1930

Technique of Instruction and Comparative Results for Classes of One Hundred in Mathematics

Clifford E. Trueblood

Follow this and additional works at: https://digitalcommons.butler.edu/grtheses

Part of the Education Commons

Recommended Citation

Trueblood, Clifford E., "Technique of Instruction and Comparative Results for Classes of One Hundred in Mathematics" (1930).

Graduate Thesis Collection. 87.
https://digitalcommons.butler.edu/grtheses/87

This Thesis is brought to you for free and open access by the Graduate Scholarship at Digital Commons @ Butler University. It has been accepted for inclusion in Graduate Thesis Collection by an authorized administrator of Digital Commons @ Butler University. For more information, please contact omacissa@butler.edu.
TECHNIQUE OF INSTRUCTION AND COMPARATIVE RESULTS
FOR CLASSES OF ONE HUNDRED IN MATHEMATICS

BY

CLIFFORD EMMETT TRUEBLOOD

A THESIS SUBMITTED TO THE GRADUATE STUDIES
COMMITTEE IN PARTIAL PULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER
OF SCIENCE IN EDUCATION

BUTLER UNIVERSITY
1930
CONTENTS

Chapter | Page
--- | ---
I. Foreword | 1
II. Introduction | 5
III. Brief History of Large Class Experiments | 8
IV. The Technique | 13
V. A Typical Recitation | 20
VI. Comparative Results | 33
VII. General Conclusions With Discussions | 58
VIII. Specific Conclusions and Recommendations | 66
Bibliography | 70
LIST OF TABLES AND FIGURES

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Comparing the pupils of Geometry I in one large class and the pupils of Geometry I in the small classes taught by twelve other teachers of the department</td>
<td>37.</td>
</tr>
<tr>
<td>II</td>
<td>This table compares the same pupils as are represented in Table I, but they are now in ten classes of Geometry II, taught by ten different teachers</td>
<td>39.</td>
</tr>
<tr>
<td>III</td>
<td>Comparing the Geometry I pupils of the large class and the Geometry I pupils of the department who recite in the forenoon</td>
<td>41.</td>
</tr>
<tr>
<td>IV</td>
<td>This table compares the same pupils as are represented in Table III, but they are now in ten classes of Geometry II taught by ten different teachers</td>
<td>43.</td>
</tr>
<tr>
<td>V</td>
<td>Comparing the number (in percent) of each final grade (A-, A, B, C, D, W.) given to the Geometry I pupils of the large class and to the Geometry I pupils of the small classes</td>
<td>46.</td>
</tr>
<tr>
<td>VI</td>
<td>The same comparison as is represented in Table V, but this data is for Geometry II pupils</td>
<td>48.</td>
</tr>
<tr>
<td>VII</td>
<td>The same type comparison as is represented in Table V, except this table makes a comparison of large and small classes of Geometry I pupils taught by the same teacher over a period of six years</td>
<td>50.</td>
</tr>
<tr>
<td>VIII</td>
<td>The same type comparison as is represented in Table V except this table makes a comparison of large and small classes of Geometry II pupils taught by the same teacher over a period of six years</td>
<td>52.</td>
</tr>
<tr>
<td>IX</td>
<td>Table IX represents the quality of work produced according to the location of the pupil in the room</td>
<td>55.</td>
</tr>
</tbody>
</table>
The purpose in this thesis is to present the technique established in teaching classes of one hundred (80-120) in mathematics and to compare the student progress with the progress made by those in small classes of the entire department. In this study the pupils have not been assigned, either to the large class (100) or the small classes (35), in any special way. In every instance, the assignment to classes has been to suit the pupil's program or the programs of the school. In other words, there has been no attempt to assign special pupils to special classes for the purpose of conducting a scientifically controlled experiment.

It has been our purpose to avoid a controlled type of investigation in order that the technique evolved might be used under normal every day teaching conditions. The long period over which the investigation runs and the large numbers of pupils compared, will over balance the inaccuracies due to lack of the special scientific arrangements which last for only a semester or two.
There have been two semesters, during the twelve semesters of this study, in which all possible scientific data have been collected. The pupils were taken by each teacher as assigned. The intelligence rating of each Geometry I pupil was obtained in the fall semester. This rating was obtained by using the Indiana Mental Survey Scale No. 1, Schedule D. Hart's Geometry Tests and the school's own departmental tests were given during the two semesters of Geometry. Four tests were given during each semester. From this data, comparisons have been made showing first, the progress made by the large class pupils and pupils of the small classes taught by twelve other teachers. Second, the ability to do the work in Geometry II has been compared. In Geometry II, the pupils from Geometry I large and small classes are thrown together into small classes taught by ten different teachers.

The technique which has been established during these twelve semesters is a natural outgrowth of a pedagogical necessity. The instructor had been trained for small classes and most of his teaching experience had been with small classes containing from ten to fifteen pupils. When confronted with forty to forty-five pupils in one class, he was compelled to devise a new plan of procedure. The technique used to meet the new situation worked satisfactorily from the beginning. The same
technique with a few refinements was tried on classes of one hundred. The same degree of success was obtained as with classes of forty to fifty. With only minor improvements, the same technique has been used successfully, with classes in Geometry and Algebra ranging in size from eighty to one hundred twenty.

Dr. Earl Hudelson of the University of Minnesota visited my first class of one hundred. His first statement to me was that he had come because he had heard that I was doing what it is commonly believed cannot be done; namely, teach effectively a mathematics class containing over fifty pupils. He further stated that in his opinion the recitation which he observed was a distinct success. I am greatly indebted to Dr. Hudelson for his encouragement. It was he who insisted that the technique be refined and the results of the experiment be published. His advice and assistance during the years of development have been very much appreciated.

Mr. Milo E. Stuart, Principal of the Arsenal Technical Schools and a member of the committee on class size of the North Central Association, assisted by visiting the class and giving many valuable suggestions. It was Mr. Stuart who gave me the opportunity to attempt this type of teaching on such a large scale. Without this whole hearted cooperation, the plan would never have
succeeded.

Mr. H. H. Anderson, head of the mathematics department, always aided with advice and directions. His splendid advice and encouragement aided in refining the technique to what we have at the present time.

Mr. D. S. Morgan and Mr. Robert C. Craig, vice-principals, encouraged the project from the administrative point of view.

My co-workers gave much time in making it possible to make a comparative study. They all cooperated with constructive criticisms. While all the co-workers aided in the project, perhaps Mr. H. L. Harshman and Mr. Charles F. Testers are the outstanding ones due to their advice on the scientific side of the compilations.

I am greatly indebted to the many visitors who have left with me the type of compliment which spur one on to greater heights of attainment. I regret that I do not have their names for more extended acknowledgements.

Dr. W. L. Richardson, Head of the Department of Education at Butler University, was an able counselor throughout the writing of this thesis.

I am very much indebted to Dr. A. B. Carlisle of the Department of Education at Butler University, under whose counsel and direction this study has been compiled. His encouragement and criticisms were important factors in the compilations.
"Necessity is the mother of invention" might be applied to this project. With a thorough background of training and teaching experience for small classes, the writer was, nevertheless, untrained for classes as large as thirty-five to forty-five pupils. It was very necessary that a different technique be established. In the small classes of ten to fifteen, a technique had been established by which each individual could advance according to his ability. The same technique would not function in a class of forty. However, the plans for the smaller classes were too valuable to discard, so an organization was developed by which the best features of the smaller classes could be applied to each group of ten to twenty in the larger group. By this plan, the training and experience of the instructor and the technique for small classes were immediately made use of but on a much larger and more comprehensive scale. The better features of the small class methods are made use of and with about the same amount of energy, on the part of the instructor, five
times as many pupils are taught.

The results of the larger classes seemed so satisfactory from the first that it seemed advisable to make some comparisons. The final grades of the entire department of ten to fourteen classes per year for six years of the same subject have been used as the control situation. All of the classes have been conducted on the same class assignment basis. No special classes under special instruction have been conducted. Each teacher has taken the group assigned to her and has taught it by her own method. The pupils were assigned to both the large and small classes without regard to any particular rating. Exceptions: Pupils in one class of one hundred were low in grades by former teachers' rating. Also a few classes of thirty to forty-five were rated high by former teachers. But out of over one hundred twenty classes during the past six years the number of special classes was insignificant. Two semesters, one of Geometry I and the same pupils in Geometry II have been used to obtain data on a more scientific basis. The pupils of Geometry I have been compared as a whole, then by intelligence ratings, and again by morning and afternoon classes. To determine how well the pupils of Geometry I were prepared, a comparison of their progress in Geometry II has also been made. Finally, comparisons have been
made of small and large classes taught by the same instructor.

Another comparison of significance is the relation of scholarship to the position of the pupil in the room. Seven semesters have been compared, and each have been used as an individual unit, and then they all have been used as an entire group. This data shows the quality of work produced from the front seat to the back seat for each semester. The average of these shows the same for the seven semesters. Again the average of the first one-third, the second one-third, and the back one-third of the room for the entire time gives a fair idea of the quality of the work over the entire seven semesters.
The investigation of the effect of the size of class upon the effectiveness of class instruction may be divided into three distinct periods. The first period is from 1898-1915. In this period no effort was made in the studies to hold constant any factor except that of class size. In fact, no actual experiment was set up. The studies were made on the basis of available administrative records or from subjective observations. These records consisted of promotion rate, percentage of withdrawals from class, percentage of class giving attention, amount of time wasted by the class and by scores on single improvised tests.

The second period is from 1915-1925. During this period, the control experiment, epitomized in the law of the single variable, was used. By this time, reliable achievement tests had been developed which could be used to measure growth of accomplishment in pupils. Reliable

---

group intelligence tests also had been constructed which could be used to equate classes that were to be compared. The complexity of the learning process was recognized. The variety of factors that affect pupil achievement was noticed. Investigators set up experiments in classes of varying size in which they attempted to control such factors as pupil age, intelligence, grade, sex, teacher ability, teacher method, course of study, length of class period, etc. As a consequence of this greater care in controlling conditions more significant results were secured.

The third period is from 1925 to the present. In this period, the importance of comprehensive records and adequate control of factors continues to be recognized. In addition, investigators are attempting to find the optimum technique for teaching large classes and the optimum technique for teaching small classes. They are concerned also with finding better ways of interpreting differences found between classes of different sizes.

Mr. Irwin credits Rice and Cornman with the first scientific investigations 1895-1915 and summarizes their conclusions by saying, that, all factors considered, there is no significant relation between class size and educational results. The studies of Rice and Cornman were made with the 7th and 8th grades.

Mr. P. R. Stevenson and Prof. Davis, University of
Michigan are given credit by Mr. Irwin as the first ones to attempt to make a scientific study at the high school level. Their experiments were conducted from 1920 to 1924 which represents the second period. Mr. Stevenson's general conclusions were that the difference in accomplishments does not justify small classes of approximately one half the size of the large ones. Mr. Davis' conclusions were that the size of class had little or nothing to do with the term marks. He further stated that the effectiveness of instruction as far as the achievement of pupils is concerned, is determined chiefly by factors other than class size.

Edmonson and Mulder of the University of Michigan, and Holland at the University of Texas, represent those experimenting at the college level. Edmonson and Mulder concluded that there is no appreciable difference in achievement of the students due to size of class. Holland concluded that the final marks were more highly correlated with intelligence scores than with size of class, and that the size of class had little or nothing to do with the amount of subject matter acquired.

Mr. Irwin has chosen typical investigations rather than an exhaustive study of class size, and states that those mentioned above lead up to the third period or to the end of 1935. He places Truscott in the third period...
judged by his experiment with a class of one hundred in Geometry in 1925. The summary is given as follows: "The results of Trueblood's study would have been much more meaningful if he had paired the pupils in his large class with pupils in a small class which he taught during the same semester. His interest and greatest contribution, however, lay in showing the possibilities of developing efficient procedures for teaching large classes."

Mr. Irwin's personal conclusions are as follows: "Since, however, the results are conflicting or show practically no difference, we must draw the conclusion from the researches that have already been made that it does not matter whether pupils are taught in classes that are large or classes that are small. Therefore, it will be necessary to develop techniques for teaching pupils effectively."

Quotations have been used freely in this short historical sketch for the reason that it represents the findings of a special committee of the North Central Association of Colleges and Secondary Schools. Perhaps no more reliable authority or source can be found, for it represents the opinions of prominent school men who have made a thorough study of the subject treated.

The purpose of this short sketch viz: to show the need of a technique for large class instruction, does not
justify the findings of each researcher described in detail, however deserving their work may be. Those mentioned are fair representatives of their period. Many others have contributed just as valuable information both for comparative results on class size and a technique of instruction for the large and small classes. In the Bibliography may be found a list of those researchers who have made valuable contributions to this field of educational research.
CHAPTER IV

THE TECHNIQUE

In the smaller classes of fifteen to twenty-five pupils, it is possible to become well acquainted with the characteristics as well as the abilities of each pupil. The teacher feels, at least, that she knows the needs of each one. She is able to keep a close check on each individual of her class. The outstanding pupils are given extra assignments, and the slow ones are given extra attention.

In a class of thirty to forty-five this close contact and knowledge of each pupil becomes less possible. It is very difficult to know the class as individuals and keep well informed upon the progress of each without an extra amount of outside grading of papers. This being true, one of two things is evident: Either the teacher spends most of her energy on grading papers to keep herself informed upon the fact knowledge of her class, or she neglects this method of checking and relies on what she may learn from class contact with the pupil. In the first
case, she spends much of her energy in grading papers, energy that is so much needed for her class room work. In the second place, a teacher cannot know the individual progress of her pupils without some kind of a check aside from recitation.

At first I was given forty pupils. It was not long until I was sitting up late at night checking papers and then going to class without the proper rest and enthusiasm. Under these conditions I began to see that the normal progress was not being accomplished by the pupils. The pupils with less ability seemed to be losing ground and the brighter pupils were becoming restless. I analyzed myself, the slow pupils, the bright pupils, and the class as a whole. It seemed there was no way out. To know how each individual was progressing meant more tests. More tests meant later hours for me or a call on "Friend Wife" for assistance which I occasionally made. The more grading I had to do meant less energy for the classes. I felt I was not gaining the end desired, which was the normal progress of the classes. I knew who the bright pupils were for two reasons: their recitations as a rule were, above normal or they were impatient because they were held back.

Out of the above experiences the following technique has developed: I decided to ask the brighter pupils to
assist me with the slower ones. One was asked to take
the roll and make out the absence blanks, to take care
of ventilation and the general appearance of the room.
Others were asked to take the test papers and look for
certain type errors that were made on the tests and re­
port the type error to me; while others were permitted
to assist the slow pupils. These brighter pupils were
given authority over the remaining members of the class
and were given the name of "helpers" or "assistants" as
the ones who took the roll etc. were called.

From that day to this the teaching of large numbers
has not been a problem. The simple plan outlined above
is the foundation of the established technique which I
have been using for several semesters. The established
technique is as follows: A large study hall with plenty
of blackboard space is used for the recitation room. This
room seats about one hundred and fifty pupils. The seats
and desks are single, and are arranged in six rows, which
run lengthwise of the room. The pupils are assigned to
this room in the same manner that pupils are assigned to
any other class. All pupils are assigned to their classes
to suit the school's program or to make the pupil's pro­
gram free of study halls. The period or time of day for
the class has been in the morning for during this time
there is a greater demand for rooms. Since this class contains one hundred pupils there is a saving of two rooms. Thus, two more classes may have earlier hours in the day.

There is assigned to this class an advanced pupil in mathematics. This pupil is one who aspires to be a leader or a teacher. She is called the "assistant." The assistant has charge of seating, taking roll, tardies, ventilation, keeping a close watch-out for those who need some special attention such as seeing, hearing, late entries, poor preparation of pupils, illness or any of the cases that a teacher of fifteen to twenty-five could detect. The assistant has general oversight of three "helpers" who have also been assigned to the class. These three helpers are pupils who are exceptionally strong in their mathematics, and desire a review or wish to become teachers or leaders. They are not necessarily as advanced in their school work as the assistant. In fact, it is better that they be younger than the assistant. These helpers have two of the six rows assigned to each of them. Each row has in it one sixth of the class or from sixteen to twenty pupils. Therefore each helper has from thirty to forty pupils in her charge.

While the assistant is taking the roll, these helpers are collecting the home papers from the class.
At the same time the class is engaged in a ten minute test which covers the subject matter discussed the previous day. The helpers check over the home papers to see the quality of effort expended on daily preparation and they record this fact. They then take up the ten minute tests papers and check for type errors which the pupils make on their test. These errors are compiled by the assistant and turned over to me at the end of the recitation. During the period from the time the tardy bell rings to the final bell at the end of the recitation my time is spent directly with the pupils. There is to be no interference. Even the many visitors are received by the assistant.

The first ten minutes of each class period, as stated above, is used for a test. After that we try to clear up the type errors made on the previous day's test. We then have general discussion on the day's assignment, discussing new subject matter and assignments for the next day. The daily recitations vary as the needs of the subject matter demand.

I keep a seating chart. From this chart, I call, upon those pupils whom I feel are a little too timid to volunteer or upon those loafers whom any class will draw occasionally. Those, likewise, who neglect their home
preparation are given an opportunity to tell the class what they "know" about the subject matter. All are given an opportunity to have a part in the recitation. No one individual is permitted to take more than the time to make a complete recitation and no recitation is accepted which the class will not accept. Any pupil reciting must speak loudly enough to be heard and make his recitation convincing enough to be accepted by his classmates. No one has any idea when he will be called on to recite; but he must be ready to add the logical step to the proof started by the class. A standing challenge is given the class that at any time the instructor, assistants, or the high rating pupils of the class make an error, the individual proving the error to the satisfaction of the class is to receive an A grade for the day.

A full period test is given about every three or four weeks, and this test is graded by myself. These test grades, together with the effort shown by their home preparation and ten minute tests, determine their marks for their report cards. Before the semester is over it is easy to determine from the recitation periods those pupils who are on the border line of failure and who are the superior ones in the class.

The only rule given the class is that each individual
is to do his best. There is much freedom in the class and each pupil feels perfectly at ease and enjoys whatever may come up in the class. Discipline is no problem whatsoever.

While my training and experience had been with the smaller classes, yet this plan, with one hundred, which contains the essence of the small class technique, makes teaching even more enjoyable and exhilarating than ever before. The inspiration of large numbers draws one out to much greater efficiency in presenting subject matter or directing discussions.
CHAPTER V

A TYPICAL RECITATION

In order to have an opportunity to study the technique when not teaching the class and yet have the entire procedure of a class for study, five stenographers were placed in different positions of the room during one recitation and they made a record of every work spoken.

This recitation, the report of which is considered typical of many, is presented not as a model, but, to give some idea of the method by which the recitations are conducted. The pupils and teacher were conscious at first of the situation but soon forgot the visitors as has always been the case in this class when others come in for observations.

The following figures were placed on the board before the class arrived. This method is practiced for all recitations. Figures which represent the plan of the lesson are always ready for the class. The instructor usually has the period preceding the class, free from assigned duties or has a study assembly in the room during which time he places the figure on the board.
(Class has assembled.)

Instructor: Class, I want you to take this construction problem for your ten minute test. Using a line as $AB$, divide it into extreme and mean ratio or the Golden Section.

(Class starts working.)

Instructor: Lay your homework papers on your desk and the helpers will collect them.

In this test, put in your construction lines only and then write the proportions in terms of your line and line segments.
(After five minutes.)

Instructor: The helpers will please take up the test papers.

There polygons on the board represent the type of work which we wish to discuss today. Review for us first the meaning of similar polygons and compare with the meaning of regular polygons.

Instructor: What is the meaning of regular polygons?

*Student No. 1: Regular polygons have equal sides and equal angles.

Instructor: In what way are they like similar polygons and in what way are they different?

*Student No. 2: In regular polygons, the angles of the polygon are all equal and the sides are equal. In similar polygons you compare two polygons in which, corresponding sides are in proportion and corresponding angles are equal.

Instructor: Let us write out proportions that are true in terms of these two regular polygons, first in terms of the sides.

Student No. 3: B is to D as E is to M. Corresponding sides of regular polygons.

*Student No. 1, 2, 3, etc. and Instructor, is the method by which the stenographers recorded those speaking during the recitation. The pupils as a rule were called on by name and from all parts of the room during the class period.
Instructor: Let us have proportions of regular polygons in terms of perimeters.

Student No. 4: The perimeter of $C$ is to the perimeter of $C'$ as side $B$ is to side $B'$.

Instructor: Give us a proportion using areas.

Student No. 5: (Could not recite.)

Student No. 6: The area of $C$ is to the area of $C'$ as side $AC$ is to side $DF$.

Instructor: What is an apothem of a regular polygon?

Student No. 7: An apothem is the radius of a circle inscribed in a regular polygon or a line drawn perpendicular to the side of a polygon from the center.

Instructor: What is the radius of a regular polygon?

Student No. 8: The radius is a line drawn from the center to the vertex.

Instructor: Give us a proportion in which you use the Apothem.

Student No. 9: $HO$ is to $DO$ as $AO$ is to $EO$.

Instructor: How many agree?

(No one agrees.)

Student No. 10: $BO$ is to $EO$ as $AO$ is to $DO$.

Instructor: How many agree with that? All right. He has given the proportion in terms of what?

Student No. 11: The radius and apothem.

Instructor: Notice the next two figures carefully. What
Student No. 12: These figures are similar polygons for the corresponding angles are equal and the sides are in proportion.

Instructor: Have we said anything about those other figures (Regular polygons) that we can not say about these?

Student No. 13: We have the apothem and the radius in regular polygons and do not have them in the similar polygons.

Instructor: Is there anything about the first that we can say about the second?

Student No. 14: The corresponding sides are in proportion in each. The area of one is to the area of the other as the square of any two corresponding side. The corresponding angles are equal.
Instructor: For those in the class who are unable to divide a line into extreme and mean ratio, let's take the line RS and work out the construction.

Instructor: What other name may we use for extreme and mean ratio?

Student No. 15: Divine Proportion or the Golden Section.

Instructor: State the first step in the construction.
Student No. 16: Draw a line perpendicular to RS bisecting RS.
   To find the mid point M.
Instructor: Next step in the construction?
Student No. 17: Draw a perpendicular to RS at S equal to
   one half of RS. Call the line OS.
Instructor: The next step?
Student No. 18: With O as a center and OS a radius construct
   circle O.
Instructor: The next step?
Student No. 19: Draw a line from R to O.
Instructor: The next step?
Student No. 20: Take R as a center and the radius RX and
   mark off on the line RS at T and connect those
   two points.
Instructor: Is it necessary to connect R and T?
Student No. 21: No, sir.
Instructor: What proportion do we have?
Student No. 22: We have the Divine Proportion.
Instructor: State the proportion in terms of our construction.
Student No. 23: Extend the line RO to the other side of the
   circle.
Instructor: Do we need any other lines, class?
Class: No, sir.
Student No. 24: RS is to RT as RT is to TS.
Instructor: Let us make some applications of the Golden Section or the Divine Proportion. Name some objects about the room, city or the home you believe applies to this rule. Does anyone have an illustration? I noticed the picture in the back of the room yesterday. The width was too long or the length too short to apply to this rule.

(No examples given by the class.)

Instructor: I wonder how many realize that the study of geometry is not so much the study of some form of mathematics that man has made, but it is simply the study of nature and seeing those relations in nature and calling it geometry. If you should take this drawing (sketch on the board) which represents a fern, growing, you will never find the leaves coming out of the stem exactly opposite each other. You will find the space between the leaves on the same side of the stem divided by the one on the other side of the stem in the Divine Proportion. Did it happen so? No. Nature has made it that way. The fern did not grow according to something that man has developed in mathematics.
The formula of proportion just developed applies to it. Notice the angle made by the leaf on the fern. The obtuse angle made by the leaf is the mean proportion between the entire angle $180^\circ$ and the acute angle. The Divine Proportion.

I wonder how many of you realize that the American flag that appears so pleasing to the eye is made according to the Divine Proportion. The flag that is beautiful, if you will measure it, you will find a certain relation between its length and its width. If its width were five units, I wonder how long the flag would be so that we could say it was beautiful. I am going to ask you to work out that little problem. Use any scrap paper. Take the length of the flag to be eight feet. Express your proportion in terms of the length and width as we have it represented by our formula which is this one over here, $\frac{W}{L} = \frac{1}{1-W}$. If the length is eight feet, work out your formula for $W$ and let us see how wide that flag should be to be arranged in the Divine Proportion.

Does someone have it finished? Give your answer.

Student No. 25: Four feet.
Instructor: Is it just four feet? Some one else.

Student No. 26: Five feet four inches.

Instructor: That is not quite five feet and a half. Some one else.

Student No. 27: Four feet.

Student No. 28: Five feet four inches.

Instructor: We do not agree on it. Well, that is more algebra than geometry.

Student No. 29: 4.94 feet.

Instructor: Correct. Let us take the answer, 4.94 ft., and call it five feet. Your flag will be, then, eight feet by five feet. Measure your flag at home and see. I was observing a picture this morning. The point which caught my eye immediately was just about at that position which we shall call point P. You will find the picture centered all around it. That part of the picture attracted my eye. Did the artist just happen to place the interest there? Is there any reason why it should be there? Would it be the same with you if you looked at the pic-
Student No. 30: That’s the place for it.

Instructor: Why?

Student No. 31: If I had been drawing, I would have put it in the center of the space for the picture.

Instructor: Do you suspect any relation or ratio between the length of the picture and the segments made by point P. Or between the width of the picture and the segments made by the point P?

Student No. 32: Why, that looks like the Divine Proportion.

Instructor: The next standard picture or work of art that you see, notice to see if the above conclusion is true.

You can take most any drawing which is standard, and you will find some central point. The division of the length and width are each in Divine Proportion. I have been told that the most beautiful building in the world is the Taj Mahal in India. Every window, every door, every measurement of any type, checks with the Divine Proportion. Now, whether those people in India did that by guess, or whether they know mathematics well enough to work out everything in that proportion I do not know.

For the next assignment, let us take in advance,
beginning on page 279. We have the word Penta-decagon, a polygon of fifteen sides. Read carefully the work on page 281, the meaning of the circle, and pages 282, 283 and 284.

I am asking you in this assignment to read carefully, thinking definitely of the meaning of the circle and the place of the circle in the advancement of civilization. That may seem odd to some, that the circle has meant anything in civilization. Will someone name what part the circle has played in the advancement of civilization?

Student No. 32: The circle has aided in the advancement of transportation.

Instructor: What has the knowledge of the circle made it possible to develop?

Student No. 33: The wheels on our vehicles.

Student No. 34: We couldn't have wheels if it were not for circles.

Student No. 35: The watch is made up of tiny wheels. We could not keep time as we do now without circles.

Student No. 36: Our machinery is based on the knowledge of circles.

Student No. 37: We could not walk because our knee caps are
Instructor: If the circle is so important, we must have knowledge of its parts. What are the parts of a circle? That is, the parts we use?

Student No. 38: The radius.

Instructor: What is it?

Student No. 39: The radius is a line drawn from the center of the circle to the circumference.

Student No. 40: The diameter.

Instructor: What is it?

Student No. 41: A line twice as long as the radius drawn through the center of the circle.

Instructor: We have talked in a previous lesson about the number 3.1416 and called it Pi. Does anyone remember how we find that value? That is the kind of work we are going into.

Student No. 42: If you divide the circumference of the circle by its diameter you will get Pi or 3.1416.

Instructor: Does it make any difference how large the circle is?

Student No. 43: No.

Instructor: Would you get the same answer by dividing the circumference of a pin head by its diameter as you would by dividing the circumference of the earth by its diameter? (Bell)

Instructor: Answer this question tomorrow. Class is dismissed.
CHAPTER VI.

COMPARATIVE RESULTS

We have the technique before us and a recitation which fairly accurately shows how the class time is used. We turn now to the results of this method of instruction, and make a few comparisons.

Keep in mind that this project was to develop a technique for large class instruction in mathematics which could be adapted to a normal school program. The pupils were assigned to the class the same as to any other class. The comparison therefore, will be made with classes as they are found in the department. The results or findings will be, then, in terms of our everyday teaching programs.

The data in the following tables are expressed in terms of the median score. The Intelligence scores "Int" were obtained by giving the Indiana Mental Survey - Scale No. 1, Schedule D. The scores are represented in percentiles rather than the I.Q. All other data are in terms of percent also.

In the tables and the figures, the columns "Int" represent the intelligence rating in percent of the groups being com-
The "All" columns are the median scores of four standardized tests given during the semester represented. These scores are for the entire group of the semester.

The "95" columns represent the median test scores of those pupils whose "Int" score is between 90-100. The "85" column compares those pupils whose "Int" score comes between 80-90. The "75" columns are for those whose "Int" score is between 70-80. The "69-" columns are for all others.

The tables and figures are read as follows:

In Table I, the "Int" column shows that the median percentile score of the large class had an intelligence rating of 80 and the median percentile score of the department had an intelligence rating of 84, giving the department an advantage of four points over the large class.

The "All" column shows that the median score of four standardized tests for the large class was 79%. The median score for the department on the same tests was 77%. This gives the large class a score of 2% over the department.

The "95" column represents the pupils in the large class and department whose "Int" rating was between 90-100. The median score for the tests in this group for the large class is 85%, and for the department the median score for the tests
The "95" and "75" columns are read the same as the "95". The "69-" column represents all degrees of intelligence from 69 down to the lowest. This column is read in the same way as the other columns. In the large class the median score on the tests was 76%, while those of the department made a median score of 69%.

Table II is read in the same way as table I. Note, however, that table II is to show how well the pupils of Geometry I are able to carry on in Geometry II. The large class data are for those pupils who were in a large Geometry I class, but are now in small classes scattered throughout the department. Ten different Geometry II teachers grading former members of Geometry I, from regular classes as well as from the large group class, gave the grades represented in Table II.

COMMENT ON TABLES AND FIGURES

Table I - Figure I

The data in this table show that the department has an advantage of four points in intelligence "Int" over that of the large class. It also shows that the large class median score for "All" the four standardized tests is two percent better than that of the department. This difference is insignificant, except to indicate that the pupils of the large class were able to do as well or better than those pupils of
the department who were in the small classes.

The columns headed by "95", "85", and "75" show the progress of the pupils of both the large and small classes, to be of a uniform standard.

The most significant difference in the median scores is in the group represented by the "69-" column. According to the intelligence tests, this group is the lowest in mental ability, yet those individuals who were in the large class made a seven percent better score on the standardized tests than did those of the department. This fact might be taken as incidental in this one case, if the same fact did not appear in every other comparison throughout this study.

The figure is the graphic representation of the data in the table.
Comparing the pupils of Geometry I in one large class and the pupils of Geometry I in the small classes taught by twelve other teachers of the department.

<table>
<thead>
<tr>
<th></th>
<th>Int.</th>
<th>All</th>
<th>55</th>
<th>65</th>
<th>75</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Class</td>
<td>80</td>
<td>79</td>
<td>72</td>
<td>72</td>
<td>73.5</td>
<td>75</td>
</tr>
<tr>
<td>Department classes</td>
<td>84</td>
<td>77</td>
<td>74</td>
<td>74</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE I.**

Graphical representation of data shown in Table I.

- 🟠 Large class.
- 🟡 Department Classes
Table II - Figure II

This table contains data which show how well the pupils of Geometry I of the large and small classes were able to "carry on" in Geometry II. The pupils were in ten different classes. Any partiality, either for or against the project was eliminated. No teacher in Geometry II knew in what class her pupils had been trained in Geometry I, furthermore the grades which any one gave her pupils would have little effect on the median scores of the grades from all the other teachers. Again all test grading was uniform throughout the department.

The data show that the pupils of the department have a four point advantage in intelligence over the pupils from the large class, yet the pupils from the large class in Geometry I did two percent better in Geometry II than did the pupils from the small classes in the department. The pupils represented in the "95", "85", and "75" columns seem to be uniform in their accomplishments.

Again the outstanding difference is with the pupils of low intelligence rating. This shows that the ten different teachers gave the pupils from the large class a median score of seventy-five percent and the same teachers gave the pupils from the small classes of the department a median score of sixty-eight percent. The pupils from the large class, of low intelligence, carried on seven percent better than the same type pupils of the department.
This table compares the same pupils as are represented in Table I, but they are now in ten classes of Geometry II, taught by ten different teachers.

<table>
<thead>
<tr>
<th></th>
<th>Int.</th>
<th>All</th>
<th>95</th>
<th>85</th>
<th>75</th>
<th>69-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Class</td>
<td>80</td>
<td>77</td>
<td>81</td>
<td>71</td>
<td>71.5</td>
<td>73</td>
</tr>
<tr>
<td>Department Classes</td>
<td>84</td>
<td>75</td>
<td>82</td>
<td>71.5</td>
<td>72</td>
<td>68</td>
</tr>
</tbody>
</table>

Figure II
Graphical representation of data shown in Table II
- Large Class.
- Department Classes.
Table III - Figure III

This table is to eliminate as nearly as possible the error which might occur due to comparing a morning class with afternoon classes. The large class of Geometry I recited the third period in the morning. The data in this table are taken from the classes reciting during the first five periods of the day.

The pupil of the department who recited in the first five periods of the day have a five point advantage in intelligence over the pupils of the large class. The pupils of the large class were able to equal those of the department on their standardized tests. The pupils of the department having a "75 Int" rating surpass those pupils of the large class of the same rating by five percent. Again the pupils with low intelligence rating in the large class exceeded by seven and one-half percent the pupils of the department having the same rating.
Comparing the Geometry I pupils of the large class and the Geometry I pupils of the department who recite in the forenoon. (The large class recites in the forenoon.)

<table>
<thead>
<tr>
<th></th>
<th>Int.</th>
<th>All</th>
<th>85</th>
<th>75</th>
<th>69-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large class</td>
<td>80</td>
<td>79</td>
<td>85</td>
<td>72</td>
<td>73</td>
</tr>
<tr>
<td>Department classes</td>
<td>85</td>
<td>79</td>
<td>85</td>
<td>71</td>
<td>73.5</td>
</tr>
</tbody>
</table>

FIGURE III

Graphical representation of data shown in Table III.

- Large Class.
- Department Classes.
Table IV - Figure IV

This table shows how well the Geometry I pupils were able to "carry on" in Geometry II when taught by ten different teachers. The groups that are compared are the pupils from the large class and the pupil from the small classes of the department in Geometry I who recited during the first five periods of the day.

The pupils of the small classes of the department have a three percent better score than those of the large class, in the "95", "85", and "75" columns. The large class pupils are slightly in the lead in the "All" column and again lead by four percent in the "69-" column.
TABLE IV.

This table compares the same pupils as are represented in Table III, but they are now in ten classes of Geometry II taught by ten different teachers.

<table>
<thead>
<tr>
<th></th>
<th>Int.</th>
<th>All</th>
<th>95</th>
<th>85</th>
<th>75</th>
<th>69-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Class</td>
<td>90</td>
<td>77</td>
<td>91</td>
<td>71</td>
<td>71.5</td>
<td>75</td>
</tr>
<tr>
<td>Department A.M. Class</td>
<td>85</td>
<td>76</td>
<td>84</td>
<td>74</td>
<td>74.5</td>
<td>71</td>
</tr>
</tbody>
</table>

FIGURE IV.

Graphical representation of data shown in Table IV.

- Large Class
- Department Classes
Table V - Figure V

The data used in this and the three succeeding tables are the teachers' semester rating of her pupils during the past six years. The data, while not scientifically correct, nevertheless represents the legal scholastic standing of the pupils in the school. There are over four thousand pupils represented. It is safe therefore to assume that this data furnish facts that are reliable.

The data in these tables are given in percent. The letters A+ - A - B - C - D - F are the school's final semester marks. "A+" represents the highest mark a pupil may receive and "F" is the failing mark. "F" means that the pupil withdrew from the class some time before the semester closed.

The data of table V show that 9.6% of the pupils of the large classes in Geometry I were given A- grades for their final or semester marks, and that 7.6% of the pupils of the small classes in the department in Geometry I received A- grades for their final marks. 16.4% of the pupils of the large classes were given an "A" grade while 18% of the pupils of the small classes were given an "A" grade. The large class had 10% "D's" while the department classes had 14% "D's".

The previous tables show that the pupils with a low intelligence rating in the large class do better work than
the same type pupil in the small classes. This table (V) indicates the same but with different, and a larger number, of pupils. 6.2% of the pupils who were enrolled in the large classes withdrew before the semester closed and 8% of the pupils who were enrolled in the small classes of the department withdrew before the semester closed.
Comparing the number (in percent) of each final grade (A-, A, B, C, D, W.) given to the Geometry I pupils of the large class and to the Geometry I pupils of the small classes of the department. This covers a period of six years. A- = highest grade, D = failure, W = withdrawal.

<table>
<thead>
<tr>
<th></th>
<th>A-</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large class</td>
<td>9.6</td>
<td>16.4</td>
<td>22.9</td>
<td>33.5</td>
<td>10.0</td>
<td>6.8</td>
</tr>
<tr>
<td>Department</td>
<td>7.8</td>
<td>15.0</td>
<td>24.0</td>
<td>22.0</td>
<td>14.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Figure V.

Graphical representation of data shown in Table V.

[Diagram showing data for large class and department]
Table VI - Figure VI

The same comparison is made in this table that is represented in Table V except, this data is for Geometry II. Twelve percent of the large class pupils received "A+" grades while 6.3% of the pupils of the small classes received "A+" grades. In the large classes, 6.3% of them failed ("D") to pass, while .12% made a D grade in the small classes of the department. There are fewer "W" (withdrawals) from the large classes than there are from the small classes.

This table indicates again that the pupils with the low "Int" scores do better work in the large classes than in the small classes.
TABLE VI.

The same comparison as is represented in Table V, but this data is for Geometry II pupils.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large class</td>
<td>12.0</td>
<td>14.6</td>
<td>20.9</td>
<td>41.0</td>
<td>16.8</td>
<td>04.0</td>
</tr>
<tr>
<td>Department</td>
<td>6.3</td>
<td>14.8</td>
<td>23.9</td>
<td>36.0</td>
<td>12.0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

FIGURE VI.

Graphical representation of data shown on Table VI.

- Large Class.
- Department.
Table VII - Figure VII

All of the comparisons so far have been made between the accomplishments of the large class pupils taught by one teacher and the accomplishments of the pupils of the small classes taught by other teachers. This table and table VIII will compare the semester marks of pupils who were in the large classes and the pupils who were in the small classes taught by the same teacher. Table VII shows that 9.6% of the pupils of the large classes received A+ grades and the same teacher gave 12.8% of his pupils from the small classes A+ grades. He gave 10.0% of his large class a "D" and he gave 18% of his small class a "D".

6.2% of his pupils of the large class withdrew and 7.2% of the pupils from his small classes withdrew.

This table again indicates that the technique used in the large class is superior to the small class technique for those pupils with low intelligence rating.
VII. 50.

The same type comparison as is represented in Table V, except this table makes a comparison of large and small classes of Geometry I pupils taught by the same teacher over a period of six years.

<table>
<thead>
<tr>
<th></th>
<th>A-</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large classes</td>
<td>9.5</td>
<td>16.4</td>
<td>23.9</td>
<td>32.3</td>
<td>10.1</td>
<td>6.2</td>
</tr>
<tr>
<td>Small classes</td>
<td>12.6</td>
<td>16.5</td>
<td>16.2</td>
<td>27.2</td>
<td>13.0</td>
<td>7.2</td>
</tr>
</tbody>
</table>

FIGURE VII.

Graphical representation of data shown in Table VII.
Table VIII - Figure VIII

This table represents the semester's marks for the pupils of Geometry II in the large and small classes taught by the same teacher. There is no appreciable difference except the "A+" grades and the percent of withdrawals.

It is rather significant that in each table there are fewer withdrawals from the large classes than there are from the small classes. Remembering that there are over four thousand pupils represented in these tables it is not fair to say that this fact is accidental.

Probably the one, almost unanimous statement of the large class pupils, "It is so much more interesting" account for fewer withdrawals.
TABLE VIII.

The same type comparison as is represented in Table V except this table makes a comparison of large and small classes of Geometry II pupils taught by the same teacher over a period of six years.

<table>
<thead>
<tr>
<th>Class</th>
<th>A-</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large classes</td>
<td>12.6</td>
<td>14.6</td>
<td>20.9</td>
<td>41.0</td>
<td>6.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Small classes</td>
<td>7.6</td>
<td>17.3</td>
<td>18.4</td>
<td>40.0</td>
<td>6.5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

FIGURE VIII.

Graphical representation of data shown on Table VIII.

- Large classes
- Small classes
Table IX - Figure IX

Table IX represents the quality of work produced according to the location of the pupil in the room. The unit of measure is in terms of honor points. Honor points are reckoned from the grade given the pupil at each grade period including his final grade. A = 3 points, A = 2 points, B = 1 point, C = 0 point, D = -1 point. Each number in the table represents the average number of honor points produced for each pupil in that row for the semester. The rows referred to in this table run crosswise of the room. The six front seats are referred to as row number one. The next seats back of the front ones are referred to as row number two, etc. back to the eighteenth row which represents the back seats in each of the long rows.

The "average" column represents the average number of honor points for that row during the seven different semesters indicated in this table. The column headed by "Rank" shows the rating of that row when compared with the eighteen rows.

To the right of the table is represented the enrollment in each class by semesters. The average number of honor points earned by each row in the front one-third of the room, and the middle one-third of the room and the back one-third of the room are also shown. The ranks of each one-third of the room for each semester and of the total semesters are
shown at the extreme right.

Figure IX shows graphically, by rank, the quality of the work of pupils from the front of the room, first row, to the back of the room eighteenth row.
This Table represents the average number of honor points earned in each of the eighteen rows of the room.

(See explanation on previous page)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Front 1/3 of the room</th>
<th>Middle 1/3 of the room</th>
<th>Back 1/3 of the room</th>
<th>Ave. by Third</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.00 0.50 3.66 0.33 0.60 0.00</td>
<td>1.33 0.50 1.50 2.3 1.0</td>
<td>5.50 7.00 2.00 1.00</td>
<td>26 1.66</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>3.35 -0.66 2.16 -1.6 1.40 3.10</td>
<td>3.50 5.16 9.83 3.7 5.66</td>
<td>5.50 7.00 2.00 1.00</td>
<td>25 1.55</td>
<td>2.0</td>
</tr>
<tr>
<td>3</td>
<td>4.00 3.00 4.00 1.50 1.50 1.66</td>
<td>4.83 2.00 4.00 2.40 -0.5 4.83 5.33 6.33 3.43 3.60</td>
<td>4.40 5.00</td>
<td>19 5.61</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>1.25 3.16 4.00 3.16 1.33 2.50</td>
<td>3.00 3.16 4.33 2.66 3.00 5.00</td>
<td>2.66 3.33 1.66 2.16 3.66</td>
<td>106 2.56</td>
<td>3.0</td>
</tr>
<tr>
<td>5</td>
<td>2.50 3.00 2.50 6.00 3.33 0.00</td>
<td>0.33 3.16 3.33 3.83 0.00 2.66</td>
<td>9.00 5.00 7.53</td>
<td>82 3.05</td>
<td>3.0</td>
</tr>
<tr>
<td>6</td>
<td>4.75 4.32 5.00 5.66 2.16 5.00</td>
<td>5.50 5.83 4.66 7.00 7.18 2.00</td>
<td>2.83 5.66</td>
<td>90 4.31</td>
<td>3.0</td>
</tr>
<tr>
<td>7</td>
<td>2.52 2.17 2.97 3.27 2.19 2.39</td>
<td>3.20 3.02 3.64 4.66 3.01 3.59</td>
<td>2.86 4.29 5.00</td>
<td>3.03</td>
<td>3.0</td>
</tr>
</tbody>
</table>

The table directly above, shows, by averaging the row averages by thirds of the room, that the back one, third ranks first, the middle one third ranks second, and that the front one third ranks third.
SOME MISCELLANEOUS FINDINGS

It is often true that the by-products of a business prove to be a great asset to the organization. There are a few miscellaneous findings in this study which might be thought of as secondary findings or by-products.

The response in attitude of the pupils in the large class and of the assistants who help in the organization is worth recording and may be taken for what it is worth. At the end of many semesters the pupils have voted as high as ten to one and never lower than six to one in favor of the large class. The reasons which they give for this vote are: That it is so much more interesting; that there are so many more ideas expressed; that no one pupil is permitted to take up too much time; that the ten minute tests make us get our lessons.

The assistants favor the project for the reason that it gives a good review of the subject, that it helps them to know some of the problems of teaching, that they learn to know the difficulties of their fellow pupils, and that they know more about the problems of the school. Many more reasons are given but the above are representative of the ideas expressed.
It is true that there are those who are opposed to the plan. Some objections are as follows: "I am afraid to recite before so many;" "I cannot hear the recitation;" "I have no chance for individual help;" "I cannot see the board;" "I like a small class better."

No assistant has expressed any opposition to his part in the organization.

The conclusions and these conclusions were presented at the St. Louis meeting of the National Association of Secondary School Principals in 1927 by [Name]

The association in the study

1. Discipline found to be a problem.
2. Numbers in classes are increasing.
3. The concept of the three teachers was successful.
4. Although the grades were on the same level as their final mark, practically every teacher felt that the change was not well received.
CHAPTER VII

GENERAL CONCLUSIONS WITH DISCUSSIONS

The following eight conclusions were derived by the author of this thesis from the large classes taught by him in 1924-1925. These conclusions and these discussions quoted below were presented at the St. Louis meeting of the National Association of Secondary School Principals in 1927 by Dr. Earl Hudelson who represented the association in the study of class size.

1. Discipline proved to be no problem whatever.

2. Numbers increased inspiration and efficiency in handling the class and the subject matter.

3. The pupils and helpers declared the plan a success by a vote of ten to one.

4. Although the pupils in Geometry II were chosen on the basis of their low marks in Geometry I, their final marks in Geometry II represented practically a normal curve of distribution.

5. No extra equipment was needed. Moreover, a vacant room was put to use.

6. One teacher did the work that ordinarily required three teachers. The time and talent thus saved were expended on other school duties.
7. The subject matter and the age of the pupils are determining factors in the success of my large classes. In Algebra II, where the pupils were younger and the material different, my plan, while by no means a failure, was less successful. In any case, the younger my pupils, the smaller should be the class (between 30 and 100.)

8. Weak helpers would decrease the efficiency of my plan. It is important, therefore, to choose one's assistants with care. There are plenty of good ones in any large school.

The fact that the large class affords the exceptional pupil opportunities to express himself and to develop accordingly, warrants the extra effort. Too little attention is given to the superior and industrious pupils compared with the help given to the less capable and less willing ones. The procedure attempts to meet this situation by first, applying to the assistance of weak pupils a force that otherwise would lie dormant in the bright pupils and second, giving these bright pupils training which will be of great value to them in their other present activities and in later life.

To succeed with large classes by this or any other plan, a teacher must know his subject and must not be afraid of numbers. An emotionally unstable teacher will not be a success. This cannot be over-emphasized. But if the proper teacher is selected and the assistants are well chosen, the writer feels justified in commanding this plan to the consideration of any large school corporation.”

The only change which further experience indicates should be made in these eight conclusions would be in No. 7. The results in recent large classes of Algebra II have proven that the age and subject matter represented in this subject is just as suitable for the technique as the age and subject matter in Geometry. An Algebra II class of one hundred is now being taught and the same
general results are obtained as were obtained in classes of Geometry.

The technique has been refined and perfected since the first classes of 1934-1935. More scientific data have been collected and many types of reliable comparisons have been made. With all of these checks on the results, the findings of the earlier classes have proved to be valid.

A few additional conclusions are as follows:

A. As far as results in class progress are concerned, the large class seems to have very little advantage over the small classes of the department except those of low intelligence rating. (See Tables I to IV, columns 69.) The results as shown in those tables would indicate that the pupils of a low intelligence rating are greatly assisted by the technique. This is probably due to the fact that they are required to make daily preparation and to take daily tests. The better pupils, in all kinds of classes, make their daily preparations more willingly. The Large Class Technique not only requires this daily check on all the pupils, but the instructor has more free time, which may be used for conferences with the pupil on the border line of failure.

This individual attention is another requirement that
aids the slow pupil and saves him from failure. (Notice the "C" and "D" columns in Figures V to VIII inclusive.)

These tables, at first thought, seem to indicate that the instructor of the large class is an easy grader and that he gives pupils "C" grades when perhaps they should have received "D" grades. However, when the facts of column 69- of the tables I to IV are referred to, these pupils show a superior rank in their scores on the standardized tests over those of the same type pupils "Int 69-" of the department. Since this is the group from which the failures come, it would appear that the "C" and "D" columns of Tables V to VIII are a fair indication of the actual standing of that type of pupil.

3. Judging from the data of Table IX the position of the pupil in the room has little or nothing to do with the quality of work produced. The old theory that a small class circled around the teacher will do the best work does not seem valid since we find the highest quality of work is produced away from the front of the room.

6. The place of the large class in a big institution has proved its worth from the administrative point of view. At a crowded period of the day the administration establishes a large class. This immediately
releases two recitation rooms and makes a place for greater numbers of pupils for that hour.

D. The instructor of the large class has two extra periods a day for other school duties. This time may be used for conferences with the slower pupils or for extra school assignments. It also helps to balance, in numbers, the small classes which are also a necessity in most school organizations.

E. Since the quality of work produced by all the pupils of the large class is not inferior to that of the department, and since the slower pupils seem to benefit by the extra attention which they receive, we feel justified in claiming that at least one-third of the instructional cost is saved by this technique without lowering the educational standards.

F. No successful business of today requires its experienced and trained men and women to perform service that could be done by less experienced ones. Neither should the experienced and highly trained teacher be required to spend her time on matters that can be accomplished by much less experienced individuals. The pupils and the tax payers are entitled to the greatest service the highly trained teacher can render. This service is due the pupils as a class and as individuals. The technique
which is presented in this thesis makes possible the above declaration.

G. The saving of the teacher's energy by the assistants and this energy in turn expended upon the class instruction aids toward efficient teaching. The aid from the superior pupils as assistants not only relieves the experienced teacher for instruction and guidance of the pupil, but it gives these assistants training in meeting life problems in a very practical manner. They receive training as teachers or leaders of groups. They become acquainted with the school problems and learn to deal with the different types of minds and abilities of their fellow pupils.

While the technique affords especial opportunity for individual attention to the slow pupils, it equally affords opportunities for the brighter pupil to express himself clearly and distinctly before large numbers. Such invaluable training is made possible by the large class.

H. Our modern life requires more of rapid thinking and quick decisions than did life in previous generations. The technique of instruction for this age must be adjusted to this situation else the interest in subject matter is lost. When the interest in subje
subject has gone, concentration is difficult to obtain and discipline becomes a problem.

1. The writer feels confident that most well-trained teachers can learn to handle successfully classes of one hundred in mathematics, and find that their energies will not be taxed as greatly as when they spend their time grading many papers from their many classes.
CHAPTER VIII

SPECIFIC CONCLUSIONS AND RECOMMENDATIONS

1. Discipline is no problem whatever.
2. This technique aids toward good discipline.
3. The quality of the work produced by the pupils in the large class is as good as the quality of work produced by the pupils in the smaller classes of the department.
4. The pupils with a low intelligence rating in the large classes make a better showing in their work than the pupils of the same intelligence rating in the small classes of the department.
5. One-third or more of the time of an experienced and highly trained teacher is saved for more direct contact with the pupils or other duties.
6. Each large class saves two recitation rooms for other classes or for other purposes, and therefore aids in administrative problems.
7. The technique uses talent of pupils and college cadets which not only saves the energy of the teacher but gives a training to these assistants which is of use.
to them.

8. The large class and technique adds interest to class recitations.

9. The plan is a financial saving, for the teacher may assist with other duties.

10. Since the teacher may devote more time to her class and pupils it increases the efficiency of teaching.

11. The technique is especially suitable for emphasizing individual attention. The assistants and helpers clarify many minor difficulties and the instructor has more free periods to devote to the individual out of class.

12. The individuals who have ability, are not so likely to become dependent upon the teacher. The instructor of the large class places the burden of preparation upon them. This develops the ability to think for themselves which is as important as it is to assist the weaker pupil.

Recommendations

Judging from the findings in this study and the experience of several years teaching in both the small and large classes, the following recommendations are here set forth as possibilities.

FIRST—No matter how favorably the Large Class Technique
may appear as here presented, there will always be a
place for the small class. It would be just as unwise
to think of making all classes large as it is now to
think of making all classes small.

SECOND—Each high school should establish a course
for pupils in the upper classes, which might be called
"A Finding Course for Teachers." The content of this
course would be problems in education. In more detail
the class would discuss the local needs of the school or
community; how to meet some of the local problems such as
building, taxation, civic, social, athletics, and discipline. A condensed history of the development of education
in America could be given.

The pupils from this course would also be used as
the helpers and assistants in the large classes of the
school. This part would serve as their daily preparation
for their discussions in their regular class. The teacher
of this course would have general oversight over the
assistants, thus assisting the teachers of the large
classes. The pupils who would choose to take the course
would naturally be those who desire to be leaders or
teachers later in life. It would acquaint them with some
of the problems to be met and in many cases they would
help solve school problems. This course would utilize
talents for the benefit of both, the student body, and the school corporation. It would help to build up a sympathetic student body for the school and at the same time they would be assisting in large classes in a way to relieve the highly trained teacher for direct contact with more pupils.

THIRD—The school day for the high school pupil should begin at 8:00 A.M. and end at 2:30 P.M. Each department should establish one or more large classes and these classes should be taught by those teachers who have established themselves in the profession as highly trained teachers. At 2:30 P.M. the Junior College pupils should come for four periods of college work. These pupils should be taught by those teachers who teach the large classes in the high school.

The taxpayers would pay the cost of the Junior College. This cost would be little more than the extra salary of the teachers. If the taxpayers were not yet able to assume this responsibility, a tuition fee could be charged to meet the actual cash expenses.

FOURTH—Heads of departments, Vice Principal and sometimes Principals are expected to teach one or more classes. Whenever they become overloaded with classes their executive efficiency is lowered. Instead of teaching
several classes each day, they can now teach the same number of pupils in one class. This will give them their pupil contact, which any executive needs, and it also lowers instructional cost.

FIFTH--One teacher will be able to teach three classes of one hundred each, and other assignments, as easily and efficiently as he can teach six classes of twenty-five to thirty, each, and other assignments.

SIXTH--Most buildings are now constructed with large study halls. These study halls at certain periods of the day may be used for the large classes. Partitions may be removed in some instances and make one large room where there were two or three before. A long room with six rows of seats with a total seating capacity of one hundred twenty-five makes a good arrangement for the large class.

SEVENTH--Normal schools and colleges would be an open field for this type of instruction, yet this prediction lies outside the field of this study and may not be in place.
TECHNIQUE OF INSTRUCTION AND COMPARATIVE RESULTS FOR CLASSES OF ONE HUNDRED IN MATHEMATICS

BIBLIOGRAPHY


