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ABSTRACT

INDIVIDUALLY PRESCRIBED INSTRUCTION (IPI) HAS BEEN CRITICIZED AS INHIBITING THE DEVELOPMENT OF CREATIVITY. IT IS PROPOSED THAT A PILOT STUDY BE CONDUCTED WHOSE GOAL WILL BE THE SELECTION AND TRIAL OF INSTRUMENTS FOR MEASURING CREATIVE PROBLEM-SOLVING ABILITY IN ORDER TO COMPARE IPI PUPILS WITH NON-IPI PUPILS, AND TO DIFFERENTIATE AMONG INDIVIDUALS WITHIN THE IPI POPULATION. THE BEST APPROACH TO THE MEASUREMENT OF CREATIVITY IN IPI MIGHT BE BASED UPON THEORY PROVIDED BY THE STRUCTURE OF INTELLECT (SI) FACTORS WHICH HAVE BEEN IDENTIFIED AND SHOWN TO PLAY SIGNIFICANT ROLES IN PREVIOUS RESEARCH STUDIES. RECOMMENDATIONS ARE MADE FOR THE USE OF PARTS OF TWO TESTING SYSTEMS AND THEIR ANALYSIS AND EVALUATION IN THE IPI CONTEXT. (JY)

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INDIVIDUALLY PRESCRIBED INSTRUCTION: A PROPOSED PILOT STUDY OF SELECTED INTELLECTUAL FACTORS

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I. Need for a Study of Creative Problem Solving in IPI

Many critics have levelled at the Individually Prescribed Instruction Program (IPI) the accusation that it does not promote the learning or expression of creativity and problem-solving skills on the part of the student. In fact, IPI may be inhibiting or even prohibiting these aspects of intellectual functioning. Such charges understandably arise after the accuser peruses the IPI instructional materials. The materials seem to be highly structured and of a unified style which leaves little room for divergent responses and little need for the pupil to set up problem solutions of his own. In most lessons, the only means of varying the materials for individual students seems to be by varying the amount the student must plow through in any one unit or skill. In many IPI skills, particularly in the lower levels, there are sound discs, filmstrips, and manipulative devices available, but even these call for structured responses on standard-type work sheets. Open-ended exercises are carefully avoided throughout the continua to allow for scoring by non-professional aides. Also, there seems to be no provision in the curriculum for taking into account the child's own interests and present abilities other than the limited competency indicated by the IPI pretests; the plan calls for him to be assigned work in his weak areas and does not seem to allow him to explore and perfect his strong skills and interests to a point where he could begin to develop creative talents in these areas. Any guidance in this direction is strictly up to the teacher. Finally, the strict division of content areas in the continua seems to preclude exercises and teaching materials in which the student must learn to solve problems requiring integration, generalization, and transfer of knowledge from all his resources and the use of productive and evaluative thinking which draws upon previous knowledge.

There is no objective evidence available, however, to either support or refute these critical accusations. The opposite situation may be true; the use of IPI in the classroom may free the teacher from the burden of teaching elementary skills such as phonics and the multiplication tables, allowing her time to encourage and stimulate the development of other talents in the children. She may spend much more time than the standard classroom teacher with individual pupils on extra-curricular learning activities, guiding pupils into independent study projects, introducing them to problem solving games, giving attention to their ideas, and similarly encouraging creative work (Torrance, 1963). It may also be the case that IPI pupils are no different than any others with respect to their creative and problem-solving abilities--that IPI neither promotes nor suppresses the development of these skills in its pupils.

Within the IPI setting, there are several questions to be answered regarding the development of creative problem-solving ability which are intriguing ones from a research point of view and which an increasing number of people concerned with the program feel need to be answered if IPI is to continue to progress. A study needs to be made of practical methods for fostering the development of creative problem-solving ability in an individualized instructional situation, and in connection with such a study, such questions as the following need to be answered: 1) Are individual differences in creative and problem-solving abilities related to achievement in IPI? 2) Is it possible to develop instructional materials for IPI which will require children to use and thus improve proficiency in higher level mental processes such as convergent and divergent production and evaluation? 3) What form might such materials take, and how can they be implemented in the classroom? 4) Is it possible to put the results of testing for creative problem solving ability into a form that is both meaningful and useful to teachers for prescribing lessons for individual pupils? 6) Is it possible to train teachers to use such information wisely? 7) Would the introduction of IPI materials designed to elicit creative problem solving responses cause changes in pupil achievement or changes in pupil and teacher attitudes toward IPI or in their functional roles in the IPI classroom?

Of course, studies to answer these questions depend upon the definition of instruments to measure creative problem solving ability. Therefore, at this point in the evaluation of the IPI Program, it seems essential that an attempt be made to formulate objective descriptions of both experimental (IPI) and control (non-IPI) populations with respect to some cognitive aspects of intellectual functioning which may be related to creative production and problem solving abilities and which have thus far been slighted in IPI appraisal studies. There are two primary reasons for attempting such descriptions or measurements. One is suggested by the charges regarding creativity or the lack of it in IPI--to obtain information with which to answer the question as to whether IPI might foster, inhibit, or simply neglect these abilities. A second purpose is to see if it is possible to identify individual differences with respect to these abilities within the IPI group so that subsequent developmental studies might be feasibly based on the measurements. Initially, it is proposed that a pilot study be conducted with its goal as the selection and trial of instruments for measuring creative problem solving ability in order to compare IPI pupils with non-IPI pupils and to differentiate among individuals within the IPI population. A test battery will be compiled and administered to children in IPI demonstration schools and their respective control schools all under the supervision of Research for Better Schools, Inc. In the following pages the rationale for the selection of specific instruments will be reviewed (section II). Finally, a procedure for the pilot study will be outlined (section III) including the administration of the instrument, analysis of the data, and possible implications for the results.

II. Rationale for the Selection of Feasible Creativity Measures

One of the first problems encountered in an attempt to measure creative and problem solving ability is that of defining creativity. A review of the psychological literature on the subject produces no single clear-cut definition. Moreover, the current consensus seems to be that creativity is not a unitary ability but rather, like "intelligence," is effected by several different intellectual factors or abilities interacting with each other. Scores on any single instrument purported to measure "creativity" as a whole are actually contaminated or complicated by the interaction of these factors so that the examiner may not know what specific ability he is measuring. Perhaps the most significant progress in giving operational definition to the construct of creativity and in factoring creative ability into its component parts has been made by the Aptitudes Research Project at the University of

Southern California under the direction of J. P. Guilford. These researchers have described aspects of creative and problem solving behavior in terms of the factors of a structure of intellect model, thus providing a frame of reference for relating these abilities to other intellectual functions such as perception, memory, ability to deal with words, numbers, pictures or with various kinds of products of thinking such as classes, relations, or implications.

A significant discovery of this sort is that many of the factors involved in problem solving and in creativity are the same, thus lending support for a sort of conglomerate construct of creative problem solving ability. The mental processes involved in producing a new (or creative) product seem to be the same ones involved in producing the solution to a problem (Guilford, 1967). In fact, the creative product might be viewed as a solution to a problem or a felt need on the part of the creator, and in a problem solving situation, the individual must usually create a solution by some sort of transformation of knowledge. This is why, earlier in this paper, creativity and problem solving were referred to together and often interchanged. Throughout this study the similarity between these two mental processes should be kept in mind by the investigators since many of the factors measured in the instruments to be compiled are essentially indicators of both creativity and problem solving skills. Any curriculum and teaching materials developed subsequently should probably attempt to enhance creative problem solving as a combination of all of these abilities rather than creativity or problem solving separately, since research seems to show that they are not entirely separate processes.

Guilford (1967) has reviewed steps in problem solving and creative production outlined by three different authors and has merged some of these ideas with an interpretation of the problem solving process based on concepts from the structure of intellect model to come up with a generalized operational model for the process. This model allows for input and cognition of relevant information at several stages as well as continuous drawal upon information from memory and frequent evaluation of both information and the products of thinking. To summarize the process of problem solving and the operational model, it seems to involve several abilities on the part of the individual which may be grouped according to sequential steps in arriving at problem solutions. 1) The first step involves the ability to detect problems, to feel or observe a need or a difficulty which can be improved and to foresee the importance or implications of its solutions. 2) Next, the person must be able to translate this felt need into a problem statement or structure in a form which can be solved whether verbal, numeric, figural (visual), or behavioral, or he must be able to understand (cognize) a problem presented to him for solution. 3) Thirdly, the individual surveys information available to him both in memory storage and in the environment and gathers relevant facts. Here a facile memory is a distinct advantage. 4) Fourthly, he must be able to generate possible solutions, perhaps after a period of incubation when no conscious thinking about the problem takes place. These solutions may be produced by a number of different means and the person's relative ability at several skills may affect the way he produces solutions and the kinds of solutions he can manufacture. The first and easiest way to find answers is by replicative recall, if those answers are available in memory. In creative problem solving, transfer recall would play a more important role and would be involved in the operations of convergent and divergent production. In convergent production, a solution is arrived at in a step by step manner by logical reasoning resulting in a single answer to meet the specifications of the problem. In divergent production, a variety of solutions are generated which could solve the problem. A decision to use one of these in preference to the others involves evaluation and takes place later in the problem solving process. Ability to produce several different types of products either convergently or divergently becomes important in the production step--these products may be unitary ideas, classes of ideas, relations, systems, or transformations. The latter, transformations, produced divergently are involved in the customary concept of originality. 5) Next in the creative process, ability to produce and to cognize the possible implications or consequences of the generated solutions comes into play. 6) Evaluation of the possible solutions must then take place, perhaps with mental "testing" of the possibilities. Finally, the most appropriate solution is cognized and accepted.

The problem-solving process does not end with these steps, however, and the steps must not be considered discrete by any means. If the solutions generated are deemed unsatisfactory, the process may recycle, gathering new information, manufacturing new solutions, testing and retesting and reevaluating, perhaps even going back as far as to restructuring the original problem. Also, the individual may exit from operation on the problem at a number of stages before actually putting the solution into application: he may decide on the basis of information that the problem is insolvable or not worth the effort; he may leave it to return later; or he may decide to use solutions in various stages of incompleteness. Also, within the production step (the fourth), his use of different thinking abilities will vary greatly depending on the nature of the problem, his own past experience, and the information available.

Knowledge about some of the abilities involved in creative production has been gained largely through factor analytic studies of tests of problem-solving. Because of the nature of this mathematical technique, the abilities identified are those which contribute largely to variance in test scores and thus differentiate among individuals' performances on the test--it does not single out abilities held in common by all of the examinees which may also be used in the problem solutions. This might be considered a limitation to the factor analytic approach. One other drawback is that it identifies abilities relative to the group of examinees so that a particular individual may be characterized by his variation from the group mean on a certain ability factor. However, he may not even employ that ability in his problem solution, arriving at an answer by completely different means. Factor analysis cannot point out the many possible individual thought processes which may operate on any one problem, but can only suggest those employed by a theoretical "average person," delineating factors on which the group varies (Guilford, 1961). In spite of these limitations, the factorial studies carried out by Guilford and his associates and based upon the structure of intellect model have probably provided empirical evidence for the most analytic and detailed description of the abilities involved in creative problem-solving so far available. For this reason, it is suggested that the best approach to the measurement of creativity in IPI might be based upon theory provided by the structure of intellect and might attempt to use tests or adaptations of tests for structure of intellect (SI) factors which have been identified and shown to play significant roles in the problem-solving process in previous research studies.

An operational definition of creativity might include a large number of SI factors shown to be involved in problem solving. For example, one study by Merrifield, et. al. (1962) turned up twelve such factors dealing with semantic content alone. There are probably this many in each of the other three SI content areas, and conceivably the number in each content is even greater. For the purposes of this study, the number of factors tested for must be limited. For one thing, the time spent on testing must fit into school scheduling and must be kept short to avoid boredom on the part of the children. Tests will need to be chosen which show promise for use with children in grades three through six; this will limit the selection of instruments, since most of the SI factor tests have been developed on adult populations. A study by Merrifield, et. al. (1964) described some of the ways in which four SI tests were restructured to the level of seventh graders. These modifications consisted mainly of substituting easier reading material, including in the directions examples more indicative of the types of answers desired, clarifying the directions, in some cases shortening the test, and generally lowering the scoring criteria. These changes helped to increase the variance in scores making frequency distributions more nearly normal and the application of factor analysis mathematically feasible. Some of the same tests used in this study and one by Schmadel, et. al. (1965) might be used for the IPI study. Another limiting dimension in the choice of tests for the IPI study can be content area. Since the results of creativity testing in IPI will be applied or related to the subject areas of reading and mathematics, first consideration might be given to tests of semantic and symbolic content and possibly a few of the figural content factors which have been shown to be related to mathematics and verbal achievement. Considering the limitations of length of testing, age of the subjects, content area, and major abilities involved in creativity, it might be suggested that tests for the following five factors be considered for inclusion in a battery to be administered to IPI and Control children: (Merrifield & Christensen, 1964; Merrifield, et. al., 1964; Schmadel, et. al., 1965)

CMI - cognition of semantic implications (conceptual foresight). This factor represents the ability to foresee the possible consequences or implications of a problem and/or its solutions.

DMU - divergent production of semantic units (ideational fluency). Tests for this factor demonstrate ability to generate a large number of ideas about a certain problem.

DMR - divergent production of semantic relations (associational fluency). This may be an ability to make meaningful connections between ideas by association thus leading to possible solutions to a problem.

DMT - divergent production of semantic transformations (originality). Tests for this factor seem to measure quality of responses rather than quantity as is implied by DMU. The responses sought are remote or clever and involve making unusual changes in ideas.

EMI - evaluation of semantic implications (sensitivity to problems). This represents the essential first step in creative problem-solving: that is, the ability to see the need for a solution.

Tests for these factors suggested by the two studies by Merrifield (1964) and Schmadel (1965) with sixth and seventh grade children include the following:

CMI - "Different Ways." The pupil is asked to list several ways of accomplishing a task. (Schmadel, 1965)

DMU - "Names for Stories (Low)." The pupil writes titles for paragraphs based nursery rhymes and is scored on the basis of the total number of pertinent titles judged non-clever.

"What Would Happen (Obvious)." Pupil lists consequences of a change and is scored for number of relevant responses. (Merrifield, 1964)

DMR - "Similar Words." The pupil writes synonyms for common words. (Merrifield, 1964)

DMT - "Names for Stories (High)." The pupil is asked to write clever titles on this test.

"What Would Happen (Remote)." On this test, indirectly associated but relevant responses are counted in the score. (Merrifield, 1964)

EMI - "Seeing Problems." This test was shown to have the highest reliability (.83) of any of the ones used with sixth and seventh grade children. It requires the pupil to list problems which might occur in connection with situations. (Schmadel, 1965)

III. Procedure for the IPI Study

A. Administration of the Instruments

For the actual administration, these seven tests could be grouped into batteries for three testing sessions of approximately thirty-five minutes each on separate days. The tests would be given by specially trained personnel to children in grades three through six in three IPI demonstration schools and three control schools accessible to Research for Better Schools. Initial testing for the pilot would take place in February 1969.

In addition to the creativity tests, pupils in all of the schools have taken the Lorge-Thorndike I.Q. tests so that verbal I.Q. scores will be available for the data analysis to help control for reading ability and verbal comprehension.

B. Analysis of the Data

Scoring of the tests will be done by trained para-professional staff members at RBS, and inter-rater reliabilities will be determined. Internal consistency reliabilities will also be determine for the final test scores.

Two-tailed tests for significance of differences between means and variances of the IPI versus non-IPI groups will be carried out for each test. The samples will be broken down by grade and sex within each IPI school compared with its matched control school. The same statistics will also be obtained by grade (sexes combined), by school, and for the total groups (IPI versus non-IPI).

Intercorrelations will be run between all of the SI factor test items and the verbal I.Q. test scores. Partial correlations between each pair of SI tests with the effects of the verbal I.Q. scores removed may also be determined.

A factor analysis of the intercorrelation matrix will be carried out to help verify whether the tests are functioning independently as demonstrated in previous studies.

C. Interpretation of Results

Results of the statistical tests for significance of differences should answer the question as to how IPI pupils compare with non-IPI pupils on these selected measures of creativity.

Examination of the intercorrelations and factors will help verify whether the tests are operating, as they have in the older sample groups, as separate factor tests or whether they are contaminated to a large extent by the limited intellectual development of the young subjects in these samples. The partial correlations would also help show whether or not the tests are independent, and, if not, in what ways they are related and to what extent they are dependent on reading ability.

In order to help answer the question as to whether these tests may be used to differentiate pupils in IPI who might benefit by an approach to teaching reading which involved creative responses, the shape of the frequency distributions and spread of scores will be of particular interest. Tests yielding relatively flat distributions with large standard deviations would be the more useful ones for discriminating among pupils.

After the results of this first administration of the instruments and analyses of the data are reviewed, procedures for subsequent study can be outlined.

REFERENCES

Guilford, J. P. An emerging view in learning theory. Symposium at Western Washington State College, Bellingham, Washington, 1961.

Guilford, J. P. *The nature of human intelligence.* New York: McGraw-Hill Publishing Co., 1967.

Merrifield, P. R. and Christensen, P. R. Descriptions of Guilford's structure of intellect factors. Mimeographed paper, Los Angeles County Superintendent of Schools Division of Research and Guidance, 1964.

Merrifield, P. R., Gardner, S. F., and Cox, Anna B. Aptitudes and personality measures related to creativity in seventh-grade children. Reports from the Psychological Laboratory, The University of Southern California, Number 29, January 1964.

Merrifield, P. R., Guilford, J. P. Christensen, P. R., and Frick, J. W. The role of intellectual factors in problem solving. *Psychological Monographs: General and Applied*, Whole Number 529, 1962.

Schmadel, Elnora, Merrifield, P. R., and Bonsall, Marcella R. A comparison of performances of gifted and non-gifted children on selected measures of creativity. *California Journal of Educational Research*, Vol. XVI, Number 3, May 1965.

Torrance, P. E. *Educational and the Creative Potential*. Minneapolis: University of Minnesota Press, 1963.