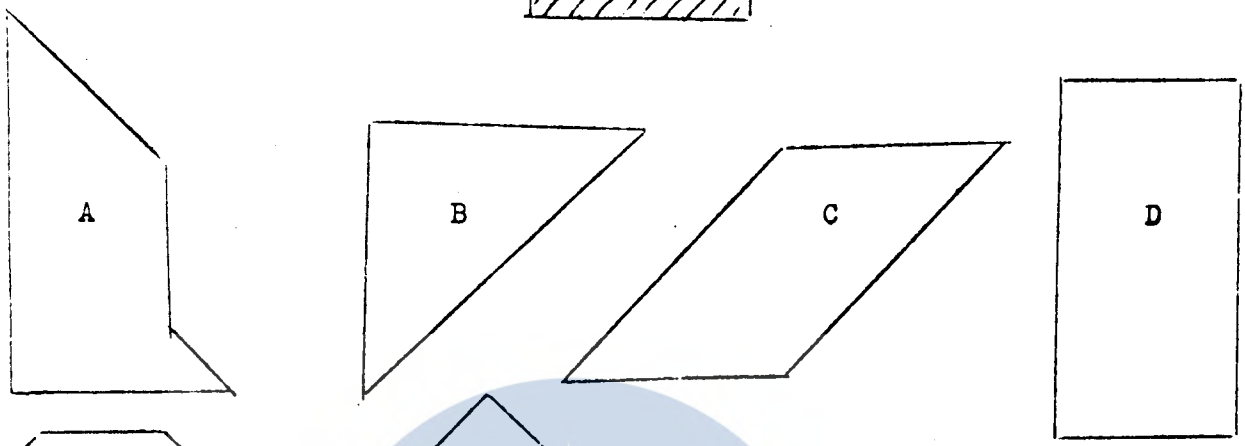




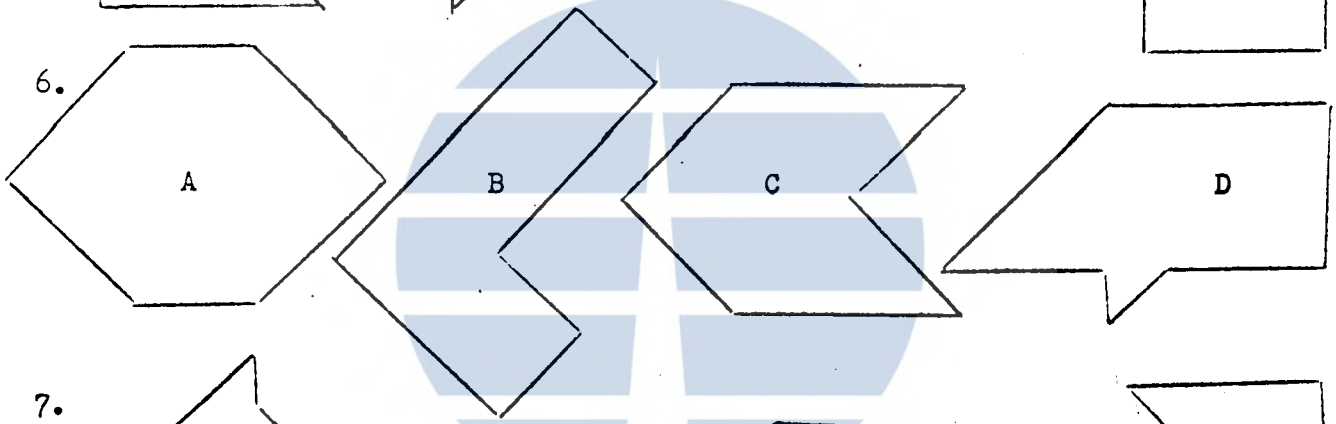
DJANGAN BERHENTI. LANDJUTKANLAH DENGAN HALAMAN BERIKUT.



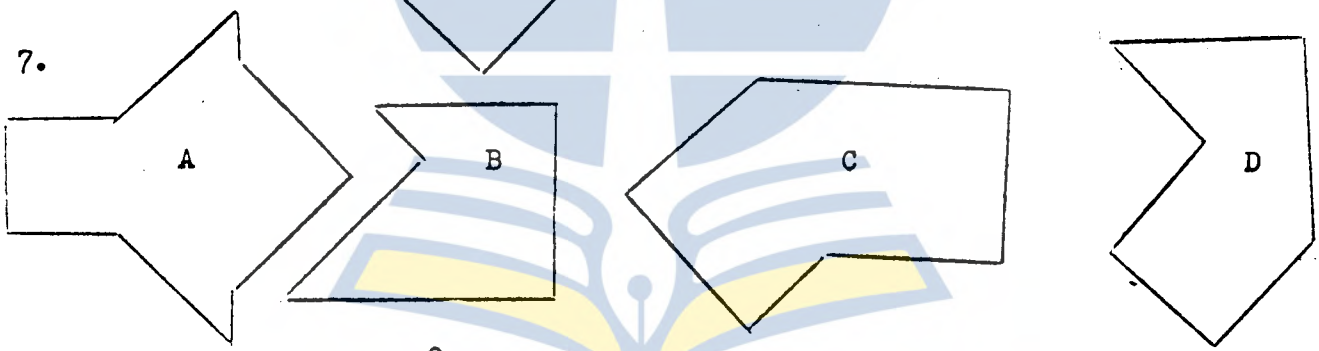
5.



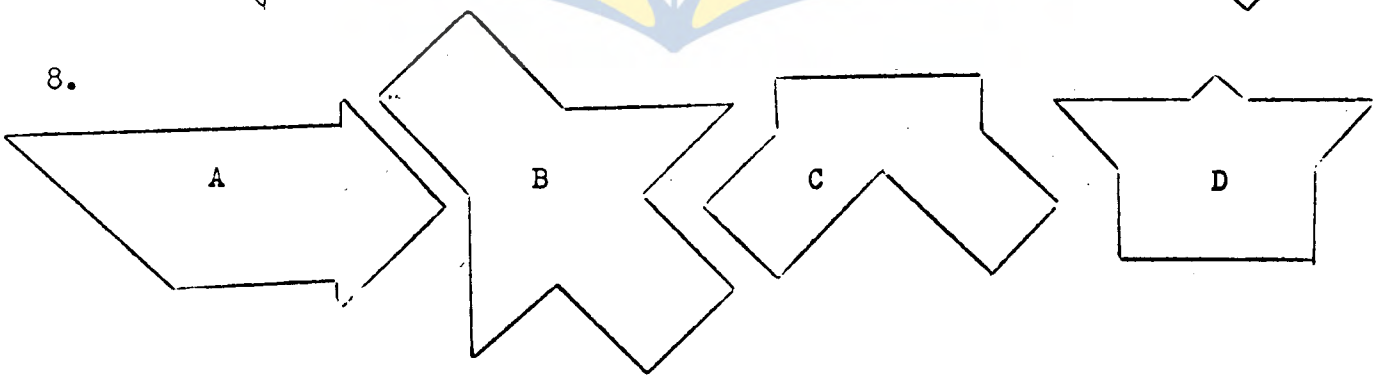
6.



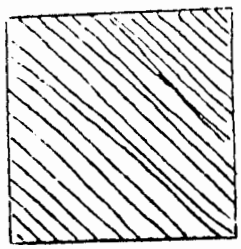
7.



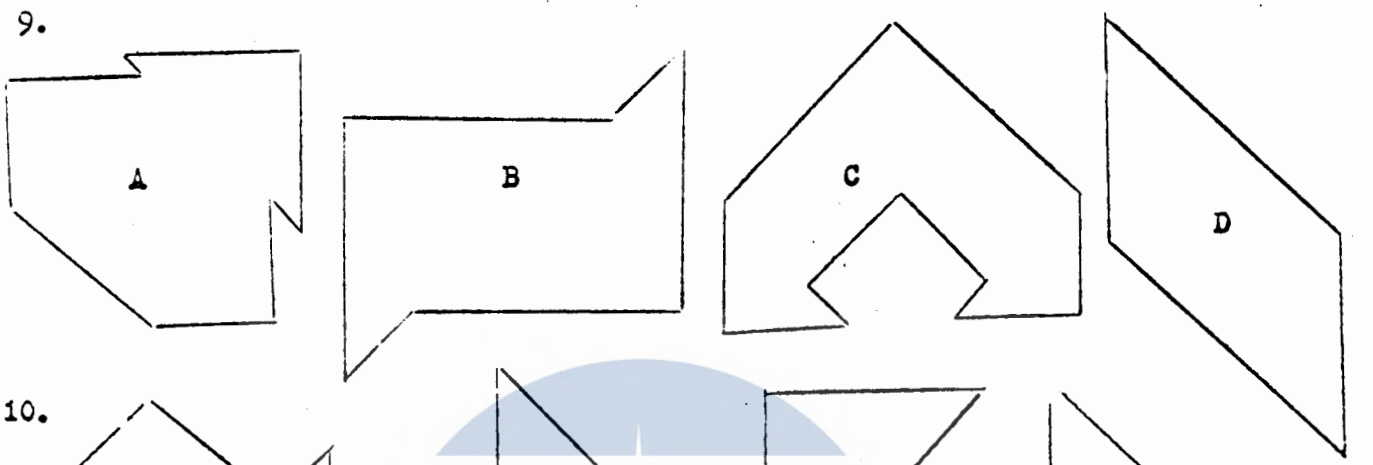
8.



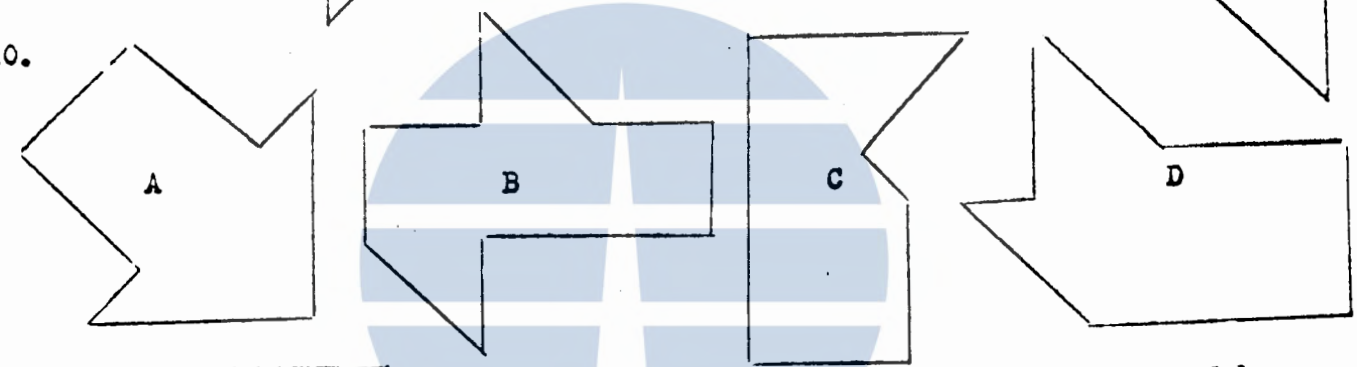
DJANGAN BERHENTI. LANDJUTKANLAH DENGAN HALAMAN BERIKUT.



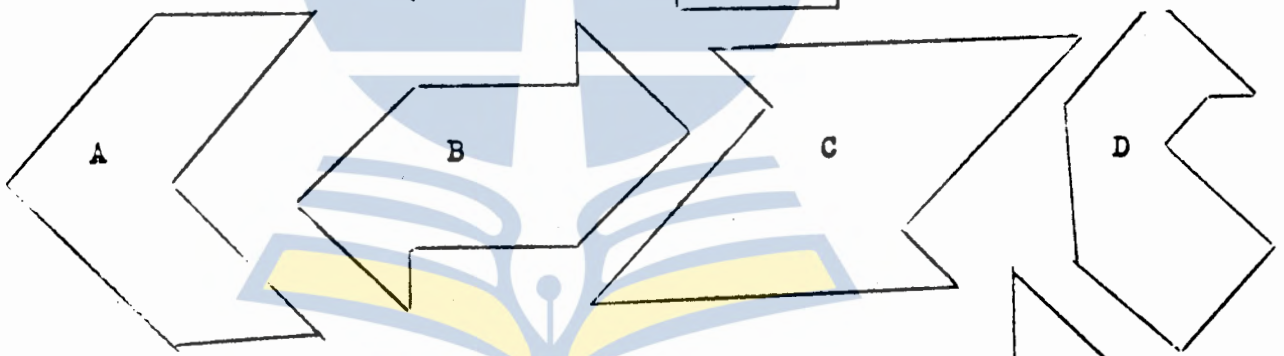
9.



10.

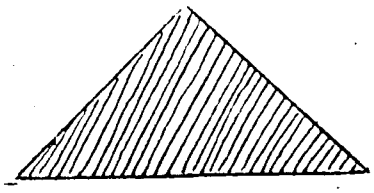


11.

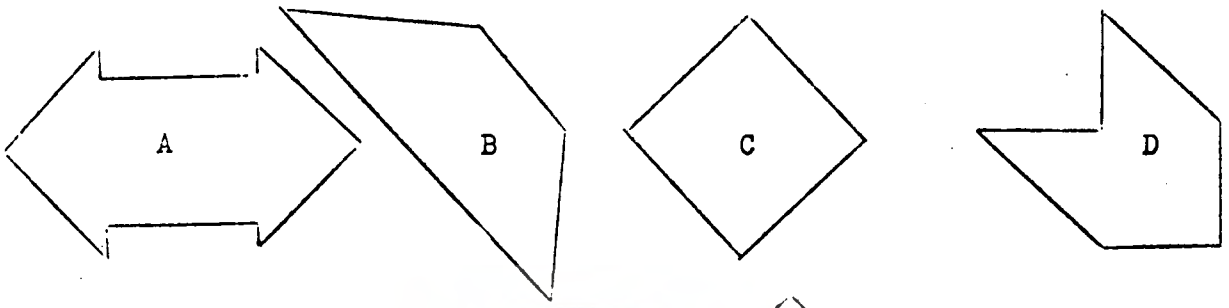


12.

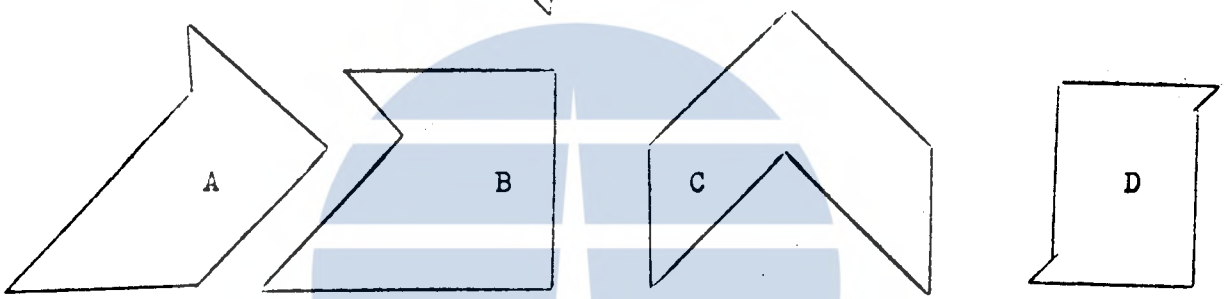
DJANGAN BERHENTI. LANDJUTKANLAH DENGAN HALAMAN BERIKUT.



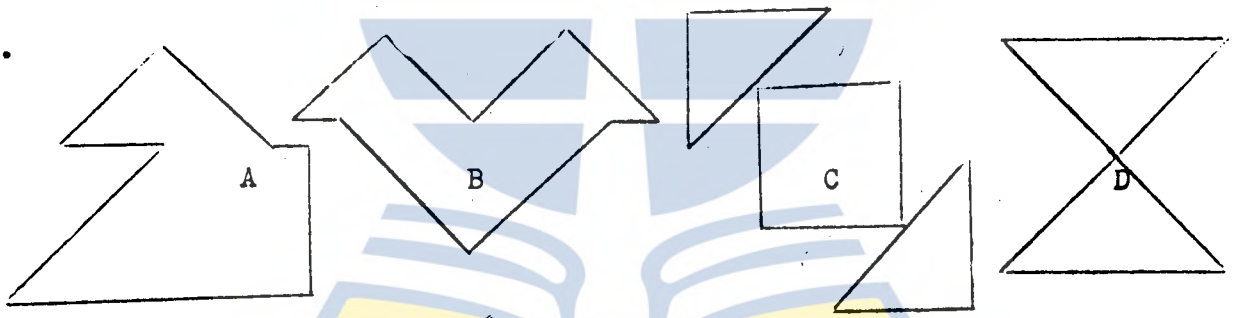
13.



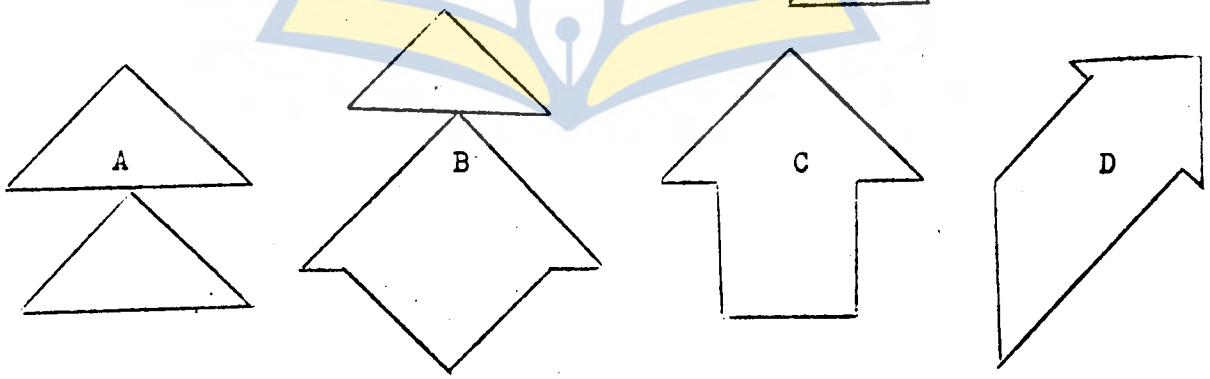
14.



15.



16.



STOP DISINI DAHULU. TUNGGULAH PETUNDJUK2 LEBIH LANDJUT.

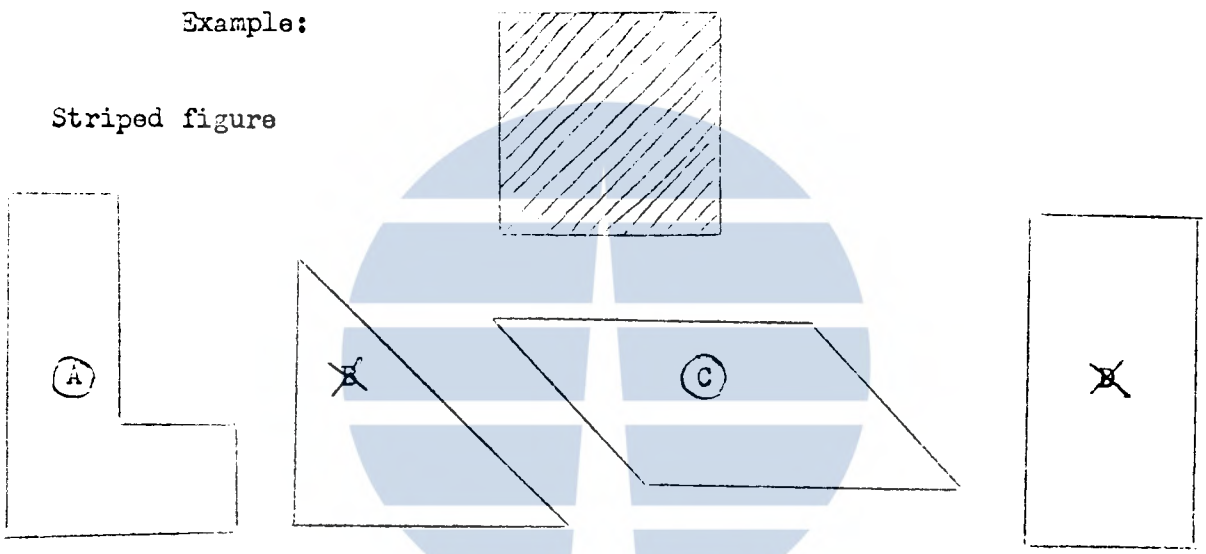
Translation of: TAKSIRAN LUAS

AREA ESTIMATION

This test consists of one striped geometric figure at the top of each page and rows of many kinds of white geometrical figures below. Each figure in the row is assigned a letter A, B, C, or D. Your task is to estimate which of the 4 figures in the row: A, B, C, and D have the same area as the striped geometric figure at the top of the page.

Example:

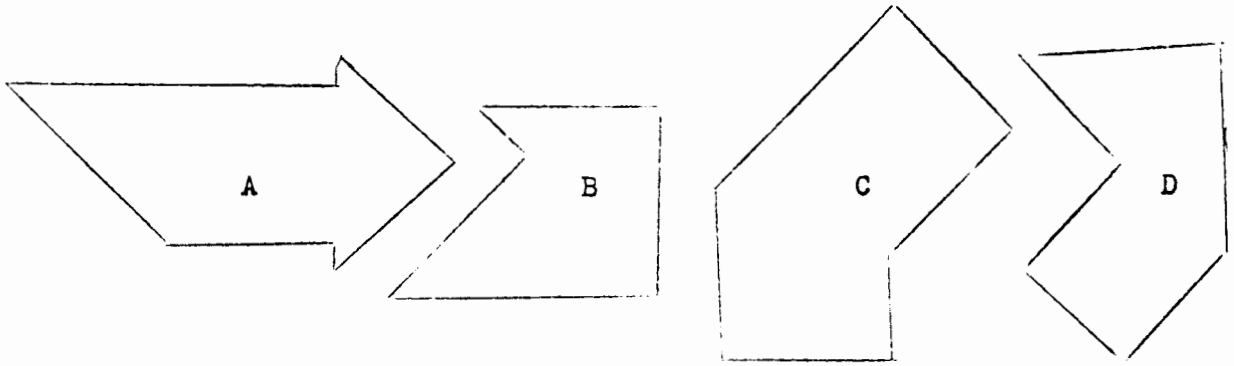
Striped figure



If you do measure the figures quite accurately figure A and figure C have the same area as the striped figure at the top. Therefore, circles are drawn around A and C, and B and D are crossed. However, it is not required that you measure the figures accurately. It is sufficient if you make a crude estimation of the areas. You are allowed to use a ruler or any other device to help you to compare the areas of the figures, but due to the very short working time given, you are not advised to try to measure accurately.

NOTICE: PUT YOUR ANSWERS ON PAGE 6 OF THE ANSWER FORM. DO NOT MARK ANYTHING ON THIS TEST.

Try to do the example problem below. You should compare the figures below with the striped figure in the first example above. You should also put your answers on the answer form.



GO TO THE NEXT PAGE FOR FURTHER INSTRUCTION

(next page)

(AREA ESTIMATION, instructions continued)

You should put a circle around A, and cross B, C, and D, because A has the same area as the striped square in the first example. B, C, and D do not have the same area as the striped square.

On the next pages there will be only one striped geometric figure, and four rows of blank geometric figures on each page. The area of each blank figure should be compared with the area of the striped figure at the top of the page.

NOTICE: IN EACH ROW THERE WILL BE AT LEAST ONE FIGURE WHICH HAS THE SAME AREA AS THE STRIPED FIGURE AT THE TOP OF EACH PAGE. THERE COULD BE TWO, THREE OR FOUR FIGURES IN THE SAME ROW WHICH HAVE THE SAME AREA AS THE STRIPED FIGURE.

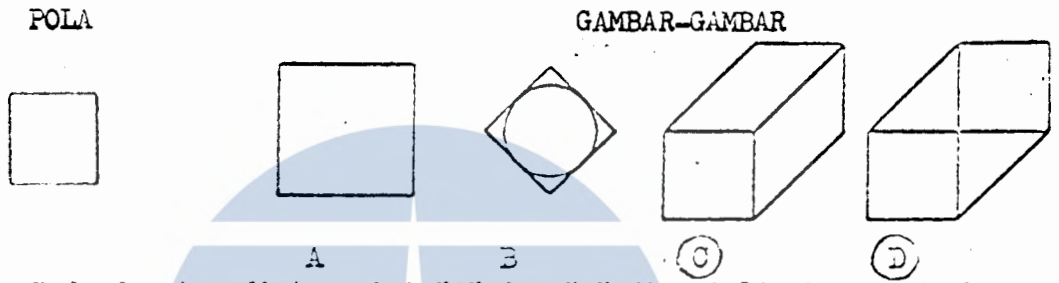
This test consists of four pages of problems. You will have only 10 minutes to complete the test. Work as rapidly as you can.

If there are any questions, please ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO

POLA-POLA TERSAMAR

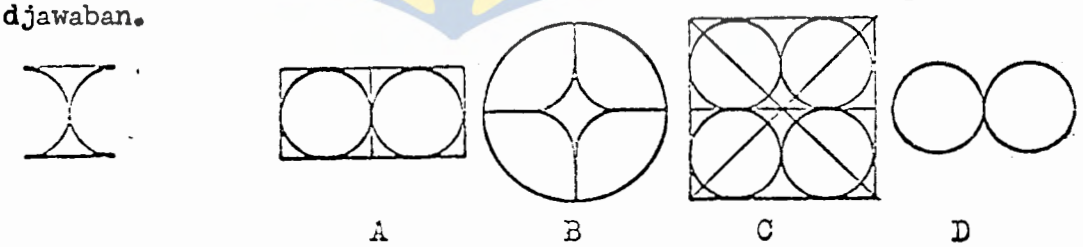
Deretan lukisan dibawah ini adalah tjontoh test. Untuk memudahkan petundjuk2 maka deretan tersebut diberi nama, tetapi nama2 itu tidak terdapat dalam test jang sesungguhnja. Lukisan disebelah kiri sendiri disebut pola. Tugas sdr. ialah untuk menentukan apakah pola itu tersamar dalam tiap2 gambar jang berdjumlah 4 disebelah kanannja. Lingkarilah huruf jang ada dibawah gambar jang mengandung pola itu. Perhatikanlah sekarang lukisan2 dibawah ini:



Pada deretan diatas ini "C" dan "D" diberi lingkaran. Gambar "A" sebetulnja djuga berupa budjur sangkar, tetapi lebih ketjil daripada pola jang ada disebelah kirinja. Meskipun gambar "B" mengandung budjur sangkar jang tepat sama besarnja dengan pola disebelah kiri, tetapi budjur sangkar ini diputar, djadi "B" tidak pula dilingkari. "C" dan "D" dilingkari karena masing2 gambar itu mengandung budjur sangkar jang tepat sama besarnja dengan pola dan tidak diputar. Bahwa pola jang terkandung dalam gambar "C" dan "D" itu tidak segaris letaknja dengan pola disebelah kiri, tidak mendjadi soal.

PERHATIAN: DJANGANLAH MEMBERI TANDA-TANDA LINGKARAN ITU PADA TEST INI, TETAPI PADA FORMULIR DJAWABAN. LIHATLAH DALAM FORMULIR DJAWABAN HALAMAN 1. DISITU TERDAPAT TJONTOH BAGAIMANA MEMBERI LINGKARAN-LINGKARAN JANG SESUAI DENGAN TJONTOH DIATAS INI. DJANGANLAH MENULIS ATAU MEMBERI TANDA-TANDA LAINNJA PADA TEST INI.

Tjobalah tjontoh dibawah ini: berikanlah djawabanmu pada formulir djawaban.



Sdr. seharusnja melingkari "A" dan "C" pada formulir djawaban.

Pada halaman2 berikut ini akan terlihat deretan lukisan seperti tjontoh2 diatas. PERHATIAN: DALAM TIAP-TIAP DERETAN TERDAPAT PALING SEDIKIT SATU POLA JANG TERSAMAR DALAM SALAH SATU DIANTARA 4 GAMBAR ITU.

Waktu jang diberikan untuk menjelesaikan seluruh 49 deretan jang ada dalam test ini hanja 10 menit. Djadi bekerdjalah dengan setjepat mungkin.

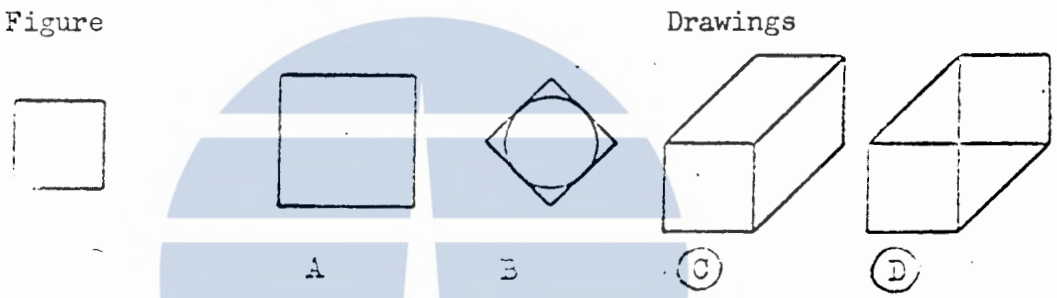
Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBALIK HALAMAN SEBELUM DIBERITAHUKAN.

Translation of: POLA-POLA TERSAMAR

CONCEALED FIGURES

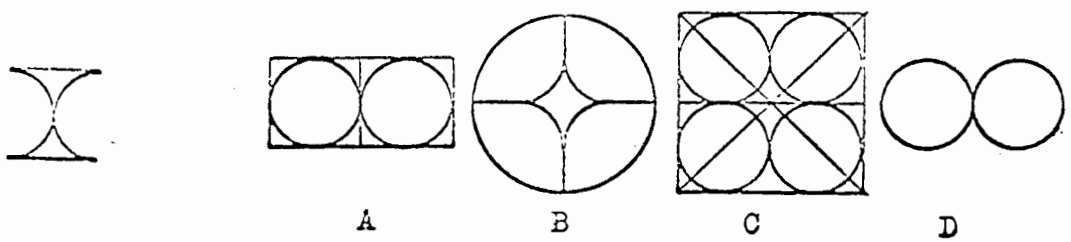
The row of designs below is a sample item of this test. To make things easier the parts have been labeled. These labels do not appear in the test items. The left hand design in each row is the figure. You are to decide whether or not the figure is concealed in each of the four drawings to the right. Circle the letter below the drawing which which contains the given figure.



In the row above C and D are circled. Drawing "A" is actually a square but it is larger than the figure at the left. Although "B" contains a square exactly the size of the given figure, but it has been turned. Therefore, "B" is not circled. "C" and "D" are circled because they each contain a square of exactly the same size as the figure and have not been turned. It does not matter that the figure contained in drawing "C" and "D" is on a different level from the figure at the left.

NOTICE: DO NOT DRAW THE CIRCLES ON THIS TEST, BUT DRAW THESE ON THE ANSWER FORM. LOOK AT PAGE 1 OF THE ANSWER FORM. ON THAT PAGE YOU COULD FIND AN EXAMPLE OF HOW TO MAKE THE CIRCLES CORRESPONDING TO THE EXAMPLE ABOVE. DO NOT WRITE OR PUT ANY MARK ON THIS TEST.

Try the example below: put your answers on the answer form.



You should have circled "A" and "C" on the answer form.

The following pages contain more rows like the sample rows. NOTICE: IN EACH ROW THERE IS AT LEAST ONE FIGURE CONCEALED IN ONE OF THE FOUR DRAWINGS.

The time given to complete all 49 rows in this test is only 10 minutes. Therefore, work as fast as possible.

If there are any questions, please ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

CMT

KESAMAAN

Dalam test ini tugas sdr. adalah untuk memikirkan, apakah jang sama pada berbagai objek jang dikemukakan dalam test ini. Setiap soal terdiri dari sepasang (2) objek dan sdr. diminta untuk menulis 6 matjam kesamaan jang terdapat pada kedua objek tadi.

Lihatlah tjontoh dibawah ini

Djambu bidji dan djeruk adalah sama:

A. manis rasanja

B. bulat

C. mempunjai bidji

D. buah-buahan

E. mempunjai kulit

F. tumbuh pada pohon

Perhatikanlah, bahwa kesamaan2 jang ditulis diatas ini semuanja mengenai sifat2 jang sungguh2 ada pada objek2 itu sendiri, seperti umpamanja: bangunnja, gunanja, atau kerdjanja. Pernjataan2 seperti: "beli dipasar", "harganja mahal", dan "disukai anak", jang tidak melukiskan objek2 itu sendiri, tidak dapat diterima sebagai djawaban jang benar. Perhatikan pula, bahwa perkataan "kedua-duanja" sudah dengan sendirinja berlaku bagi setiap djawaban, djadi tidak perlu ditulis.

Soal2 berikut ini serupa dengan tjontoh diatas. Djadi sdr. diminta menulis 6 kesamaan untuk setiap pasang objek. Bila sdr. tidak dapat menemukan 6 kesamaan itu dengan segera, tuliskanlah sebanjak jang sdr. ketahui sadja, dan landjutkanlah dengan soal berikut karena waktunja sangat terbatas.

PERHATIAN: DJANGANLAH SEKALI-KALI MENULIS ATAU MEMBERI TANDA APAPUN PADA TEST INI. BERIKANLAH SEMUA DJAWABANMU PADA FORMULIR DJAWABAN HALAMAN 4 DAN 5.

Test ini terdiri dari 12 soal. Waktu jang diberikan hanja 10 menit. Bekerdjalah dengan setjepat mungkin.

Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBALIK HALAMAN SEBELUM DIBERITAHUKAN.

1. Kentang dan wortel adalah sama:

   A. _____

   B. _____

   C. _____

   D. _____

   E. _____

   F. _____

2. Kutjing dan tikus adalah sama:

   A. _____

   B. _____

   C. _____

   D. _____

   E. _____

   F. _____

3. Lokomotif dan traktor adalah sama:

   A. _____

   B. _____

   C. _____

   D. _____

   E. _____

   F. _____

LANDJUTKAN DENGAN HALAMAN BERIKUT INI

4. Susu dan daging adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

5. Pasar dan rumah makan adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

6. Biola dan piano adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

LANDJUTKANLAH DENGAN HALAMAN BERIKUT INI.

7. Radio dan telepon adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

8. Djam dan mesin tik adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

9. Tirai (kordijn) dan tikar adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

LANDJUTKANLAH DENGAN HALAMAN BERIKUT INI.

10. Bangku dan kursi adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

11. Telor dan bidji tanaman adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

12. Dompet dan kopor adalah sama:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

STOP DISINI. TUNGGULAH PETUNDJUK2 LEBIH LANDJUT.

Translation of: KESAMAAN

SIMILARITIES

In this test your task is to think of ways in which different objects are alike. Each item will consist of one pair (2) objects and you are to write down six ways in which the two objects are alike.

Look at the sample below.

Djambu bidji (Indonesian fruit) and orange are alike:

A. sweet

B. round

C. have seeds

D. fruit

E. have skins

F. grow on trees

Notice that the similarities listed concern real characteristics of the objects such as structure (form), use or operation. Such statements as "bought in stores", "cost money," and "liked by children," which do not describe the objects, are not acceptable as answer and need not be written down.

The following problems are of similar type. Thus, you are to write down six similarities for each pair of objects. If you cannot think of six similarities quickly, write as many as you can and go on to the next item because you have only a very limited time.

NOTICE: DO NOT WRITE OR PUT ANY MARK ON THIS TEST. PUT YOUR ANSWERS ON PAGE 4 AND 5 OF YOUR ANSWER FORM.

This test consists of 12 items. You will have only ten minutes to complete your test. Work as fast as you can.

If there are any questions, ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

DMT

KEPALA-KEPALA KARANGAN

Dalam test ini akan diberikan dua karangan. Saudara diminta menulis sebanjak mungkin kepala jang sesuai dengan setiap karangan. Kepala2 tersebut harus mempunjai hubungan jang djelas dengan masing2 karangan.

Kepala2 karangan itu boleh aneh atau tidak. Sjarat satu2nja ialah, bahwa kepala2 itu harus djelas hubungannja dengan karangannja.

Dibawah setiap karangan terdapat garis2 jang diberi nomor. Pergunakanlah hanja satu garis untuk setiap kepala karangan. Bila tanda telah diberikan (sekarang belum), bukalah halaman berikut ini, dan tulislah sebanjak mungkin kepala jang dapat sdr. karang untuk setiap karangan jang ada diatas garis2 bernomor tersebut.

PERHATIAN: DJANGAN SEKALI-KALI MENULIS DJAWABANMU ATAU MEMBERI TANDA APAPUN PADA TEST INI. BERIKANLAH SEMUA DJAWABANMU PADA FORMULIR DJAWABAN HALAMAN 2 DAN 3.

Test ini terdiri dari 2 karangan. Waktu jang diberikan untuk setiap karangan hanja 4 menit, djadi bekerdjalah setjepat mungkin.

Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBUKA HALAMAN BERIKUT SEBELUM DIBERITAHUKAN.

TULISKANLAH SEBANJAK MUNGKIN KEPALA-KEPALA
JANG SESUAI DENGAN KARANGAN DIBAWAH INI. 1

Abdullah berasal dari Mesir. Tinggi badannja 2 meter dan beratnja 130 kg. Ia seorang pembalap mobil ketjil dan ikut dalam balapan "Grand Prix", balapan mobil ketjil jang terpenting didunia. Pada putaran terachir Abdullah berada paling depan dan beberapa meter dimuka mobil berikutnja. Tetapi sekonjong-konjong mesinnja matjet dan mobilnja berhenti beberapa langkah dari garis finis. Mobil dibelakangnja kelihatannja djelas akan mendjadi djuara, akan tetapi kemudian Abdullah mengangkat mobilnja dan lari melampaui garis finis. Dengan demikian ia memenangkan hadiah besar itu.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

STOP DISINI DAHULU. TUNGGULAH PETUNDJUK LEBIH LANDJUT.

TULISKANLAH SEBANJAK MUNGKIN KEPALA-KEPALA
JANG SESUAI DENGAN KARANGAN DIBAWAH INI. 2

Ada seorang laki2 jang mempunjai isteri jang tidak dapat bitjara. Ia mendjumpai seorang dokter jang dapat mengembalikan kemampuan bitjara isterinja. Tetapi kemudian ketenteraman hidupnja dikatajaukan karena isterinja bitjara terus menerus. Ia minta kepada dokter tadi untuk membedahnja sehingga ia tidak dapat mendengar isterinja sepatah katapun, meskipun isterinja bitjara tak ada hentinja.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

STOP DISINI DAHULU. TUNGGULAH PETUNDJUK LEBIH LANDJUT.

Translation of: KEPALA-KEPALA KARANGAN

STORY TITLES

In this test you will be given two stories and you are to write as many appropriate titles as you can for each story.

The titles may be clever or not. The only requirement is that they be clearly related to the story.

Below each story there will be numbered lines. Use only one line for each title. When the signal is given (not yet), turn the page and write as many titles as you can for the story at the top of the page.

NOTICE: DO NOT WRITE YOUR ANSWERS OR PUT ANY MARK ON THIS TEST. PUT YOUR ANSWERS ON PAGE 2 AND 3 OF YOUR ANSWER FORM.

This test consists of 2 stories. You will be given only four minutes for each story, therefore work as fast as possible.

If there are any questions, ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

EMT

TAKSIRAN PRAKTIS

Ini adalah suatu test untuk mengetahui seberapa djauh sdr. dapat membuat taksiran dalam hidup sehari-hari. Sdr. diminta untuk membandingkan hal2 seperti: pandjang, berat, ketjepatan dsb. Pilihlah diantara djawaban2 jang sudah disediakan, mana jang sekiranja paling tepat, sesuai dengan taksiran dan pengetahuan sdr. Meskipun sdr. tidak jakin benar akan kebenaran pilihan sdr, sebaiknja sdr. mentjoba sadja mendjawabnja. Dalam banjak hal, taksiran jang tjerdik akan membawa saudara pada pilihan jang benar. Lingkarilah huruf dimuka pilihan djawaban sdr.

Lihatlah tjontoh dibawah ini.

Dengan mempergunakan sebuah tjangkul, bahan manakah jang dapat sdr. pergunakan untuk mengisi penuh sebuah kotak setjepat mungkin?

A - tanah lunak
B - pasir kering
C - batu kerikil
D - tjampuran batu dan pasir

Makin banjak bahan jang dapat ditjangkul setiap kalinja, makin tjepat kotak dapat diisi penuh. Tanah lunak dapat ditjangkul lebih banjak setiap kalinja daripada pasir kering, batu kerikil, atau tjampuran batu dan pasir. Karena itulah, maka djawaban jang betul adalah "A" (tanah lunak), dan "A" kita lingkari.

Test ini terdiri dari 28 soal. Waktu jang diberikan adalah 14 menit. Bekerdjalah setjepat mungkin.

PERHATIAN: BERIKANLAH SEMUA DJAWABANMU PADA FORMULIR DJAWABAN HALAMAN 6. DJANGAN SEKALI-KALI MENULIS ATAU MEMBERI TANDA APAPUN PADA TEST INI.

Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBUKA HALAMAN BERIKUT SEBELUM DIBERITAHUKAN.

1. Seorang dapat berdjalan 100 meter dalam waktu jang paling tjepat

   A - melalui air sedalam 20 cm
   B - melalui pasir lepas (tidak padat)
   C - melalui alang-alang
   D - melalui djalan jang menandjak 2 meter setiap 100 meter

2. Jang dapat paling tjepat dikerdjakan oleh seseorang

   A - mengikat tali sepasang sepatu but tentara
   B - mengantjingkan 30 kantjing (kantjing biasa, bukan kantjing djepret)
   C - turun trap sebanjak 75 tingkat
   D - naik tangga setinggi 20 meter

3. Manakah jang paling sedikit menimbulkan lelah, bila dibawa berdjalan 1 km

   A - air satu ember sebanjak 20 liter
   B - kaju djati dengan ukuran 5 X 15 X 300 cm
   C - sekarung semen seberat 45 kg
   D - satu drum ter seberat 36 kg

4. Manakah diantara huruf2 dibawah ini (tinggi huruf 5 cm) dapat dilihat paling djelas pada djarak 30 meter?

   A - huruf2 putih diatas latar belakang hitam
   B - huruf2 djingga diatas latar belakang putih
   C - huruf2 djingga diatas latar belakang hitam
   D - huruf2 hitam diatas latar belakang putih

5. Manakah jang dapat ditempuh dengan djalan kaki dalam waktu paling singkat

   A - setengah km melalui tengah2 semak2
   B - 1 km melalui tengah2 alang2
   C - 1 km melalui djalanan penuh batu kerikil
   D - 3 km melalui tanah padat

6. Manakah jang dapat dilakukan dalam waktu paling singkat

   A - mengganti ban pada mobil jang sudah didongkrak
   B - memotong rumput memakai roda pemotong rumput dilapangan seluas 5 m2
   C - berdjalan ditengah kota sedjauh 2 km
   D - mengangkat beras seberat 3 kg sedjauh 1½ km

7. Manakah jang memakan waktu jang paling sedikit

   A - pinsil didjatuhkan dari tinggi 7 meter
   B - melempar bola baseball setjepat-tjepatnja dari pelempar ke penangkap
   C - menggerakkan mobil dari stop hingga ketjepatan 25 km sedjam
   D.- menendang bola (sepakbola) sedjauh 10 meter

DJANGAN BERHENTI. TERUSKANLAH DENGAN HALAMAN BERIKUT

8. Manakah diantara logam2 dibawah ini akan mendjadi paling panas sesudah didjemur dipanas matahari selama satu djam

   A - perak
   B - tembaga
   C - nikel
   D - badja

9. Membatja dan menulis kata2 jang terdiri dari 5 huruf; manakah jang mengambil waktu jang terbanjak?

   A - membatja keras 100 kata
   B - membatja diam 300 kata
   C - menulis 25 kata
   D - mengedja 15 kata

10. Manakah jang dapat mentjapai ketjepatan jang terbesar

    A - balapan kuda
    B - lari 100 meter
    C - terdjun keair dari tinggi 3 meter
    D - balapan sepeda tanah datar

11. Manakah jang paling perasa (peka) untuk sentuhan halus

    A - telapak kaki
    B - gigir tangan
    C - putjuk lidah
    D - putjuk deridji

12. Manakah jang akan kering lebih dahulu sesudah barang2 tersebut dibawah ini diletakkan dibawah hudjan

    A - pantalon drill
    B - anduk mandi
    C - serbet makan
    D - putjuk deridji

13. Bila benda2 tersebut dibawah ini diletakkan diluar dalam malam jg. berkabut, manakah jang paling banjak menghisap air untuk setiap gram beratnja?

    A - roti tawar
    B - gula pasir
    C - kobis
    D - krupuk

14. Manakah jang paling kuat untuk menarik muatan berat ditempat jang penuh sampah dan pasir jang lunak dan kering?

    A - tractor dengan ban karet berkekuatan 10 HP (kekuatan kuda)
    B - satu pasangan kuda sebanjak 4 ekor
    C - 20 orang menarik bersama-sama
    D - mobil sedan Ford

DJANGAN BERHENTI. TERUSKANLAH DENGAN HALAMAN BERIKUT.

15. Manakah jang paling tebal

A - pak rokok sigaret
B - kotak korek api
C - buku (sampul tipis) setebal 200 halaman (kertas biasa)
D - kotak obat "NASPRO" (20 tablet)

16. Manakah jang paling tinggi letaknja

A - ikat pinggang orang jang tingginja 1,75 meter
B - knop pintu rumah pada umumnja
C - medja tulis
D - medja ping-pong

17. Manakah jang paling banjak djumlahnja

A - setjangkir kedele
B - setjangkir kwatji
C - setjangkir uang logam tengahan (jang ketjil)
D - setjangkir djagung

18. Manakah jang paling mendekati lingkaran sempurna dilihat dari salah satu seginja

A - kedele
B - kepala orang
C - pergelangan tangan
D - telor ajam

19. Manakah jang paling mendekati budjur sangkar

A - buku
B - korek api
C - pak rokok sigaret
D - separo lapangan badminton

20. Manakah jang paling pandjang?

A - tinggi rata2 orang laki2
B - pandjang rata2 depa orang laki2
C - dua kali keliling rata2 dada orang laki2 (keadaan istirahat)
D - dua kali pandjang rata2 kaki orang laki2

21. Manakah jang paling pandjang

A - pandjang rata2 kaki orang dewasa
B - pandjang djangkauan lengan kemuka
C - keliling rata2 dada orang laki2 dewasa
D-- pandjang rata2 badan hingga putjuk kepala

DJANGAN BERHENTI. TERUSKANLAH DENGAN HALAMAN BERIKUT.

22. Manakah jang paling pandjang

A - keliling terpandjang telor ajam
B - keliling bola baseball
C - keliling knop pintu rumah
D - keliling bola kasti

23. Manakah jang terbanjak djumlahnja

A - satu ember (4 liter) penuh telor ajam
B - satu krandjang sedang penuh djeruk
C - korek api sekotak penuh

24. Manakah jang paling pandjang

A - pandjang rata2 kilan orang dewasa (dari putjuk ibu djari keputjuk djari kelingking)
B - kertas tik
C - 3 bola tennis didjadjarkan
D - 2 uang kertas satu rupiah didjadjarkan memandjang

25. Manakah jang mempunjai garis tengah jang terpandjang

A - pinsil biasa
B - rokok sigaret
C - kawat pesawat tilpun
D - obeng sekrup ukuran tengahan

26. Manakah jang terpandjang

A - lebar dua kolom surat kabar
B - djepit kertas (paper clip) jang diluruskan
C - 2 kali pandjang rokok sigaret
D - keliling bawah botol limun ketjil

27. Manakah jang terpandjang

A - keliling terpandjang pak rokok sigaret
B - Keliling terpandjang sabun mandi ("LUX" atau "BRIS")
C - keliling uang kertas serupiah
D - 34 cm

28. Manakah jang terberat

A - berat rata2 baji jang baru lahir
B - berat 4 liter bensin
C - berat mesin tik portable jang sedang
D - separo berat rata2 anak umur setahun

BERHENTI DAHULU. TUNGGULAH PETUNDJUK2 LEBIH LANDJUT.

NMT

PEROBAHAN GUNA

Dalam setiap soal berikut ini saudara dihadapkan dengan suatu persoalan jang hanja dapat dipetjahkan dengan menggunakan satu bagian dari salah satu objek jang tersebut dibawah setiap soal. Pemetjahannj persoalan mungkin membutuhkan suatu ketjerdikan. Lingkarilah huruf dimuka nama objek jang menurut pendapat saudara mempunjai bagian jang dapat paling tepat digunakan untuk memetjahkan soal.

Umpamanja:

Untuk membuat api:

A - vulpen
B - bawang merah
C - djam saku
D - bola lampu listrik
E - bola sepak bola

Djawaban jang tepat ialah "C". Djadi huruf "C" dilingkari. Djawaban ini betul karena saudara dapat mempergunakan gelas djam saku sebagai lensa pembakar (dengan sinar matahari).

PERHATIAN: BERIKANLAH DJAWABANMU PADA FORMULIR DJAWABAN HALAMAN 1. DJANGAN SEKALI-KALI MENULIS ATAU MEMBERI TANDA APAPUN PADA TEST INI.

Test ini terdiri dari 20 soal. Waktu jang diberikan untuk menjelesaikan seluruhnja hanja 10 menit. Djadi bekerdjalah setjepat mungkin.

Bila ada pertanjaan2, silahkanlah mengemukakannja sekarang.

DJANGANLAH MEMBUKA HALAMAN BERIKUT SEBELUM DIBERITAHUKAN

1. Menggambar lingkaran sempurna dengan pinsil

   A - sendok makan
   B - taplak medja plastik
   C - kemedja kaos dalam
   D - lampu duduk (teplok)
   E - gapijak (bakijak

2. Membuat djarum

   A - kobis
   B - kendi
   C - daging
   D - kotak koran
   E - ikan

3. Menghentikan keluarnja darah

   A - pisau tjukur
   B - katjang tanah
   C - bola lampu
   D - sepatu
   E - peti limun

4. Memotong tahu

   A - guitar
   B - botol thermos
   C - palu
   D - tjelana pandjang
   E - kasur

5. Membersihkan lantai dari tjat minjak jang sudah kering

   A - korek batu
   B - sabun
   C - badju kaos
   D - kursi
   E - nasi goreng

6. Menempelkan gambar didinding kaju

   A - setjangkir kopi
   B - ajam panggang
   C - gapijak
   D - peluru senapan
   E - pinsil

7. Mengikat dua benda

   A - kuwih donat
   B - buku
   C - sisir
   D - rak buku
   E - piano

8. Menambal ember botjor

   A - pinsil
   B - madjalah
   C - vulpen
   D - paku djamur
   E - djalan besar

9. Melitjinkan titik pergeseran

   A - air segelas
   B - pinsil
   C - tinta sebotol
   D - karet penghapus
   E - kamus

10. Menjapu lantai

    A - pohon
    B - kwas (untuk mengetjat)
    C - kaos kaki
    D - almari ketjil
    E - tas sekolah

DJANGAN BERHENTI. TERUSKANLAH DENGAN HALAMAN BERIKUT.

11. Membersihkan lantai dari tetesan malam (untuk membatik)

A - poluru pestol
B - sabun mandi
C - buku
D - rokok kretek
E - bulu ajam

12. Mengikat bungkusan ketjil

A - korek api
B - tjatut
C - bola lampu listrik
D - kuntji
E - madjalah

13. Membuat mata boneka jang dibuat dari kain

A - setjarik kertas
B - sisir
C - katja mata
D - garam
E - kemedja

14. Menambal ban dalam sepeda

A - pinsil
B - madjalah
C - vulpen
D - paku djamur
E - djalan besar

15. Mengambil sesuatu diluar djangkauan kita

A - tempat abu rokok
B - mesin tik
C - pohon
D - pisau
E - botol thermos

16. Untuk dipakai sebagai pipa air

A - pohon djambu
B - rokok kretek
C - kemedja
D - sepeda
E - katjamata

17. Membuat tjorong untuk mengisi pil dibotol

A - kursi
B - sendok makan
C - katjamata
D - buku
E - gelas minum

18. Untuk mengisi bantal

A - pinsil-pinsil
B - orang-orang
C - batu-batu
D - ajam panggang
E - peluru-peluru

19. Membuat alat pembersih kuping

A - batang pohon
B - korek batu
C - ban dalam mobil
D - djeruk
E - batu kerikil

20. Untuk mentjukur rambut

A - patjul
B - botol bir
C - piring
D - bambu
E - kursi

STOP DISINI DAHULU. TUNGGULAH PETUNDJUK2 LEBIH LANDJUT.

Translation of: PEROBAHAN GUNA

TRANSFORMATION OF USE

In each of the following items you will be presented with a problem which may be solved by using a part of one of the objects listed below each problem. The solution may be one requiring ingenuity. Draw a circle around the letter in front of the object which you think has a part which would best solve the problem.

For example:

To start a fire:

A - a fountain pen
B - an onion
(C)- a pocket watch
D - a light bulb
E - a soccer ball

The correct answer is "C", therefore "C" is circled. This answer is correct because you could use the crystal from a pocket watch as a burning glass (with sun rays).

NOTICE: PUT YOUR ANSWERS ON PAGE 1 OF THE ANSWER FORM. DO NOT WRITE OR PUT ANY MARK ON THIS TEST.

This test consists of 20 items. The time given to complete all items is only 10 minutes. Therefore, work as fast as you can.

If there are any questions ask them now.

DO NOT TURN THE PAGE BEFORE INSTRUCTED TO DO SO.

APPENDIX C

TABLES OF COMPUTER OUTPUT FOR ANALYSIS OF VARIANCE

TABLE XIII

ANALYSIS OF VARIANCE FOR SPLIT -HALF RELIABILITIES OF THE TESTS

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.110	1	0.110	1.58	not significant
Contents (B)	2.915	1	2.915	41.92	.001
Speed (C)	0.170	1	0.170	2.45	n.s.
Operations (D)	3.572	3	1.190	13.10	.01
A X B	0.216	1	0.216	3.11	n.s.
A X C	0.230	1	0.230	3.31	n.s.
A X D	0.118	3	0.039	0.43	n.s.
B X C	0.015	1	0.015	0.21	n.s.
B X D	0.824	3	0.274	3.02	n.s.
C X D	0.027	3	0.009	0.10	n.s.
A X B X C	0.038	1	0.038	0.55	n.s.
A X B X D	0.650	3	0.216	2.38	n.s.
A X C X D	0.215	3	0.071	0.78	n.s.
B X C X D	0.498	3	0.166	1.82	n.s.
A X B X C X D	0.084	3	0.028	0.30	n.s.
Group (R): A X B X C	0.556	8	0.0695		
D X R : A X B X C	2.180	24	0.090		
Total	12.427	63			

TABLE XIV

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN CIVICS

Source	Sum of Squares	df	Mean of Square	F	Probability
School (A)	0.185	1	0.185	1.45	not significant
Contents (B)	0.0002	1	0.0002	0.001	n.s.
Speed (C)	0.102	1	0.102	0.80	n.s.
Operations (D)	0.154	3	0.051	0.93	n.s.
A X B	0.154	1	0.154	1.21	n.s.
A X C	0.052	1	0.052	0.40	n.s.
A X D	0.103	3	0.034	0.62	n.s.
B X C	0.092	1	0.092	0.72	n.s.
B X D	0.103	3	0.034	0.62	n.s.
C X D	0.071	3	0.023	0.43	n.s.
A X B X C	0.031	1	0.031	0.24	n.s.
A X B X D	0.115	3	0.038	0.70	n.s.
A X C X D	0.017	3	0.005	0.10	n.s.
B X C X D	0.024	3	0.008	0.14	n.s.
A X B X C X D	0.296	3	0.098	1.79	n.s.
Group (R): A X B X C	1.019	8	0.127		
D X R : A X B X C	1.323	24	0.055		
Total	3.849	63			

TABLE XV

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN INDONESIAN LITERATURE

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.054	1	0.054	0.46	not significant
Contents (B)	0.097	1	0.097	0.83	n.s.
Speed (C)	0.198	1	0.198	1.69	n.s.
Operations (D)	0.022	3	0.007	0.19	n.s.
A X B	0.096	1	0.096	0.82	n.s.
A X C	0.212	1	0.212	1.81	n.s.
A X D	0.227	3	0.075	1.96	n.s.
B X C	0.345	1	0.345	2.95	n.s.
B X D	0.190	3	0.063	1.64	n.s.
C X D	0.189	3	0.063	1.63	n.s.
A X B X C	0.020	1	0.020	0.17	n.s.
A X B X D	0.157	3	0.052	1.36	n.s.
A X C X D	0.195	3	0.065	1.69	n.s.
B X C X D	0.003	3	0.001	0.02	n.s.
A X B X C X D	0.072	3	0.024	0.62	n.s.
Group (R): A X B X C	0.935	8	0.116		
D X R : A X B X C	0.925	24	0.038		
Total	3.944	63			

TABLE XVI

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN HISTORY OF INDONESIA

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.0001	1	0.0001	0.001	not significant
Contents (B)	0.288	1.	0.288	4.02	n.s.
Speed (C)	0.339	1	0.329	4.59	n.s.
Operations (D)	0.174	3	0.058	1.01	n.s.
A X B	0.0008	1	0.0008	0.01	n.s.
A X C	0.034	1	0.034	0.48	n.s.
A X D	0.002	3	0.0006	0.01	n.s.
B X C	0.891	1	0.891	12.43	.01
B X D	0.109	3	0.036	0.63	n.s.
C X D	0.150	3	0.050	0.87	n.s.
A X B X C	0.008	1	0.008	0.11	n.s.
A X B X D	0.065	3	0.021	0.38	n.s.
A X C X D	0.468	3	0.156	2.71	n.s.
B X C X D	0.034	3	0.011	0.20	n.s.
A X B X C X D	0.128	3	0.042	0.74	n.s.
Group (R): A X B X C	0.573	8	0.071		
D X R : A X B X C	1.379	24	0.057		
Total	4.641	63			

TABLE XVII

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN GEOGRAPHY OF INDONESIA

Source	Sum of Squares	df	Mean Sqaure	F	Probability
School (A)	0.003	1	0.003	0.03	not significant
Contents (B)	0.008	1	0.008	0.09	n.s.
Speed (C)	0.008	1	0.008	0.09	n.s.
Operations (D)	0.128	3	0.042	1.15	n.s.
A X B	0.009	1	0.009	0.11	n.s.
A X C	0.023	1	0.023	0.26	n.s.
A X D	0.116	3	0.038	1.04	n.s.
B X C	0.155	1	0.155	1.77	n.s.
B X D	0.252	3	0.084	2.26	n.s.
C X D	0.051	3	0.017	0.46	n.s.
A X B X C	0.003	1	0.003	0.04	n.s.
A X B X D	0.098	3	0.032	0.88	n.s.
A X C X D	0.193	3	0.064	1.74	n.s.
B X C X D	0.133	3	0.044	1.19	n.s.
A X B X C X D	0.231	3	0.077	2.07	n.s.
Group (R): A X B X C	0.699	8	0.087		
D X R : A X B X C	0.890	24	0.037		
Total	3.008	63			

TABLE XVIII

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN MATHEMATICS

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.193	1	0.193	2.45	not significant
Contents (B)	0.073	1	0.073	0.93	n.s.
Speed (C)	0.006	1	0.006	0.07	n.s.
Operations (D)	0.396	3	0.132	2.15	n.s.
A X B	0.035	1	0.035	0.44	n.s.
A X C	0.063	1	0.063	0.80	n.s.
A X D	0.250	3	0.083	1.36	n.s.
B X C	0.822	1	0.822	10.40	.05
B X D	0.053	3	0.017	0.28	n.s.
C X D	0.232	3	0.077	1.26	n.s.
A X B X C	0.005	1	0.005	0.06	n.s.
A X B X D	0.214	3	0.071	1.16	n.s.
A X C X D	0.158	3	0.052	0.86	n.s.
B X C X D	0.134	3	0.044	0.73	n.s.
A X B X C X D	0.110	3	0.036	0.59	n.s.
Group (R): A X B X C	0.632	8	0.079		
D X R : A X B X C	1.470	24	0.061		
Total	4.854	63			

TABLE XIX

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN PHYSICS

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.0003	1	0.0003	0.001	not significant
Contents (B)	0.001	1	0.001	0.006	n.s.
Speed (C)	0.0001	1	0.0001	0.0009	n.s.
Operations (D)	0.093	3	0.031	0.70	n.s.
A X B	0.105	1	0.105	0.57	n.s.
A X C	0.001	1	0.001	0.01	n.s.
A X D	0.121	3	0.040	0.92	n.s.
B X C	0.058	1	0.058	0.31	n.s.
B X D	0.034	3	0.011	0.26	n.s.
C X D	0.192	3	0.064	1.45	n.s.
A X B X C	0.073	1	0.073	0.39	n.s.
A X B X D	0.167	3	0.055	1.26	n.s.
A X C X D	0.031	3	0.010	0.23	n.s.
B X C X D	0.125	3	0.041	0.95	n.s.
A X B X C X D	0.150	3	0.050	1.13	n.s.
Group (R): A X B X C	1.473	8	0.184		
D X R : A X B X C	1.056	24	0.044		
Total	3.686	63			

TABLE XX

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN CHEMISTRY

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.004	1	0.004	0.03	not significant
Contents (B)	0.0008	1	0.0008	0.006	n.s.
Speed (C)	0.0006	1	0.0006	0.004	n.s.
Operations (D)	0.530	3	0.176	3.75	n.s.
A X B	0.270	1	0.270	2.11	n.s.
A X C	0.076	1	0.076	0.59	n.s.
A X D	0.071	3	0.023	0.50	n.s.
B X C	0.089	1	0.089	0.70	n.s.
B X D	0.065	3	0.021	0.46	n.s.
C X D	0.340	3	0.113	2.40	n.s.
A X B X C	0.045	1	0.045	0.35	n.s.
A X B X D	0.181	3	0.060	1.28	n.s.
A X C X D	0.069	3	0.023	0.49	n.s.
B X C X D	0.133	3	0.044	0.94	n.s.
A X B X C X D	0.160	3	0.053	1.13	n.s.
Group (R): A X B X C	1.023	8	0.127		
D X R : A X B X C	1.131	24	0.047		
Total	4.196	63			

TABLE XXI

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN BIOLOGY

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.034	1	0.034	0.23	not significant
Contents (B)	0.477	1	0.477	3.28	n.s.
Speed (C)	0.079	1	0.079	0.54	n.s.
Operations (D)	0.134	3	0.044	1.15	n.s.
A X B	0.091	1	0.091	0.63	n.s.
A X C	0.0001	1	0.0001	0.001	n.s.
A X D	0.049	3	0.016	0.42	n.s.
B X C	0.752	1	0.752	5.17	n.s.
B X D	0.157	3	0.052	1.35	n.s.
C X D	0.031	3	0.010	0.26	n.s.
A X B X C	0.009	1	0.009	0.06	n.s.
A X B X D	0.020	3	0.006	0.18	n.s.
A X C X D	0.173	3	0.057	1.49	n.s.
B X C X D	0.156	3	0.052	1.35	n.s.
A X B X C X D	0.043	3	0.014	0.37	n.s.
Group (R): A X B X C	1.163	8	0.145		
D X R : A X B X C	0.928	24	0.038		
Total	4.305	63			

TABLE XXII

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN WORLD HISTORY

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.097	1	0.097	1.45	not significant
Contents (B)	0.000003	1	0.000003	0.00005	n.s.
Speed (C)	0.087	1	0.087	1.30	n.s.
Operations (D)	0.086	3	0.028	0.65	n.s.
A X B	0.012	1	0.012	0.19	n.s.
A X C	0.170	1	0.170	2.53	n.s.
A X D	0.280	3	0.093	2.12	n.s.
B X C	0.387	1	0.387	5.77	.05
B X D	0.067	3	0.022	0.51	n.s.
C X D	0.047	3	0.015	0.35	n.s.
A X B X C	0.005	1	0.005	0.08	n.s.
A X B X D	0.003	3	0.001	0.02	n.s.
A X C X D	0.147	3	0.049	1.11	n.s.
B X C X D	0.150	3	0.050	1.13	n.s.
A X B X C X D	0.002	3	0.0009	0.02	n.s.
Group (R): A X B X C	0.536	8	0.067		
D X R : A X B X C	1.057	24	0.044		
Total	3.142	63			

TABLE XXIII

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN ENGLISH

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.006	1	0.006	0.03	not significant
Contents (B)	0.044	1	0.044	0.24	n.s.
Speed (C)	0.036	1	0.036	0.19	n.s.
Operations (D)	0.182	3	0.060	1.21	n.s.
A X B	0.039	1	0.039	0.21	n.s.
A X C	0.109	1	0.109	0.58	n.s.
A X D	0.179	3	0.059	1.18	n.s.
B X C	0.499	1	0.499	2.67	n.s.
B X D	0.178	3	0.059	1.18	n.s.
C X D	0.317	3	0.105	2.11	n.s.
A X B X C	0.006	1	0.006	0.03	n.s.
A X B X D	0.074	3	0.024	0.49	n.s.
A X C X D	0.293	3	0.097	1.94	n.s.
B X C X D	0.030	3	0.010	0.20	n.s.
A X B X C X D	0.099	3	0.033	0.66	n.s.
Group (R): A X B X C	1.494	8	0.186		
D X R : A X B X C	1.203	24	0.050		
Total	4.797	63			

TABLE XXIV

ANALYSIS OF VARIANCE FOR RELATIONSHIPS OF 4 LEVELS OF OPERATIONS, 2 LEVELS OF CONTENTS, AND 2 LEVELS OF SPEED WITH GRADES IN ECONOMICS AND COOPERATIVES

Source	Sum of Squares	df	Mean Square	F	Probability
School (A)	0.089	1	0.089	1.49	not significant
Contents (B)	0.148	1	0.148	2.47	n.s.
Speed (C)	0.009	1	0.009	0.15	n.s.
Operations (D)	0.348	3	0.116	2.51	n.s.
A X B	0.014	1	0.014	0.23	n.s.
A X C	0.003	1	0.003	0.05	n.s.
A X D	0.064	3	0.021	0.46	n.s.
B X C	0.032	1	0.032	0.53	n.s.
B X D	0.085	3	0.028	0.61	n.s.
C X D	0.102	3	0.034	0.73	n.s.
A X B X C	0.0006	1	0.0006	0.01	n.s.
A X B X D	0.119	3	0.039	0.86	n.s.
A X C X D	0.146	3	0.048	1.05	n.s.
B X C X D	0.114	3	0.038	0.83	n.s.
A X B X C X D	0.095	3	0.031	0.69	n.s.
Group (R): A X B X C	0.478	8	0.059		
D X R : A X B X C	1.107	24	0.046		
Total	2.961	63			

BIBLIOGRAPHY

A. BOOKS

Ahmann, J. Stanley, and Marvin D. Glock. Evaluating Pupil Growth. Boston: Allyn and Bacon, Inc., 1959.

American Society of Animal Production. Techniques and Procedures in Animal Production Research. n.p.: n.d.

Bloom, B.S., and F.R. Peters. The Use of Academic Prediction Scales for Counseling and Selecting College Entrants. New York: Free Press of Glencoe, 1961.

Buros, Oscar K. (ed). The Fourth Mental Measurements Yearbook. Highland Park, N.J.: The Gryphon Press, 1953.

_____. The Fifth Mental Measurements Yearbook. Highland Park, N.J.: The Gryphon Press, 1959.

Freeman, F.N. Theory and Practice of Psychological Testing. Third Edition. New York: Holt, Rinehart and Winston, 1962.

Ford, J.S., et al. Employment Aptitude Survey. Los Angeles: Psychological Services, Inc., 1952.

Gage, N.L. (ed.). Handbook of Research on Teaching. Chicago: Rand McNally and Company, 1963.

Guilford, J.P. Personality. New York: McGraw-Hill Book Company, 1959.

Lazarsfeld, P.F. (ed.). Mathematical Thinking in Social Sciences. Glencoe, N.Y.: Free Press, 1954.

McNemar, Quinn. Psychological Statistics. New York: John Wiley and Sons, Inc., 1962.

Vernon, P.E. The Structure of Human Abilities. Revised Edition. London: Methuen and Company, Ltd., 1960.

Walters, Fred C. A Statistical Study of Certain Aspects of the Time Factor in Intelligence. New York: Bureau of Publications, Teachers College, Columbia University, 1927.

Winer, B.J. Statistical Principles in Experimental Design. New York: McGraw-Hill Book Company, Inc., 1962.

B. PERIODICALS AND MONOGRAPHS

Brogden, H.E. "Increased Efficiency of Selection Resulting from Replacement of a Single Predictor with Several Differential Predictors." Educational and Psychological Measurements, 9, (Winter, 1951), pp. 173-179.

Burt, C. "The Structure of Mind: A Review of the Results of Factor Analysis." British Journal of Educational Psychology, 19, (June-November, 1947) pp. 100-111, 176-199.

Cline, Victor B., J.M. Richards, and Clifford Abe. "The Validity of a Battery of Creativity Tests in a High School Sample." Educational and Psychological Measurements, 22 (Winter, 1962), pp. 781-784.

Educational Testing Service. Proceedings, Invitational Conference on Testing Problems, 1958. Princeton, N.J.: Educational Testing Service, 1959.

Eysenck, H.J. "The Organization of Personality." Journal of Personality, 20 (September, 1951), pp. 107-117.

French, John W. Aptitude and Achievement Tests in Terms of Rotated Factors. Psychometric Monographs No. 5, Chicago: University of Chicago Press, 1951.

_____. "The Logic of and Assumptions Underlying Differential Aptitude Testing." Proceedings of the 1955 Invitational Conference on Testing Problems. Princeton, N.J.: Educational Testing Service, 1956, pp. 40-48.

_____. "The Factorial Invariance of Pure-Factor Tests." Journal of Educational Psychology, 48 (April, 1957), pp. 93-109.

_____. "Comparative Prediction of College Major-Field Grades by Pure-Factor Aptitude, Interest, and Personality Measures." Educational and Psychological Measurements, 23 (Winter, 1963), pp. 767-774.

Gershon, A., J.P. Guilford, and P.R. Merrifield. Figural and Symbolic Divergent-Production Abilities in Adolescent and Adult Populations. Reports from the Psychological Laboratory, The University of Southern California, No. 29, 1963.

Guilford, J.P. "The Structure of Intellect." Psychological Bulletin, 53 (July, 1956), pp. 267-293.

Guilford, J.P. Revised structure of Intellect. Report of the Psychological Laboratory, University of Southern California, No. 19, 1957.

_____. "Human Abilities in Education." California Journal of Instructional Improvement, 1 (December, 1958), pp. 3-6.

_____. "Three Faces of Intellect." American Psychologist, 14 (August, 1949), pp. 469-479.

_____, B. Fruchter, and H.P. Kelley. "Development and Application of Tests of Intellectual and Special Aptitudes." Review of Educational Research, 29 (Spring, 1959), pp. 26-41.

_____, and P.R. Merrifield. The Structure of Intellect Model: Its Uses and Implications. Reports from the Psychological Laboratory, The University of Southern California, No. 24, 1960.

_____. "Basic Conceptual Problems in the Psychology of Thinking." Annals of the New York Academy of Science, 91 (1960), pp. 6-12.

_____. "The Nature of Intelligence." Proceedings, Annual Summer Conference. Bellingham, Washington: Western Washington College, 1960, pp. 3-16.

_____. "Factorial Angles to Psychology." Psychological Review, 68 (January, 1961), pp. 1-20.

_____, et al. "Some New Symbolic Factors of Cognition and Convergent Production." Educational and Psychological Measurements, 21 (Autumn, 1961), pp. 515-541.

_____, and R. Hoepfner. Current Summary of Structure of Intellect Factors and Suggested Tests. Reports from the Psychological Laboratory, The University of Southern California, No. 30, 1963.

Guthrie, George M. "Structure of Abilities in a Non-Western Culture." Journal of Educational Psychology, 54 (April, 1963), pp. 94-103.

Knapp, Robert T. "The Effects of Time Limit on the Intelligence Test Performance of Mexican and American Subjects." Journal of Educational Psychology, 51 (February, 1960), pp. 14-20.

Lindquist, E.F. "An Evaluation of a Technique for Scaling High School Grades to Improve Prediction of College Success." Educational and Psychological Measurements, 23 (Winter, 1963), pp. 623-646.

Lord, Frederick M. "A Study of Speed Factors in Tests and Academic Grades." Psychometrica, 21 (March, 1956), pp. 31-35.

_____. "Formula Scoring and Validity." Educational and Psychological Measurements, 23 (Winter, 1963), pp. 663-672.

Merrifield, P.R., et al. "The Role of Intellectual Factors in Problem Solving." Psychological Monographs, 76 (Whole No. 529), 1962.

Michael, W.B., A.L. Comrey, and B. Fruchter. "J.P. Guilford: Psychologist and Teacher." Psychological Bulletin, 60 (January, 1963), pp. 1-34.

Merenda, P.F. "Relative Predictive Efficiency of a Short Versus a Long Test Battery for High School Students." Psychological Reports, 8 (February, 1961), p. 62.

_____. et al. "Relative Predictive Efficiency of the DAT and a Short Multifactor Battery of Tests." Psychological Reports, 11 (August, 1962), pp. 71-81.

Milholland, John E., and B.G. Fricke. "Development and Application of Tests of Special Aptitudes." Review of Educational Research, 32 (February, 1962), pp. 25-39.

Peterson, H., et al. Determination of "Structure-of-Intellect" Abilities Involved in Ninth-Grade Algebra and General Mathematics. Reports from the Psychological Laboratory, The University of Southern California, No. 31, 1963.

Schwarz, Paul A. "Adapting Tests to the Cultural Setting." Educational and Psychological Measurements, 23 (Winter, 1963), pp. 673-685.

Super, Donald E. "The Use of Multifactor Test Batteries in Guidance." The Personnel and Guidance Journal, 35 (September, 1956), pp. 9-15.

Thurstone, L.L. Primary Mental Abilities. Psychometric Monograph No. 1, Chicago: University of Chicago Press, 1951.

Wellman, F.E. "Differential Prediction of High School Achievement Using Single Score and Multiple Factor Tests of Mental Maturity." The Personnel and Guidance Journal, 35 (April, 1957), pp. 512-517.

Wesman, A.G. "Some Effect of Speed in Test Use." Educational and Psychological Measurements, 20 (Summer, 1960), pp. 267-274.

Wolking, William D. "Predicting Academic Achievement with Differential Aptitude and the Primary Mental Abilities Tests." Journal of Applied Psychology, 39 (April, 1955), pp. 115-118.