# The Interaction Of Conceptualisation Styles On Discovery Learning*

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**Kajian ini cuba meninjau perkaitan di antara satu gaya kognitif dan pembelajaran melalui pendekatan jumpaan (penemuan). Gaya kognitif yang dikaji adalah gaya pengkonsepan mod inferensial, mod perihalan (descriptive), mod berkait (relational). Pendekatan jumpaan yang digunakan dalam kajian ini terdiri daripada situasi di mana pelajar diberi sesuatu masalah tetapi cara penyelesaian dan jawapan tidak diberi kepadanya. Keputusan dari kajian ini menunjukkan prestasi seorang pelajar yang mempunyai kecenderungan tinggi untuk mod inferensial adalah lebih baik dalam situasi pembelajaran jumpaan.**

## Introduction

In education literature especially relating to the teaching of science and mathemathics, the present fashion is the advocacy of learning by discovery as the most effective teaching method. This is evidenced by the large number of science and mathematics which have designed learning using the discovery or inquiry approach. The essence of learning by discovery is that the thing learned is not solely by communication from teacher or text to student.It involves induction which is a procedure of giving exemplars of a more general case that permits the student to induce the general implicit pattern involved. From this it can be seen that discovery learning relies on the intuitive behaviour of a learner and his ability to analyse and synthesize observable phenomena into a meaningful learning outcome. When viewed with the concept of cognitive style which suggests that individuals differ in their mode of processing information, learning by discovery appears not to be a viable approach for all types of students.

The purpose of this study was to examine the possible interaction of the conceptualisation styles on learning by discovery. The conceptualisation styles were isolated by Kagan et.al. (1960), and they refer to the ways individuals process and categorise their environment to form concepts. Kagan et.al. have suggested three different modes of conceptualisation:

(i) **Relational conceptualisation style** - This style is in evidence if an individual groups together different stimuli on the basis of relationships which he assumes to exist between them. For example, given three stimuli, viz., man, watch and ruler, an individual may put together the man and the watch on the ground that the watch is worn by the man. In other words, a relational dependence is invoked between the two stimuli.

(ii) **Descriptive conceptualisation style** - Individuals are said to display a descriptive conceptualisation style if they tend to group stimuli together on the basis of similarities perceived in some physical attributes of the stimuli. Such attributes

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may be size, shape, colour, etc., which are shared by the stimuli. With respect to the example mentioned in (i), the selection of watch and ruler on the ground that both show numerals, would be indicative of a descriptive conceptualisation style. The important characteristic is that the attention is focused on the physical attributes of the stimuli and not on the functional link between them as in the relational style.

(iii) **Inferential conceptualisation style** - This conceptualisation is displayed when stimuli are grouped together on the basis of an inferred characteristic possessed by them without this being inherent in the nature of the stimuli. For example, in the above situation, an alternate reason for grouping together watch and ruler might be that they both represent measuring instruments. In this case, no reference is made in the classification to the physical attributes associated with the stimuli.

Studies carried out relating conceptualisation styles to learning behaviour and/or achievement (Kagan et.al., 1963; Beller, 1967; Ogunyemi, 1973; Gray and Knief, 1975; Roach 1979) reveal that conceptualisation styles do have some relationship with learning behaviour and achievement. Hence this study was designed to investigate the interaction of a students' conceptualisation style on learning by discovery.

With respect to learning, in the direct sense, conceptualisation styles are likely to affect students' behaviour in concept attainment tasks. Concept attainment, as is readily recognised, involves the student in the abstraction of particular stimuli from exemplars which he is confronted with and the synthesis of these stimuli into a pattern or a class embracing all the stimuli. This means that we may associate with concept attainment an analytical component as well as a synthetic component.

Of the three conceptualisation styles, both the descriptive and inferential modes certainly comprise an analytical part; i.e., from a set of stimuli figures presented, some common element has to be abstracted by analysis. This aspect is essentially absent from the relational mode and it may therefore be suggested that this particular conceptualisation style should not have any influence on students' concept attainment.

Of the two modes containing an analytical component it is the inferential conceptualisation style which, in addition to this analysis component, also contains a substantial synthesis component. Through this, the stimuli originally analysed are brought together in a higher order class. This process is essentially one of concept attainment. In so far as the inferential conceptualisation style comprises both analysis and synthesis, it may be hypothesised that it would have the greatest bearing on student concept attainment. The descriptive conceptualisation mode, in so far it does contain an analysis component, may also be expected to have some influence on students' concept attainment skill, but probably to a lesser degree than the inferential mode, because of the absence of the synthesis component.

Linking now the foregoing argument concerning concept attainment and conceptualisation style to the issue of discovery learning, it may be agreed that since most discovery learning involves students in the recognition and formulation of concepts, the inferential conceptualisation style should have a direct bearing on students' success in discovery learning. To a perhaps lesser extent the same might apply to the descriptive conceptualisation mode also, but not to the relational conceptualisation style.

## Research sample and design

The sample for this study consisted of 206 third formers form two comprehensive schools in Northwest Midlands, UK. They were all members of the top and middle band classes in their respective schools. Of these 93 were boys and 113 were girls. The average age of the sample was 14 years and four months.

An examination of the interaction of conceptualisation styles on learning by discovery was made, based on the learning outcomes fromk a set of five short learning exercises which had previously been used in several published researches on the comparative effectiveness of discovery learning and expository teaching. The five exercises selected involved the following tasks:

(i) unscrambling scrambled words

(ii) uncoding coded words

(iii) completing a letter series

(iv) completing a number series

(v) finding the formula for calculating the sum of odd numbers series.

Not all the learning tasks mentioned above could be administered to all the student in the two schools due to time constraint. However, an attempt was made to ensure that each student completed at least two of the learning tasks besides the conceptualisation styles test.

The general statistical technique applied to the scores of the learning outcomes was the analysis of variance in its one way format. For the analysis, subjects were divided into three groups (high, intermediate, low) on the basis of their scores for each of the conceptualisation styles, thus forming a 1 × 3 research design.

**Conceptualisation styles instrument**

The conceptual preference test designed by Kempa (1976) following the pattern described by Sigel (1963) was selected as the measure of conceptualisation styles. The test consists of 24 triads of line drawings of common objects. Each picture also carried the name

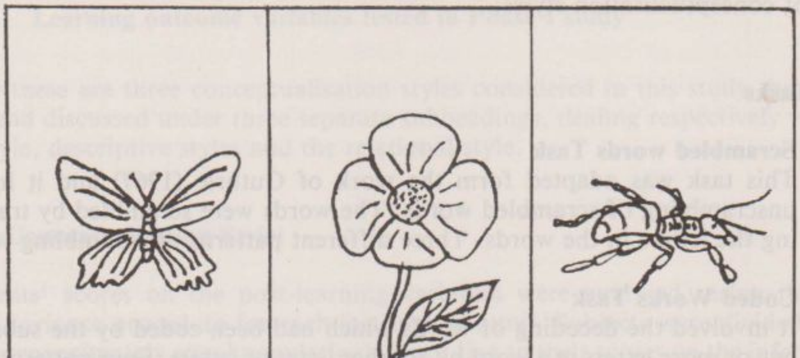


FIGURE 1: **Sample item from Conceptual Preference Test.**

*Source:* Kempa R.F. **Conceptual Preference Test,** University of Keele, U.K. 1976.

of the object, so as to avoid any ambiquity. For each triad, three statements are given expressing respectively, a relational linkage a descriptive linkage and an inferential (categorical) linkage between two of the objects. The order of these statements is entirely random for the test as a whole. Figure 1 below illustrates a typical item.

(a) A and C have segmented body.

(b) A can get nectar from B.

(c) A and C are insects.

In completing the test, students were asked to select from the three responses given for each picture triad the one they most preferred and the one they least preferred.

The procedure adopted for the scoring of this test was as follows. Three points were assigned to the most preferred statemant; one point to the least preferred statement and two points to the remaining one. On this basis, three scores were derived for each student expressing, respectively, his (i) preference for inferential concepts, (ii) preference for descriptive concepts, (iii) preference for relational concepts, with the scores ranging from 24 to 72. The scores obtained in this way are ipsative in nature, i.e. have the characteristic of adding up to a fixed total:

$$S_{\text{inferential}} + S_{\text{descriptive}} + S_{\text{relational}} = \text{Constant}$$

Whilst ipsative scores have the advantage of providing high discrimination between the response modes and thus enhance the distinction between students in relation to their preference for different conceptualisation styles, their interpretation is somewhat problematic because of the interdependence of the scores. This makes the usual statistical procedures of data analysis inappropriate and inapplicable, ruling out, for example, correlational work. There is no easy solution to this problem. Researchers using the ipsative conceptual preferences test have either dichotomised the student sample in terms of two of the scales, e.g. descriptive vs. relational, ignoring thereby the third score (Kagan et.al., 1963; Scott, 1973) or they have treated each scales as an independent variable, without reference to the remaining two scales. In the latter case, normative statistics have generally been used for the data analysis (Wallach and Kogan, 1965; Ogunyemi, 1973). For the purpose of the present study, the latter procedure has been adopted, treating the three scales as independent measures of conceptualisation styles.

**Learning Tasks**

(i) **Scrambled words Task**
This task was adapted form the work of Guthrie (1967) and it involved the unscrambling of scrambled words. The words were scrambled by transpositioning the letters in the words. Three different patterns of scrambling were used.

(ii) **Coded Works Task**
It involved the decoding of words which had been coded by the substitution of one or more letters in a word by another letter or letters. Four patterns of subtitution were employed. This task was also adopted from the work of Guthrie (1967).

(iii) **Letter Series and Number Series Tasks**
Both of these were adapted from the work of Simon and Kotovsky (1963) and were concerned with the identification of patterns in letter series and number series.

(iv) **Sum of Odd-number Series Task**

This mathematics task was adapted from the work of Kersh (1958, 1962). It concerned finding the relationship between the number of members in an odd-number series beginning with one and the sum of the series.

All these learning tasks were prepared in two different versions, the discovery version and the expository version using the self instructional format. For this study only the discovery version was used. In the context of the present study discovery learning/instruction consisted of learning situations in which the learner was provided with a set of exemplars implying a rule. The learner was required to "decode" the exemplars, i.e. identify or deduce the rule implicit in them. In short, the present discovery approach may be summarised using Hermann's (1969) suggestion for categorising instructional sequence as: exemplars given - answer not given - rules not given.

The learning outcomes from these learning tasks were assessed by additional exercises within the learning programme or be separate post learning tasks as appropriate.

**Results and discussion**

The independent variables of this study were conceptualisation styles (inferential, descriptive, relational) and the dependent variables were post learning outcome scores. Table 1 lists the learning outcome variables tested in the study.

| Learning Task | Type of learning outcome variables tested | | |
|---|---|---|---|
| | Knowledge of rule | Direct application of rule | Application of Inverse rule |
| (i) scrambled words | x | x | x |
| (ii) coded words | x | x | x |
| (iii) Letter series | | x | |
| (iv) Number series | | x | |
| (v) Sum of Odd-number series | | x | |

TABLE 1: **Learning outcome variables tested in Phase I study**

Since these are three conceptualisation styles considered in this study the results are presented and discussed under three separate subheadings, dealing respectively with the inferential style, descriptive styles and the relational style.

**Inferential Conceptualisation Style:**

Students' scores on the post-learning variables were analysed, using the one-way analysis of variance procedure for each instructional unit. Subjects were divided into three groups (of approximately equal population), according to their scores on the inferential style part of the Conceptual Preference Test. Table 2 gives the means and standard deviations achieved by these three groups on the various post-learning variables. The variables as such are identified in the table. Table 3 summarises the results of the one-way analyses of variance on these data.

It is seen that in both situations where students were required to learn and recall rules (scrambled words task and coded words task), a statistically significant variation of scores with levels of inferential thinking is observed. Qualitatively, it is seen that the higher the students' learning towards the inferential thinking mode, the higher is their mean score on the knowledge of the rules. This finding is in full agreement with the hypothesis advanced earlier, namely, that students with a high tendency towards the inferential thinking mode should perform better than other students as far as the learning of rules by the discovery procedure is concerned. It may be concluded therefore, that the tendency towards high inferential thinking in students promoted their success in learning tasks which require the abstraction of information from stimuli and the subsequent synthesis of such information into patterns.

| Learning Outcome Variable | Task (Max. Score) | Peformance Score of Subgroups | | |
|---|---|---|---|---|
| | | High Inferential | Intermediate | Low Inferential |
| Knowledge of Rules | Scrambled Words (Max. Score = 6) | 5.66 (0.64) N = 35 | 5.17 (1.32) N = 30 | 4.25 (2.11) N = 24 |
| | Coded Words (Max. Score = 8) | 7.19 (1.83) N = 26 | 6.56 (1.94) N = 25 | 5.74 (2.21) N = 27 |
| Direct Application of Rules | Scrambled Words (Max. Score = 6) | 5.34 (1.16) N = 35 | 5.13 (1.56) N = 30 | 4.45 (2.21) N = 24 |
| | Coded Words (Max. Score = 8) | 7.27 (1.22) N = 26 | 6.68 (1.46) N = 25 | 6.81 (1.80) N = 27 |
| | Letter Series (Max. Score = 12) | 11.04 (1.40) N = 25 | 10.73 (1.78) N = 30 | 10.55 (1.92) N = 11 |
| | Number Series (Max. Score = 12) | 10.28 (2.17) N = 25 | 9.47 (2.73) N = 30 | 10.73 (2.00) N = 11 |
| | Sum of Odd-Numbers Series (Max. Score = 8) | 6.00 (2.21) N = 21 | 4.31 (3.52) N = 29 | 6.25 (1.88) N = 32 |
| Application of Inverse Rules | Scrambled Words (Max. Score = 6) | 4.71 (1.72) N = 35 | 4.00 (2.02) N = 30 | 3.46 (2.19) N = 24 |
| | Coded Words (Max. Score = 8) | 4.54 (3.05) N = 26 | 2.28 (2.26) N = 25 | 2.78 (2.66) N = 27 |

TABLE 2: **Mean Scores and Standard Deviations on Learning Outcome Variables from All Tasks with Respect to Levels of Inferential Conceptualisation.**

| Variable | Task | df | Mean Squares | | F-ratio | Signif. |
|---|---|---|---|---|---|---|
| | | | Between | Within | | Level p≤ |
| Knowledge of Rules | Scrambles Words | 2/86 | 14.16 | 1.94 | 7.31 | 0.01 |
| | Coded Words | 2/75 | 14.05 | 4.02 | 3.50 | 0.05 |
| Direct Application of Rules | Scrambled Words | 2/86 | 5.79 | 2.67 | 2.17 | N.S |
| | Coded Words | 2/75 | 2.45 | 2.30 | 1.07 | N.S |
| | Letter Series | 2/63 | 1.13 | 2.79 | 0.41 | N.S |
| | Number Series | 2/63 | 8.15 | 5.85 | 1.39 | N.S |
| | Sum of Odd-Numbers Series | 2/79 | 32.15 | 7.02 | 4.58 | 0.01 |
| Application of Inverse Rules | Scrambled Words | 2/86 | 11.64 | 3.82 | 3.04 | 0.05 |
| | Coded Words | 2/75 | 36.27 | 7.76 | 4.67 | 0.01 |

TABLE 3: **Summary of One-Way Analyses of Variance of Learning Outcome Variables with Respect to Levels of Inferential Conceptualisation.**

This view is also confirmed by the superior performance of high inferential thinkers on the two sets of tasks requiring the application of the inverse rules. The application of inverse rules requires students to have gained a level of insight, beyond that required for the mere discovery of the basic rules. It may, in fact, be argued that the inverse application of the original rules presupposes the discovery of a further set of rules from the original ones. In this case, in relation to students of high inferential thinking style, a similar advantage would be expected as in the original discovery task leading to the formulation of the basic rules. This is borne out by the present result. It is seen that the higher the learning towards inferential thinking, the greater is the performance level of the three groups of the students on the task requiring the application of the inverse rules.

As far as the direct application of the rules variables are concerned no significant difference appears in the performance level of the groups having different levels of inferential thinking, except in the case of the sum of odd-number series task. The difference here is due to the peculiar performance of the middle group, rather than to a systematic variation. The general absence of any systematic and significant difference between the groups may be due to the fact that the tasks involved in the direct application of rules can be solved simply by applying the procedure used for decoding the original examples. If this is so, the differential learning of individuals towards inferential thinking cannot be expected to have any direct influence on this achievement here.

**Descriptive Conceptualisation Style**

For the purpose of the analysis, the subjects were divided into three groups according to their scores on the descriptive style part of the Conceptual Preference Test. Table 4 gives the means and standard deviations achieved by the three groups on the post-learning variables, and Table 5 presents a summary of the one-way analyses of these data.

It is seen from Table 4 that the performance on the 'knowledge of rules' variables does not show any major variation across the groups. This is confirmed by the analysis of variance which fails to reveal any significant difference between the groups. The same is true for the 'direct application or rules' variables, where no significant influence of this style is observed in relation to students' performance on the verbal tasks (scrambled words, coded words and letter series). However, some such influence appears in the numerical tasks (number series and sum of odd-number series) where is higher learning towards the descriptive conceptualisation style is accompanied by a higher performance on the relevant variables. However, the analyses of variance data reveal this trend to be significant only in the case of the sum of odd-numbers task.

The strong effect of descriptive style on the sum of odd-numbers rule may be explained in terms of the nature of this task. Unlike the other tasks in the study, this task requires the

| Learning Outcome Variable | Task (Max. Score) | Peformance Score of Subgroups | | |
|---|---|---|---|---|
| | | High Descriptive | Intermediate | Low Descriptive |
| Knowledge of Rules | Scrambled Words (Max. Score = 6) | 5.07<br>(1.66)<br>N = 30 | 5.36<br>(1.08)<br>N = 25 | 4.97<br>(1.60)<br>N = 34 |
| | Coded Words (Max. Score = 8) | 6.34<br>(2.17)<br>N = 35 | 6.68<br>(1.99)<br>N = 25 | 6.50<br>(2.07)<br>N = 18 |
| Direct Application of Rules | Scrambled Words (Max. Score = 6) | 5.07<br>(1.93)<br>N = 30 | 5.40<br>(1.08)<br>N = 25 | 4.74<br>(1.73)<br>N = 34 |
| | Coded Words (Max. Score = 8) | 6.86<br>(1.78)<br>N = 35 | 1.28<br>(1.02)<br>N = 25 | 6.56<br>(1.50)<br>N = 18 |
| | Letter Series (Max. Score = 12) | 10.70<br>(1.82)<br>N = 23 | 10.64<br>(1.63)<br>N = 25 | 11.22<br>(1.48)<br>N = 18 |
| | Number Series (Max. Score = 12) | 10.26<br>(2.09)<br>N = 23 | 10.16<br>(2.84)<br>N = 25 | 9.25<br>(2.25)<br>N = 18 |
| | Sum of Odd-Numbers Series (Max. Score = 8) | 6.72<br>(1.03)<br>N = 29 | 5.22<br>(2.92)<br>N = 23 | 4.53<br>(3.36)<br>N = 30 |
| Application of Inverse Rules | Scrambled Words (Max. Score = 6) | 3.70<br>(2.28)<br>N = 30 | 4.48<br>(1.73)<br>N = 25 | 4.26<br>(1.91)<br>N = 34 |
| | Coded Words (Max. Score = 8) | 3.14<br>(2.86)<br>N = 35 | 3.64<br>(2.80)<br>N = 25 | 2.72<br>(3.25)<br>N = 18 |

TABLE 4: **Mean Scores and Standard Deviations on Learning Outcome Variables from All Tasks with Respect to Levels of Descriptive Conceptualisation.**

| Variable | Task | df | Mean Squares | | F-ratio | signif. Level p⩽ |
|---|---|---|---|---|---|---|
| | | | Between | Within | | |
| Knowledge of Rules | Scrambled Words | 2/86 | 1.14 | 2.24 | 0.51 | N.S |
| | Coded Words | 2/75 | 0.83 | 4.37 | 0.19 | N.S |
| Direct Application of Rules | Scrambled Words | 2/86 | 3.21 | 2.73 | 1.18 | N.S |
| | Coded Words | 2/75 | 2.88 | 2.29 | 1.26 | N.S |
| | Letter Series | 2/63 | 2.04 | 2.76 | 0.74 | N.S |
| | Number Series | 2/63 | 4.46 | 5.97 | 0.75 | N.S |
| | Sum of Odd-Number Series | 2/79 | 36.66 | 6.90 | 5.31 | 0.01 |
| Application of Inverse Rules | Scrambled Words | 2/86 | 4.61 | 3.99 | 1.56 | N.S |
| | Coded Words | 2/75 | 4.53 | 8.61 | 0.53 | N.S |

TABLE 5: **Summary of One-Way Analyses of Variance of Learning Outcome Variables with Respect to Levels of Descriptive Conceptualisation.**

students to analyse a set of information and abstract a relationship between the information provided. There was no 'decoding of exemplars' involved as in the other tasks. Also, the explicit knowledge of the rule is a prerequisite for success in further tasks. It appears that the analysis component of the descriptive style thinking has a significant influence on such learning situation. This appears to supports the findings of Gray and Knief (1975) and Roach (1979) who found that mathematics achievement in school was law but significantly related to descriptive style.

As for the application of inverse rules variable, no clear trend appears in the performance level of the groups and also no significant difference is observed between the groups.

In general, it can be said that the hypothesized (mild) influence of the preference for descriptive conceptualisation style, (which is that a high learning towards the descriptive style would be associated by a somewhat higher performance level on the post-learning tasks) is absent in the verbal tasks, but appears to extent in the numerical tasks.

**Relational Conceptualisation Style**

For the analysis of the effect of the relational style, the same procedure was used as for the other two conceptualisation styles. The subjects were divided into three groups according to their scores in the relational style part of the Conceptual Preference Test. Table 6 gives the means and standard deviations achieved by these groups. Table 7 summarises the one-way analyses of variance on the data.

The performance level in the "knowledge of rules" variables generally indicate an inverse relationship with relational thinking style, i.e., the lower the preference for relational style the higher the learning outcome. In the case of the scrambled words task, this trend is statistically highly significant ($p<0.01$). This finding would seem to be in conflict with the theoretical argument advanced above, according to which no association was expected between levels of relational thinking and performance on discovery learning tasks. On theoretical grounds, there is no obvious reason why the original argument should be abandoned and, therefore, explanations for the observed trend have to be looked for in other directions. Two possible explanations present themselves, in fact. The first arises from the ipsative nature of the conceptual preference data. As the correlational analysis revealed, a strong inverse relationship was found between relational and inferential scores on the conceptual preference test. The r-value calculated using the usual normative procedure, was - 0.62; (for an 'unbiased' ipsative test with three variables, a value of - 0.5 would be expected). Thus, in terms of score values as such, a low relational score, is equivalent to a high inferential score and vice versa. This, it must be stressed is a consequence of the ipsative nature of the conceptual preference data, and no psychological significance can be attributed to it. Nevertheless, it does have the effect of producing artificially the inverse association of levels of relational thinking with 'learning-of-rules' scores.

| Learning Outcome Variables | Task (Max. Score) | Performance Score of Subgroups | | |
|---|---|---|---|---|
| | | High Relational | Intermediate | Low Relational |
| Knowledge of Rules | Scrambled Words (Max. Score = 6) | 4.59<br>(1.89)<br>N = 34 | 5.11<br>(1.34)<br>N = 28 | 5.78<br>(0.51)<br>N = 27 |
| | Coded Words (Max. Score = 8) | 6.30<br>(1.96)<br>N = 23 | .04<br>(2.32)<br>N = 23 | 6.94<br>(1.92)<br>N = 32 |
| Direct Application of Rules | Scrambled Words (Max. Score = 6) | 4.68<br>(1.98)<br>N = 34 | 4.93<br>(1.61)<br>N = 28 | 5.59<br>(1.05)<br>N = 27 |
| | Coded Words (Max. Score = 8) | 6.78<br>(1.41)<br>N = 23 | 6.87<br>(1.52)<br>N = 23 | 7.06<br>(1.62)<br>N = 32 |
| | Letter Series (Max. Score = 12) | 10.63<br>(1.92)<br>N = 19 | 10.80<br>(1.57)<br>N = 15 | 10.94<br>(1.56)<br>N = 32 |
| | Number Series (Max. Score = 12) | 10.0<br>(2.21)<br>N = 19 | 9.60<br>(3.20)<br>N = 15 | 10.16<br>(2.20)<br>N = 32 |
| | Sum of Odd-Numbers Series (Max. Score = 8) | 5.11<br>(3.04)<br>N = 37 | 5.58<br>(2.94)<br>N = 26 | 6.16<br>(1.74)<br>N = 19 |
| Application of Inverse Rules | Scrambled Words (Max. Score = 6) | 4.03<br>(2.14)<br>N = 34 | 3.93<br>(1.82)<br>N = 28 | 4.48<br>(2.03)<br>N = 27 |
| | Coded Words (Max. Score = 8) | 2.78<br>(2.99)<br>N = 23 | 2.74<br>(2.72)<br>N = 23 | 3.84<br>(2.96)<br>N = 32 |

TABLE 6: **Mean Scores and Standard Deviations on Learning Outcome Variables from All Tasks with Respect to Levels of Relational Conceptualisation.**

| Variable | Task | df | Mean Squares | | F-ratio | Signif. |
|---|---|---|---|---|---|---|
| | | | Between | Within | | Level p≤ |
| Knowledge of Rules | Scrambled Words | 2/86 | 10.65 | 2.02 | 5.28 | 0.01 |
| | Coded Words | 2/75 | 5.89 | 4.34 | 1.39 | N.S |
| Direct Application of Rules | Scrambled Words | 2/86 | 6.54 | 2.65 | 2.47 | N,S |
| | Coded Words | 2/75 | 0.57 | 2.35 | 0.24 | N.S |
| | Letter Series | 2/63 | 0.56 | 2.80 | 0.20 | N.S |
| | Number Series | 2/63 | 1.58 | 6.06 | 0.26 | N.S |
| | Sum of Odd-Number Series | 2/79 | 7.03 | 7.65 | 0.92 | N.S |
| Application of Inverse Rules | Scrambled Words | 2/86 | 2.41 | 4.04 | 0.60 | N.S |
| | Coded Words | 2/75 | 11.08 | 8.43 | 1.31 | N.S |

TABLE 7: **Summary of One-Way Analyses of Variance of Learning Outcome Variables with Respect to Levels of Relational Conceptualisation.**

The other possible explanation stems from the fact that of the three conceptualisation style variables, only the relational preference scores correlate negatively with IQ ($r = -0.32$, $p < 0.05$).[1] If it is assumed that an IQ-influence exists on learning performance as such, the group with the low 'relational' classification would be expected to perform better than that with the high classification. This is indeed the case and, although the present argument is speculative in nature, it may well represent an acceptable explanation.

The inverse relationship noted in the foregoing is maintained in the direct application of rules and in the application of inverse rules variables but the difference in the performance levels of the groups are not large enough to show statistical significant difference between the groups. This may be due to the generally high performance level of all the groups in the direct application of rules variables and the low and varied performance of the members of all the groups in the application of inverse rules. This phenomenon could have masked any difference that might have existed in reality.

**Conclusion**

In general, the results are in agreement with the initial hypothesis that the inferential conceptualisation style has a significant influence on concept attainment in discovery learning. But the initial hypothesis that the descriptive conceptualisation style too might have a moderate influence on discovery learning was not generally borne out by the results. It appears only to a moderate extent with the numerical tasks. In the case of the relational conceptualisation style no direct relationship to learning outcomes was envisaged. The result is in support of this. However, a moderate general inverse relationship is observed. If low relational score is taken as indicative of positive preference for a more analytical style, the results bear support to the initial hypotheses, i.e., learning towards analysis - synthesis thinking has a significant influence on concept attainment via the discovery procedure.

The practical significance of this study lies in its potential for suggesting ways by which classroom teachers can apply knowledge of individual difference in cognitive styles in the design of learning outcome. The result from the present study suggests that in processes which involve the selection and organisation of information for the purpose of forming a concept or generalisation, the low inferential thinkers are placed in a disadvantaged position.This may be due to their low tendency or preference to analyse the stimuli in the learning environment and synthesise them to form a whole. Such students certainly need greater help and guidance from the teacher in the process of analysing the information available and linking them together to see a general pattern. Since discovery learning involves a lot of analysis-synthesis processes such students could also find discovery learning situations threatening. Hence extensive use or reliance on discovery learning approaches in classroom teaching could pose serious problem for some learners.

This study should also sensitize teachers to differences in learning approaches adopted or preferred by subgroups of students in their classrooms. Some students may be unable to breakaway from their preferred way of processing information and consequently may be unable to see the events from the teacher's point of view. In such situations the teacher should attempt to explain the context from different frames of reference. Also, an understanding of a student's styles preference may aid the teacher in the interpretation of his achievement and difficulties faced in the classroom. An analysis of the difficulties faced by a student in the classroom learning task may provide some information to the classroom teacher concerning this differential effect of style on learning and hence aid him to device instructional strategies to help different set of students. If the cognitive styles of students are to be considered in the teaching-learning processes at the classroom level, then a cognitive profile of every students need to be compiled. To do this would require the popularisation of the cognitive style instruments and the relevent literature so that they are easily available to the classroom teachers.

## Note

[1]Correlation done as part of the main study

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