CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

DIFFERENTIAL CREDIT ALGEBRA:
A SELF-PACED INDIVIDUALIZED COURSE OF STUDY

A project submitted in partial satisfaction of the requirements for the degree of Master of Arts in Secondary Education

by

Betty Keith McIntosh

May, 1975
The project of Betty Keith McIntosh is approved:

__________________________
Committee Chairman

California State University, Northridge

May, 1975
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ABSTRACT

DIFFERENTIAL CREDIT ALGEBRA:
A SELF-PACED INDIVIDUALIZED COURSE OF STUDY
by
Betty Keith McIntosh
Master of Arts in Secondary Education
May, 1975.

The DCA Project centers on a self-paced course in algebra for 9th grade students, 1974-75, at Patrick Henry Junior High School, Granada Hills. The grading technique of differential credit, found practical in general mathematics courses, was used. Each student in an experimental class of thirty-one proceeded at his/her own pace in learning, aided by small group activities, individual assistance from teacher, student teacher, and teaching assistant, and by various mechanical aids. Semester credits were directly related to the amount of lesson material covered by the different students: less material learned, fewer credits, but the grade earned was a C or better. Compared with a matched group of regular algebra students, the DCA group performed significantly poorer. The reason for this was that the experimental DCA group did not cover all the
material as fast as the control group, and that both
groups were tested alike to determine the significant dif-
ference. When compared on the basis of what the DCA
students had covered, there was no significant difference
in the performance of the two groups. A follow-up study
is planned after the two groups finish the second year of
the algebra course used in the project.
CHAPTER I

INTRODUCTION

Background of the study. Education oscillates between innovation and tradition. A persistent innovation theme is individualization. Personalized Student Instruction (PSI) is one term for this multifaceted concept. Many PSI courses have made substantive changes in teaching, while others have only relabeled the methods.

Rationale and purpose of the study. The Administration of Patrick Henry Junior High School, Granada Hills, is concerned with developing better teaching techniques. The Mathematics Department Chairman and the Principal of the Patrick Henry Junior High School encouraged the writer to try a Differential Credit Algebra (DCA) course during the 1974-75 school year. This course was modeled after the Differential Credit Basic Mathematics course developed by Leslie Winters (26) of Kennedy High School, Granada Hills. In Winters' flexible-time course a student who earned three credits of grade C in a semester received that grade and three credits. Without Differential Credit this student would have received five credits of D. The DCA project is
similar.

Delineation of the project. The writer planned and taught the first year's topics of the two-year Algebra Experiences course on a Differential Credit basis. She developed the five units of the course with these considerations in mind:

1) to adapt the textbooks and supplementary materials available to a DCA course without any special funding;

2) to use a flexible-time pace like that of the Differential Credit Basic Mathematics course of Kennedy High School;

3) all procedures would be tentative, so pupil needs could be met as they appeared.

An outline of the project puts its components in perspective.

I. Purpose:

A. to develop a flexible-time, self-paced, individualized Algebra Experiences course;

B. to observe the effectiveness of small study groups with respect to learning;

C. to observe changes in the degree of responsibility taken by pupils for their own learning progress.
II. Topics and materials:

A. list of five units, with related reading, problems, and quizzes, all from the algebra text;

B. supplemental exercises in algebra in kit form, a hand calculator, tape cassettes of lectures;

C. special record keeping methods for evaluation of the pupils and of the project.

III. Classroom management and procedures:

A. lectures and presentations:
   1) 2 to 3 days per week;
   2) 10 to 25 minutes duration.

B. testing times and locations fitted to needs;

C. best use of the time and talents of teacher, student teacher, and the 9th grade teaching assistant (TA):
   1) student teacher doubles time-wise the amount of individual help for students;
   2) TA keeps records, files and special materials in order.

D. variable size groups study together for quizzes and tests.
IV. Selection of DCA class and controls:

A. Period 4 class selected for DCA experiment:

1) student teacher available at that time;

2) students programmed into this period by
the counselor;

3) control group selected from the writer's
other four classes;

4) experimental-control pairs matched by
scores on the SRA Modern Mathematics
Understanding Test, Form C (MMT) and by
sex where possible;

5) DCA students graded only on unit quizzes
and unit finals, only C or better
accepted;

6) project hypothesis tested by comparisons
of scores of the two groups on 10th,
20th and 30th week examinations; also,
the DCA group scores were compared with
the entire population of the other four
classes.

Questions to be answered by the project. A number of
questions arose during the course of this project. The
more significant are these:
1) Does the student understand mathematical concepts as well when these are learned at a pace determined by the student instead of by the teacher?

2) How can the tendency of some pupils to procrastinate be overcome without removing self-paced feature of DCA?

3) Do students in the DCA course know more or less algebraic concepts at the end of the course when compared to students taught in the regular, scheduled classes?

4) In the future (end of the second year of Algebra Experiences) what is the success percentage of the DCA students compared to the Control group? "Success" means to receive a final grade of C or better at the end of the second year.

The null hypothesis. The delineation and questions suggested a test of the following null hypothesis: algebra experiences instruction which allows each student to progress at his own pace (flexible-time) will make no significant difference in the level of learning reached by these students at the time they have completed the course, as compared to the level of learning reached by students instructed on a fixed schedule.
Definition of terms

1) **Academic credits** are the five credits awarded per semester for solid courses such as English, history, foreign languages, and algebra; these fulfill some college entrance requirements.

2) **Non-academic credits** are the five credits awarded per semester for physical education, industrial crafts, and other non-solids; they count toward fulfillment of high school graduation requirements.

3) **Differential Credits** are in a one-to-one ratio with the number of units passed in a course, with no set number of credits required per semester. The minimum grade accepted is C.

4) **Algebra Experiences** refers to a two year course of the topics taken by Algebra I AB students in one year.

5) A, B, C, or D are passing grades in Los Angeles City Schools; a D in an academic subject is not acceptable for college entrance requirements.

6) **D.F.** represents degrees of freedom in the statistical tables.

7) **SD** represents standard deviation in statistical discussion and tables.

8) **Science Research Associates' Modern Mathematics Understanding Test, Form C** (MMT), tests students for basic
mathematical skills; the scores from this test were used to classify the ability levels of 9th grade Algebra Experiences students involved in the DCA project.

9) Teaching Assistant (TA) is a 9th grade student at Patrick Henry who does clerical work, errands, and some classroom management tasks. The TA receives five non-academic credits for this service.

Importance of the study. Los Angeles City Schools desire to provide education for a large, ethnically and culturally mixed student body. Some method of PSI would help fill the needs of this varied student population. This Project is an attempt to develop one method to satisfy such student needs.
CHAPTER II

HISTORY OF PSI AND REVIEW OF RELATED LITERATURE

This chapter discusses the history of PSI, funding and aims of PSI research, methods and materials used for PSI, evaluation of results of PSI research, and controversy over PSI.

History. During the 19th century, methods of teaching in America were far from uniform. PSI was non-existent. The first "group teaching" was used in Joseph Lancaster's Monitorial Schools, Pennsylvania, in 1818. Knight (13) states that Lancaster's system was highly structured, efficient as well as cheap, and humane for the times. Private tutors for the children of the wealthy provided the only PSI. In the early 20th century the movement called Progressive Education did not use PSI as it is presently understood, but it did open the education profession to new methods, because the child was considered a client instead of an unruly young human to be schooled. According to Knight (13) there was no consistent philosophy of education in America in the 19th century and early 20th
century. Very little research mentions PSI before 1965. Individualized instruction began in several forms at about that time when the term, PSI, appeared in the indexes of educational research.

Since 1965, many commercial firms and textbook publishers teamed with educators to develop materials for individualized classroom instruction. SRA's algebra skills kit, used with DCA, is an example of these materials.

Funding and aims of PSI research. Benton (2) reports that the Federal Government funds much of the research into new educational methods, including PSI. New methods of teaching students with different mental abilities, different vocational ambitions, different degrees of maturity at a given age, and very different language and cultural backgrounds are developed. With respect to the aims of PSI research, Benton suggested making Title III proposals to the Office of Education (OE) to obtain funding in this manner, "Provisions for individualization should be included in proposals focusing upon instructional improvement, and where individualization is the main task of the proposal, provisions for its achievement should be . . . detailed." Individualized instruction needs day to day description of procedures, lists of materials to use, and adequate planning. Broad, general descriptions of the
aims of a PSI course are not enough to satisfy the needs of a classroom full of individuals. The PRAISE Program of Individualized Mathematics Instruction developed by Jerry Burrill, Canyon High School, Saugus, California, is an example of excellent, detailed planning. The outline of this course, and samples of the materials used were presented at the Job-Alike Conference, Kennedy High School, January 14, 1975. The materials, texts, exercise pamphlets and study-tapes for the PRAISE program have been copyrighted and are for sale to schools who wish to use them. The acronym, PRAISE, symbolizes proper placement, rapid reinforcement, arithmetic-algebra, individual itinerary, self worth, and educational equipment. This program is used as a part of the SWAS (School Within a School) individualized mathematics course at Granada Hills High School. The overall aim of the SWAS course is to keep potential dropouts in school by better satisfying their individual learning needs, and by showing that the school is concerned with their academic difficulties. Spanish speaking students and Black students who speak Black English stay in school longer in the SWAS program than in the regular school curriculum, according to Mr. Yokoyama, director of the Mathematics section of the SWAS program at Granada Hills High School, speaking at the Job-Alike
Finch (6) lists many useful Government reports available to teachers planning PSI courses, which describe materials and methods not commonly known. Krulik (14) notes that budgetary limits prevent implementing true PSI courses. Because student-teacher ratio in the public schools is high and will remain high, he recommends group study and local development of learning packets for group use; commercial materials are expensive.

Trimble (24) asserts that most PSI research is dedicated to increasing the efficiency of teaching of concepts, a good thing; but he feels the essential thing is learning to learn. Not enough research is investigating this very individual activity to search out why too many high school students are unable to learn by themselves.

Methods. Norton (18) feels the present thrust of education is toward PSI. A good PSI program uses teaching talent and personnel to decrease the student-teacher ratio. Student teachers, tutors from higher grades, and parent volunteers can augment the teacher in the classroom. A good program, in Norton's opinion, has specially prepared materials to provide instruction at different levels at the same time. The good PSI program is planned over the long range of the student's schooling, so that PSI is
provided continuously. Inservice training for faculty and administrators is equally necessary to overcome personality conflict, rigid tradition and schedules, and lack of administrative support. These problems must be dealt with before even a good, detailed PSI plan can succeed. Norton says that PSI planners must avoid requiring excessive group efforts from the students. The materials and facilities needed are different from those used in the regular curriculum, often have to be made by the PSI teachers, and are unique for a given class and time.

Project R-3 for the 8th grade at Herber Hoover Junior High School, San Jose, has used games and simulations in a PSI program since 1969. Kansky (11) states that low achievers are performing better in this R-3 program which stresses readiness, relevance, and reinforcement. The instructors have adapted The California Strands of Mathematics subject matter to their PSI curriculum.

Goodlad (8) reports on a non-graded system at University Elementary School, UCLA, in 1965. The system was directed toward individualizing instruction for each pupil. A student could be at a low level in reading and given remedial instruction, yet at the same time receive advanced instruction in music or some other subject where his understanding was greater. This system was successful,
but very expensive.

Martin and Burrows (15) cite a non-graded PSI system at Bossier Parish, La. Students learn at their own pace, and may take considerable time to learn. This may involve staying at a given grade level for two years or more, but there is no stigma attached to this as there once was. Failure is not allowed to occur. The system requires great patience on the part of the instructors and varied materials at the same levels to avoid boredom for the pupils. Reading is the subject that gets the most attention.

Davidson (5) used small groups and had each student act as a teacher in turn because, among others, Postman (19) showed that a student who teaches a concept learns that concept. It was the function of the teacher to prepare and assist the group members in presenting lessons to their own group.

Fremont (7) found that his students who taught their peers within a small group provided better learning for individual pupils and allowed better use of the teacher's time. Fremont questions whether true PSI is really possible for one teacher with thirty or more students. His answer to this common student-teacher ratio is the group format, with individual students responsible for their own learning. The students are included in the decisions made
about their schedules, what should be learned and when; the students must live with the consequences of their decisions.

Brammell (3) considers learning in small groups a strong motivation for individual learning; the group of peers shows respect and interest in the lessons brought to the group by the individual. Being treated like a "teacher" does increase the teaching pupil's morale and his sense of worth.

Scandura (22) studied the results of different methods and orders of concept presentation to students. The same introduction of a particular concept was combined in various orders with lists of formulas to memorize, guided discovery, expository lectures, and opportunity for discovery. The groups receiving only a list of formulas, or the list of formulas plus the opportunity for discovery of applications, performed at a significantly lower level than other groups exposed to different combinations of methods and order of presentation. This study is helpful with respect to designing lecture presentations for PSI courses.

**PSI Materials.** According to Krulik (14) a good Individual Learning Packet (ILP) contains all materials needed for one pupil or small group to reach a specific
learning objective. The ILP, a) states the objective, b) contains appropriate learning activities with feedback, c) has an evaluation device related to all activities in the packet, and d) presents the topic in small logical increments. Krulik feels that commercial learning packets are inferior to teacher devised ILP's, made with actual students in mind. The writer believes most of these commercial packets are very good, but very expensive; most of the commercial packet materials are consumable.

Towle (23) presents a complete system for programming a computer to perform the tasks of generating quizzes, recording and grading, allowing the instructor to give more personal attention to individual students. McDermott (16) discusses other aids such as filmstrips and cassettes. These materials are generally available throughout the Los Angeles City Schools and are used in regular classes. The costs of such materials are listed by McDermott, and he gives an evaluation of the results of their use.

The use of rewards or tokens for learning must be carefully considered before including them into a PSI plan. Such extrinsic rewards can undermine intrinsic motivation to learn, according to Greene and Lepper (9).

Evaluations of results of PSI programs. Kansky (12) reports that ILP's were developed by teachers at Montgomery
Junior High, San Diego, and used for reading and arithmetic instruction with an ethnic mix of 750 students. The effectiveness of Montgomery Junior High's ILP teaching was evaluated by comparing one year's attendance records for one experimental group of students (ILP users) with those of a group of regular students of similar ethnic backgrounds. The ILP group had only 65 percent as many absences, and 36 percent as many tardies as the regular group. Only one of 129 ILP students was referred for discipline during the year, compared to 10 of 124 regular students referred.

McDermott's (16) report on the intermediate algebra class at Hendrix College, Conway, Arkansas, showed slightly better performance by students who had human help in addition to tape cassettes and filmstrips. He notes that too much human help produced dependency on the instructor.

Controversy and reports opposed to PSi. Goodlad (8) reports that the non-graded system used at University Elementary School, UCLA, aroused considerable controversy among parents and teachers in 1965. The expense of individualized instruction worried the administrators; fears that knowledge of the basics of reading and arithmetic would not be acquired worried the parents.
Mueller (17) states that PSI featuring self-pacing does not necessarily include self-starting. Time-flexible instruction simply does not work well for all pupils, nor can all teachers instruct in a time-flexible format.

Winters (26) asserts that Differential Credit cannot provide a successful PSI program unless all teachers in a mathematics department are committed to making the program effective. Winters doubts that Differential Credit is suitable for an academic course such as algebra because of the possible academic credit penalties that a student could suffer, not to mention the resulting problems with his college entrance requirements.

Dahlke (4) stresses that pupils should be screened for PSI and self-paced mathematics courses. They must have maturity, which is necessary but not sufficient for success, a strong motivation to learn, and a good grasp of arithmetic fundamentals. He also states that more personal help and instruction is needed than is ever available.

Innovation alone produces good results for a time (the Westinghouse Effect) so any PSI plan should be evaluated over a period of at least three years to determine its usefulness. Rosenthal (21) reports that teacher expectation (the Pygmalion Effect) profoundly influences pupil performance. There are many professional
psychologists who disagree with Rosenthal's results and cannot reproduce them. It would be well to consider that a particular PSI program could show widely varying results if used by different teachers who have divergent expectations of their pupils.
CHAPTER III

DESIGN OF THE DCA PROJECT

This chapter discusses details of designing the project: plan of the course, materials and methods, and selection of experimental and control groups.

Plan of the Course. The DCA course was planned to present all the topics covered in the regular Algebra Experiences course (RAE). DCA offered flexible-time self-pacing, accepted no grade lower than a C, required a student to take parallel forms of a test until he passed with a C or better, and (within broad limits) had no penalty for lagging.

A copy of the outline of the year's course, with a complete list of test problems was given to each student (see appendix). A list of page numbers in the text guiding the students to explanatory paragraphs and practice problems was also prepared for each student. These lists were printed on punched paper to be kept in a notebook.

Students were expected to read explanatory material, and to work and check practice problems by themselves,
using answer keys checked out from the TA. Additional helpful instructions, study suggestions and details of classroom procedures for turning in work to be graded were printed in the form of letters to the students. These were informal and friendly in tone. Extra copies were available.

During the first semester, the plan required that lectures, explanations and studying took place on Mondays, Wednesdays and Fridays. On Tuesdays and Thursdays, students who wanted to take quizzes or tests were seated at one side of the room. Those groups still studying were seated on the other side. This timing was reversed by popular vote. Students could then take tests three days a week. Some pupils asked to take quizzes and tests at home, which was allowed. Parents were asked to time this home effort and sign the test paper, stating that no help had been given.

Methods and materials. In order to implement this plan with a class of thirty-one students, available materials, facilities and class time were adapted to time-flexible teaching. DCA permitted small groups of students to study together preparing for a test. Those who preferred to work alone did so. The teacher and student teacher answered questions and gave explanations to groups
and individuals. The records, test papers, answer pamphlets, and supplementary materials were taken care of by the TA.

The textbook first used was Dolciani, *Modern Algebra*; it proved too sophisticated for average ability students. At the semester break the text was changed to Johnson, *Algebra--Its Structures and Applications*, usually used in the second year of *Algebra Experiences*. Chapters 1 through 9 of Johnson were regrouped into five units for DCA:

Unit I. Chapter 1, *Numbers*, the building blocks of mathematics; Chapter 3, using the language of algebra, symbols and rules.

Unit II. Chapter 5, the algebra of positive and negative integers; Chapter 6, the rational number system.

Unit III. Chapter 7, solving equations and inequalities.

Unit IV. Chapter 2, sets (notation and theory); Chapter 4, introduction to logical thinking.

Unit V. Chapter 8, problem solving with equations; Chapter 9, graphs of linear equations and inequalities.

This regrouping facilitated the transition from the Dolciani to the Johnson text. In the future, Johnson's order of chapters will be followed from the beginning of the year.
Completed tests were given to the Student Teacher, who corrected and returned them the next school day. The student could look over his graded work; if he had passed he would get a star for the progress chart. Graded work, passing or failing, was recorded and filed by the TA.

A number of supplementary materials were available to fit the needs of students learning at varying paces. An *Algebra Skills Kit* (Science Research Associates) held cards printed on each side with specific types of algebra problems, with answers; this kit was most suitable for use by pairs of pupils. Lectures and question-answer sessions were recorded on tape cassettes for absent students. Students could also use a hand-held calculator with square roots, reciprocals, trigonometric functions and log functions, as well as the four basic operations. A progress chart was posted on the bulletin board. Gold stars were awarded for C's, blue stars for B's and red stars for A's. The 9th graders took great interest and pleasure in this chart; other classes watched the race of stars and made favorable comments about the leaders. The school Mathematics Laboratory provided a separate room for test takers; the noise and chatter of lectures and group study no longer interfered with concentration during tests.
Letter grades were used in DCA and RAE classes. Grades for all students were recorded under a given date in RAE classes. In the DCA class, grades were scattered over many dates. A code giving the unit number in Roman numerals, quiz number in Arabic numerals, the letter F for a final test, and A, B, C, or 0 for representing the grade earned. Examples:

\[
\begin{array}{c}
\text{III}_2 \\
\text{C}_2
\end{array}
\quad
\begin{array}{c}
\text{III}_3 \\
\text{0}_3
\end{array}
\]

A zero, non-passing grade was circled completely to call attention to the fact that the pupil had to take this test again. This also recorded the number of attempts made by a pupil before passing a quiz. Records kept by the student teacher, the TA and the writer were compared periodically to eliminate errors and omissions.

Before the DCA course was implemented, Winters (26) expressed fears that some pupils would finish the five units well before the year was over; only one student did so. With the head counselor's permission, she will serve as a TA in another class. This student discovered all the kinks in the sets of practice problems and unit tests; her difficulties and suggestions were one source of unit revisions made during the year. Future planning will include
extra units or special elective credits for any students who finish more than two weeks before the end of the school year.

Adaptations of procedures continue to evolve. It has been necessary to cut the size of groups studying together in the interest of efficiency. The TA has had the additional task of checking pupils to see if they have done any written homework on the practice problems. Some pupils have been made to study alone, because they do more playing than working when with other students. An outline of the second nine chapters of Johnson's Algebra has been put into the form of five units for the second year of Algebra Experiences. The listing of the actual problems and pages of explanatory reading is also finished for future use.

Selection of groups. Students were programmed into the five Algebra Experiences classes by the 9th grade counselor in the usual manner. The writer taught all five of these classes.

Period 4 was chosen as the DCA experimental class because a student teacher was available at that time. At the end of the first week, these students were informed that they were in an experimental class. A letter was sent to their parents describing the nature of the experiment. Parents were asked to transfer their children to another
class if they felt the course was not suitable or if the family might move during the year. While no child left DCA for either reason, two pupil requests for transfer were granted before the second week of school. A third pupil requested a transfer at the semester break. Finally, the DCA class consisted of thirty-one students, twelve boys and nineteen girls. There remained 111 RAE students.

An overview of the ability level of all 9th graders is presented in Table 1, both by individual classes and by separation according to RAE and DCA groupings. Their basic mathematical skills were measured by MMT in September, 1974.

TABLE 1
COMPARISON OF MMT SCORES

<table>
<thead>
<tr>
<th></th>
<th>High Score</th>
<th>Low Score</th>
<th>Mean Score</th>
<th>No. in class</th>
<th>SD</th>
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<tbody>
<tr>
<td>Per. 1</td>
<td>44</td>
<td>22</td>
<td>30.38</td>
<td>26</td>
<td>5.61</td>
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<tr>
<td>Per. 2</td>
<td>44</td>
<td>17</td>
<td>32.07</td>
<td>30</td>
<td>6.66</td>
</tr>
<tr>
<td>Per. 3</td>
<td>43</td>
<td>20</td>
<td>30.42</td>
<td>24</td>
<td>7.18</td>
</tr>
<tr>
<td>DCA 4</td>
<td>39</td>
<td>17</td>
<td>31.23</td>
<td>31</td>
<td>5.52</td>
</tr>
<tr>
<td>Per. 6</td>
<td>43</td>
<td>17</td>
<td>31.58</td>
<td>31</td>
<td>7.41</td>
</tr>
<tr>
<td>RAE -</td>
<td>44</td>
<td>17</td>
<td>31.22</td>
<td>111</td>
<td>6.80</td>
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<td>Control</td>
<td>39</td>
<td>17</td>
<td>31.26</td>
<td>31</td>
<td>5.43</td>
</tr>
</tbody>
</table>
Several observations are noteworthy. The mean scores of the separate RAE classes were quite close, all well within one SD of the group mean. The scattering of scores was greatest in period 1 and period 6. The DCA group and the Control group had the smallest SD and the lowest high score of any class.

The Control group was selected, but not separated, from the four RAE classes. Each member was matched according to sex and ability with a DCA member as closely as possible. These control students were unaware that they were part of an experiment; it was not necessary to tell them, since only their scores entered into the comparison.
CHAPTER IV

EVALUATION OF THE PROJECT

This chapter describes the types of data used to evaluate the project together with the statistical methods used to analyze and interpret the results, presents the data in tabular form, and gives the observations made and gathered by the writer while teaching the experimental DCA course.

**Data.** Multiple-choice, machine-scored tests based on the Johnson text were given all Algebra Experiences classes at the end of the 10th, 20th and 30th weeks of school. Tests received a numerical score rather than a letter grade. Table 2 compares the means, ranges and standard deviations of the raw scores for each class, as well as for the RAE and Control groups. Several observations are pertinent. First, while the total number of students in the RAE class remained constant (111) there was some shifting of students between the first and second semesters. Hence, in the column "Number of students," the number in the upper left refers to the first semester, in the lower right to
the second semester. Secondly, the means of the raw scores for the DCA class are the lowest of all. Third, the range of DCA scores is within the extremes of the range for the total RAE group (Appendix A, Figure 1).

**TABLE 2**

**COMPARISON OF THE RANGE, MEAN AND SD OF RAW SCORES FOR ALL CLASSES**

<table>
<thead>
<tr>
<th>No. of Students</th>
<th>Item</th>
<th>Class</th>
<th>10th Week</th>
<th>20th Week</th>
<th>30th Week</th>
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<tbody>
<tr>
<td>26</td>
<td>Range</td>
<td>Per. 1</td>
<td>20-43</td>
<td>11-35</td>
<td>10-28</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td>26.69</td>
<td>23.12</td>
<td>20.16</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td></td>
<td>5.38</td>
<td>6.34</td>
<td>4.18</td>
</tr>
<tr>
<td>30</td>
<td>Range</td>
<td>Per. 2</td>
<td>21-43</td>
<td>17-42</td>
<td>13-25</td>
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<td>5.40</td>
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</table>
To compensate for the effects of having covered less material at the time of each test, an adjusted score for each DCA student was determined. All test questions were related to the DCA unit and quiz level required to understand and answer them. The unit and quiz level which had been passed by each DCA student at the time of the three examinations were matched with the specific number of test questions which that student could be expected to answer. Then the number of correct answers to that reduced set of questions was counted. A simple proportion was then used to convert these correct answers back into terms of the original number of questions.

For example, at the 20th week, the test of fifty questions yields an adjusted score, thus:

\[
\frac{\text{number correct}}{\text{number expected}} = \frac{\text{adjusted score}}{50}
\]

The adjusted score was equal to fifty times the number of correct answers to the reduced set of questions, divided by the total number of problems in this reduced set.

This method of obtaining an adjusted score avoids bias due to correct answers deduced by a DCA student for questions not yet studied, or due to lucky guesses. Of the ninety-three scores adjusted, there were nine which were lower than the raw score for a pupil, and six which
were equal to the raw score. Since the DCA score was not always raised by this proportionally adjusted scoring method, it is not unreasonable nor is it speculative. The adjusted score is obtained directly from actual performance for each pupil.

Since the null hypothesis is concerned with the DCA and Control groups, their scores on the three tests merit particular attention. Table 3 presents all their raw individual scores and adjusted scores for the DCA class. An asterisk indicates sex difference for matched pairs; a cross signals a difference of one point on the MMT (the DCA subject is placed first).

Several observations are pertinent. On the whole, the mean of the raw scores of the DCA group is behind the mean of the Control group on each test. This was expected because the DCA group had not covered all the material of the tests, as had the control group. Self-pacing does not prepare for the same kind of testing as scheduled pacing. Note, however, that the raw DCA means are within one standard deviation of the control means, this indicates that the effects of time-flexibility and self-pacing were not punitive to DCA. These overlapping ranges are shown graphically in Appendix A, Figure 1.
**TABLE 3**

**COMPARISON OF THE DCA-CONTROL PAIRS AND THEIR RAW AND ADJUSTED SCORES ON THE THREE TESTS GIVEN**

<table>
<thead>
<tr>
<th></th>
<th>10th Week</th>
<th></th>
<th></th>
<th></th>
<th>20th Week</th>
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<th>30th Week</th>
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<td>4.08</td>
<td>4.80</td>
<td>2.70</td>
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</table>

**Note:** The adjusted score is lower for one or more tests in lines 6, 8, 16, 17, 19, 21, 28, and 31. The adjusted score is the same for one test in lines 6, 8, 13, 18, 28, and 31.

* Sex of pair differs.
+ Score on MMT differs by one. DCA score listed first.
Statistical analyses. The analyses are based on the assumption that the entire group of Algebra Experiences students is normally distributed. Hence, the t-test was used for evaluating the difference of the means for several pairs of classes to determine whether DCA's, Controls, and others were or were not representative of the total group. Table 4 gives the t-values on the raw score means for these pairs of classes. The t-value for the DCA-Control pair, given first, rejects the null hypothesis. There is a significant difference between the means of their raw scores. The t-value for the DCA-RAE pair also rejects the null hypothesis. However, the lower confidence levels (p) regarding a significant difference between the remaining pairs tested suggest possible hidden biases in the instruments used to test ability and/or achievement, or perhaps unmeasured variables which affected the subjects.

The aim of this project was to sustain the null hypothesis, and show that flexible-time pacing made no significant difference in the ultimate achievement of DCA students when compared to Control students; therefore t-values comparing the Adjusted score means for DCA's and raw score means for the controls were determined and are shown in Table 5.
### TABLE 4

**STUDENT'S t-TEST VALUES FOR PAIRS OF CLASSES, 30TH WEEK RAW SCORES**

<table>
<thead>
<tr>
<th>No.</th>
<th>Class Pair</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>DF</th>
<th>t-Value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCA Control</td>
<td>18.94</td>
<td>4.08</td>
<td>60</td>
<td>3.516</td>
<td>p 95%</td>
</tr>
<tr>
<td>2</td>
<td>DCA RAE</td>
<td>18.94</td>
<td>4.08</td>
<td>140</td>
<td>3.009</td>
<td>p 95%</td>
</tr>
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<td>3</td>
<td>DCA Period 1</td>
<td>18.94</td>
<td>4.08</td>
<td>54</td>
<td>1.1000</td>
<td>p 95%</td>
</tr>
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<td>4</td>
<td>Period 1 RAE</td>
<td>20.16</td>
<td>4.18</td>
<td>134</td>
<td>1.3767</td>
<td>p 95%</td>
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<td>5</td>
<td>Controls RAE</td>
<td>22.03</td>
<td>2.70</td>
<td>140</td>
<td>0.8581</td>
<td>p 15%</td>
</tr>
</tbody>
</table>

### TABLE 5

**STUDENT'S t-TEST VALUES, ADJUSTED DCA SCORES VERSUS RAW CONTROL SCORES**

<table>
<thead>
<tr>
<th>Test</th>
<th>Class Pair</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>DF</th>
<th>t-Value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>10th week DCA Control</td>
<td>30.03</td>
<td>5.46</td>
<td>60</td>
<td>0.7029</td>
<td>p 60%</td>
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<tr>
<td>20th week DCA Control</td>
<td>26.61</td>
<td>6.79</td>
<td>60</td>
<td>0.4627</td>
<td>p 50%</td>
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<tr>
<td>30th week DCA Control</td>
<td>22.13</td>
<td>4.80</td>
<td>60</td>
<td>0.1011</td>
<td>p 50%</td>
<td></td>
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</tbody>
</table>
Table 5 shows that it is reasonable to sustain the null hypothesis as there is less than a 50 percent probability there is a significant difference in the learning of DCA and Control students when compared according to the amount of material covered by the individual pupils without regard to the time spent.

Observations. The first set of observations are those made by the writer, student-teacher or TA, and are noted without any necessary priority. The second set is introduced with the results of an opinion survey made in the DCA class at the end of the 30th week, Table 6.

The students became less competitive with each other and more attentive to the lessons. They quickly learned that insufficient study impeded progress, that haste to get a better score than someone else brought no rewards. They could attend longer (actually, about ten minutes longer as compared with RAE). The longer attention span may be due to fewer lectures in the DCA class. There was no penalty for absenteeism since the DCA students would simply resume their activity and take the tests when ready. DCA students whose pace slowed to a standstill found themselves motivated to resume serious work (this occurred after the 10th week) by the lack of recognition of progress on the "star chart." Nonetheless, the general opinion of all


**TABLE 6**

RESULTS OF OPINION SURVEY MADE IN DCA CLASS

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>Undecided</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you like this course where people are allowed to go at their own rate?</td>
<td>22</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2. Would you prefer a course where there is a definite time for turning in work?</td>
<td>6</td>
<td>9</td>
<td>16</td>
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<tr>
<td>3. Do you sometimes put off studying when there is no definite due date?</td>
<td>21</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>4. Do you get enough help from the two teachers?</td>
<td>22</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5. Do you get useful help from your classmates at any time?</td>
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<td>7</td>
<td>9</td>
</tr>
<tr>
<td>6. Does the noise of groups studying and talking bother you?</td>
<td>6</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>7. Do you work best alone?</td>
<td>12</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>8. Do you work best in groups, and seldom play or gossip instead of working?</td>
<td>11</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>9. Could you be further along by now if you'd worked harder, and sooner?</td>
<td>23</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>10. Have you made use of the &quot;extras&quot; like the tapes, SRA kit or the calculator?</td>
<td>Often</td>
<td>Some</td>
<td>None</td>
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</tbody>
</table>
concerned was that self-pacing brought too much procrastination; this phenomenon reflects Dahlke's observation (4). Procrastination is inherent in a flexible-time class. Hence, to overcome this disability, there must be some limit to the self-pacing such as setting a few definite deadlines which the students must be familiarized with at the inception of the course.

The use of the Algebra Skills Kit dropped rapidly after the first four weeks, but rose again after the 30th week test. The tape cassettes were used frequently by absentees the first fifteen weeks. Unfortunately, the tape recorder had no revolution counter, which made it difficult to locate a specific lecture after fifteen weeks of material had been recorded. The hand-held calculator has been used throughout the year. The chalkboard, the answer pamphlets and the textbook are the materials used most frequently. The teachers and the TA continue to act as sources of information and help.

The results of the student opinion survey very nearly speaks for itself.

These responses were reinforced by optional comments made by the students on the survey form. The following are typical remarks:
Yes (this course style) is good for some people who can't work under pressure. I work much better when I have an assigned due date.

I hate this course. I'm a lazy one. If someone doesn't push me I won't do it. If I were you I'd stop this experiment right away. I'd say the experiment was a failure.

I like this course the way we can go at our own rate, but I do not understand it.

I find that sometimes Debbie (TA) is more helpful at explaining so I can understand than the teachers.

I think that going at your own pace gives you more time to study.

Among other things the students' responses indicate a need for due dates in study assignments (questions 2 and 3), the value of peer assistance (question 5) but not necessarily in groups (questions 7 and 8), and a doubtful advantage of the "extras" (question 10). With respect to this last reaction, however, what may really be shown by their responses was a lack of proper orientation to the equipment.

Limitations and Weaknesses. The distribution of the ability levels in the DCA class was not a normal curve. Inspection of Column one of Table 3, showing five pupils with an MMT score of thirty-eight, makes this obvious. The pupils in the DCA class were aware that they were in an experimental group. The psychological effects of this
knowledge may have contributed biases to the experiment. The size of the two groups given the two different kinds of instruction were not equal. Selection of the control group was an artificial device, and not made by random selection.
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

A Differential Credit Algebra Experiences course, featuring self-pacing and a flexible-time format, was developed and taught at Patrick Henry Junior High School, Granada Hills, during 1974-75. The DCA students learned at a slower rate than RAE students and their raw score means on all tests given to both groups were consistently lower than that of either the Controls or the RAE group. The t-values on raw scores indicated a significant difference at the 95 percent confidence level between DCA's and Controls as well as DCA's and RAE's. These differences were slightly in favor of the regular structured classes.

The t-values on the raw scores of other pairs of classes could indicate hidden biases, not only in the tests used for comparisons of performance, but in the effects of time of day, level of hunger, and other unmeasured variables.

The null hypothesis is tentatively confirmed at this time by the t-values on the DCA adjusted scores versus
those of the Controls. Algebra Experiences instruction which allows each student to progress at his own pace makes no significant difference in the level of learning reached by these students at the time they have completed the course as compared to the level of learning reached by students instructed on a fixed schedule. The t-values obtained by comparing the means of DCA's and Controls on each of the three tests given indicate a significant difference only for the raw scores. Although this difference is negative for the DCA class, it is not a large difference. It is probably due to the flexible-time feature and should disappear at the time all DCA students and Controls have completed their Algebra Experiences course at the end of their 10th grade year of school, which suggests the first recommendation below.

Recommendations. The following recommendations grew out of this project:

1. At present and in general, second year Algebra Experiences students have a 52 percent probability of earning a final grade of C or better. Hence, a follow-up study of the success-failure ratio of the DCA and RAE students in 1976 should be made.
2. The course should begin with special sessions on how to study efficiently alone and in groups. The goals and outline of the study problems should be far more detailed, with more emphasis than given in this project. The lectures and discussions should be taped on a recorder that has a counter so that particular topics can be located quickly.

3. Computer facilities should be used to generate similar versions of the unit quizzes and final tests, so that all versions are slightly different but of the same degree of difficulty.

4. Individual learning packets directly related to the text used for the Algebra Experiences course should be available for group study.

5. Procrastination should be countered by presenting a list of deadlines for each unit, using the semi-forced pacing mentioned by Powers and Anthony (20).

6. A second year DCA course is needed to make the time-flexible feature a reality for the complete Algebra Experiences course.

7. Academic credits earned by students in DCA should be reported separately from their non-academic credits, so that students and parents will know exactly where they stand in relation to completion of the course.
8. The ratio of lecture days and test days should return to three to two, as it was at the beginning of the year, because the students need more formal guidance for study before they are allowed to proceed on their own initiative.

9. The DCA course should be an elective in the future, so students would know what will be expected of them.

10. The units should be rearranged in this order:

Unit I. Chapter 1, symbols; chapter 2, sets; and chapter 3, language of algebra.

Unit II. Chapter 5, integers.

Unit III. Chapter 6, rational numbers.

Unit IV. Chapter 7, equations and inequalities; chapter 8, problem solving.

Unit V. Chapter 9, graphing linear equations.

Chapter 4, logic, should be reserved for an extra unit for the ambitious, who finish the five credits early. The high school instructors do not feel Chapter 4 is particularly necessary to prepare students for the second year of Algebra Experiences.
BIBLIOGRAPHY


Appendix A  -  Range, Mean and Dispersion of Raw Scores

B  -  Letters to Concerned Persons

C  -  Outline and Planning for the Differential Credit Algebra Experiences Course Presented to the Patrick Henry Junior High School Administration in August, 1974

D  -  Differential Credit Algebra Experiences Study Sheet

E  -  Differential Credit Algebra Experiences Course

F  -  Differential Credit Algebra Experiences based upon Dolciani Modern Algebra
Figure 1

This graph shows that the mean, $\bar{X}$, of any one group on any one test, plus or minus 1 SD overlaps that of the other two groups. The mean of the DCA class is consistently lower than that of the Controls or RAE's because of their slower pace. The solid lines indicate the means, plus or minus 1 SD. The dotted lines indicate the full range of scores on each test.
Dear Parents:

Your child's Algebra Experiences Class is an experimental one. The mathematical content is not changed, but the approach to teaching is different in that the student is provided opportunity to learn at a rate most suitable to the individual. Each student has the total list of assignments and quiz problems to be done by Christmas. The student should do these as rapidly as possible, earning a "C" or better on each quiz. These assignments and quizzes can be done in class or at home. To finish all the assignments, home work four nights a week is necessary. A half-hour on Monday, Tuesday, Wednesday, and Thursday is recommended. Maturity and responsibility for one's own work are as important in this experimental course as the Algebra problems.

Would you please sign this letter to indicate you have read it and ask your child to return it to me?

Sincerely,

Mrs. McIntosh

Approved: Principal
Mathematics Chairman
Dear Period Four Students:

Please give your quizzes to be graded to the Student teacher. They will be graded after school and you will know the results the next day. With this system, the student teacher can put in full time helping you during class. Students won't spend any more valuable class time waiting for a fast return of graded quizzes. It is nice to know how you made out on a quiz within a few minutes of finishing it, but it is more reasonable for everyone to get a quiz back the next day, instead of the few who get theirs graded before the bell rings.

Now, after turning in a quiz, get right to work on the next section to be studied—let's get more done this semester. You voted to make yourselves get busy and work faster on your own.

After picking up graded quizzes, if you have no questions and have passed, the TA will give you your star, and file your quiz and make a record of the grade. If you did not pass, study your mistakes, then turn the failing paper over to the TA to be filed, and get ready to try again. Study the practice materials and the reading more carefully.
Not many of you are checking out the answer pamphlets for your practice work. You had better start doing this.

A summary of the Properties of Numbers, the Properties of Zero and One, as well as important definitions are listed on pages 32 and 33. They are different from the Properties of Equalities and the Properties of Inequalities which are explained in several places throughout Chapter 7. You will have to search them out with careful reading.

Help is available after school if you let me know that you want to come in and when. I stay regularly on Thursdays and will stay other days if needed.

Mrs. McIntosh
January 23, 1975
To: Head Counselor
From: B. McIntosh

As you know, present policy gives 5 non-academic mathematics credits for the Fall semesters in 9th and 10th grade Algebra Experiences. Five academic credits in mathematics are granted for each Spring semester. This equalizes the academic credits earned in this slower course with the credits earned in Algebra I AB in one year, and also grants the Algebra Experiences students 10 extra credits for the second year they spend learning at a slower rate.

My present urgent question is, what is the best way to mark the "Credits" box on the report cards? Alternatives:

1) Subject Credits Mark W.H. Code Signature

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This represents one unit academic credit earned, plus four non-academic credits for this semester's time. Most pupils have completed this level, but have not completed the second unit.

2) Fill out the report cards as usual, with 5 credits in the box, and send a form letter home informing parents of the child's level of achievement to date and giving details on how well he is pacing himself. This letter would need
the principal's approval, and would go home some time after the report cards.

The purpose of such a letter is to give the pupils full credit for what they have accomplished, and to give parents complete information about their child's progress.

Note: The second alternative was used.
To Head Counselor:

One of the Differential Credit students is going to finish the Algebra course (with a $B^+$ or an A) in about two weeks, some time before the end of the semester. She has requested permission to report to class, then go to help in the Ceramics classroom. She could do this, or she could serve as a mathematics TA in the Differential Credit Algebra class.

B. McIntosh

Note: The first alternative was permitted.
APPENDIX B (Continued)

April 15, 1975

To: Head Counselor
Mathematics Department Chairman

From: Mrs. McIntosh

I have felt it is necessary to change the format of the Differential Credit Algebra class from a flexible time scheme to a structured scheme. This was begun this week, immediately after the 30th week report cards.

Reasons: 1) A follow up Differential Credit Algebra course is not yet available for the 10th grade year at either Kennedy High School or Granada High School.

2) I believe the structured class format will help those students whose pace has been slower than that of others to enter the 10th grade course with the algebra concepts which they will need. The students whose pace has been adequate, will merely have to adjust to a new routine.

A letter to parents to follow the midterm report card of the second semester has been written. A copy of it is attached for revisions, suggestions and approval before sending it to the Principal. After he approves the letter, it will be sent home to parents of the Differential Algebra Class students.
APPENDIX C

Outline and Planning for the Differential Credit Algebra Experiences
Course Presented to the Patrick Henry Junior High School Administration in August, 1974

I. Explanatory lecture sessions for each unit as needed
   
   A. Expanded explanations to be given to small groups of slower pupils while faster ones work on own units. Tape record lectures for absentees.
   
   B. SRA Algebra Skills Kit, Mathematics Laboratory, and other supplementary facilities to be used.

II. Use the chapters in Dolciani, Modern Algebra, as the basis for course units.

   Unit I. Chapters 1 and 2
   Unit II. Chapter 3 and Cumulative Review
   Unit III. Chapters 4 and 5
   Unit IV. Chapter 12
   Unit V. Chapter 6

   Equivalent to one year of work, for 5 academic credits and 5 non-academic credits.

   Unit VI. Chapter 7 and Cumulative Review through Ch. 7
   Unit VII. Chapter 8
   Unit VIII. Chapter 9
   Unit IX. Chapter 10
   Unit X. Chapter 11 and Cumulative Review through Ch. 11

   Equivalent to second year of work, for 10 credits as in the first year.

   Each unit has a value of one academic semester credit and will have a final grade of A, B, or C. No D's or F's will be accepted.

   Extra units and semester credits for faster pupils, of needed:

   Unit XI. Chapter 13, systems of three equations
   Unit XII. Chapter 14, Trigonometry introduction
   Unit XIII. Chapter 15, Statistics and probability
These extra units would be of value to the Science and Mathematics majors who are sure they will take advanced Algebra, Geometry, Trigonometry and/or Mathematics Analysis in High School.

III. Later on the learning unit materials could be programmed into the big computer, in a form similar to what we use on the small Tutor Computer machines. To program this, the problems in the Dolciani Book would have to be used as a basis for determining the limits for variables within which the particular problem form could be randomly generated. Programming the Unit Final Tests would be done first. Printed materials from the Text and the related workbooks may have to be used to start the course.

IV. The Kennedy High School Differential Credit course in Basic Mathematics worked out by Leslie Winters requires a pupil to pass a unit test by a certain percentage for a given letter grade--no curving of grades. Any pupil who fails a test is expected to go over the learning material again and try another similar unit test. We plan to have three tests per credit unit.

V. Ideas for the mechanics and classroom management are found in Leslie Winters' description of his course. There are materials about the Long Beach project for individualized instruction in notebooks #108 to #113 in the P. H. Lab.

VI. At present, a minimum accomplishment has not been set. Flexibility of time is the salient feature of the Differential Credit course. It is possible for a pupil to drop the Differential Algebra course any time after one credit with a C or better was earned and have no stigma of a Fail or a D. He would have one semester-credit in mathematics, and under the present requirements for High School graduation, he would have enough credits.

VII. This variation in point credits for each pupil is hard to sell to the counseling departments. There might also be problems that would be raised by high schools outside the ones served by this Junior High.
VIII. Grouping according to Orleans-Hanna Algebra Readiness Test would be helpful. Regrouping would occur naturally within the Differential Credit Class, as slower and faster pupils sorted themselves out. At present we have movement of pupils down from Algebra 1 AB classes to Algebra Experiences and the Algebra Experiences pupils go down to 9th grade or career mathematics.

IX. Bright pupils who complete their point credits early are able to earn more advanced semester credits. They could also have a choice of being TA's for service credits or take an elective the remainder of the semester.

X. The records on the status of each pupil's progress must be kept up to date faithfully, so some sort of student clerical help is needed. In fact, the course will require a great deal of pupil responsibility and involvement to carry out. I feel that this training in responsibility and record-keeping is an essential part of the Differential Credit course in Algebra.

XI. If the Differential Credit Course is continued through into the High School years, which seems to be another essential feature of the plan, the uniformity and completeness of the semester-credit units is very important, and should be carried through at the high school level.

XII. Using a tape recorder in the classroom during the explanatory sessions and at student group sessions is one method proposed for assessing what is going on in the way of teaching and learning.
APPENDIX D

DIFFERENTIAL CREDIT ALGEBRA EXPERIENCES

Study Sheet

Unit I. Chapters one and three.


Final Exam. Try the odd numbered problems in chapter tests on page 38 and page 100.

Always read explanations. Look up words you don't know. Anything underlined here or in the book is important. Printing in a different color or in italics should be given particular attention. Don't rush into the tests; do your studying first.

Unit II. Chapters five and six.


Review exercises.

Final. Do the odd numbered problems from chapter test
p. 177-8 and the chapter test p. 212.

Unit III. Chapter seven.

p. 222 PE. Read p. 222 through 226 wherever there is
explanatory material. On p. 224-5 PE. p. 227 set A.

Quiz 2. Read p. 228-229 top. p. 229 set A. Read
p. 230-1. p. 232 set A. Read p. 233-4 and do Dis-
covery Questions. p. 234 set A.

p. 241 set A.

Quiz 4. Read Chapter Summary p. 242. p. 243-244
Review exercises.

Final. Do some odd numbered problems from the chapter
test on p. 212.

Unit IV. Chapters two and four.

Quiz 1. p. 43 PE. p. 46 PE, Discovery Questions.

Quizzes 2 and 3. Read p. 130 summarizes of properties
of numbers. Read p. 123-129 and do the Discovery Ques-

Final. Do some of the odd numbered problems in the
chapter test on p. 66 and the chapter test p. 134. The
Venn diagrams in this unit will be shown on the chalk-
board. You should practice drawing them well before
you do the tests.

Unit V. Chapters eight and nine.

p. 262-263. p. 263 PE. p. 265 set A.


Final. Do odd numbered problems from chapter test p. 272 and from chapter test p. 318.

Whenever you finish a test, please start to study for the next quiz or Final that you want to take. Don't spend any class time when there is a teacher or tutor available doing something playful. Our time is shorter than you think.

Most of you are doing quite well, considering the change in books and the new procedures. Don't let up on yourselves now.

When you get to High School, you will probably be as much on your own responsibility as you are in this experimental course, but you will have to turn in work at a certain time. I'd be very surprised if you have a extra teacher in the room.

Notes for graphing ordered pairs in chapter 8. For a number pair like (3,6), (-2,5) take the first number on the x-axis (it is horizontal, flat and you go right from zero for a positive first number, left for a negative first number.) After you get there, consider the second number in relation to the y-axis (up or down). Positive second numbers go up and negative second numbers go down. The ordered pair (3,6) is located three units to the right of zero and 6 units up from the x-axis. The ordered pair (-2,5) is located two units to the left of zero and five units up from the x-axis.
APPENDIX E
DIFFERENTIAL CREDIT ALGEBRA EXPERIENCES

Dear Students:

The instructions for the Credit Units in the Johnson Algebra book are more general than in the Dolciani Modern Algebra. It is up to you, the student, to do the reading and the practice lessons. It is a good idea to try the Practice Exercises, the Discovery Questions and some of the problems in the A and B sets of exercises. The gray answer books give the answers to all odd numbered problems. These answer books can be checked out from the TA for classroom use only.

Please put the Roman Numeral Unit Number on your quizzes as well as the Arabic numeral for the quiz itself. You have been forgetting those Unit numbers. The Units are out of order with the order of the chapters in the book. This is because we have changed books. You have already covered the concepts of Units I, II and III if you have done up to quiz 2, Unit II from Dolciani. Your progress should be faster and less frustrating from now on.

The Units for the 9th grade year follow:

Unit I: Chapters 1 and 3, pp. 1 to 38 and pp. 68 to 100.
Unit II: Chapters 5 and 6, pp. 138 to 178 and pp. 179 to 212.
Unit III: Chapter 7, pp. 214 to 246.

Unit IV: Chapters 2 and 4, pp. 40 to 67 and pp. 102 to 135.

Unit V: Chapters 8 and 9, pp. 248 to 272 and pp. 274 to 318.

There are plans to offer Algebra Experiences during Summer School this year for any who feel they need it and can attend. All of you have made great progress in self-direction this past semester, and I have great hopes that you will go ahead at a much faster pace, and get more satisfaction out of learning this Spring semester.

Sincerely,

Mrs. McIntosh
# Differential Credit Algebra Experiences Course

Unit I. Chapters 1 and 3, Johnson, *Algebra, Its Structures and Applications*

**Quiz 1**, problems in "B" sets of exercises

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<tr>
<th>First try</th>
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<tr>
<td>p. 13 #2, 8, 14, 20, 26, 32</td>
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<td>#4, 10, 16, 22, 28, 34, 40</td>
<td>#6, 12, 18, 24, 30, 36, 42</td>
</tr>
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Twenty problems in each try: A = 20, B = 18 - 19, C = 14 - 17. No D's accepted, let alone Fails.

**Quiz 2**, problems in "B" sets of exercises

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<td>#6, 12, 18</td>
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<td>p. 81 #2, 8, 14</td>
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<td>#6, 12, 14</td>
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<td>p. 84 #2, 8, 14</td>
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<td>p. 88 #2, 8, 14</td>
<td>#4, 10, 16</td>
<td>#6, 12, 18</td>
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Twelve problems in each try: A = 12, B = 10 - 11, C = 8 - 9.

**Quiz 3**, "B" sets

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<td>p. 93 #2, 8, 14</td>
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<td>p. 97 #2</td>
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Five problems, 2 points each; 1 point for showing work.
and your set-up, 1 point for the correct answer.
A = 10, B = 9, C = 7-8.

**Unit I Final Examination for One Course Credit:** from Chapter tests.

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<td>p. 100</td>
<td>#2, 8, 14, 20, 26</td>
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Nine problems in each try: A = 9, B = 8, C = 6 - 7.

**Unit II. Chapters 5 and 6, pp. 138 to 212.**

**Quiz 1**, problems in "B" sets of exercises

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<td>p. 155- 156</td>
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<td>p. 159</td>
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**Quiz 2**, "B" sets of exercises

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**Quiz 3**, "B" sets

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<tr>
<td>p. 175</td>
<td>#2, 8, 14</td>
<td>#4, 10, 16</td>
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</table>

Quiz 4, "B" sets of exercises and Review Exercises on p. 211

First try Second try Third try

p. 197 #2, 8, 14 #4, 10, 16 #6, 12, 18
p. 206 #2, 8, 14 #4, 10, 16 #6, 12, 18
p. 211 #26, 32, 38, 46, 54, 66, 72, 74 #28, 34, 40, 48, 58, 68, 70, 76 #30, 36, 42, 50, 62, 72, 78, 80


Unit II Final Examination for One Course Credit: from Chapter tests.

First try Second try

pp. 177-8 #2, 6, 10, 14, 18, 22, 26 #4, 8, 12, 16, 20, 24, 28
p. 212 #2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42 #4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44

Eighteen problems: A = 18, B = 16 - 17, C = 12 - 15.

Unit III. Chapter 7, pp. 214 to 246. "B" sets of exercises and some of the Review Exercises are in the Quizzes.

Quiz 1, "B" sets

First try Second try Third try

p. 217 #2, 8, 14, 20 #4, 10, 16, 22 #6, 12, 18, 24
p. 219 #2, 8, 14 #4, 10, 14 #6, 12, 14
p. 227 #2, 8, 14 #4, 10, 16 #6, 12, 18

Ten problems: A = 10, B = 9, C = 7 - 8.
Quiz 2.

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<td>p. 234</td>
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Thirteen problems: A = 13, B = 11 - 12, C = 9 - 10.

Quiz 3.

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Quiz 4, Review exercises

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</tr>
<tr>
<td>p. 244</td>
<td>#44, 50, 62</td>
<td>#40, 46, 52, 64</td>
</tr>
</tbody>
</table>

Ten problems: A = 10, B = 9, C = 7 - 8.

Unit III Final Examination for One Course Credit: from Review exercises and the Chapter test

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 244</td>
<td>#56, 60, 64, 68, 76, 80</td>
</tr>
<tr>
<td>p. 245, top</td>
<td>#84</td>
</tr>
</tbody>
</table>

p. 245-6 in the Chapter test:

#2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42
If a third try is needed, get special dittoes from the teacher.

Nineteen problems: A = 19, B = 17 - 18, C = 13 - 16.

Unit IV. Chapter 2, pp. 40 - 67 and Chapter 4, pp. 102 - 135.

**Quiz 1**, in the Practice Exercises. There are no "B" sets in Chapter 2.

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
<th>Third try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 46 #2, 8</td>
<td>#4, 10</td>
<td>#6, 12</td>
</tr>
<tr>
<td>p. 49 #2, 8, 14, 20</td>
<td>#4, 10, 16, 22</td>
<td>#6, 12, 18, 24</td>
</tr>
<tr>
<td>p. 52 #2, 8</td>
<td>#4, 10</td>
<td>#6, 8</td>
</tr>
<tr>
<td>p. 53 #2, 8, 14</td>
<td>#4, 10, 14</td>
<td>#6, 12, 14</td>
</tr>
</tbody>
</table>


**Quiz 2**, from the "B" sets in Chapter 4.

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
<th>Third Try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 105 #4, 10</td>
<td>#2, 10</td>
<td>#6, 10</td>
</tr>
<tr>
<td>p. 109 #2, 10</td>
<td>#4, 10</td>
<td>#6, 10</td>
</tr>
</tbody>
</table>

From Practice exercises on the following pages:

| p. 112 #2, 8, 14 | #4, 10, 16 | #6, 12, 18 |
| p. 115 #2 | #4 | #6 |
| p. 119 #2, 12 | #4, 14 | #6, 16 |

Twelve problems: A = 12, B = 11, C = 8 - 10.

**Quiz 3**, "A" sets of exercises.

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 131 #2, 6, 10</td>
<td>#4, 8, 12</td>
</tr>
</tbody>
</table>

From Review Exercises:

| p. 133 #2, 6, 10, 14, 18, 22 | #4, 8, 12, 16, 20, 22 |

Nine problems: A = 9, B = 8, C = 6 - 7.

**Unit IV Final Examination for One Course Credit**: from Chapter tests.
First try | Second try
--- | ---
p. 66-7 | #2, 6, 10, 14, 18, 22, 26, 30
p. 134 | #2, 6, 10, 14, 18, 22

Fourteen problems: A = 14, B = 12 - 13, C = 8 - 11.

Unit V. Chapter 8, pp. 248 - 272 and Chapter 9, pp. 274 - 318.

**Quiz 1**, the "A" sets of problems

- **First try**
  - p. 256-7 #2, 6, 10
  - p. 261-2 #2, 6, and Set B #2
  - p. 265 #2, 4, 6
  - p. 268 Practice problem #4

- **Second try**
  - First try Second try
  - p. 256-7 | #2, 6, 10
  - p. 261-2 | #2, 6, and Set B #2
  - p. 265 | #2, 4, 6
  - p. 268 | Practice problem #2

Ten problems: A = 10, B = 9, C = 7 - 8.

**Quiz 2**, Review questions

- **First try**
  - p. 269-270 #2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42

- **Second try**
  - p. 269-270 #2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42


It is expected that by now, you will not need three tries for a Final but that you get your reading done and ask all the necessary questions and practice thoroughly before you attempt a final test.

**Quiz 3**, "A" sets of problems, except where noted.

- **First try**
  - p. 278 #2, 8
  - p. 285-6 #2, 8, set B #4
  - p. 292-3 #2, 8, 14
  - p. 295-6 #2, 8, 14
  - p. 301-2 #2, 8, 14, 20

- **Second try**
  - p. 278 #4, 10
  - p. 285-6 #4, 10, set B #4
  - p. 292-3 #4, 10, 16
  - p. 295-6 #4, 10, 16
  - p. 301-2 #4, 10, 16, 22

- **Third try**
  - p. 278 | #6, 12
  - p. 285-6 | #6, and set B #2, 8
  - p. 292-3 | #6, 12, 18
  - p. 295-6 | #6, 12, 18
  - p. 301-2 | #6, 12, 18, 24
Fifteen problems: A = 14 - 15, B = 12 - 13, C = 8 - 11. Use graph paper, or the graph stamp to do the plotting problems.

Quiz 4, "A" sets

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
<th>Third try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 306</td>
<td>#2, 8, 14</td>
<td>#4, 10, 16</td>
</tr>
<tr>
<td>p. 309</td>
<td>#2, 8</td>
<td>#4, 10</td>
</tr>
</tbody>
</table>

Review exercises on the following pages:

p. 314-317 #2, 8, 14, 20, 26, 32, 38, 44, 50, 56, 62, 40, 46, 52, 58, 64, 62, 64

Sixteen problems: A = 15, B = 13 - 14, C = 9 - 12.

Unit V Final Examination for One Course Credit: from Chapter tests.

<table>
<thead>
<tr>
<th>First try</th>
<th>Second try</th>
</tr>
</thead>
<tbody>
<tr>
<td>p. 272</td>
<td>#2, 6, 10</td>
</tr>
<tr>
<td>p. 318</td>
<td>#2, 6, 10, 14, 18, 22, 26</td>
</tr>
</tbody>
</table>

Ten problems: A = 10, B = 9, C = 7 - 8.

If a third try is needed, ask teacher for a special ditto sheet test.

All Differential Credit Algebra Experiences students will take the same midterms and semester examinations that the other classes take. This will have only the weight of one grade, whereas theirs has the weight of three grades. These tests are given to your group in order to compare your progress with theirs. We hope that all of you will get this far before the week of June 2, 1975. Best of luck.
APPENDIX F

Differential Credit Algebra Experiences
based upon Dolciani Modern Algebra

Page
Nos.

Unit I.  1-10 Basic use of Real numbers
10-16 Simplifying numerical expressions, including exponential notation
16-25 Set language and line graphs
26-39 Variables
39-43 Chapter 1 Review and the Chapter test
47-70 Basic properties of Algebraic addition
71-76 Direct Proof - consider omitting this. Note that these pages contain information on some basic properties of the equality (=) sign, which must be included in the pupil's knowledge of Algebra.
76-87 Addition practice; the basic properties of Algebraic multiplication; multiplication practice
87-89 Chapter 2 Review and Chapter 2 test

Unit examination. 70% to 84% correct answers = C; 85% to 94% correct answers = B; 95% to 100% = A for the unit-credit.

II. 95-106 Algebraic addition practice (numbers and variables) which includes subtraction by using inverse concepts
106-115 Algebraic multiplication (numbers and variables) which includes division by using inverse concept
116-136 Equations; solving equations and word problems to which equation form can be applied
137-139 Chapter 3 Review and Chapter 3 test
141 Cumulative Review of Chapters 1, 2, and 3

Unit examination. Same percentages required for determination of grade as in Unit I of credit.
Unit III. 145-150 Inequalities and their properties
150-156 Proof with inequalities; indirect proof-consider omitting this.
157-168 Solving inequalities
169-180 Solving word problems by application of inequalities
181-183 Chapter 4 Review and Chapter 4 Test
189-197 Ordered pairs of numbers
197-205 Graphing of ordered pairs; Cartesian coordinate system
206-216 Linear equations and lines in the coordinate plane. Equation to graph; graphed line to equation.
216-219 Chapter 5 Review; Chapter 5 Test

Unit examination. Same percentages required for determination of grade for semester credit.

IV. This unit and Unit V may be switched if instructor deems it desirable.
473-485 Algorithms, flow charts and computer programs
485-490 Loops and subscripts
490-505 Computer language; controls, writing computer programs
505-509 Chapter 12 Review; Chapter 12 Test

Unit examination; turn in a computer program.

V. 223-235 Systems of linear equations in two variables; graphic solutions
236-239 Linear combination method of solving pairs of linear equations
240-244 Substitution method of solution of linear equations
244-251 Problem applications of pairs of linear equations
252-258 Solving linear inequalities
258-262 Chapter 6 Review; Chapter 6 Test

Unit examination; conditions as before.