THE FIRST YEAR ALGEBRA PROGRAMS
OF POTTAWATAMIE COUNTY, IOWA

BY

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CHAPTER I

INTRODUCTION

Algebra is everywhere. To the moon and back in two and one-half seconds! This was the amazing journey that took place several years ago. The trip was by radio impulse; beamed at the moon it collided with it in just one and one-fourth seconds after leaving the transmitter. All of the while its path was watched by a group of men gathered around a radar screen. A radar screen can collect information, but it takes a person to interpret it. This person must know and be able to use algebra.

Look out the window. Are you in a city? The mighty steel and concrete buildings, automobiles in the streets, traffic lights at the corner are just a few of the witnesses to the use of algebra in modern life. Are you in a rural region? The terraced slopes, contour plowing, farm machinery, hybrid corn, too are evidences of the application of algebra.

Of course algebra is not alone, but algebra is basic. Algebra is a tool to be utilized in many situations. It is essential in many fields and useful in
many others. Furthermore, it is a means of understanding the world of today. It is a tool for solving the problems of the present and for improving the conditions of the future. It is equipment that people need, if they are to take their places as educated persons in the modern world.

What is algebra? Algebra is the universal language of higher mathematics and of science. There are few fields in which its uses are not necessary. To build a bridge, to lay out a highway system, or to construct a building, algebra is one of the principal tools used. Measurements must be made, plans drawn, and formulas used to determine the stresses and strains in construction.

Formulas are used in business and finance, in setting up social security and pension plans and the like. It is used in economics, social science, and industry. In nearly every skilled occupation, profession, or trade, some knowledge of algebra is necessary.

Many people have a complete misconception of the meaning of algebra. Some think of algebra as something that is hard to learn, something mysterious, something that only "brains" and geniuses can comprehend. All--or nearly all--of algebra is just the four simple fundamentals of arithmetic: addition, subtraction, multiplication, and division. It shows people how to use these four parts
of arithmetic to solve difficult problems and how to do these problems quickly and easily. Dr. Young has the following to say about mathematics.

There is no subject, except the use of the mother tongue, which is so intimately connected with everyday life, and so necessary to the successful conduct of affairs. Wherever we turn in these days of iron, steam, and electricity, we find that mathematics has been the pioneer and guarantees the results. Were its backbone of mathematics removed, our material civilization would collapse.¹

There are plenty of algebraic problems in life-work, but they generally remain unformulated owing to a lack of knowledge. Often these problems are not even recognized, even as danger is not recognized by small children. It is natural in such circumstances to claim that they do not exist! The need of algebra is then more real than apparent. Unable to avail themselves of algebra, people substitute guessing methods with all the attached dangers and costs. Hence, to the end of life they remain convinced that algebra is a useless or unnecessary subject. Breakages, accidents, loss of contracts, and so on, are considered inevitable factors in business. Not having the standards of comparison, they never realize the high cost of their lack of algebraic ability.

The world today is very complicated for it has

changed much in the past forty years. Forty years ago there were comparatively few scientists and engineers; the world was only beginning to realize how important science and engineering are. The automobile was just getting started. Airplanes were a novelty. Radio and television had not been born. Most homes had no electricity. There was very little need for technical people in those days. Over one-third of all the people who worked were unskilled; they needed very little education--they worked mostly with their muscles, not their brains.

Today, although there are still more unskilled workers than any other occupation, their total number has dropped from approximately 13,400,000 to 11,500,000, while the total number of people working has increased from approximately 37,300,000 to 55,800,000! Meanwhile the number of skilled and semi-skilled workers increased during the same period. The skilled workers doubled from 5,500,000 to 11,000,000. In 1910 there were only 60,000 engineers in the entire United States. Only one of every 621 people working was an engineer, but by 1950 the ratio had increased to one of every 139 working persons.¹

Yes, the world is very complicated today, compared to forty years ago. Almost every occupation deals with at

In a lecture to a group of young people Professor Karpluski stated that:

The most important thing is not the problem itself, but the way you think about it. Mathematics is the language of the universe. It's essential in any such conception of the world today. People who think in this way are able to understand the world in which they live. The world of mathematics helps us to understand the world of science.

For example, to solve the problem of the world today, you need to think in terms of mathematics. This is not just a problem, but a way of life. Mathematics can help you to understand the world around you, and to solve problems in a systematic and effective way.

Mathematics is not just about numbers and equations. It's about understanding the world, and how it works. By thinking in terms of mathematics, you can develop a deeper understanding of the world, and how to solve problems in a systematic and effective way.
Many teachers of mathematics state that algebra is the basic language for all mathematics above arithmetic. Hart states that algebra is the very foundation of all higher mathematics.

Algebra supplies the language and is the principal tool of all mathematics above the level of arithmetic. Many problems that can be solved by arithmetic alone can be done more effectively by means of algebra. It has been suggested that advances in the use of science would have been more rapid if some of the pioneers had been able to use algebra to express the rules which they discovered.¹

All this suggests the practical reason for the study of algebra. Nothing has been said about training the mind, although the study of mathematics is possibly an effective introduction to logical thinking and promotes neatness, order, and diligence. In school a child has the opportunity and the privilege of studying various kinds of knowledge that great thinkers of the past have discovered and organized. Hart says: "Study mathematics first, for the fun of it and second, for the profit that may come from having studied it."²

The Problem

This study is a survey of the first year algebra program in use in the public high schools of Pottawattamie County, Iowa in 1954.

¹W. W. Hart, A First Course in Algebra, p. 3.
2Tbid., p. 3.
Purpose

The purpose of this field study is to compare the algebra program in Pottawattamie County, Iowa with what the authorities in the field believe to be minimum requirements for an acceptable program. This comparison includes the following points:

1. The objectives used in first year algebra and the methods used to form them.

2. The methods used in teaching first year algebra.

3. The audio-visual aids and other supplementary aids used in classes.

4. The methods used in evaluating students' progress.

This comparison is made so that recommendations may be offered for the improvement of the first year algebra course in Pottawattamie County, Iowa.

Procedure

For this study the author did extensive reading in the field of teaching first year algebra and set up criteria to be used for personal interviews of every first year algebra teacher in the twelve high schools, as well as personal inspection of the algebra rooms and libraries.

Using the criteria established, the author made a sample set of questions for a personal interview and tried the questions on fifteen algebra teachers attending the 1953 summer session at Drake University. When the
questions were considered adequate, they were set down as the ones to be used in the study. Extreme caution was exercised in formulating the interview questions to guarantee a uniform and unbiased survey in every school. The schools were contacted and the time was set for the interviews. Each interview required a period of from one to two hours depending upon the situation encountered.

Need of the Study

There appeared to be a definite need for a study in the field of first year algebra as the author was able to find little information in this particular field. By making this study, present plus future algebra teachers may derive some knowledge of how the authorities believe algebra should be taught.

Limitations

The study is somewhat limited in that it covers only the schools in one county, in that it was difficult to determine the difference between the stated objectives and those actually used in practice, and in that actual methods which are used could only be derived by personal interview rather than long time observations.
CHAPTER II

OBJECTIVES, METHODS OF TEACHING, AUDIO-VISUAL AIDS, AND EVALUATION OF FIRST YEAR ALGEBRA

Any endeavor which is conceived intelligently will aim at certain outcomes or results. Only to the extent that it does this is it purposeful, and only to the extent that it is purposeful can it be effective. Instruction in algebra is no exception to this principle. If it is to be worthwhile, it must be planned with the idea of attaining certain aims and objectives which represent those values thought to accrue to the study of the subject. The formulation of these aims and objectives, therefore, should be the first step in organizing a course of study in first year algebra. and (4) disciplinary values.

Tradition alone is no longer regarded as sufficient justification for the selection or the organization of the subject matter of any algebra course. Courses of study are now coming to be thought of as means to ends rather than as ends in themselves, and subject matter can be justified only insofar as it gives promise of being the means through which certain desirable objectives can be obtained. If the aims and objectives are clearly formulated, they provide a
basis for selecting and arranging the subject matter in such a way that it is most probable that these objectives and aims may be obtained.

The aims and objectives have been variously classified. Young, for example discusses the principal values of the study of mathematics under these three general headings: "(1) Practical values of mathematics, (2) mathematics as a mode of thought and (3) other functions of mathematics." Under this third heading he mentions values which are in the nature of attitudes, habits and ideals.

Breslich classifies the principal aims as: "(1) Understandings, (2) skills, (3) problems and methods, (4) appreciations, (5) attitudes, and (6) habits." Blackhurst lists them as "(1) attitudes, (2) concepts, and (3) information." Minnick discusses them under the four headings of "(1) practical values, (3) preparatory values, (3) cultural values, and (4) disciplinary values."

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In 1945 the Second Report of the Commission on Post-War Plans was published. This comprehensive report deals with proposals to improve mathematical instruction, the emphasis being mainly on the program for the secondary school. This report contains no categorical list of objectives. Various objectives are either stated or implied at different places in the report. They might be broadly summarized as follows: (1) to develop mathematical power and (2) to develop functional competence in mathematics.¹

Other classifications and discussions of objectives exist, but those already cited should be sufficient to show the general tendencies of writers in considering the values and outcomes of mathematical instruction. With somewhat varying degrees of detail and emphases the aims given in The Report of the National Committee on Mathematical Requirements seem to cover, almost without exception, much the same ground as the aims expressed by other authorities in the field. They list the aims in three classes as: "(1) Practical or utilitarian, (2) disciplinary, and (3) cultural."² It should be clearly kept in mind, however, that the three classes mentioned are not commonly inclusive


and the convenience of discussion rather than logical necessity often assigns a given aim to one or the other of these classes. Any truly disciplinary aim is also practical and, in a broad sense, the same is true of cultural aims.

This committee defines a practical or utilitarian aim as the immediate or direct usefulness in life of a fact, method, or process in mathematics.

1. The immediate and undisputed utility of the fundamental processes of arithmetic in the life of every individual demands our first attention. Accuracy and facility in numerical computation are of such vital importance, however, to every individual that effective drill in this subject should be continued throughout the secondary school period, not in general as a separate topic, but in connection with the numerical problems arising in other work. In this numerical work, besides accuracy and speed, the following aims are of the greatest importance:
   a. A progressive increase in the pupil's understanding of the nature of the fundamental operations and power to apply them in new situations. The fundamental laws of algebra are a potent influence in this direction.
   b. Exercise of common sense and judgment in computing from approximate data, familiarity with the effect of small errors in measurements, the determination of the number of figures to be used in computing and to be retained in the result, and the like.
   c. The development of self-reliance in the handling of numerical problems through the consistent checks on all numerical work.

2. Of almost equal importance to every educated person is an understanding of the language of algebra and the ability to use this language intelligently and readily in the
expression of such simple quantitative relations as occur in every-day life and in the normal reading of the educated person. Appreciation of the significance of formulas and ability to work out simple problems by setting up and solving the necessary equations must nowadays be included among the minimum requirements of any program of universal education.

3. The development of the ability to understand and to use such elementary algebraic methods involves a study of the fundamental laws of algebra and at least a certain minimum of drill in algebraic technique, which, when properly taught, will furnish the foundation for an understanding of the significance of the processes of arithmetic already referred to.

4. The ability to understand and interpret correctly graphic representations of various kinds, such as nowadays abound in popular discussions of current scientific, social, industrial, and political problems, will also be recognized as one of the necessary aims in the education of every individual.

The Committee defines disciplinary aims as aims which relate to mental training, as distinguished from the acquisition of certain specific skills discussed in the preceding section.

In formulating the disciplinary aims of the study of mathematics the following should be mentioned:

1. The acquisition, in precise form, of those ideas or concepts in terms of which the quantitative thinking of the world is done.

2. The development of ability to think clearly in terms of such ideas and concepts. This ability involves training in:
   a. Analysis of a complex situation into simpler parts. This includes the recognition of essential factors and the rejection of the irrelevant.

1Tbid., p. 6-8.
b. The recognition of logical relations between interdependent factors and the understanding and, if possible, the expression of such relations in precise form.

c. Generalization; that is, the discovery and formulation of a general law and an understanding of its properties and applications.

3. The acquisition of mental habits and attitudes which will make the above training effective in the life of the individual. . . .

4. Many of these disciplinary aims are included in the broad sense of the idea of relationship or dependence in what the mathematics in his technical vocabulary refers to as a 'function' of one or more variables. Training in 'functional thinking', that is, thinking in terms of and about relationships, is one of the most fundamental disciplinary aims of the teaching of mathematics.

By cultural aims it refers to those somewhat less tangible, but none the less real and important, intellectual, ethical, esthetic or spiritual aims that are involved in the development of appreciation and insight and the formation of ideals of perfection.

1. Appreciation of beauty in forms of nature, art and industry.

2. Ideals of perfection as to logical structure, precision of statement and of thought, logical reasoning and discrimination between the true and the false.

3. Appreciation of the power of mathematics and the role that mathematics and abstract thinking, in general, have played in the development of civilization, in particular in science, in industry, and in philosophy.1

The general aims which have just been discussed are expressed in more detail by Davis. He lists them as follows:

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1Ibid., pp. 11-13.
1. Abilities
   a. To express thoughts clearly and accurately.
   b. To systematically organize and interpret given data.
   c. To reach correct conclusions by accurate and logical thinking.
   d. To analyse a problem discovering fundamental relationships.
   e. To perform original thinking and investigation.
   f. To exercise intuitive powers and common sense.
   g. To accurately generalize special concepts.

2. Appreciations
   a. Of the contributions of mathematics to physical and natural sciences, engineering, philosophy, and other fields.
   b. Of the influence of mathematics upon human progress and our modern civilization.
   c. Of the vocational values of mathematics in modern business and industrial activities.
   d. Of mathematics as a mode of thought which serves as a model for scientific thinking in other fields.
   e. Of the rigor and power of mathematical processes and of the accuracy and the precision of the results attained.
   f. Of the cultural values of mathematics.
   g. Of mathematics for leisure time activity.

3. Attitudes
   a. To form the habit of systematically and logically pursuing a task to completion.
   b. To cultivate proper habits of study and power of concentration.
   c. To train the mind in scientific thinking and in reasoning logically toward conclusions.
   d. To attain the power of clear and accurate expression.
   e. To seek the ability to do independent and original thinking.
   f. To seek knowledge with an open mind for the sake of its possible usefulness.
g. To build self-confidence and reserve powers which constitute a strong personality.¹

These statements of the general aims which should govern the teaching of mathematics show more clearly the nature of general objectives. They should give the first year algebra teacher the basis on which to construct and teach a useful and valuable course for the students.

There are several methods of obtaining lists of objectives. One method consists of making an analysis of the purpose of the course—that is, of trying to formulate an answer to the question as to why algebra should be taught in high school. A second method frequently used consists of analyzing textbooks on the subject and attempting to identify the purpose of each topic. In a report by the Committee on the Function of Mathematics in General Education of the Commission on Secondary School Curriculum, it states that, "a combination of these two methods is highly desirable."²

In using the first type of analysis, the objectives are often stated so vaguely that other teachers are not sure what is meant. The interpretations given to these objectives depend upon the mathematical and educational training of the


interpreter, and are thus subject to wide variations.

In using the second method, the statements tend to be too specific and too numerous. They are usually stated in terms of specific content; for example, the ability to multiply signed numbers. Points of major emphasis are often lost sight of because of the extensive-ness of the list. They also tend to restrict the curricu-lum rigorously to the items mentioned in the list.

In order to overcome these difficulties, it is helpful to use a form of statement of objectives which achieves a balance between concreteness and generality and such that the list is reasonably complete but not too extensive. This means that the teacher must try to describe what the students are to do, think, or feel, when they have achieved the objective. The effort to formulate such statements usually result in clarification of the meaning of the objective, and it points the way to improved methods of teaching and evaluation. It also gives the student a feel-ing of belonging in the class.

Experience has shown that, if effective teaching is to be accomplished with economy of time and effort, systematic teaching methods must be employed. Different methods may be used equally well to secure good results, and fre-quently it may be advantageous to use several distinct methods within the same class period. The art of using any particular method will improve through experience. However,
an understanding of the different techniques which have proved successful for specific purposes should be an essential part of any algebra teacher's preparation.

Davis states the standard techniques in use and classifies them according to their principle characteristics and manner of execution as follows:

1. Methods of individual instruction
   a. Project
   b. Laboratory
   c. Heuristic

2. Methods of group instruction
   a. Genetic
   b. Lecture
   c. Drill
   d. Question-answer
   e. Supervised study

3. Procedures based on the character of the instructional material
   a. Developmental
   b. Unit plan of teaching

The principal characteristics of each of these teaching methods will be discussed in order. It will be noted that the methods of individual instruction are limited somewhat because they are unsuitable for extensive use by teachers since they deal with only one student at a time. Hence they should be reserved for special cases. The methods of group instruction each has its own disadvantages which make it inadvisable to use any one method continually. The methods of procedures are determined by the subject matter, leaving the teacher a freedom of choice of methods to employ.

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\(^1\)Davis, op. cit., p. 28.
It is essential that the advantages and disadvantages of each of these methods be carefully considered, so that in actual practice an effective working combination can be evolved. In the project method an assigned task is worked out by each student, who is usually required to make a written report showing the work accomplished by the results attained. While this method is not as prevalent in algebra as in some other subjects, there are certain phases of algebra that are readily adopted to the project method. Throughout algebra there are frequent occasions when display charts, diagrams, or graphs can be used advantageously in the analysis and interpretation of a set of data.

In this method a series of projects is presented in outline form for the students to accomplish individually, each according to his own ability and capacity for work. As soon as one project is completed, satisfactorily, the student may start another one. Minimum requirements are set up and credit for extra work is allowed.

The project method is especially designed to take care of individual differences. With the better students it is very effective as a supplementary method. It is also of great service to small classes. It does have some serious limitations. In the first place, if this method is predominate, a class of moderately varying ability may soon be widely separated in attainment. Directed cooperative classwork in investigating, developing, and interpreting new
material, and discussion of organized basic subject matter for the purposes of understanding and accomplishing different projects may cease to exist. This means that many times the student receives very little assistance in securing an understanding of the fundamental concepts, processes, and generalizations upon which real progress depends. In such cases, the course many times degenerates into a series of problem solving projects which show some application of certain principles and skills, but very little knowledge of the significance of the study matter involved. Usually, first year algebra students lack the maturity to profit greatly from the use of the project method except as a supplementary device.

The laboratory method is a modification of the project method. It involves the use of instruments or mechanical devices. Successful operation of this method requires a mathematical laboratory which includes not only the simpler instruments necessary for first year algebra, but also surveying instruments, modern calculating machines and sufficient scientific equipment to illustrate practical applications and the necessary mathematical principles. The expense and labor of equipping and maintaining such a laboratory usually prevents the use of this method except to a limited extent as a supplementary method.

It keeps the student aware of the values of algebra and its vital contributions to modern day life. If used
extensively, the student does not attain sufficient mathematical growth, and class growth is retarded by lack of contact with the basic fundamentals and concepts to attain a high degree of algebraic efficiency. Many times the lack of equipment makes it necessary for students to work in groups, so that some do all or most of the work while others are idle. At best this method is time consuming, and unless the benefits derived are worth the expenditure of time and effort, most students will lose interest. However, the laboratory method fills a definite need and can be used successfully in the teaching of certain suitable algebraic problems.

In the heuristic method, unlike the preceding two methods, the activity of the student is continually directed. Algebra as a mode of thought is emphasized. Its chief purpose is to lead the student to the discovery and understanding of new concepts through carefully worded and well directed questions which encourage him to think independently and logically. It requires a great amount of patience and persistence on the part of the teacher, and usually progress is slow at first. Therefore, it is most effective in the hands of a skilled teacher. It depends upon the fact that eventually the power and skill of the student increases rapidly, until the time initially lost is more than regained. One of the chief disadvantages is that the teacher continually works with one student until a particular phase of subject
matter is developed, while simultaneously he must maintain
the interest of the rest of the class. When working with
a slow student, the work has to be simplified so that many
of the others in the class lose interest. Conversely,
with better students progress is frequently so rapid that
poorer students are left bewildered. It is the function
of the teacher to direct the line of activity but to give
direct assistance only when necessary. The student is thus
led to formulate the accepted rules of procedure and funda-
mental concepts as if he were the actual discoverer. This
method is well adapted to the ultimate objective of making
a self-confident and independent worker of the student.

certain The genetic method is a modification of the heuristic
method and has proved more successful. It is designed espe-
cially for the development of new material. The teacher
directs the work of the class as a group by means of questions
and suggestions, and the class actively participates in the
development and use of the subject matter. It may be used
before or after the student has studied the book's explana-
tion. The first method enables the student to cultivate
more rapidly the ability to think independently and to become
less dependent on the text, while the latter method tends to
conserve time and effort.

The class discussion is carried on freely, with con-
tributions from all the class if possible. The teacher is
responsible for directing the work toward a definite goal,
for arousing and maintaining interest, for supplying desirable information, for insisting on logical reasoning, and for interpretation and application of the results obtained. This method depends upon the skill, experience, preparation, and resourcefulness of the teacher. Its chief advantage is that it keeps the class working actively together, maintains interest, promotes understanding, and aids with disciplinary problems. It is well adapted to the use of analysis in the approach to a new theory. With this method the teacher has a very good opportunity to accomplish real teaching. Its chief recommendation is its wide and successful use.

The lecture method is based on the exposition of certain phases of the subject matter in a well-organized discourse to the students. The lecture may vary from a few minutes to a full class period. A good lecture requires a thorough knowledge of the subject, its organization, interpretation, and applications. The students should have adequate preparation to profit from this method. In such cases the student may grasp a complete understanding so that much time is saved. It is very useful in supplementing the text, interpretations, the correlation of instructional material, and the generalization of important concepts. A large part of the information which is necessary for success can be secured in practically no other way.

If the lecture method is to be effective, the student must have sufficient information to understand and to
assimilate the content of the lecture without having to take notes. The student should be free to devote his entire attention to the absorption of the material being given.

Experience has shown that younger students profit very little from a lecture. The span of attention for first year algebra students is also many times rather short. However, if the lecture is clear and simplified, it can be used effectively even on new concepts. It should be used as an auxiliary method, to be judiciously employed along with other methods of instruction.

In the drill method, the learner is required to apply repeatedly a particular process or concept until his mental reaction is immediate and accurate. This type of instruction is often misused because many times the learner is requested to follow meaningless processes without adequate explanation of their use or meaning. Meaningful drill is very essential, especially if a particular response should be made a habit of the learner. Throughout algebra many opportunities that require the repeated applications of the essential skills should be supplied.

On many occasions this method should be used for the assimilation of the fundamental processes, operations with signed numbers, and the evaluation of formulas. The drill method should be varied as the students grow in maturity of subject matter and experience. The young child learns mostly by imitation and repetition, while the older child
learns more by the power of associative thinking. It is a good procedure to teach for understanding and then apply meaningful drills.

Diversity of material applying to the same skill tends to motivate the student. A few minutes of intensive oral or written drill work repeated at frequent intervals is much better than continued drill. In the acquisition and maintenance of skills much thought should be given to the psychological factors of frequency, intensity, and fatigue.

Although the question-answer method resembles the genetic method in some respects, it differs considerably in purpose and matter of execution. The students formulate answers to questions directed by the teacher. The chief purposes are to check on the accuracy of the students' information and to assist in harmonization of instructional material. Questions are directed to the entire class but only one student answers. If a given question does not receive the correct response, other related questions replace the first one until the desired information becomes class property by a related chain of related questions. Any reaction of the teacher to students' requests for information about the question should be directed into other questions limited to clarify the original question and to lead them to the discovery of the correct answer. This procedure is highly recommended by the authorities to help maintain student activity and interest.
From experience, it is evident that a well-formulated question stimulates constructive thinking and the recall of associated ideas if the student has the necessary background. It is effective for oral quizzes designed to check quickly on the degree of preparation or achievement over a particular unit of work. It creates pressure on the student and challenges him to do logical and accurate thinking.

The question-answer method does have several limitations. It does not provide the teacher with an accurate picture of the student. It is difficult to ask all the students the same number of questions. Questions may be too easy for some, but too hard for others. Some students do not respond well under pressure. The questions should be formulated by the teacher as the discussion of the subject matter progresses rather than read from a prepared list. Care must be used so that this method does not degenerate into questions which have no bearing on the road to the desired goal. This method is not well adapted to the development of the new material or to the accurate evaluation of class achievements.

When assigned work is performed by the students in the classroom under the supervision of the teacher, the procedure is called the supervised study method. This method is designed to provide an opportunity for each student to make as much progress as he is capable of and for the teacher to give assistance to the individual student when it is needed.
It is not individual, but is more so than other methods in which the class is handled as a group. Supervised study tends to provide the atmosphere for each student to understand and assimilate the material to the best of his ability.

The principal duties of the teacher are to direct and to assist the students in their work. Assistance should be given only when the student is unable to overcome his own difficulty. This gives the teacher the opportunity to understand the deficiencies and the abilities of the student.

The method of supervised study is widely and effectively used. Only part of the class period is needed for explanation while the rest may be used as a supervised study period. If done properly, this period will act as an incentive for the student to work and to finish his work.

Certain difficulties do arise in the supervised method. Usually, an undue amount of time is used up assisting the poorer students, while neglecting the better students. This may even act as a retarding process to the better student. In a large class when many students require assistance, it is many times advantageous to explain the problem on the board calling everyone’s attention to it. Sometimes it is necessary to reteach certain information. The efficiency depends upon the groundwork laid beforehand and the ability of the teacher to keep each student working steadily, to dispense with problems quickly, but thoroughly, to be on the floor continually watching the progress of the students,
and, when advisable, to offer suggestions for the improvement of their work.

The developmental method is not concerned so much with special techniques employed in performing a certain phase of teaching as it is with the ultimate objective. It recognizes that the special methods have advantages and disadvantages so it employs several different methods in the development and assimilation of a unit of subject matter. The developmental method is not a fixed standardized procedure, but includes those teaching methods which seem best suited to the achievement of the teacher’s objectives. To do this the teacher must have depth, breadth of preparation, and the ability to sense the prevailing psychological attitude of the class.

With adequate experience and preparation, the teacher can make this method highly successful. It overcomes many limitations and difficulties which confront the teacher when a special method is used excessively. This method is widely and effectively used because of the freedom allowed the teacher on the methods most appropriate for the situation. The objectives must be kept clearly in mind so that the different techniques may be coordinated toward the accomplishment of these aims. The teaching objectives must be the principal guides in developmental teaching so that there will be no rambling.

The unit method is a direct outgrowth of the developmental method. All of the subject matter material is,
supposedly, carefully organized into homogeneous units of work, consistently and logically developed about a central concept. These units should be arranged in proper sequential order for the development of the unit and for teaching purposes. All the work in the unit is toward the ultimate objective, which is an adequate understanding of the unit material.

In the teaching of each unit there are five distinct steps in classroom work, which Davis characterized as follows:

1. Exploration and preview
2. Presentation and development at hand
3. Discussion and assimilation
4. Organization and review
5. Examination and evaluation

There is no one method which is best. What will work for one teacher may not work for another. A good teacher will seldom use the same methods in teaching the same subject to different classes. The teacher should use the method or methods which he finds best suited for himself, for the class, and for the subject taught.

Teachers of first year algebra can supplement any method of teaching by the use of training aids. Training aids will broaden the sensory experiences of the learner and intensify his impressions of living experiences beyond the

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1Tbid., p. 40.
Immediate environment of the student. A clearer understanding may be gained of fundamentals by the use of training aids. They help to make classroom procedures more realistic. They tend to enhance motivation and interest which in turn should be followed up by actual experiences and direct use of materials or concepts which are illustrated in visual form.

If the training aids are to be most effective, they must be related directly to the concept or problem at hand. They should be thoroughly studied by the teacher to make certain that it has some value and that it fits the problem at hand.

Dr. Flaum states that the following things will result from the use of training aids:

1. There is an increased interest in school work and a greater participation in activities.

2. There is a greater ability to generalize and discuss problems on the basis of vicarious as well as direct experiences.

3. A clearer and richer understanding of the value and significance of direct experience can be obtained.

4. A more realistic visualization of abstract or academic concepts can be achieved.

Concepts which teachers should have in reference to the use of visual aids are:

1. Visual aids are an aid to good teaching, not a method in itself.

2. They should be used as direct needs indicate.
3. They should be included in the planning of activities.

4. They should be pointed, direct, significant, and timely.

5. They should be accurate and reliable.

6. There should be a great variety of visual aids used for a variety of problems.

7. They should be natural and creative.

8. They provide means for teaching new materials which cannot be taught adequately by word symbols.

9. They can be used effectively in spite of vocabulary deficiencies on the part of students.

10. Many types of visual aids leave lasting experiences in the minds of the students.

11. They help create emotional responses to learning situations.¹

There are several types of visual aids which can be used effectively. Their values and limitations will be discussed in turn. Dr. Flaum lists the functional values to be found in the use of objects, forms, and models as follows:

1. They give the student a realistic presentation of information.

2. They add interest to the activity.

3. They provide practice for the student in assembling, organizing, and creating models.

4. They develop a sense of aesthetic appreciation.

5. They develop a sense of functional value of models.

6. They extend the imaginative scope of the student.

7. They allow for individual or group creative expression through the making of models.

The common types of charts and diagrams which are effective visual aids are:

1. Graphs
2. Drawings
3. Bar charts
4. Area charts
5. Solid diagrams
6. Pictorial statistics
7. Numerical charts and diagrams

The chief function of charts and diagrams is to present information through the use of symbols which may be more easily understood than word symbols because they indicate relative areas, amounts, changes, and numbers and because they resemble clearly the materials to which they refer.

Some cautions to be considered in using charts and diagrams are these:

1. They require interpretation of symbols.
2. They may present a distorted view of a situation.
3. They have to be accurate in order to be useful.
4. There are many types and the use of each type will probably require a separate explanation of the symbols used.
5. The charts and diagrams must be related directly to the activity problem.
6. Suit the charts and diagrams to the maturity level of the students with whom they are to be used.
Flat pictures include any pictorial material, printed, drawn, painted or reproduced photographically on flat material such as paper or cloth. The teacher may use the flat picture:

1. To introduce and arouse interest in an activity.

2. To explain unfamiliar aspects of a problem.

3. To introduce related materials in a study unit.

4. To summarize the materials developed in an activity problem.

5. As a means of stimulating the drawing of further inferences with regard to a problem.

6. For purposes of testing the comprehension of the learners.

7. To provide opportunities for student participation in carrying on a unit.

The slidefilm or filmstrip is a strip of 35-Millimeter film on which a series of still pictures are printed in a definite sequence for projection.

Functional values to be found in the use of slides and filmstrips:

1. They possess great realism and may be used to depict accurately almost any subject that does not require motion for an understanding of its nature.

2. They may be viewed by the class at one time and thus serve as a means of focusing the attention of all learners on the problem at hand.

3. They may be kept before the class for close examination of all important details and can be changed when the teacher is certain that their usefulness has served its purpose.

4. The equipment for their projection is comparatively inexpensive and simple to operate.

5. Slides and slidefilms are comparatively inexpensive and have relatively long life when given good care.
6. With simple camera equipment it is possible to make slides and filmstrips of items of local interest.

7. The production of slides and even slide-films, can be a learner activity of much value.

Principles of good uses of slides and slidefilms:

1. Select slides and slides films with a definite objective in mind and get materials that will accomplish this objective.

2. Arouse class interest in the materials to be used and prepare them to look for the information that is to be presented...

Teachers frequently make these mistakes when slides and slidefilms are used:

1. The slides do not pertain to the unit and are brought in merely for entertainment and with no definite educational purpose in mind.

2. Slides are presented without preparing learners for what they are to see.

3. Slides are unrelated or are shown so rapidly that learners fail to get all information they might have got if slides had been shown correctly.

4. Projection techniques are poor and the effectiveness of the content of the slides is diminished because of pictures difficult to see or because of other distracting elements.

5. The use of the material is not accompanied by class discussion to bring out important items of information that each member of the class should get.

6. Little or no attempt is made to use the slides as a means of supplementing various types of student activities.

7. The slides are used at the wrong time in the activity for most effective results...
Some important values that can be obtained from the use of motion pictures:

1. They offer one of the most effective means of presenting concrete, factual materials of all kinds.

2. They contribute significantly to the permanence of learning.

3. They catch and hold attention.

4. They offer an instructor one of the most effective means of bridging inequalities of background, experience, intelligence, language comprehension, and maturity.

5. They are an especially good tool for showing relationships, time relationships, and physical relationships.

6. They contribute significantly to the exercise of creative powers.

7. The use of films tends to increase student imagination about the activity in which they are working.

8. Because of their realism and ability to show motion, they are good for the purpose of teaching actual skills that must be observed before they can be learned successfully.

9. They offer the teacher one of his most powerful means of influencing attitudes and emotions.

10. They can be used in either small or large groups with almost equal success, provided follow-up activities are substantially the same for the members of the groups.

Teachers' errors frequently made in using films for teaching purposes:

1. The film is selected by means of insufficient description and does not pertain to the activity or is of little value.

2. The students are not prepared for the film they are to see.
3. There are no follow-up activities after the film has been used.

4. Long films either bore the classes or give so much information that the students are bewildered and confused.¹

Visual aids may be very effective if they are used properly. It must be remembered that the aids should be selected to fill the needs of the students and not the teachers. Some things can be presented visually with much success while others cannot. They should not be used to replace thinking, but as an aid in arriving at and understanding a concept. If they are used properly, they will act as a stimulant to the pupil's thinking. They can be used to best advantage when they are used to help reflect on and analyze a concept or problem. They are a definite and important part of the teaching of any subject and may be used to great advantage in first year algebra.

There are many sources of free material, such as information sent out by General Electric and Westinghouse. It may be used as a supplement in the teaching of many different concepts in algebra. This information should be utilized as much as possible because every aid must be developed fully in order to help the student understand and assimilate all the information he can attain.

The purpose of evaluation is to help the student understand himself and his growth in relation to his

¹Tbid., pp. 73-81.
professed needs and objectives. It must also be designed to help the teacher guide the student successfully in his school life. Furthermore, it should be constantly emphasized that the most significant functions of effective evaluation include not merely its use as an aid in determining pupils' marks, but its use as an aid to the improvement of instruction.

The determination and perfection of techniques to be used in the evaluation of mathematical instruction is a definite responsibility of teachers of mathematics. These techniques include teacher judgments and teacher-made tests or commercially produced tests. Teachers should be extremely conscientious in their efforts to evaluate student effort. In those situations which do not submit themselves well to measurement scales, appraisals should be based on discriminative and objective judgments arrived at through careful deliberation. Such judgments can be made through oral recitations in class, comparative class observations, personal interview, and the prolonged case study.

The teacher must decide the comparative advantages and disadvantages of standardized and teacher-made tests. In comparing the two types of tests, the standardized tests usually have the following advantages: (1) they possess norms which provide for more equitable comparisons between groups, (2) they are constructed by individuals of wide experience and preparation in both subject matter and the
techniques of testing, (3) they are usually subject to a
greater degree of objectivity in administering and in
scoring, (4) they diminish the time which the teacher needs
to devote to the details of a testing program.

Some of the advantages of the teacher-made tests
over standardized tests are that: (1) they test subject
matter mastery over material the class has studied and no
other material, (2) they emphasize those things which are
emphasized in class, (3) they can take into account the
different levels of ability of the students in the class,
(4) they are relatively inexpensive, (5) they have an
inexhaustible availability.

In the reading done by the author, it was the opinion
of the authorities that both the standardized and teacher-
made tests should be used in evaluating the progress of the
students toward their objectives. By using both, a clearer
understanding of the students' progress can be determined.

There are several other methods of evaluation which
have been only mentioned briefly, but are of equal importance
in doing a thorough job of evaluation. These are daily
papers, personal interview, observation, participation in
class discussion, and student self-appraisal. The value of
daily papers is of debatable importance. Many teachers feel
that they should be collected every day and checked complete-
ly. Other teachers feel that they are of little importance
and check them only several times a week. The authorities
agree that they should be checked quite often to determine if the student is making an effort to do his daily work.

Personal interviews are of importance in helping determine if the student is well adjusted to the class and in helping determine what the students' objectives for the class are. They should be given early in the course and then whenever it is deemed necessary to find out more about the student and to help him wherever possible.

Observation of the students should take place each day. The whole child, his attitudes, his behavior, and many other traits, should be observed. Participation in class discussion should take place as often as possible with all students participating. Its value is debatable, however, since some students are bothered a great deal emotionally when asked a question in class. The teacher should help the student overcome this if possible.

Student self-appraisal tends to make the student study himself. It helps him to discover his weaknesses and strengths, thus giving him a better understanding of where improvement is most needed. If the student is then guided properly, he can help himself a great deal in overcoming his weaknesses.

Accurate evaluation of a student is a very difficult task. It is one which confronts the teacher daily, not just at regular periods. Much care must be taken so that it is done properly. All of the methods discussed must be used so
that the teacher can know the student as an individual and thus better help him understand and assimilate all of the concepts of first year algebra that he is capable of obtaining.

CHAPTER IX

PRESENTATION OF DATA

Every first year algebra teacher in Buchanan County, Iowa, was interviewed to obtain the information for this study. The same questions were used in each case and all data can be verified by the first year algebra teachers themselves.

In Table 1 the question of whether first year algebra was required or elective, the percentages of students in school who take algebra, and the average number of students in each class was taken into consideration. The data show that two of the twelve schools in the county, or 16.6 per cent, require all of the students to take first year algebra. In the two schools, Abraham Lincoln and Thomas Jefferson of Council Bluffs, Iowa, which offer first year algebra as an elective course, approximately 50 per cent of the students in both schools take algebra. The data show a large variation in sizes also ranging from thirty-six in Abraham Lincoln to fifteen in the high schools in both Neola and Beaver, Iowa. This is a very significant range of size.

The first year algebra students in the two schools, in which first year algebra was an elective course, were
CHAPTER III

PRESENTATION OF DATA

Every first year algebra teacher in Pottawattamie County, Iowa was interviewed to obtain the information for this study. The same questions were used in each case and all data can be verified by the first year algebra teachers themselves.

In Table 1 the question of whether first year algebra was required or elective, the percentages of students in school who take algebra, and the average number of students in each class was taken into consideration. The data show that ten of the twelve schools in the county, or 83 per cent, require all of the students to take first year algebra. In the two schools, Abraham Lincoln and Thomas Jefferson of Council Bluffs, Iowa, which offer first year algebra as an elective course, approximately 50 per cent of the students in both schools take algebra. The data show a large variation in class size ranging from thirty-six in Abraham Lincoln to fifteen in the high schools in both Neola and Treynor, Iowa. This is a very significant range of size.

The first year algebra students in the two schools, in which first year algebra was an elective course, were
TABLE 1
INFORMATION ON FIRST YEAR ALGEBRA CLASSES AS DETERMINED
BY A SURVEY OF THE TWELVE HIGH SCHOOLS
IN POTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>Schools</th>
<th>Algebra Required</th>
<th>Elective</th>
<th>Percentage of students taking algebra</th>
<th>Average class enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Lincoln</td>
<td>-</td>
<td>x</td>
<td>50</td>
<td>36</td>
</tr>
<tr>
<td>Avoca</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>21</td>
</tr>
<tr>
<td>Carson</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>26</td>
</tr>
<tr>
<td>Hancock</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td>Macedonia</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>16</td>
</tr>
<tr>
<td>Minden</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>18</td>
</tr>
<tr>
<td>Neola</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>Oakland</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>24</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td>-</td>
<td>x</td>
<td>50</td>
<td>31</td>
</tr>
<tr>
<td>Treynor</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>Underwood</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Walnut</td>
<td>x</td>
<td>-</td>
<td>100</td>
<td>25</td>
</tr>
</tbody>
</table>

asked what influenced them most to take the subject. The data show various reasons why the students take first year algebra. One hundred and thirteen of the 335 students, or 34 per cent, said they took algebra as a possible requirement to enter college. One hundred of the 335 students said that they were interested and wanted the course; that is, 30 per cent of the students were interested and wanted first year algebra. Seventy-five of the 335 students took first
Table 2
EXPERIENCE AND PREPARATION OF THE FIRST YEAR ALGEBRA TEACHERS IN THE HIGH SCHOOLS IN FOTTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>School</th>
<th>Years of experience teaching algebra</th>
<th>Experience in present school</th>
<th>Mathematics is</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Major</td>
</tr>
<tr>
<td>Abraham Lincoln</td>
<td>31</td>
<td>26</td>
<td>x</td>
</tr>
<tr>
<td>Teacher A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher B</td>
<td>4</td>
<td>3</td>
<td>x</td>
</tr>
<tr>
<td>Avoca</td>
<td>7</td>
<td>7</td>
<td>x</td>
</tr>
<tr>
<td>Carson</td>
<td>15</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Hancock</td>
<td>18</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Macedonia</td>
<td>11</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Minden</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Neola</td>
<td>18</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td>Oakland</td>
<td>1</td>
<td>1</td>
<td>x</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher A</td>
<td>3</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td>Teacher B</td>
<td>14</td>
<td>11</td>
<td>x</td>
</tr>
<tr>
<td>Treynor</td>
<td>12</td>
<td>6</td>
<td>x</td>
</tr>
<tr>
<td>Underwood</td>
<td>3</td>
<td>2</td>
<td>x</td>
</tr>
<tr>
<td>Walnut</td>
<td>5</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

Year algebra because of the influence of friends, parents, or teachers; that is, 22 per cent were influenced by another person or persons. Forty of the 335 students, or 12 per cent, said they took first year algebra to prepare themselves for future schoolwork. Only seven, or 2 per cent, took first
year algebra, because they wanted to be with a friend.

The preparation and experience of the first year algebra teacher of the twelve high schools in Pottawattamie, County, Iowa is revealed in Table 2. The data show a wide variation in the experience of the teachers ranging from thirty-one years to one year, with seven, or one-half, of the teachers having had eleven or more years of experience. The range of experience in their present schools was from twenty-six years to one year with six teachers having had six or more years of teaching first year algebra in their present schools. The study also indicates that nine of the fourteen teachers in the county majored in mathematics with a major considered as twenty or more semester hours of college work in mathematics. This shows that 64 per cent of the teachers majored in mathematics. In the study a minor was considered as having had between fourteen and twenty semester hours of college mathematics. Only one teacher, or 7 per cent, of the teachers of first year algebra in the county had neither a major nor minor in mathematics.

Table 3 deals with the supplementary academic schedule of the first year algebra students. The data reveal that ten of the teachers, or 71 per cent, carry an academic load of four or more classes in addition to their first year algebra classes. The data show that teacher A in both Abraham Lincoln and Thomas Jefferson have three separate first year algebra classes. Teacher B in both
Abraham Lincoln and Thomas Jefferson plus the mathematics teacher in the high schools of Avoca, Oakland, and Underwood have two separate classes of first year algebra.

Table 4 deals with regular duties outside the classroom of the first year algebra teachers. The data reveal that three of the teachers are administrators. That is, 21 per cent of the teachers in the county are administrators. There are three of the fourteen who, in addition to their regular academic load, coach football and track or boys and girls basketball. Six of the teachers, or 43 per cent, have no duties outside of classroom teaching.

The method of determining the objectives of the course was also requested and all fourteen, or 100 per cent, of the algebra teachers stated that the objectives were fixed in advance. Only one of the teachers, or 8 per cent, did not make the objectives known to the students at the beginning of the class. The data revealed various methods of presenting the objectives to the students. Six of the teachers, or 43 per cent, made the objectives known to the students by writing them on the blackboard and having the class discuss each one. Four, or 29 per cent of the teachers in the county, stated and explained the objectives to the class and then had a class discussion on each objective. The other three teachers simply stated and explained the objectives to the class.

The objectives for the first school interviewed are as follows:
<table>
<thead>
<tr>
<th>School</th>
<th>Abraham Lincoln Teacher A</th>
<th>Avoca</th>
<th>Carson</th>
<th>Hancock</th>
<th>Macedonia</th>
<th>Minden</th>
<th>Neola</th>
<th>Oakland Teacher A</th>
<th>Thomas Jefferson Teacher A</th>
<th>Treynor</th>
<th>Underwood</th>
<th>Walnut</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td></td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 4
DUTIES OTHER THAN CLASSROOM INSTRUCTION OF TEACHERS OF FIRST YEAR ALGEBRA IN THE TWELVE HIGH SCHOOLS IN POTTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>School</th>
<th>Administration</th>
<th>Coaching</th>
<th>Dramatics</th>
<th>Class Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Lincoln</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Teacher B</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avoca</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Carson</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Hancock</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Macedonia</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Minden</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Neola</td>
<td>-</td>
<td>-</td>
<td>x</td>
<td>-</td>
</tr>
<tr>
<td>Oakland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>x</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Teacher B</td>
<td>-</td>
<td>x</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Treynor</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Underwood</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Walnut</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. To gain a thorough foundational view of all the mathematical processes.
2. To understand the background of problems.
3. To develop individual participation.
4. To develop accuracy, neatness, and form.
5. To be able to apply algebra to practical situations.
6. To find and correct weaknesses in mathematical ability.

The objectives for the second school interviewed are as follows:

1. To gain a basic understanding of the fundamentals of algebra.

2. To obtain accuracy and a full knowledge of algebra.

3. To be able to apply algebra to practical situations.

4. To perform original thinking and organization.

The objectives for the third school interviewed are as follows:

1. To be able to apply algebra to practical situations.

2. To gain a mastery and the ability to use the basic fundamentals of algebra.

3. To build self-confidence and accuracy.

4. To reason logically.

The objectives for the fourth school interviewed are as follows:

1. To gain a clearer understanding of the fundamentals of mathematics.

2. To build self-confidence and accuracy.

3. To gain the ability to think more logically.

4. To be able to apply algebra to practical situations.

The objectives for the fifth school interviewed are as follows:
1. To gain a basic understanding of the fundamental processes and concepts of algebra.

2. To be able to apply algebra to practical situations.

The objectives for the sixth school interviewed are as follows:

1. To gain accuracy.

2. To promote the fundamental operations of algebra.

3. To be able to apply algebra to practical situations.

4. To reason logically.

5. To organize and interpret data.

6. To build self-confidence.

The objectives for the seventh school interviewed are as follows:

1. To gain an appreciation of algebra.

2. To understand the basic fundamentals of algebra.

3. To be able to apply algebra to practical situations.

The objectives for the eighth school interviewed are as follows:

1. To understand the basic fundamentals of algebra.

2. To be able to apply algebra to practical situations.

The objectives for the ninth school interviewed are as follows:

1. To develop accuracy.
2. To perform original thinking and organization.

3. To gain a sound knowledge of the fundamental operations.

4. To understand the cultural values of algebra.

5. To be able to apply algebra to practical situations.

The objectives for the tenth school interviewed are as follows:

1. To reason logically.

2. To be able to apply algebra to practical situations.

3. To organize and interpret data.

4. To express thoughts clearly and accurately.

5. To appreciate the influence of mathematics on world progress.

The objectives of the eleventh school interviewed are as follows:

1. To gain a knowledge of the basic fundamentals of algebra.

2. To be able to apply algebra to practical situations.

3. To promote an attitude which is healthful toward algebra.

4. To be able to reason logically.

5. To organize and interpret data.

6. To build self-confidence and accuracy.

The objectives of the twelfth school interviewed are as follows:

1. To express thoughts clearly and accurately.
2. To organize and interpret data.
3. To reason logically.
4. To appreciate the contributions of algebra to various occupations and world progress.
5. To build self-confidence and accuracy.
6. To be able to apply algebra to practical situations.
7. To understand the basic fundamentals of algebra.
8. To understand the cultural values of algebra.

The teachers of first year algebra in the twelve high schools were asked to state their objectives for the course. The data reveal that all of the schools, or 100 per cent, gave as their main objectives, the ability to apply algebra to practical situations and to acquire a thorough understanding of the basic fundamentals of algebra. Eight of the schools, or 67 per cent, said that the development of accuracy was an important objective. Six of the twelve schools, or 50 per cent, believed algebra necessary for the student to learn to think logically. There were a number of other objectives mentioned but the above objectives appeared most often.

In Table 5 the methods used in teaching first year algebra to the students of the twelve Pottawattamie County high schools are indicated. The developmental and lecture methods were used by twelve of the fourteen teachers in the county. That is, 86 per cent of the teachers in the county
used the developmental and lecture methods. The genetic method was used by eleven of the teachers while the question-answer and the supervised study methods were used by ten of the teachers. All of the other methods were used by at least several of the teachers except the laboratory and daily test methods which were not used.

**TABLE 5**

METHODS USED IN TEACHING FIRST YEAR ALGEBRA IN THE TWELVE HIGH SCHOOLS IN POTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>Methods</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Heuristic</td>
<td>9</td>
</tr>
<tr>
<td>Genetic</td>
<td>11</td>
</tr>
<tr>
<td>Lecture</td>
<td>12</td>
</tr>
<tr>
<td>Drill</td>
<td>5</td>
</tr>
<tr>
<td>Question-answer</td>
<td>10</td>
</tr>
<tr>
<td>Supervised study</td>
<td>10</td>
</tr>
<tr>
<td>Developmental</td>
<td>12</td>
</tr>
<tr>
<td>Daily test</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 6 shows the methods which were used most by the first year algebra teachers in their respective classes. Seven of the teachers, or 50 per cent, said that they used the supervised study method most. Six of the teachers, or 43 per cent, used the genetic method most. Either the genetic or supervised study method was most used or second
### Table 6

**Methods used most in teaching first year algebra in the twelve high schools in Pottawattamie County, Iowa, 1954**

<table>
<thead>
<tr>
<th>School</th>
<th>Most used</th>
<th>Second most used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Lincoln</td>
<td>Supervised study</td>
<td>Lecture</td>
</tr>
<tr>
<td>Teacher A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher B</td>
<td>Supervised study</td>
<td>Lecture</td>
</tr>
<tr>
<td>Avoca</td>
<td>Supervised study</td>
<td>Genetic</td>
</tr>
<tr>
<td>Carson</td>
<td>Lecture</td>
<td>Drill</td>
</tr>
<tr>
<td>Hancock</td>
<td>Supervised study</td>
<td>Genetic</td>
</tr>
<tr>
<td>Macedonia</td>
<td>Genetic</td>
<td>Supervised study</td>
</tr>
<tr>
<td>Minden</td>
<td>Genetic</td>
<td>Supervised study</td>
</tr>
<tr>
<td>Neola</td>
<td>Genetic</td>
<td>Question-answer</td>
</tr>
<tr>
<td>Oakland</td>
<td>Genetic</td>
<td>Lecture</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td>Supervised study</td>
<td>Lecture</td>
</tr>
<tr>
<td>Teacher A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher B</td>
<td>Supervised study</td>
<td>Genetic</td>
</tr>
<tr>
<td>Treynor</td>
<td>Supervised study</td>
<td>Genetic</td>
</tr>
<tr>
<td>Underwood</td>
<td>Genetic</td>
<td>Supervised study</td>
</tr>
<tr>
<td>Walnut</td>
<td>Genetic</td>
<td>Question-answer</td>
</tr>
</tbody>
</table>

most used by thirteen, or 93 per cent, of the first year algebra teachers of the county.

In Table 7 available resources for learning and teaching of first year algebra in the twelve high schools are analyzed. As may be seen from the Table, two of the twelve schools in the county were using textbooks more than
TABLE 7

RESOURCES FOR LEARNING AND TEACHING AVAILABLE IN FIRST YEAR ALGEBRA IN THE TWELVE HIGH SCHOOLS IN POTTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>School</th>
<th>Texts in use over five years</th>
<th>Use other algebra books</th>
<th>Use sets of practical problems</th>
<th>Use mimeographed sheets of problems</th>
<th>Use workbook</th>
<th>Use magazines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Lincoln</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Avoca</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Carson</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hancock</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Macedonia</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Minden</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Neola</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Oakland</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Treynor</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Underwood</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Walnut</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
five years old. That is, 17 per cent of the high schools have books with publishing dates prior to 1949. Other algebra books are used to supplement the texts in ten of the twelve schools, or 83 per cent. Sets of practical problems and mimeographed sheets of problems were used in five of the twelve schools, or 42 per cent. Workbooks were not used at all while magazines were used in four schools, that is, 33 per cent of the schools of the county use magazines to supplement the texts.

The audio-visual aids and equipment that are used in the twelve schools in the county are revealed in Table 8. It is noted that four schools, or 33 per cent, use a projector. Field trips are taken by three, or 25 per cent, of the schools. Film strips and slides are used in two, or 17 per cent, of the schools. Data reveal that the tape recorder is not used. Charts and free material are used in six, or 50 per cent, of the schools. Models are utilized in seven, or 58 per cent, of the schools.

The actual objectives of a class are revealed by determining which factors are being stressed in the evaluation program in that class. In Table 9 the objectives stressed most in the evaluation program of the twelve high schools are indicated. It is noted that 100 per cent of the teachers, or all fourteen, attempt to measure the student's understanding of basic skills. Eleven of the teachers desire to measure the student's ability to apply algebra to practical
<table>
<thead>
<tr>
<th>School</th>
<th>Projector</th>
<th>Field Trips</th>
<th>Slides</th>
<th>Film Strips</th>
<th>Rape Recorder</th>
<th>Charts</th>
<th>Models</th>
<th>Free Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Lincoln</td>
<td>No</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Avoca</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Carson</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Hancock</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>No</td>
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</tr>
<tr>
<td>Macedonia</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Minden</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Neola</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Oakland</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Thomas Jefferson</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Treynor</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Underwood</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Walnut</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Objectives</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement of attitudes toward courses</td>
<td>7</td>
</tr>
<tr>
<td>Understanding of basic skills</td>
<td>14</td>
</tr>
<tr>
<td>Ability to apply algebra to practical situations</td>
<td>11</td>
</tr>
<tr>
<td>Behavior patterns</td>
<td>7</td>
</tr>
<tr>
<td>Improvement of social attitudes</td>
<td>6</td>
</tr>
<tr>
<td>Eagerness to cooperate</td>
<td>11</td>
</tr>
<tr>
<td>Willingness to go ahead and do work alone</td>
<td>10</td>
</tr>
<tr>
<td>Appreciation of the functions of algebra</td>
<td>10</td>
</tr>
</tbody>
</table>

situations and his eagerness to cooperate, that is, 79 per cent of the teachers wish to measure the two objectives just mentioned. Ten of the teachers, or 71 per cent, wish to measure the student's willingness to go ahead and do work alone and his appreciation of the functions of algebra.

Table 10 reveals the methods used in the evaluation of the first year algebra students. Twelve, or 86 per cent, of the teachers use observation and teacher-made tests for evaluation of the student. Eleven, or 79 per cent, use daily papers. The checking of daily papers varied from three times a week to five times a week depending upon the value placed on them by the individual teacher. Six, or 43 per cent, of the teachers based their evaluation program on both
TABLE 10

METHODS USED IN EVALUATION OF STUDENT PROGRESS IN FIRST YEAR ALGEBRA IN THE TWELVE HIGH SCHOOLS IN POTTAWATTAMIE COUNTY, IOWA, 1954

<table>
<thead>
<tr>
<th>Methods</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized tests</td>
<td>5</td>
</tr>
<tr>
<td>Daily papers</td>
<td>11</td>
</tr>
<tr>
<td>Personal interview</td>
<td>6</td>
</tr>
<tr>
<td>Observation</td>
<td>12</td>
</tr>
<tr>
<td>Participation in class discussion</td>
<td>6</td>
</tr>
<tr>
<td>Student self-appraisal</td>
<td>5</td>
</tr>
<tr>
<td>Teacher-made tests</td>
<td>12</td>
</tr>
</tbody>
</table>

observation and participation in class discussion. Only five, or 36 per cent, used standardized tests and student self-appraisal.

Teacher-made tests were rated as the most important means of evaluation by seven, or 50 per cent, of the teachers. Daily papers were rated as the most important means of evaluation by four, or 29 per cent of the teachers. The data reveal that three, or 21 per cent, of the teachers of the county thought observation to be the most important.
CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions were reached after careful consideration of the material gathered in the personal interviews with the first year algebra teachers in the twelve high schools in Pottawattamie County, Iowa:

1. Teacher load is heavy.

2. The interests of the child are not considered as much as they should be.

3. The curriculum is too much teacher-centered.

4. The students do not participate enough in setting up the objectives for the course.

5. The child's environment is not taken into careful enough consideration when setting up the objectives for the course.

6. The students see the objectives of the course only once during the entire year.

7. There is not enough use of the audio-visual aids.

8. Insufficient use of the available community resources.

9. There is not enough use made of free and inexpensive materials.
Recommendation

In view of these conclusions the following recommendations are made:

1. Teachers loads should be lightened.

2. A greater interest in the child's needs should be taken into consideration. This could be accomplished by having the students help set up the objectives and by taking the child's interests and environment into greater consideration.

3. The objectives of the course should be placed before the child so that he can see them every day.

4. The teachers should use audio-visual aids more frequently.

5. The teachers should take greater advantage of the available community resources.

6. The teachers should take advantage of various free and inexpensive materials.

7. The formation of an algebra teachers' club or committee to try and develop a more flexible curriculum in the county should be encouraged.
APPENDIX

Questions Used for Personal Interview of First Year Algebra Teachers in Penobscot and Hancock Counties

1. Is algebra a required or an elective course in your school?
   a. Required
   b. Elective

2. If elective, approximately what percentage of the students take algebra?
   a. About 75 per cent
   b. About 50 per cent
   c. About 25 per cent
   d. About 10 per cent
   e. Other

3. If algebra is a required course, how does it fit into the curriculum? Is it a prerequisite for any other course?
   a. Required a prerequisite for other courses.
   b. Required but not necessarily a prerequisite for other courses.
   c. Not required.
   d. Other

4. What is the average number of students in each of your classes?
   Number.

5. How many years have you taught algebra?

6. How many years have you taught algebra at this particular school?

7. What percentage of your students minute this type of preparation in college?
   a. None
   b. Some
   c. Either
APPENDIX

Questions Used for Personal Interview of First Year Algebra Teachers in Pottawattamie County, Iowa

1. Is algebra a required or an elective course in your school?
   a. Required
   b. Elective

2. If elective, approximately what percentage of the students take algebra?
   a. About 75 per cent
   b. About 50 per cent
   c. About 25 per cent
   d. About 10 per cent
   e. Other

3. If your algebra is elective, why do students take the course? Which of the following reasons apply in influencing them to enroll?
   a. Take algebra as a possible requirement to enter college.
   b. They are interested and want the course.
   c. Influenced by parents, teachers, or friends to take the course.
   d. A friend is enrolled, and they wish to be with him.
   e. No other course available of greater interest.
   f. They need algebra to prepare them for future school work.
   g. It was the most practical course to take.
   h. Algebra is necessary for a full education.
   i. Others.

4. What is the average number of students in each of your classes?
   Number.

5. How many years have you taught algebra?

6. How many years have you taught algebra in this particular school?

7. Was mathematics your major or minor field of preparation in college?
   a. Major
   b. Minor
   c. Neither
8. What other courses do you teach this semester?

9. Do you have any additional duties such as coach of athletics, sponsor of clubs, administrative duties, and the like?
   a. Yes
   b. No
   c. If yes, what are they?

10. Are the objectives in your algebra class the result of planning and discussion with your pupils, or are they fixed in advance?
    a. Result of pupil-teacher planning.
    b. Fixed objectives.

11. You stated that the objectives are fixed and prepared ahead of time.
    a. Do you make them known to the pupil at the beginning of the class?
       1) Yes
       2) No
    b. If yes, how are the objectives made known to class members? Are they:
       1) Written out and handed to students?
       2) Written on the board?
       3) Stated and explained to the students?
       4) Discussed in class?
       5) Others?

12. Upon what basis are your pupil-teacher planned objectives in your algebra class determined? Which of the following apply in your case?
    a. Extensive study of the areas of interest of your students.
    b. Attempts to determine the use of algebra for professional preparation.
    c. Determine how many students need algebra for ordinary problems in everyday living (not necessarily professional).
    d. Determine the level of aptitude and achievement of members of the class.

13. What method is used in setting up these pupil-teacher planned objectives? Which of the following apply in your case?
    a. Class determines objectives under your guidance in the classroom.
    b. Determined by a committee of students working under your guidance.
    c. Each student writes out a list of his own, the class objectives being derived from the lists.
d. You place a list of objectives before the children and let them make changes.

c. Others.

14. Would you state the objectives in your present algebra class or classes in your own words?

15. Experience has shown that if effective teaching is to be accomplished, systematic teaching techniques must be employed. Which of the following methods do you use?

a. Project
b. Laboratory
c. Heuristic
d. Genetic
e. Lecture
f. Drill
g. Question-answer
h. Supervised study
i. Developmental
j. Daily test
k. Others

16. Which of these methods do you use most often, and what other methods do you use? Which of these two do you use most often?

a. Project
b. Laboratory
c. Heuristic
d. Genetic
e. Lecture
f. Drill
g. Question-answer
h. Supervised study
i. Developmental
j. Daily test
k. Others

17. Do you use a textbook older than a five year copyright?

a. Yes
b. No
c. Name of book
d. Author
e. Publisher

18. What resources other than the textbook do you use? If you use any of the following, please check.

a. Other algebra books
b. Workbooks
c. Sets of practical problems
d. Mimeographed sheets of problems
e. Magazines
f. Others
   a. Projector 16 MM
   b. Slide projector
   c. Film strip
   d. Tape recorder
   e. Charts
   f. Field trips
   g. Models
   h. Others

20. Do you use any free materials?
   a. Yes
   b. No
   c. If so, what are they?

21. In your evaluation program, which of the following do you attempt to determine?
   a. Improvement of attitudes toward course
   b. Understanding of basic skills
   c. Ability to apply algebra to practical situations
   d. Behavior patterns
   e. Improvement of social attitudes
   f. Eagerness to cooperate
   g. Willingness to go ahead and do their work alone
   h. Appreciation of the functions of algebra
   i. Others

22. How do you evaluate to determine if those objectives you mentioned are realized?
   a. Standardized tests
   b. Daily papers
   c. Personal interview
   d. Observation
   e. Participation in class discussion
   f. Student self-appraisal
   g. Teacher-made tests

23. In your final evaluation, what method do you consider of most importance in evaluating your algebra class? Of second importance? Of third importance?
BIBLIOGRAPHY


BIBLIOGRAPHY

Books


**Articles**
