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THE EFFECT OF INTENSIVE INSTRUCTION OF CHEMISTRY FUNDAMENTALS ON THE LEVEL II ISCS STUDENT

by

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CHAPTER I

INTRODUCTION

The Intermediate Science Curriculum Study (ISCS), developed at Florida State University in cooperation with the National Science Foundation, is an individualized course of study involving problem solving techniques through a series of laboratory activities rather than the lecture method of instruction.

Specifically, Level II ISCS focuses on the building of a model to explain the nature of matter. Working on a day-to-day basis with step-by-step investigative activities, the junior high school student may find himself engaged in mechanical fulfillment of a required set of actions without comprehension.

It seems overly optimistic to assume that even the most carefully constructed learning units will solve the learning problems of all students and, therefore, pose no problems for the teacher. Equally doubtful is the notion that it is easy to diagnose the problems and to determine what alternative material they then need.

Activity-centered instruction has a central role in the ISCS program as indicated in the ISCS teacher module, Rationale for Individualization.[1] Suggestions are made in the ISCS teacher modules as to the teachers' role in a laboratory oriented science program. It remains, however, that little research has been focused on the effectiveness of additional intensive background information.

The purpose of this study was to determine if students in a Level II ISCS classroom would achieve a higher level of understanding of chemistry fundamentals when given one class period per week of instruction through lecture and group study as compared to students receiving regular ISCS instruction.

The lecture and group study periods, an independent variable, consisted of one class period of fifty-five minutes per week. All Students were required to attend science classes daily. The following tools were used:

1. Lecture
2. Demonstration
3. Discussion

Table 1 shows the topics covered and the number of class periods spent on each area of chemistry.

TABLE 1

Areas of Chemistry Covered In
Lecture and Group Study

Topic	Class Periods
Measurement of Matter	6
Matter - Its Properties and Changes	6
Atomic and Molecular Structure	6
Nature of Some Common Gases	6
Acids, Bases and Salts	6

DEFINITIONS

The following is a clarification of the terms used in this study.

The Control Group was composed of students taught using the ISCS individualized self-paced approach.

The Treatment Group consisted of students taught using the ISCS individualized self-paced approach the same as the Control group with the exception of one class period per week. During that period students were exposed to material supplementing the ISCS chemistry principles through group study, lecture and demonstration.

Group Discussion Method is defined as that approach wherein there is a free and unhampered consideration of a problem by a cooperative group. It is a student-centered situation in which the teacher serves as a guide.

The Lecture Method refers to a teacher-centered situation in which the teacher gives an oral presentation of facts, concepts, or principles.

The Demonstration Method was usually conducted by students for the class with an occasional demonstration done by the teacher.

Self-Paced means each student was allowed to progress through the ISCS laboratory experiments at a rate compatable with his or her abilities.

HYPOTHESIS

In the Level II ISCS, no significant difference in the level of basic understanding of chemistry concepts will exist between students receiving periodic lecture and group study and students receiving minimum additional instruction.

SIGNIFICANCE

It is the hope of this researcher that this study will stimulate teacher awareness of the continuing need for further research for an improved method of instruction to better meet the needs of the Junior High School student and to encourage teachers to seek out that approach which best utilizes the strong points of their personality.

For example, what a tragic mistake it would be for a great lecturer not to share his way with words, or for a great showman to never give his subjects the benefit of a stimulating demonstration.

Another valuable source of learning is the considerable wealth of abilities which may be found within the class itself. What a waste of talent if students are never given an opportunity to share their wisdom through group discussion. For the real joy in learning can be experienced only through sharing.

CHAPTER II

REVIEW OF THE LITERATURE

Since 1920 many experimental studies and investigations have been carried out on the use of lecture, class-discussion, small group-discussion, demonstration, self-paced, individualized instruction and combinations of these methods. Who is right?

Two methods of instruction in high school biology were investigated by Taylor.[2] Three classes of biology were involved in the study. One class was taught by individual study, lecture, and class-discussion. The other two classes were taught by the small group-discussion method. Results showed that students taught by the group-discussion method achieved more in a unit study than did those taught by the lecture method although the test taken at the end of the study showed equal gains by all three groups.

Hyman[3] concluded that, "teachers will need to use a mixed bag of teaching methods, organizational patterns, and schedules because students have varying learning preferences and needs. There is no single approach that works for every student."

Tillman,[4] Dean, School of Education, George Washington University, feels individualized instruction programs fall short in stressing many of the most valuable skills needed for successful learning - skills of discussion and interpersonal relationships. Gooler[5] feels any curriculum must be carefully and thoughtfully evaluated throughout the developmental process

The changing conclusions of educational research suggest, according to Smith,[6] that, "there is no such thing as an immutable science of learning," and that those engaged in teaching children make a mistake if they accept any learning theory as the final word. The best attitude, it seems, is one of open-mindedness with a touch of healthy skepticism.

Henderson[7] in reviewing the reports of many distinguished educators, concluded that individualized instruction is supported by educators in all major disciplines but that the practice of using self-study as the only mode of instruction is deplored.

It appears that, although most argue that individualized instruction most certainly has great value in teaching, it by no means answers all questions or solves all problems. And Herd,[8] an advocate of individualized instruction, agrees with most educators that it is no easy task to measure statistically the success of such an approach to teaching.

There are many supporters of the individualized self-paced ISCS approach. James[9] has pointed out, "One of the basic problems in individualized instruction has been that of freeing the teacher from restrictions of group instruction techniques so that he may meet his students on a one-to-one basis." The Intermediate Science Curriculum Study has met that problem as well as any program of studies to this date. As Burkman[10] has quoted, "A year of ISCS teaching convinces many teachers that this has been their first chance to really teach."

It appears there is no "best" approach. A teacher must then search to determine what combination of efforts is most appropriate.

It is important to understand that this study is not intended to compare ISCS with any other similar course, but only to investigate a comparitive analysis of a completely self-paced individualized approach to that of a combination of teaching approaches.

The basic question of this researcher is whether more effective learning occurs when students work individually using only the ISCS program of studies or when ISCS is supplemented with demonstration, lecture, and group study.

CHAPTER III

SELECTION OF SUBJECTS

One hundred forty-two subjects composing five classes participated in the study. The groups were established before the research began and were formed for scheduling purposes only. Absolutely no ability grouping was used.

None of the subjects were aware of the study. Each class was assigned a number and numbers were randomly selected by a colleague to determine which was to become a control group and which was to receive the treatment. It was predetermined that the first, third, and fifth numbers selected would be the treatment groups and the second and fourth numbers selected would become control groups.

INSTRUMENTATION

The testing instrument was developed by a five member panel of ISCS teachers in the South St. Paul Junior High School. All members of the panel had a minimum of two years experience using ISCS. The instrument was composed of selected items from the ISCS testing package. To eliminate the possibility of prebiasing the results, this researcher did not contribute items to be used.

RESEARCH DESIGN

The research design to be used in this study was the post test only control group design. The treatment groups received periodic lecture and group study. The control groups received minimum additional instruction. By definition, minimum additional instruction means only that instruction which the student asks for or exhibits a need for.

TREATMENT

The treatment was administered one day per week for a period of thirty weeks. Subjects were tested at the conclusion of the treatment and were tested only on the ISCS chapters which they have completed. No questions were asked that are not covered in the Level II ISCS text. This necessitated that test results be reported as percent of correct answers.

It might be worthwhile to remind the reader that this researcher is aware of the possibility of bias entering into the study since the treatment was administered by the researcher. Every effort was made by the researcher to avoid contamination of the study by interjecting his bias in the treatment.

CHAPTER 4

RESULTS

The primary purpose of this study was to ascertain whether, and to what extent lecture and group discussion used one class period per week as an alternative to regular Intermediate Science Curriculum Study approach to teaching science can be used effectively.

The groups participating in the study were intact groups established before the research began. None of the groups were the result of ability grouping. To make sure all groups were of equal ability, a distribution of students' scores on the California Test of Mental Maturity (CTMM) was compiled. The mean and standard deviation scores for each of the groups in the study are shown in Tables 2 and 3.

Each class was assigned a number and numbers were randomly selected by a colleague to determine which was to become a control group and which was to receive the treatment. It was predetermined that the first, third and fifth numbers selected would be the treatment groups and the second and fourth numbers selected would become the control groups.

TABLE 2

Mean Scores and Standard Deviation on the
California Test of Mental Maturity for Control Groups

Control Group	No. of Subjects	Mean	SD
1	29	110.15	14.27
2	30	106.80	13.24

TABLE 3

Mean Scores and Standard Deviation on the
California Test of Mental Maturity for the Treatment Groups

Treatment Groups	No. of Subjects	Mean	SD
1	29	107.24	15.08
2	32	104.56	18.24
3	22	108.64	15.44

The mean and the standard deviation taken from the distribution of scores of all subjects composing the two control groups and the mean and the standard deviation of scores of all subjects composing the three treatment groups are shown in Table 4.

TABLE 4

Mean and Standard Deviation of
Subjects in Control and Treatment Groups

Group	Mean	SD
Control	108.4	13.75
Treatment	106.7	16.25

Since the 1.7 difference between the means of the two groups was negligible it can be assumed that the two groups are near equal ability.

At the conclusion of the thirty week treatment period all subjects were tested on chemistry fundamentals presented in the ISCS Laboratory Text. Since subjects progressed at different rates, each was tested only on those chapters which he or she had completed. The subjects scores on the post-test represent the percent of correct responses to test items.

The mean and standard deviation from the distribution of post-test scores for the control groups and treatment groups are shown on Tables 5 and 6.

TABLE 5

Mean and Standard Deviation of
Post-Test Scores for Control Groups

Group	No. of Subjects	Mean	SD
1	29	73.52	11.97
2	30	72.93	10.62

TABLE 6

Mean and Standard Deviation of
Post-Test Scores for Treatment Group

Group	No. of Subjects	Mean	SD
1	29	76.38	10.22
2	32	75.91	10.69
3	22	78.45	6.76

This researcher is aware that the comparatively small number of subjects composing group three may have been a contributing factor in the level of competence shown by that group.

The mean score and the standard deviation for all 59 subjects composing the two control groups and the 83 subjects composing the three treatment groups are shown in Table 7.

TABLE 7

Mean and Standard Deviation for
the Control and Treatment Groups

Group	No. of Subjects	Mean	SD
Control	59	73.22	11.21
Treatment	83	76.37	9.56

A statistical analysis of post-test scores as shown in Table 8, indicates that no significant difference existed between the two groups.

TABLE 8

Results of Statistical Analysis

Treatment Group	Control Group	t. ratio
76.37	73.22	1.790

Not significant at the .05 Level of Confidence
Critical value of t^{o} at .05 level of confidence = 1.960

These results support the null hypothesis that no significant difference in the level of basic understanding of chemistry concepts will exist between students receiving periodic lecture and group study and students receiving minimum additional instruction.

CHAPTER 5

CONCLUSION

A major trend in contemporary science education is the extension of independent study beyond the usual emphasis on superior students to include students representing all ranges of ability. One way to achieve this extension is through the ISCS individualized course of study.

The objective of this study was to test the effectiveness of lecture and group discussion used one class period per week as an alternative to the self-paced study. It was expected by this researcher that participation in group discussion and lecture would result in a significant improvement in understanding of basic chemistry fundamentals as presented in the ISCS program of studies. The study did not, however, show this to be true. The null hypothesis was supported. Students receiving periodic lecture and group study did not attain a significantly higher level of understanding of basic chemistry concepts than those receiving minimum additional instruction.

Although there was not a significant improvement in scholastic achievement, the overall laboratory behavior of the treatment groups was far superior to that of the control group. Although no statistics were kept there seemed to be fewer accidents, less chemical contamination, and less confusion within the treatment group. This observation may

have resulted from increased confidence in recognizing chemicals and their behavior, and a greater sense of direction in their work.

There also a sense of togetherness that was accomplished without destroying the rational of ISCS. The student-teacher rapport was also much stronger.

It is interesting to note that although the treatment groups spent 30 fewer hours on ISCS laboratory work there was little difference in the number of chapters completed. See Table 9.

TABLE 9

Average Chapter Completion

Group	Chapter Completion
Control 1	14.5
Control 2	16.5
Treatment 1	14.5
Treatment 2	16.7
Treatment 3	15.5

IMPLICATIONS

The following are suggested based on the observations of the researcher:

1. As a result of the discussions, students were more actively involved in their own learning.

2. The discussions generally forced students to think, to organize their ideas, and to prepare for class meetings.

3. Students own ideas were clarified in the process of discussions with others.

4. There were definitely improved communications between students and teachers and between students.

5. Group discussions created a more congenial atmosphere.

Apparently many Junior High School students can benefit from a more diversified approach. The use of lecture, demonstration, and discussions seems worthwhile. It provides for a more organized atmosphere through which the fundamentals of chemistry concepts can be learned. It also provides group cohesiveness important for interpersonal relationships. Advocates of the completely individualized approach indicate that they can attain the same objective but it seems more difficult for some classroom teachers.

This researcher feels that the use of the more diversified approach may help the students who have a difficult time managing their time and determining objectives. Many students find it a difficult transition to move from the usually highly structured classroom experienced in most subject areas to the freedom of the ISCS approach.

The observations made by this researcher and the attitudes expressed by the students have indicated that this is at least a partial answer to the question of motivation.

Future studies of this type could be enhanced by student input into instruction methods used and evaluation through student feedback.

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The Intermediate Science Curriculum Study (ISCS) is an individualized course of study involving daily laboratory activities. Each student, through a series of carefully designed experiments, is expected to gain a concept of the structure of matter and the behavior of elements, compounds, mixtures, etc. The purpose of this study was to determine if students in the Level II ISCS classroom, receiving weekly study through lecture and group discussion, would attain a significantly higher level of understanding of chemistry fundamentals than those students receiving regular ISCS instruction.

This study took place at South St. Paul Junior High School, South St. Paul, Minnesota and involved 142 eighth grade ISCS students. Each student received either intensive training or minimum additional instruction in the structure of matter.

Following the administration of treatment and control, a record of student comprehension of fundamentals presented in ISCS was compiled.