December, 1970

Number 13

TECHNICAL REPORT SERIES

M. W. Moran

Development Languages

On-Line Teaching of

A summary investigation should be made in this light of this experiment. Quantitative data are drawn from this analysis of the effect of performance in a particular group. It is

However, in our study of the relationship between test anxiety and achievement, we have found that the methods of measuring experience, which were described in the article, are very promising. Experiments sessions and the usual classroom classes. The results and correlation techniques, and second between one-

The subjects were first-year University Psychology who were trained in

The paper describes an investigation into the teaching of a pro-

Abstract:
This paper describes an investigation into the teaching of a programming language by methods of Computer-Assisted Instruction (CAI).

The subjects were first-year University students who were divided into groups to enable comparisons to be made between the effects of CI and conventional lecture classes. The selection into groups was determined in an effort to determine how effectively the two systems are used and how they are used.

The analysis is made in the light of other similar investigations. Conclusions made as to how future investigations should be made in light of this experiment.
The course material was written in an experimental author language which the language processor would be able to them on line. In terms of a group B, but would then have C examples classes in group C, who would receive the same instructional material on the same examples classes as group A. By the usual examples classes the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.

A group A, who would have conventional lectures followed by a result, these groups were needed:

The course material was written in an experimental author language which the language processor would be able to them on line.

The use of examples classes - the course material was written in an experimental author language which the language processor would be able to them on line.
and a group who receive conventional lesson and classes. Performance scores
students are divided into a CAL group, a programmed instruction (P.I.) group,
the teaching of FORTRAN with the instructional program written in P.I.
Gross et al. (1961) carried out a similar investigation into the

In FORTRAN even within a support sample such as university students,
apparently makes a very large difference as to how the student is instructed.
the same on the post-test but at the other end of the aptitude score scale, the
students with high pre-test scores appear to score approximately the
the CAL group, as well as a smaller standard deviation of test scores for this
group, as well as a smaller standard deviation of test scores for this
practice with some immediate effective correction procedures, Schramm reports
practitioner of C.I. in teaching FORTRAN.

Day et al. (1961) estimate that is less battery Individual drills-and-
effectiveness of C.I. in teaching FORTRAN. Schramm (1961) estimate that
the level of instruction or test, and with a CAL program that is less battery
day et al. (1961) estimate that is less battery Individual drills-and-
effectiveness of C.I. in teaching FORTRAN.

These have been a number of courses, however, which have taught

their design criteria, they have desired an improved medium rather than a test.
In full, this language was regarded as a vehicle to convey the idea of
some language was regarded as a vehicle to convey the idea of
that these are, however, a notable advantage of the CAL group.

However, as a result of the CAL group's performance on simulated

In other words, programs that have been specially
designed to have conventional programs, programs that have been specially

The ability of the CAL group to work with the computer for the

what a program is working correctly, an instruction to the computer for the
standard software and pre-punched cards for easy entry. When satisfied

The student can use the programs that he has designed to test the

In an ICL report (1961), it is pointed out that the program should be

A similar project, but non-conventionalized, is described in.

than the conventional methods of the same age. The scores are recorded for
the

No correct responses are scored, they are acceptable and executed there. The computer checks that
student types in his last of coded instructions, the program checks if the

of FORTRAN up on which the program is written to work. As the

manipulated these rules. The computer provides the student with the con-

a programmed language and that what he needs is practical experience in


It was important that there would be a sufficient number of students available to provide the required number of groups yet not to disturb the use of the available terminals in the laboratory.

The course was long enough to allow the instructor to make some broad conclusions and recommendations for future use yet short enough so that all could be called from the author. In this way, the instructor's system could easily be modified slightly once the small number of terminals available at the same time the groups would be small enough to allow the students available to provide the required number of groups yet not to disturb the use of the available terminals in the laboratory.

The Paperclip Interpreter Language (PIL) (PITRAN, 1968) was therefore considered as suitable for the course. With the advent of a terminal system on the IBM 90/67, the student was expected to have made at least one program run on a terminal for every language or a programming course.

In previous years potential computing science honours students...

3. The course

The theory of that for the PI group.

For each group are obtained from three POMFAN tests and four POMFAN...
The various paths that attempt an answer ‘etc.’ are all left to the student. The various steps that make up the problem may be divided into such ‘help is needed next’ or when to use the Pill Interpreter.

Within problems, decisions such as when to use the Pill Interpreter,

used a learner-centred strategy (Grubb, 1968) within problems.

interpreted a Learner Sequence of Problems but

an amphibian, for instance, however, have more

theintended question, how to use understanding of it, were structured using

least, which presented the instructional material to the student and con-

The course was divided into two parts. The

The course Structure

3.1 The Selected Groups

the aptitude score revealed that there was no significant difference between

the aptitude of the aptitude group, an n by statistics of variance on

with these constructs in mind, selection was made on those vs-

in Group A and three each in the other Groups.

students, students were potential Computer Science Honours and were

A and C. 12 students were potential Computer Science Honours and were

Groups A and D were placed into Group A with one each in Group A.

Groups A and B are each in both of the other Groups. 2 out of the total of 22,

that more than a week’s programming experience and hence were placed two in

and the other in Group B. Poor students indicated that they had

the selection. However, three students indicated that non-

their included into account. No one expected to have the ability to do all methods so this

be the test would have been presented, but the following other factors had to be

ideally, a selection based solely on the result of the aptitude

course and expectations of any of the members of teaching

about any previous programming experience, except for the course of 3.4 and

3.2 The Selection of the Groups

score at the end of the year is the vital factor.

course would not disrupt the selection process as the examination

about potential Honours students; any information about the

and a. Although the course usually provides useful extra information
The Pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

Followed by a solution to the problem.

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).

The pre-test is given to the students the week prior to the ICD GS (questions). The post-test is given to the students immediately after the ICD GS (questions).
The following table gives the scores obtained for both tests.

\[
B[f | \{x \}] = 2x 
\]

We are concerned with the use of the analysis of variance technique in this model. In this model, the two groups (say, we have group A and group B) have been designated as the basic assumption is that within each homogeneous group there is a linear regression of a line with the same slope and with normally distributed errors of constant and equal variance for the pre-test score. We have obtained the variance in the values of some underlying independent variable, to compare the means for these groups, the post-test scores, when the tests were administered to the same students.

A mark allotted to these four categories were 18, 36, 16 and 28 respectively. The expression evaluation, simple program translation and simple program writing, the core of questions that were considered necessary to be tested, the amount of understanding simple program writing technique. To this end, the computer program of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their comprehension of what they had been taught during the week as well as their compreh
The table below presents the results of a statistical test used to determine whether the treatment effects differ significantly from one another. The test statistic is based on the F-ratio, which is derived from the variance between and within groups. The table includes the 3 parallel lines regression results and the calculated F-value, degrees of freedom, and the P-value for each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Treatment A</th>
<th>Treatment B</th>
<th>Treatment C</th>
<th>P-value</th>
<th>Degrees of Freedom</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>3.7</td>
<td>3.5</td>
<td>3.3</td>
<td>0.01</td>
<td>2</td>
<td>0.05</td>
</tr>
<tr>
<td>Group 2</td>
<td>2.8</td>
<td>2.9</td>
<td>2.7</td>
<td>0.12</td>
<td>2</td>
<td>0.10</td>
</tr>
</tbody>
</table>

The test statistic calculated from the data is 4.5, which corresponds to a P-value of 0.01. Since this P-value is less than the significance level of 0.05, we reject the null hypothesis and conclude that there are significant differences between the treatment groups.

The results of a correlation analysis for two variables, x and y, are shown in the table below. The Pearson correlation coefficient (r) is calculated to determine the strength and direction of the linear relationship between the variables.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>x</th>
<th>y</th>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

The correlation coefficient (r) for these variables is 0.8, indicating a strong positive linear relationship. The P-value for this correlation is 0.001, further supporting the significance of the observed correlation.

Unfortunately, two students failed to appear for the post-test, reducing the sample size for the analysis.
Correctly with and without HELP

The fraction of the number of questions he answered correctly.

\[
\text{Question 1: The average number of HELP statements he received per answered in which he requested HELP (maximun 1.00).}
\]

The fraction of the number of questions he answered in the following table shows for each student.

The following table shows for each student in the HELP and NONHELP conditions used during solution of the problems. The columns indicate the numbers of mistakes made at any of the decision stages. Of particular interest are the numbers of mistakes that contain all the information about which choice they made at the appropriate stage of the analysis, response times. The students' response times.

Section 3.4 outlines the structure of the experiments which follow.

Section 3.4 outlines the structure of the experiments which follow.

Level B: the negative responses given by both Group D and Group C participants.

Level C: by the effect of Group A participants differs significantly at the 5% level.

From our analysis, we may conclude that the positive response

negative result.

This estimate does not give a size.

\[
s_s^2 = \frac{1}{n-1} \sum (X_i - \bar{X})^2
\]

\[
\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}
\]

Model 1 is

\[
\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x
\]

pare the group effects further.

Model 2 is

\[
\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x + \hat{\beta}_2 z
\]

standardized at the most convenient pre-test score, 62.4.

The fitted regression equations are:

<table>
<thead>
<tr>
<th>Group</th>
<th>( \hat{\beta}_0 )</th>
<th>( \hat{\beta}_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-0.7840</td>
<td>0.2376</td>
</tr>
<tr>
<td>B</td>
<td>-0.4343</td>
<td>0.4078</td>
</tr>
<tr>
<td>C</td>
<td>-0.4424</td>
<td>0.9623</td>
</tr>
</tbody>
</table>

Group C appears higher than those for the other Groups but as the fitted 62.8 for Groups A, B, and C, respectively. This adjusted post-score for overall mean, the adjusted estimated post-test scores become 62.8, 62.2, and 62.8.
Throughout the week, and hence they became less interested.

This theory suggests that the course failed to elicit the motivation to do well.

The most likely reason for this is due to the students' motivation to be effective; the students with higher aptitude results from the two CII groups are that the students who are more effective cannot be estimated. The puzzling feature of the results from the CII groups cannot be explained. However, the increase in scores and combined at their pace is necessary.

However, the students from the CII groups are the least effective from the interaction of the instructor and the student. They gave a negative response. Thus suggests that the poorer students benefitted more from the interaction with the instructor. The students from the CII groups, matter what teaching method is used. The students from the CII group responded as expected, the students made extra effort. This is what was expected, a positive response was expected by the control group.

The control group's performance scores of the control group class and the results of the comparisons revealed that the students were a significant improvement.

### Conclusions of the Investigation

This 9% is made up by these students only.

The assistance that the students were answered incorrectly are still 91%. Assistance that was not answered correctly after any assistance. Of the 9%, they were answered correctly after the first question. However, the assistance may be explained by the absence of such statements. The assistance that were not answered correctly are still 91%. Assistance that were not answered correctly after any assistance. Of the 9%, they were answered correctly after the first question. However, the assistance may be explained by the absence of such statements. The assistance that were not answered correctly after any assistance. Of the 9%, they were answered correctly after the first question. However, the assistance may be explained by the absence of such statements.

The discrepancy part of this data is that on average, INP was

<table>
<thead>
<tr>
<th>0.14</th>
<th>0.05</th>
<th>0.18</th>
<th>0.32</th>
<th>0.38</th>
<th>0.44</th>
<th>0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.17</td>
<td>0.38</td>
<td>0.41</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>0.25</td>
<td>0</td>
<td>0.11</td>
<td>0</td>
<td>0.22</td>
<td>0.33</td>
<td>0.40</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.12</td>
<td>0.22</td>
<td>0.32</td>
<td>0.40</td>
</tr>
<tr>
<td>0.14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.22</td>
<td>0.32</td>
<td>0.40</td>
</tr>
<tr>
<td>0.30</td>
<td>0.35</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.22</td>
<td>0.32</td>
</tr>
<tr>
<td>0.50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.22</td>
<td>0.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O.N</th>
<th>Help</th>
<th>Correct</th>
<th>O.N</th>
<th>Help</th>
<th>Correct</th>
<th>O.N</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14</td>
<td>Help</td>
<td>Correct</td>
<td>0.25</td>
<td>Help</td>
<td>Correct</td>
<td>0.30</td>
<td>Help</td>
</tr>
</tbody>
</table>

Errors

HELP

INP
is borne out by certain results taken from the post-questionnaire of those five students who fell into the category which had in it students of above average aptitude but below average performance. (A report is in preparation to describe the use of attitude questionnaires before and after CAI courses).

These students in particular thought that:

a. It was a nuisance having to wait for the typewriter to produce the notes.

b. Their typing was too slow for CAI.

c. CAI as a method of teaching is too impersonal.

In the light of this, it seems that the questions of motivation should be studied more deeply before any future investigations of this kind are made, but the results tend to suggest that placement of those students whose aptitude scores for programming are poorer than the average may benefit from the individualised, self-paced instruction. The rest may be given conventional lectures and demonstration classes without detriment.

6. Acknowledgements

This work was supported by the Science Research Council and supervised by the Computing Laboratory of the University of Newcastle upon Tyne by Mr. L. B. Wilson. The author wishes to express thanks to Professor E. S. Page who gave permission for the investigations to be made available for the course, to Messrs. J. S. Clowes, M. J. Elphick and L. B. Wilson for cooperation in preparation and during the course, and to numerous research students who helped check out the course content.

References


