AN EXPLORATORY INVESTIGATION OF THE EFFECTS OF CLASS SIZE AND SCHEDULING RELATED TO ACHIEVEMENT AND MOTIVATIONAL OUTCOMES

Thesis for the Degree of Ed. D.

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Clarence Murray Williams

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This is to certify that the

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AN EXPLORATORY INVESTIGATION OF
THE EFFECTS OF CLASS SIZE AND SCHEDULING
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BY

CLARENCE MURRAY WILLIAMS

A THESIS

Submitted to
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AN ABSTRACT OF A THESIS

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ABSTRACT

AN EXPLORATORY INVESTIGATION OF
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Clarence Murray Williams

The problem in this exploratory investigation was to examine the effects of different class sizes and scheduling on the educational development of students in high school physics, chemistry, and senior English. Educational development outcomes for the study were measured in, (1) subject matter and skill achievement, and (2) motivation.

In the experimental school, the class sizes ranged from approximately 60 to 100 students, meeting twice a week in double periods interspersed with one small class (6-24 students) "seminar" and laboratory periods (for appropriate subjects) for each student. In the control school, class size was standard of approximately 30 students and scheduled five times a week in 50 minute periods with necessary and appropriate laboratory periods for the subjects.

The control school was selected for the investigation by members of the state education department. The main variable on which selection was based was completed years of high school and college of the parents of the students included in the investigation in both schools. Other conditions such as suburban location and size of the school were approximated as closely as possible.

The general hypothesis was that there would be no differences in either achievement or motivation outcomes as result of instruction under different class sizes and scheduling. Nine specific statistical null hypotheses were tested on achievement outcomes using analysis of covariance to control, in each of the three subject matter areas, for intelligence, pre-achievement, and motivation. Furthermore, five specific statistical null hypotheses were tested on motivational outcomes. Analysis of covariance was used to control, in each of the three subject areas, pre-motivation differences. A fourth motivation outcome analysis was made of the entire experimental sample compared to the control sample using analysis of covariance to adjust for pre-motivation. In a fifth instance, an instrument designed to detect self-initiation of instruction-related projects, provided scores for a "t" test of means between the total experimental sample and total control sample.

The achievement instruments used for the study were those provided by the state education department. For chemistry, a state education score was available in biology as a pre-achievement measure. For physics, a math 10 test score was available as a pre-achievement measure. The junior English examination served as both a pre- and post-instrument because the senior examination was discontinued recently. For pre- and post-motivation scores a new scale, the Word Rating List which measures "Academic Self-Concept" was used. This scale was developed by Farquhar and associates in an on-going investigation sponsored by the U.S. Office of Education and Michigan State University.[1] Another new instrument, the Self-Initiated Projects Questionnaire[2] is under development by the writer and was used as a measure of self-initiation of instruction-related projects. These two instruments are correlated .15.

Significant differences in statistically adjusted achievement outcomes were obtained in all three specific tests in senior English in favor of the experimental conditions. In physics, the adjusted achievement outcomes were not significantly different and in chemistry, the adjusted outcomes in achievement favored the control conditions. No differences were found in motivation within each subject but the analysis of covariance on the entire experimental sample compared to the control sample was significantly different in favor of the experimental conditions. No difference was obtained between the entire experimental sample and the control sample on self-initiation.

The major conclusion of this exploratory investigation is that class size, as a variable, affects the teaching and learning situation. Due to certain concessions necessary to experiment in a field setting and necessary assumptions regarding achievement measures, it was impossible to separate sufficiently the full effects of class size on

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[1]Farquhar, William W., "A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students," Research Project N. 846 (8458) in cooperation with the U.S. Office of Education, 1959.

[2]Williams, Clarence M., The Development of a Measure of Self-Initiation Related to Instruction, in preparation, 1962.

instruction and learning and motivation outcomes. However, awareness of the importance to teaching of manipulation of class size (with the attendant schedule shifts) was increased.

CHAPTER I

THE PROBLEM

Purpose of the Study

Writers in education[1, 2] advocate that class size and scheduling be changed so that better use of teaching staff, student time, and school facilities might be obtained. This study was designed to compare some relevant outcomes of instruction under two different class size and scheduling arrangements.

Need for the Study

How to gain the effective use of teacher-time has concerned educators for some time. Because the profession of education is still faced with a shortage of qualified teachers, and more and more students are finishing high school, the efficient use of teacher-time has become even more critical. Furthermore, the number of students continuing their educational experience increases year by year.

The increasing use of technology in classrooms makes it possible for teachers to instruct different sized groups using such learning aids as movies, slides, film strips, over-head and opaque projectors,

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[1]Arthur D. Morse, _Schools of Tomorrow-Today_. (Garden City, New York: Doubleday and Company, 1960).

[2]Lloyd J. Trump and Dorsey Baynham, _Focus on Change - Guide to Better Schools_. (Chicago: Rand, McNally and Company, 1961).

television, and programmed learning. Small group instruction and well prepared assignments also help in that they place more responsibility on the student and so prepare him for advanced study.

In summary, the need for the present study is based on the following factors:

1) a proportionately smaller number of qualified teachers are available each year,

2) an increasing number of students are finishing high school and continuing their education, and

3) a better understanding of the relationships between teacher aid-technology and instruction is emerging.

These factors demand controlled empirical investigations of manipulations of class sizes (with the attendant shifts in scheduling) and their effects on teaching and learning outcomes. Because all of the variables are not evident at this time, an exploratory study is necessary.

Statement of the Problem

The problem in this exploratory investigation was to examine the effects of different class size and scheduling on the educational development of students in high school physics, chemistry, and senior English. Educational development outcomes for the study were measured in, 1) subject matter and skill achievement, and (2) motivation.

General Hypothesis

The basic assumption of the study is that achievement outcomes, as they are commonly measured, will not be affected significantly by manipulation of class size and scheduling. If is further assumed that motivational outcomes, such as "Academic Self-Concept" as found in the Word Rating List[3] and self-initiation of individual projects related to instruction[4] would not be affected by varying class size and scheduling.

The general hypothesis, therefore, is that there will be no differences in either achievement or motivation outcomes as a result of instruction under different class sizes and scheduling.

Overview of the Study

The remainder of the study is separated into four chapters. In chapter two is found a review of the pertinent literature related to class size and scheduling. The procedures used to select the experimental control schools, how large and small class size and different scheduling affected instructional procedures, the instruments used for data collection, and the statistical models are described in chapter

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[3]William W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students, Research Project No. 846 (8458); Supported by the U.S. Office of Education, in cooperation with Michigan State University, 1959.

[4]Clarence M. Williams, The Development of a Measure of Self-Initiation Related to Instruction, in preparation, University of Rochester, 1962.

three. The data analysis is found in chapter four. The summary, conclusions, discussion, and recommendations of the study are included in chapter five.

CHAPTER II

REVIEW OF THE LITERATURE

Most of the literature on the effects of class size and scheduling on instructional outcomes is spread over a number of years and is confounded with ancillary variables such as single-subject-matter analysis, visual aids, or teacher-centered versus student-centered methods. Most investigators conclude that class size, as a variable, has negligible effects on outcomes of instruction[1, 2]. Meanwhile, visionaries are suggesting that, "the future secondary school will be organized around large-group instruction, individual study, and small group discussion.[3]

The majority of reports on class size effects are not experimental in that a problem is defined, hypotheses developed, a methodology for data collection and analysis detailed, and warranted conclusions based on probabilities drawn. Only a few directly related studies are available which meet the minimum requirements of being scientific inquiry. Other reports using class size as a subsidiary variable slightly extend the body of knowledge in this area.

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[1]C.M. Fleming, "Class Size as a Variable in the Teaching Situation." Educational Research, February, 1958, pp. 35-48.

[2]Wallace B. Nelson, "An Experiment in Class Size in the Teaching of Elementary Economics." Educational Research, October, 1959, pp. 330-341.

[3]J. Lloyd Trump, Images of the Future - A New Approach to the Secondary School. Urbana: University of Illinois, Commission on the Experimental Study of the Utilization of the Staff in the Secondary School, 1959, 46 p.

The major emphasis of this review will be on the directly related research with passing reference given to a few pertinent studies which treat class size as a by-product.

An ongoing study is described by Trump as "teachers (in Snyder, Texas) are experimenting with sections consisting of seventy-five students each. Each teacher teaches three such sections, utilizing many audio-visual aids, and then has three periods a day free for planning and conferences[4]." To date, no other follow-up could be found on the experiment in large-group instruction in Snyder, Texas.

Another author reported that "students do not suffer by being in large classes...(and)...teachers varied in their success in accordance with their ability to endure the strain of a number of large classes...[5]" but does not document or present evidence of a systematic study of these factors. In addition, several "experiments" and investigations are alluded to without citation.

A comprehensive study of large-group instruction at the university level where achievement in large groups in several subject areas was controlled by achievement in small classes was conducted in Miami[6].

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[4]J. Lloyd Trump, New Horizons for Secondary School Teachers. Urbana, Illinois: University of Illinois, Commission on the Experimental Study of the Utilization of the Staff in the Secondary Schools, 1956, 35 p.

[5]Dora V. Smith, "Vital Factors in the Present Situation in Class Size." English Journal, Vol. 22, 1933, pp. 366-74.

[6]Lawrence Siegel, F.G. Macomber, and James F. Adams, "The Effectiveness of Large-Group Instruction at the University Level." Harvard Educational Review, Vol. 29, 1959, pp. 216-226.

Achievement scores in general were not adversely affected by large group instruction. A confounding variable for which no control was provided was the use of television as a media in the large group instruction. The authors report for controls that the course content, the instructors, and the final examination were constants in the experiment.

Teaching effectiveness is equated with objective test scores and final grades in another study of class size in economics[7]. The author reports that large and small group students were matched for major subject, student classification, sex, and the remaining differences eliminated by analysis of covariance. Unfortunately, the original source of this information is not available for detailed study.

When English literature is the subject material, learning is reported as enhanced when taught in large groups and compared to learning in small groups[8]. This finding is said to be true for "general reading also." In addition, "students preferred large class and the teacher found them more active." Again, no mention is made in this article of any kind of control or attempt to systematize the investigation. This specific article is being used in a number of summaries and reviews on achievement in large classes versus small classes as <u>favorable evidence</u> for large group instruction.

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[7]Wallace B. Nelson, "An Experiment in Class Size in the Teaching of Elementary Economics." <u>Educational Research</u>, Vol. 40, October, 1959, pp. 330-341.

[8]Dora V. Smith, <u>Class Size in High School English: Methods and Results</u>. University of Minnesota, 1931.

Another improper use of research information is found in the doctoral dissertation of Bittick[9]. He concludes, "students from large high schools where classes tend to be large achieve as much in the language arts as do students from small high schools where classes tend to be small." The same logic could be used in favor of small classes.

Large lecture sections make for increased motivation of lecturers to engage in more careful preparation and may have provided for greater stimulation for excellence in presentation is the conclusion of another reporter[10]. The statistical comparison of the efficiency of the large lecture section and the small recitation section was not analysis of covariance and did not provide control over differences when assignment to large or small class was not random. The Critical Ratio between large and small class means obtained by an unidentified weighting of quizzes and examinations was not significant.

A project entitled SUPRAD conducted under the auspices of Harvard University is described by Morse[11]. He reports that "large group, small group, and individual tutoring are all in the context of best

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[9]Edsel F. Bittick, Differentials in College Success At The University of Texas of Students From Large and Small Texas High Schools. Doctor's Thesis, University of Texas, 1956.

[10]Richard W. Husband, "A Statistical Comparison of the Efficiency of Large Lecture vs Small Recitation Sections upon Achievement in General Psychology." Journal of Psychology, Vol. 31, 1951, pp. 297-300.

[11]Arthur D. Morse, Schools of Tomorrow-Today. (New York: Doubleday and Company, 1960).

use of talents of the group of teachers in SUPRAD project." No research evidence is supplied to support this contention. No further information about what is being done specifically is supplied.

Goodlad, in writing on "Classroom Organization," for the 1960 Encyclopedia of Educational Research, concludes,

> "... Class size, like other problems of classroom organization, cannot be satisfactorily studied apart from the problems of curriculum and instruction tied up with it[12]."

While this seems a reasonable conclusion and one which says that class size still needs to be investigated along with other problems, another conclusion is reported by Fleming as he completes a review of the literature on class size,

> "There have been many investigations; but with few exceptions...under typical conditions, class size in itself appears to be an unimportant factor. The benefits of small classes, though commonly taken for granted by theorists, are as yet largely undemonstrated in the pages of accredited research reports. This conclusion has been reached at every level from infant-room to university lecture-theatre. It has been formulated in relation to many subjects; and it is supported both by test results and by assessment of various types[13]."

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[12] John I. Goodlad, "Classroom Organization," Encyclopedia of Educational Research. (Ed. by Chester W. Harris. New York: The Macmillan Company, 1960).

[13] C.M. Fleming, "Class Size as a Variable in the Teaching Situation." Educational Research, February, 1958, pp. 35-48.

These two points of view are too contradictory to leave unconsidered. The latter appears to be built on uncritical acceptance of many reports of studies of class size from pre-school to university applications. The controversy demands empirical testing.

An interesting study of the effects of large group instruction is discussed by Dranes[14]. He first states that there are no critical differences between mean achievement and attitudes of large and small group classes of the same subject. The results, however, favored the small classes. The study was then rerun adjusting the teaching method so that the instructors could know the students better, plan the semester work more carefully, and provide more opportunity for discussion with individuals. In the next semester, the large group did better than the large group of the previous semester. The conclusion drawn was that method and class size are inseparably related.

There is a suggestion in a study by Entwisle[15] that for certain purposes it is better to instruct students in large groups. If the purpose of instruction is to widen the scope of knowledges to which a student is exposed then Entwisle's statement, "merely calling attention to a given body of subject matter (administering attensity) fostered learning irrespective of the means by which attention was directed," has some merit. There are reasons why instruction should be directed

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[14]David Daniel Dranes, "A Study of Class Size and Instructional Methods," Doctoral Dissertation, The University of Wisconsin, 1957.

[15]Doris R. Entwisle, "Attensity: Factors of Specific Set in School Learning." Harvard Educational Review, Vol. 31, Winter, 1961, pp. 84-101.

to large groups which might be different from those developed for small groups. Support for this notion comes from a summary of teaching methods in science education. The reviewer states that if the aim is to produce learning of the informational type, demonstration methods (in lectures) are as effective as individual laboratory work[16].

In a study in which the election of advanced courses in psychology was used as one criterion, McKeachie[17] reports that the more autocratic recitation method as compared to discussion and tutorial methods proved not only to produce superior performance on the final examination but also to produce greater interest in psychology as measured by the election of advanced courses in psychology.

In another study of higher education, Giffin and Bowers[18] conclude that the "mass-lecture" method of teaching can be employed without significantly diminishing the amount of learning. They used "several" control groups and experimental groups of fourteen students each in a course, Fundamentals of Speech, in which the aim was to bring about improvement in speaking skill. The total number of students was 297. The experimental condition was one "mass-lecture" per week by the

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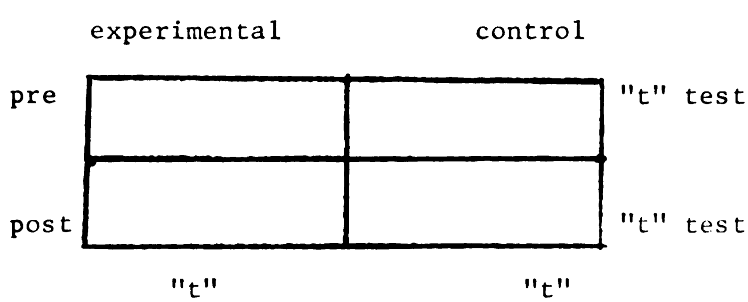
[16]Harry A. Cunningham, "Lecture Demonstration Versus Individual Laboratory Method in Science Teaching--A Summary." Science Education, Vol. 30, 1946, pp. 70-82.

[17]Wilbert J. McKeachie, "Students, Groups, and Teaching Methods." American Psychologist, Vol. 13, 1958, pp. 580-584.

[18]Kim Giffin and John Waite Bowers, "An Experimental Study of the Use of Lectures to Large Groups of Students in Teaching the Fundamentals of Speech." The Journal of Educational Research, Vol. 55, No. 8, May, 1962, pp. 383-385.

department head with all students in experimental classes attending and then separation into small groups of fourteen students each for two discussion periods per week. The control groups met in classes of fourteen each for three periods per week. The presentation of the substance of the fundamentals of speech was during the "mass-lecture" for the experimental group. For the control group, the fundamentals were presented when needed or at opportune times between the short (two to six minute) speeches of students. In order to control experimental variables the same graduate assistants were used as instructors, all classes met in the mornings of the same days and met in the same or comparable classrooms. The assignment of students to the different sections at enrollment time was assumed to be random.

An oral speaking test and an objective test were administered pre- and post- the course. The oral test was rated (one to ten) by three judges and the mean scores used for analysis. The two form objective test consisted of fifty-five items with no estimates of reliability or validity. The model for data analysis was a two by two cell arrangement with a "t" test between pre- and post-results for both groups and between both groups pre- and post for both the oral and the objective tests.



The major criticism of this study is the use of different instructors to present the substance of the course to the experimental and control groups. The differential effects of the department head's presentation in the "mass-lecture" might have been lessened had he guest-lectured in each of the control classes on the same topics. Other criticisms are, (1) the assumption of random assignment to sections by normal enrollment procedures, (2) the lack of estimates of reliability or validity on the tests, and (3) the method of data analysis. For the possible non-random assignment of students to experimental and control sections and the method of data analysis the statistical method, analysis of covariance, would have improved the design. Means are available for obtaining estimates of the reliability of the tests. Other conclusions might have been made. For example, Giffin and Bowers might have concluded that large group instruction does not significantly diminish the amount of learning when the lecturing is done by an experienced lecturer. Or, that graduate assistants can supply the necessary course substance to students when they have small classes to deal with. These kinds of tentative conclusions perhaps should have been made because it would have shown the possibilities for serendipity in research.

As an example of how school personnel are beginning to manipulate the schedule in order to improve teaching-learning the following description of a schedule change plan is given. In a junior high school, the basic unit of time has been reduced to twenty-two minutes.[19] This

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[19]M.H. Robb, "Modular Scheduling at Euclid Central." National Association of Secondary School Principal's Bulletin, Vol. 46, February, 1962, pp. 66-69.

unit or "module" is considered to be sufficient for some classes like foreign language instruction in the seventh and eighth grades and in certain remedial sections. Other classes like the "core" classes in social studies might have as many as five modules. The teachers can use the time in the assigned modules any way they wish, according to the subject, assignments, and individual student's need. As of the writing of the report, the author states that now school personnel are considering "sliding classes." If one teacher needs more than the planned time, she takes it and gives it up later in exchange to the teacher from whom it was originally taken.

Summary

There is little empirical research available on class size as a variable which effects the outcomes of instruction. When reports relating to class size are found, other variables such as a single subject matter, visual aids, or teacher-centric versus student-centric methods are confounded with it.

Several reports in which claims about the effects of class size are presented are not well conceived in research design, and/or described in such a way as to mask clear understanding. Some of the reports allude to findings not presented and others refer to "experiments" not described or cited.

A controversial issue arises when comparing two different reviews of the literature. One reviewer states that class size is inextricably tied up with problems of curriculum and instruction and needs further study while another reviewer concludes that class size is an unimportant factor in teaching-learning situations.

One recent study was reviewed in detail. The design did not account for teacher differences between the large group and small group instruction, did not include estimates of reliability or validity for the instruments used, and the analysis of data did not provide for non-random assignment of students to the two treatments. A possibility for other tentative conclusions such as, an experienced teacher can lecture to all the students in a "mass-lecture" and then graduate assistants can monitor speeches as a method to expose all students to the experienced teacher for the substance of the course or that graduate assistants can teach the substance of the course in small group situations was suggested.

No research was located on scheduling as a variable. Some recent articles refer to "experimentation" in scheduling and one was reviewed so that an idea of what is being considered and applied by school personnel might be gained. In this article, the scheduling unit or "module" is described as twenty-two minutes in length. Numbers of modules vary from one to five depending on the kind of class and its purpose. The author also describes the next procedure, that of adopting "sliding classes." If a teacher needs more time to finish a lesson or assignment, she takes it and releases the students when she is finished. She "repays" the time to the class from which it was taken at a later date.

CHAPTER III

PROCEDURES

In order to understand the setting in which an experimental manipulation of class size and scheduling was possible, it is necessary to describe, in the procedures section, the designation and selection of an experimental and a control school, define the experimental conditions, and show preliminary evidence that the experimental conditions affected the teaching-learning situation. Finally, in this section, the data instruments are described and the schedule for the collection and analysis of data is reported.

Experimental and Control Schools

The experimental school was a suburban New York school where the administrators and staff of the secondary unit were interested in manipulating class size in English IV, physics, and chemistry. In cooperation with the State Department of Education in Albany, New York, a control school was selected. Members of the education research division of the State Department made the selection using data already available from their continuing study of education quality.[1] The chief variable on which selection was based was the number of years of high school and

[1] William D. Firman and associates, Procedures in School Quality Evaluation, mimeographed report, published by the Division of Research, State Education Department, Albany, New York, 1961.

college completed by the parents of the students. This variable is one which has been identified as a stable indicator of achievement in a particular school. The data was collected for the parents of students in the three experimental classes and sent to Albany. Selection of a school of similar parent backgrounds and as comparable as possible with respect to size and type of location (both schools were in suburban areas) was then made. The control school staff's cooperation in administering the testing schedule was secured. A coordinator of the project was named in the education department's research division. His function was to serve as an intermediary to facilitate communication between the experimental and control schools. At no time, however, did the personnel in the two schools know the other's identity and location.

Because the relinquishing of complete direction over both treatments in the experiment was necessary in order to get complete separation of the experimental and control situations this cumbersome technique for selection and data collection was accepted. It constitutes a limitation on the study in that some data was lost. The inordinate length of time necessary for communication to be effective meant, in most cases, that fill-in and replacement data were not available due to the press of year-end school time committments and the students dispersing.

Non-Standard and Standard Class Size and Scheduling

Non-standard class size and scheduling[2] refers to two large group (with 60 to 90 students) instruction periods of double length per week interspersed with small group for seminars, independent study, and laboratory experiences. Standard class size and scheduling refers to classes of approximately 30 students in regular length periods of from 45 to 55 minutes meeting five times a week with the laboratory periods appropriate to the subject. The total time in minutes per week was the same.

Other Experimental Conditions

It is necessary at this point to explain more fully three aspects of the study, objectives for the three courses, English IV, physics, and chemistry, their relation to the examinations provided by the state, and the necessary and complete separation of the experimental and control schools with the attendant assumptions.

The objectives for Regent's courses in New York State are stated in general terms. For English IV, they are[3]:

Reading and literature

1. To develop skill in reading (with concentration, speed, comprehension, organization, and recall).

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[2]See Appendix No. 1 for a copy of the class schedule in the experimental school compared to traditional scheduling.

[3]Personal communication, the principal of the experimental school.

2. To develop skill in the use of the tools of reading, including the card catalog, reference books, the dictionary, the book index, and table of contents.
3. To form a permanent reading habit based upon a love of reading.
4. To become acquainted with the reading field including books and current periodicals.
5. To develop skill in making discriminating choices of reading materials.

Expression

1. To develop skill in expressing thought in clear, correct, courteous, interesting, and forceful oral English.
2. To develop skill in taking part in public discussion within the rules and courtesies of parliamentary procedures.
3. To develop skill in expressing thought in clear, correct, courteous, interesting, and forceful written English.

For physics:

"The objectives of the course in physics should extend far beyond a minimal comprehension of the basic facts and principles outlined in these syllabuses. The appreciation of the scientific method, the ability and willingness to change beliefs and opinions after careful weighing of new evidence, and the development of the habit of critical thinking are the intangible but most important outcomes of the study of this science ...[4]"

The aims of the physics course "... should extend far beyond acquisition of knowledge about utilitarian applications of physics principles ... should be the practice laboratory ... (to) ... reinforce the so-called 'scientific method' ... afford a glimpse of the orderliness of the patterns ... of the universe ... part played by math as an expression of this systematic organization should be brought home to the ... student ...[5]"

For chemistry:

"The objectives of the course in chemistry should extend far beyond a minimal comprehension of the basic facts and principles outlined in these syllabuses. The appreciation of the scientific method, the ability and willingness to change beliefs and opinions after careful weighing of new evidence, and the development of the habit of critical thinking are the intangible but most important outcomes of the study of this science ...[6]"

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[4] Chemistry and Physics: An Outline of the Scope of the Content and Related Understandings of the Courses of Study. Pub. by Secondary Curriculum Development, New York State Education Department, 1957, p. 7.

[5] Physics Handbook. Publication of Bureau of Secondary Curriculum Development, New York State Education Department, 1956.

[6] Chemistry and Physics: An Outline ... p. 7.

The Rengent's examinations in New York State are revised each year by a committee of teachers from various schools throughout the state working with test specialists of the education department. These tests are constructed to fit the broad objectives contained in the state syllabi. In essence, the items in these tests probably could be said to be the operationally defined objectives of the particular Regent's course[7]. Insofar as this is true, then, the Regent's courses English IV, physics, and chemistry as taught in the experimental school and the control school are similar. They are similar in content, extent and breadth of coverage, the kinds of experiences needed to establish and reinforce the particular skills, and in the source materials used. This is a broad but necessary assumption for the exploratory study.

Because the Regent's syllabi and examinations are accepted by school personnel desiring to offer Regent's credit to students and because of state-wide teacher participation in examination preparation it is assumed, then, for this exploration, that the only major variable unaccounted for is the teacher. This limitation was accepted in order to achieve separation of the experimental and control conditions and so that a preliminary study of achievement and motivational outcomes could be made. Also, it was thought that the non-standard class size and scheduling might affect instruction and prove a source of contamination to the standard classes.

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[7]This year's examinations (1962) were not available at this writing.

An observation schedule was developed to permit study of the effects of non-standard class size and scheduling on instruction. It was thought this procedure would provide information which might prove helpful in explaining results. Pre-experimental discussion and planning with the teachers revealed that a sufficient description of the method and findings of the observations should be reported to increase their understanding of some possible effects of non-standard size and scheduling on teaching.

Rationale of the Observation Schedule

Three weeks in late winter were selected as being a period of time relatively free of radical distraction in which to conduct a study of the effects of non-standard class size on teacher method in the experimental school. The mid-year activities were over and sufficient time remained in the school year before the press of closing activities. Furthermore, the three weeks constituted a period which best approximated a sample of the total forty weeks of instruction.

Three observers were chosen who were doctoral candidates in the College of Education, University of Rochester. Each spent several periods of observations in the experimental school as part of his training. All had had three or more years of teaching experience.

The observation schedule for each observer was set to be twelve complete class periods randomly selected out of the possible forty-five to sixty-one periods available in the non-standard size classes. Two conditions in the selection of observation periods were made. The first was an equal division of observations of large and small group classes; the second was a ten per cent overlap of observer time in the schedule. The latter condition was made to gain some logical estimate of reliability of observations. In addition, on inspection, there appeared to be no logical differences when observations overlapped.

The teachers being observed were asked to check the observer's reports[8], indicate discrepancies and make adjustments pertaining to instructional procedures, sequence, or content. In only a few cases did teachers change some aspect of an observation. None of the changes proved to be substantial or logically significant. In the following summary all overlapping observations were deleted:

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[8]See Appendix No. 2 for copy of Observer's Check Sheet.

The data included in Tables 3.1, 3.2, 3.3, and 3.4 serve to characterize the kind of instruction being practiced in the experimental large and small classes.

Table 3.1

Frequency Comparisons of Observations of Pace of Instruction related to Subject Materials and Students in Large and Small Groups in the Experimental School

	Classification of Observed Sessions*	
Pace of Instruction:	Large Group	Small Group
Very Fast	0	2
Fast	4	4
Moderate	9	9
Slow	3	0
Pace: for Subject Materials:		
Quite Appropriate	8	7
Appropriate	7	6
Somewhat Appropriate	1	2
Inappropriate	0	0
Pace: for Students		
Quite Appropriate	6	8
Appropriate	6	6
Somewhat Appropriate	4	1
Inappropriate	0	0

* Large groups were two periods and small groups were one period in length.

From Table 3.1 can be observed that in three out of sixteen observations the pace was rated Slow for large group instruction whereas in two of fifteen observations of small class instruction the pace was rated Very Fast. The points of most difference suggests a possibility that speed of instruction is not adequately taken into account as a factor when teachers plan activities.

Table 3.2

Frequency Comparisons of Observations of Activities Considered to be Articulatory or Connecting one Instruction Period or Topic to Another

	Classification of Observed Activities	
	Large Group	Small Group
References to other periods of instruction (within same subject)	0	6
Introductory or Preparatory Remarks	10	8
Teacher Summary as Closing Activity	3	1
Student Summary at Close of Session	0	0

Table 3.3

Frequency Comparisons of Observations of
Certain Categories of Classroom Activities
in Large and Small Classes

	Classification of Observed Activities	
Assignment Activities:	Large Group	Small Group
Giving	9	0
Clarifying	4	0
Checking	4	0
Use of Resources and Aids:		
Textbook	2	1
Local "expert"	0	1
Over-head Projector	3	0
Chalkboard	6	0
Movies	3	0

Table 3.4

Frequency Comparisons of Observations of Categories
of Teaching-Learning Activities
and Control of Learning

	Classification of Observed Sessions	
Dominant Teaching-Learning Activity:	Large Group	Small Group
Lecture	15	1
Discussion	0	13
	Classification of Observed Activities	
Problem-Solving:	Large Group	Small Group
by Group	0	7
by Individuals	1	7
Critical Thinking Practice	0	11
Individual Review	0	1
	Classification of Observed Sessions	
Control of Learning Activities:	Large Group	Small Group
Teacher-centered	15	5
Student-centered	1	10

The data in Tables 3.2, 3.3, and 3.4 indicate that the "largeness" or size of a class influence the activities of the teacher and student within the classroom. In Tables 3.2 and 3.3, it can be seen that teachers behaved differently in terms of articulatory and assignment activities in classes of different sizes. More significantly, the tendency toward teacher-centered instruction noted in nearly all of the large group classes and in one-third of the small classes indicates the need for investigating the teaching-learning variables which arise when class size and scheduling is manipulated. The significant question still remains, do these reactions and adjustments made to different class sizes affect instruction and achievement?

Instrumentation

There are several factors which limit the time available for teaching and learning in the modern high school. In addition to the careful scheduling, there is the press of desire for knowledge, the competition of students for marks, and the increasing rigor of college admission policies. School personnel are wary, justifiably or not, of the experimenter who wishes to take time from the schedule to administer tests. Therefore, as much use as possible had to be made of instruments which already had a place in the testing schedule of the school. Even though the staff of the control school expressed an interest in the study, some guidance and administrative resistance had to be overcome. The forced choice of instrumentation therefore places a limitation on the study.

Achievement

The achievement instruments employed in the study were the New York State Regent's tests for the subjects, English III, Physics, and Chemistry. Because most schools follow state recommendations for sequence of courses, and use state syllabi and tests, a Regent's Math 10 score was available in both schools as a pre-achievement measure for physics. A Regent's Biology score was available as a pre-achievement measure for chemistry. These data were used because it was thought they might prove helpful in determining the usefulness of the control school selection technique and in further exploration of their importance as predicting variables. It would, of course, have been desirable to have pre-achievement measures in the appropriate subjects but this was not possible. In the 1961-62 school year, the English IV Regent's test was cancelled. In lieu of any more satisfactory substitute, the Regent's English III test was re-administered in both schools. This test, then, served as both a pre- and post-achievement measure.

The test-retest reliability of Regent's examinations is reported in past years as .93 for English III in 1959, .97 for Chemistry in 1957, and .96 for Physics in 1957.[4] Reliability data on the current administrations are not available at the time of this writing.

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[4]Regent's Test Development Office, Personal communication.

Intelligence

The Otis Quick-Scoring Mental Ability Test,[5] form Gamma, was administered in the fall as a measure of intelligence. The inter-form (test - retest) coefficient of correlation is reported to be .86. The validity coefficients range from .20 to .69 when correlated with grade point average.

Motivation

The Word Rating List of the Michigan State Motivation Scales developed by Farquhar[6] and associates was used as a measure of motivation. This scale is a measure of "Academic Self-Concept." The WRL has a reported reliability coefficient of .93.[7] A validity coefficient of .43 is reported[8] when WRL is correlated with GPA on a stratified proportionate sample drawn from nine high schools in cities of various size in Michigan. A detailed description of the scale along with its rationale for

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[5]A.S. Otis, Manual for the Otis Self-Administering Tests of Mental Ability. (Yonkers, N.Y.: World Book Co., 1922).

[6]William W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students, Research Project No. 846 (8458); Supported by the U.S. Office of Education, in cooperation with Michigan State University, 1959.

[7]William W. Farquhar, Personal communication.

[8]William W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students, Research Project No. 846 (8458); Supported by the U.S. Office of Education, in cooperation with Michigan State University, Preliminary Report, 1961.

development can be found in Payne's doctoral dissertation.[9]

Self-Initiation

A Self-Initiated Projects Questionnaire of thirty-two items designed to detect variable amounts of self-initiated projects such as designing and building a model, discussing class-learned concepts with adults outside the school situation, and reading an instruction-related book or novel has been under development as part of another study at the University of Rochester.[10] Two different scales, "I Do" and "I Would Like To," have yielded data from students in secondary schools indicating the possibilities of added dimensions to present motivation instruments. The "I Do" scale was chosen as a measure of self-initiation in the present study because of its possible orthogonal relationship to the WRL. The coefficient of correlation between the "I Do" scale of SIPQ and WRL is .15 on a sample of 83 students. The coefficient of reliability of SIPQ "I Do" scale as determined by Hoyt's analysis of variance method[11] is .70.

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[9] David Allen Payne, *A Dimension Analysis of the Academic Self-Concepts of Eleventh Grade Under- and Overachieving Students*, Doctoral Dissertation, 1961, (Ann Arbor, Michigan: University Microfilms, Inc.).

[10] Clarence M. Williams, *The Development of a Measure of Self-Initiation Related to Instruction*, in preparation.

[11] C.J. Hoyt, "Test Reliability Estimated by Analysis of Variance," *Psychometrika*, Vol. 6, 1941, pp. 153-160.

Specific Hypotheses

The general null hypothesis described in chapter one is separated into two sets of hypotheses. Set A is composed of those hypotheses relating to achievement and Set M consists of those related to motivation.

<u>Set A</u>. Hypotheses A1, A2, and A3: There will be no differences in achievement outcomes between the experimental and control conditions in English when statistically controlled for (1) intelligence differences, or (2) pre-achievement differences, or (3) pre-motivation differences.

Hypotheses A4, A5, and A6: There will be no differences in achievement outcomes between the experimental and control conditions in Physics when statistically controlled for (1) intelligence differences, or (2) pre-achievement differences, or (3) pre-motivation differences.

Hypotheses A7, A8, and A9: There will be no differences in achievement outcomes between the experimental and control conditions in Chemistry when statistically controlled for (1) intelligence differences, or (2) pre-achievement differences, or (3) pre-motivation differences.

<u>Set M</u>. Hypotheses M1, M2, M3: There will be no differences in motivation outcomes as measured by the WRL between the experimental and control conditions in (1) English IV, or (2) Physics, or (3) Chemistry when pre-motivation

differences are statistically controlled, or in

Hypothesis M4: All three subjects combined when combined pre-motivation differences are statistically controlled.

Hypothesis M5: There will be no differences in motivation outcomes between the experimental and control conditions as measured by the SIPQ.

The level of confidence for the rejection of the null hypotheses is .05.

Statistical Models

As a method for controlling possible differences between the experimental and control groups in ability, past achievement, and motivation where there was not random assignment of subjects, the analysis of covariance model[12] was chosen. This type of analysis allows for statistical control of differences which might exist in the two groups of the sample before the experimental condition or treatment is begun. Because the two groups were in two different schools, no random assignment of students was possible. Therefore, for the I.Q., achievement

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[12]Allen L. Edwards, Experimental Design in Psychological Research, (New York City: Rinehard and Company, Inc., 1950).

scores, and the WRL scale, the following two by two model is applicable as a design:

	Experi-mental School	Control School
Pre-test (X) I.Q., Achievement and Motivation WRL		
Post-test (Y) Achievement and WRL		

Analysis of Covariance

For the SIPQ scores (which were collected only at the end of the school-year) the "t" test of differences between means[13] was chosen.

Data Analysis

Available in the university computing center library was a covariance program for the IBM 709. Originally, an attempt was made to modify the program for the 7070, however, after encountering much difficulty, it was decided an original 7070 covariance program ought to be developed. The program which the center devised and validated tests the covariance assumptions of linearity and homogeneity of regression. It tables the output data with analysis of variance, means, analysis of covariance, and computes F on the mean squares obtained from the adjusted sums of squares and adjusted degrees of freedom.

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[13] Ibid.

Summary

The study in an experimental school where there were staff members who wished to explore the instructional outcomes of different class sizes and scheduling necessitated the selection of a control school. The State Department of Education in New York chose the control school in which the parent population in the secondary unit matched that of the experimental school in educational background or years of high school and college completed.

The experimental variable was non-standard size and scheduling which refers to two large instruction groups with 60 to 90 students meeting twice a week for double periods interspersed with small groups for seminars, independent study, and laboratories. The control school used standard size and scheduling or 30 students meeting in single periods five times a week. The objectives for the three Regent's courses, English IV, physics, and chemistry were examined and found to be abstract. They are used by all teachers in New York State who teach the Regent's subjects. They are also used by selected teachers from throughout the state who with test specialists in the state education department revise the examinations each year. It was assumed that teachers teaching these subjects and using the common objectives and examinations would be similar in their use of teaching method and materials. It was also assumed that the only major variable unaccounted for in the exploratory study was the use of different teachers.

An observation rationale was developed for the experimental classes to better understand how non-standard size and scheduling might effect instruction. Major points of difference between large and small group instruction were found in the pace of instruction, the appropriateness of the pace for the subject material and students, the articulation of topics and materials between different classes on same subject, the giving of assignments, the use of resources and aids, in the kinds of teaching-learning activities, and in whether the control of the class was teacher or student-centered.

The instruments selected for the study consist of Regent's examinations for achievement; the Otis Intelligence test; the Word Rating List; and the Self-Initiated Projects Questionnaire. Each of these is described and, for each, estimated reliability and other information reported.

Two sets of hypotheses were made. Set A is comprised of nine different null hypotheses about achievement outcomes. Three were made for each of the three subject areas. In each subject area the first null hypothesis is concerned with differences statistically controlled for intelligence scores. In the second, the statistical adjustment is for pre-achievement, and in the third, for pre-motivation. In set M are five null hypotheses. The first, second, and third were made in the three subject areas English IV, Physics, and Chemistry, and in each, post-score differences are adjusted for pre-scores. The fourth M hypothesis was made regarding motivation differences over the combined population of the three subject areas. And the last null hypothesis is again over the combined population but with a different measure of motivation.

The statistical model chosen for the two by two design of pre- and post-achievement and motivation in the experimental and control schools was the analysis of covariance. This model allows for statistical control of prior differences in the two groups since there was no matching or random selection of students possible. A "t" test statistic was chosen to test the significance of mean differences obtained from data collected only post the instruction period.

The data were analyzed in the university computing center using an original analysis of covariance program for the IBM 7070. The program tested the assumption of linearity and homogeneity of regression.

CHAPTER IV

ANALYSIS OF DATA

Chapter four is divided into two parts. Those data pertaining to achievement in the three subjects, English IV, Physics, and Chemistry are included in the first part. In the second part, data on two different and orthogonal dimensions of motivation are presented.

Part One Achievement

Hypotheses A_1 through A_9 are concerned with the expectancy of finding no significant differences in achievement between two different treatments of class size and scheduling. Analysis of covariance was used as a statistical test of such differences.

Three tables for each subject are provided. In each table is presented means and analysis of covariance for the dependent or achievement variable (Y) and a different independent variable (X). Also included are the adjusted sums of squares, the appropriate adjusted degrees of freedom (df), and mean squares for the experimental and control conditions. F is shown with level of significance where appropriate.

Analysis of English IV Scores

English achievement in relation to the treatment effects was analyzed adjusted for intelligence, pre-achievement, and pre-motivation.

English IV: A_1 H_0: $\mu_1 = \mu_2$, Adjusted for I.Q. Means and analysis of covariance for achievement in English adjusted for I.Q. scores are shown in Table 4.1.

Table 4.1

Means and Analysis of Covariance for English Controlled for I.Q.

	N	I.Q. Means (X)	(Re-test) English III (Y)
Experimental	63	116.16	82.24
Control	52	116.08	78.00
Total	115	116.12	80.32

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	500.48	1	500.48
Within	5319.53	112	47.50
Total	5820.01	113	

$F_{1, 112} = 10.5374 \quad p < .01$

The data in Table 4.1 indicate that achievement in English, when adjusted for intelligence is better in the experimental school than in the control school. The obtained F of 10.5374 with the appropriate degrees of freedom 1 and 112 is significant beyond the one percent level of confidence. Hypothesis A_1, therefore, is rejected.

English IV: A_2 H_0: $\mu_1 = \mu_2$, Adjusted for pre-achievement. Means and analysis of covariance for achievement in English adjusted for pre-achievement are presented in Table 4.2

Table 4.2

Means and Analysis of Covariance
for English Controlled
for Pre-Achievement

	N	Pre-Ach Means (X)	English III (Y)
Experimental	63	80.81	82.24
Control	52	78.25	78.00
Total	115	79.65	80.32

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	171.22	1	171.22
Within	4138.68	112	36.95
Total	4309.90	113	

$F_{1, 112} = 4.6334 \quad p < .05$

Achievement in English, as indicated in Table 4.2, when controlled for pre-achievement differences is higher for the experimental school over the control school. The F with 1 and 112 degrees of freedom of 4.6334 is significant beyond the five percent level of confidence and is cause for rejection of Hypothesis A_2 of no difference.

English IV: A_3 H_0: $\mu_1 = \mu_2$, Adjusted for pre-motivation. In Table 4.3 is presented means and analysis of covariance of English achievement adjusted for motivation differences obtained on the Word Rating List.

Table 4.3

Means and Analysis of Covariance
for English Controlled for Motivation (WRL)

	N	Motivation Means (X)	English III (Y)
Experimental	63	30.16	82.24
Control	52	32.87	78.00
Total	115	31.38	80.32

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	749.37	1	749.37
Within	6460.78	112	57.69
Total	7210.15	113	

$F_{1,\ 112} = 12.9906 \quad p < .01$

The data presented in Table 4.3 show that achievement in English when adjusted for motivation differences is higher in the experimental school. Hypothesis A_3 of no difference is rejected by the obtained F with one and 112 degrees of freedom of 12.9906 which is the one percent level of confidence.

Analysis of Physics Scores

Physics achievement in relation to the treatment effects was analyzed adjusted for intelligence, pre-achievement, and pre-motivation.

Physics: A_4 H_0: $\mu_1 = \mu_2$, Adjusted for I.Q. Means and analysis of covariance for achievement in Physics adjusted for I.Q. scores are shown in Table 4.4.

Table 4.4

Means and Analysis of Covariance
for Physics Controlled for I.Q.

	N	I.Q. Means (X)	Physics (Y)
Experimental	32	119.62	79.97
Control	58	119.96	82.55
Total	90	119.84	81.63

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	117.53	1	117.53
Within	8301.19	87	95.42
Total	8418.72	88	

$F_{1, 87} = 1.2318$ not significant (ns)

Achievement in Physics, when controlled statistically for differences in I.Q. scores, is very similar in the two treatments. The obtained F with 1 and 87 degrees of freedom of 1.2318 is not significant. Therefore, Hypothesis A_4 of no difference is accepted. The unadjusted mean difference in achievement of approximately two and a half points is in favor of the standard class size and scheduling treatment.

Physics: A_5 H_0: $\mu_1 = \mu_2$, Adjusted for pre-achievement. In Table 4.5 is presented Physics achievement means and analysis of covariance adjusted for pre-achievement.

Table 4.5

Means and Analysis of Covariance
for Physics Achievement Controlled
for Pre-Achievement

	N	Pre-Ach Means (X)	Physics (Y)
Experimental	32	81.94	79.97
Control	58	82.69	82.55
Total	90	82.42	81.63

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	104.78	1	104.78
Within	7775.22	87	89.37
Total	7880.00	88	

$F_{1, 87} = 1.1725$ ns

Physics achievement, when controlled statistically for differences in pre-achievement in Math 10, is not very different between the two treatments of class size and scheduling. The analysis of covariance presented in Table 4.5 provides an F with one and 87 degrees of freedom of 1.1725. Minor Hypothesis E of no difference is accepted.

Physics: A_6 H_0: $\mu_1 = \mu_2$ Adjusted for pre-motivation. Physics achievement differences analyzed and adjusted for pre-motivation are shown in Table 4.6.

Table 4.6

Means and Analysis of Covariance
for Physics Achievement Controlled
for Motivation

	N	Motivation Means (X)	Physics (Y)
Experimental	32	35.78	79.97
Control	58	32.17	82.55
Total	90	33.46	81.63

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	299.56	1	299.56
Within	9200.19	87	105.75
Total	9299.76	88	

$F_{1, 87} = 2.8328$ ns

The F value of 2.8328 is insignificant and Hypothesis A_6 of no difference in achievement between the two treatments is accepted.

Analysis of Chemistry Scores

Physics achievement in relation to the treatment effects was analyzed adjusted for intelligence, pre-achievement, and pre-motivation.

Chemistry: A_7 H_0: $\mu_1 = \mu_2$, Adjusted for I.Q. Results for achievement in Chemistry controlled for differences in I.Q. scores are shown in Table 4.7.

Table 4.7

Means and Analysis of Covariance for Chemistry Achievement Controlled for Intelligence

	N	I.Q. Means (X)	Chemistry (Y)
Experimental	41	119.78	79.86
Control	40	115.80	87.75
Total	81	117.81	83.75

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	1787.85	1	1787.85
Within	10584.25	78	135.70
Total	12372.10	79	

$F_{1, 78} = 13.1755$ $p < .01$

When Chemistry achievement is adjusted for I.Q. score differences, the mean difference is significant. The standard class size and scheduling treatment is favored in the difference and Hypothesis A_7 is rejected.

Chemistry: A_8 H_0: $\mu_1 = \mu_2$, Adjusted for pre-achievement. In Table 4.8 is presented mean scores on Chemistry achievement statistically adjusted for pre-achievement scores.

Table 4.8

Means and Analysis of Covariance
for Chemistry Achievement Controlled
for Pre-Achievement in Biology

	N	Pre-Ach Means (X)	Chemistry (Y)
Experimental	41	85.95	79.85
Control	40	81.15	87.75
Total	81	83.75	83.75

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	2807.87	1	2807.87
Within	6069.08	78	77.81
Total	8876.95	79	

$F_{1, 78} = 36.0869$ $p < .01$

In Table 4.8 is presented mean scores on Chemistry achievement statistically adjusted for pre-achievement scores. A significant difference in favor of the control conditions is again obtained. Hypothesis A_8 of no difference is rejected.

Chemistry: A_9 H_0: $\mu_1 = \mu_2$, Adjusted for pre-motivation. Mean scores on Chemistry achievement adjusted for pre-motivation differences are shown in Table 4.9.

Table 4.9

Means and Analysis of Covariance
for Chemistry Achievement Controlled
for Motivation

	N	Motivation Means (X)	Chemistry (Y)
Experimental	41	34.29	79.85
Control	40	32.07	87.75
Total	81	33.20	83.75

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	1677.14	1	1677.14
Within	9086.75	78	116.50
Total	10763.90	79	

$F_{1, 78} = 14.3965 \quad p < .01$

Chemistry achievement adjusted for motivation differences between the two treatment groups is significantly higher for the control treatment. Therefore, Hypothesis A_9 of no difference is rejected.

Part Two Motivation

Hypotheses M_1 through M_4 are null hypotheses concerned with the finding of no significant differences in motivation between the two different treatments of class size and scheduling. The statistic, analysis of covariance was used as a means of adjusting final scores obtained by administering the Word Rating List for scores obtained on the same instrument before the treatments.

The next three tables, 4.10 through 4.12, contain separate covariance analyses on pre- and post-motivation scores for the population in each of the three subjects, English IV, Physics, and Chemistry. In Table 4.13 is presented an analysis of covariance of combined pre- and post-WRL data from all three of the subject populations. The last table in this chapter contains a comparison of mean scores obtained on the Self-Initiated Projects Questionnaire from the combined experimental and control groups with a "t" test of the significance of the mean difference.

Analysis of Motivation (WRL) Scores

Motivation in English: M_1 H_0: $\mu_1 = \mu_2$, Adjusted for pre-motivation.

In Table 4.10 is data on post-motivation scores adjusted for pre-motivation differences.

Table 4.10

Means and Analysis of Covariance
of Pre- and Post-Motivation (WRL)
for English Population

	N	Pre-Motivation (X)	Post-Motivation (Y)
Experimental	63	30.16	33.38
Control	52	32.86	32.06
Total	115	31.38	33.69

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	34.98	1	34.98
Within	5056.92	112	45.15
Total	5091.90	113	

$F_{1, 112} = 0.7747$ ns

Post-motivation mean scores adjusted for pre-motivation scores were not significantly different as presented in Table 4.10. The non-standard treatment did not significantly effect motivation as measured by the WRL in English IV. Hypothesis A_{10} of no difference is accepted.

Motivation in Physics: M_2 $H_0: \mu_1 = \mu_2$, Adjusted for pre-motivation.

Analysis of covariance of pre- and post-motivation scores obtained from the population of students in both schools in physics is presented in Table 4.11.

Table 4.11

Means and Analysis of Covariance
of Pre- and Post-Motivation (WRL)
for Physics Population

	N	Pre-Motivation (X)	Post-Motivation (Y)
Experimental	32	35.78	36.97
Control	58	32.17	33.17
Total	90	33.46	34.52

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	38.11	1	38.11
Within	4253.44	87	48.89
Total	4291.55	88	

$F_{1, 87} = 0.7795$ ns

The adjusted post-motivation scores yield an F of insufficient value to be significant. Hypothesis A_{11} of no difference is therefore accepted.

Motivation in Chemistry: M_3 H_0: $\mu_1 = \mu_2$, Adjusted for pre-motivation.

For the Chemistry population, when post-motivation means are adjusted for pre-motivation differences, as shown in Table 4.12.

Table 4.12

Means and Analysis of Covariance
of Pre- and Post-Motivation (WRL)
for Chemistry Population

	N	Pre-Motivation (X)	Post-Motivation (Y)
Experimental	41	34.29	36.66
Control	40	32.07	32.80
Total	81	33.20	34.75

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	114.46	1	114.46
Within	2734.55	78	35.06
Total	2849.01	79	

$F_{1, 78} = 3.2647$ ns

Analysis of covariance produces an insignificant F. Hypothesis A_{12} is accepted.

Motivation in Combined Subjects Population: M_4 H_0: $\mu_1 = \mu_2$, Adjusted for pre-motivation.

For all three subjects population combined, analysis of covariance of pre- and post-motivation scores obtained over both treatments as shown in Table 4.13 provide an F of sufficient amount to be significant. Hypothesis A_{13} is rejected.

Table 4.13

Means and Analysis of Covariance
of Pre- and Post-Motivation (WRL)
for Combined Population

	N	Pre-Motivation (X)	Post-Motivation (Y)
Experimental	136	32.73	35.21
Control	150	32.39	33.38
Total	286	32.55	34.25

Source	Adjusted SS (Y)	Adj. df	Mean Squares
Between	183.95	1	183.95
Within	12067.88	283	42.64
Total	12251.83	284	

$F_{1, 283} = 4.3137 \quad p < .05$

<u>Motivation (SIPQ) in Combined Subjects Population:</u> $M_5\ H_0: \mu_1 = \mu_2$, <u>"t" test on post-motivation</u>.

Using another measure of motivation, the Self-Initiated Projects Questionnaire, data obtained from all students in both treatments is analyzed by a "t" test of significance as shown in Table 4.14.

Table 4.14

Experimental and Control SIPQ
Means, Variance, and "t" test

	Means	N	S^2 (variance)
Experimental	82.297	138	391.688
Control	84.42	99	148.959

Standard error of difference - 2.08

$$t = \frac{84.420 - 82.297}{2.08} = 1.021 \quad \text{ns}$$

In this measure, the higher the score, the lower is self-initiation. While the trend is in favor of the experimental treatment, the "t" of 1.021 proved to be not significant. Therefore, Hypothesis A_{14} of no difference is accepted.

Part One Summary

Achievement, as measured by Regent's examinations in all three subjects, English IV, Physics, and Chemistry, was adjusted statistically for independent measures of intelligence, pre-achievement, and motivation. The F values obtained through covariance techniques indicated that: (1) mean differences favored the experimental or non-standard treatment in English IV in all three adjustments, (2) means in Physics were not significantly different for all three adjustments, and (3) mean differences favored the control or standard treatment in Chemistry for all three adjustments.

Part Two Summary

For the separate subjects, English IV, Physics, and Chemistry, motivation scores of the Word Rating List from the experimental and control groups were analyzed using covariance techniques. No significant differences were obtained for the individual subject populations. However, when the combined subject populations were analyzed the F was of sufficient amount to be significant in favor of the experimental treatment. Therefore, null hypotheses M_1 through M_3 were accepted and M_4 was rejected.

The combined subject population means on the Self-Initiated Projects Questionnaire were tested with a "t" test and the difference was not significant. Null hypothesis M_5 was accepted.

CHAPTER V

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Summary

The main problem of this exploratory study was to examine the effects of non-standard class size and scheduling on achievement and motivation outcomes of instruction in three high school subjects, English IV, physics, and chemistry. An experimental and control school were established for data collection under the two conditions, non-standard and standard class size and scheduling. The effects of large class size and reduced scheduling on instruction were also considered.

Regent's examinations in the three subject areas were used for achievement measures. Motivation data consisted of the Word Rating List[1] of Farquhar and associates and the Self-Initiated Projects Questionnaire[2]. The analysis of covariance was selected as a test of all the comparisons where pre- and post-data were obtained. The "t" test was used for a comparison of means obtained from the Self-Initiated Projects Questionnaire scores.

For English IV achievement, the null hypotheses were rejected in favor of the experimental conditions. The null hypotheses were accepted for physics achievement. For chemistry achievement, the null hypotheses were

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[1]William W. Farquhar, A Comprehensive Study of the Motivational Factors Underlying Achievement of Eleventh Grade High School Students, Research Project No. 846 (8458); Supported by the U.S. Office of Education in cooperation with Michigan State University, 1959.

[2]Clarence M. Williams, The Development of a Measure of Self-Initiation Related to Instruction, in preparation, 1962.

rejected in favor of the control conditions.

In a comparison of motivation differences between the two conditions in each of the subject matter areas, pre- and post-WRL scores were tested with analysis of covariance. All null hypotheses were accepted. When the motivation data for the three subject matter areas were combined, a pre- and post-analysis of covariance provided a significant difference in favor of the experimental conditions of large class size and reduced scheduling. Therefore, the null hypothesis was rejected. In a similar test, combining scores for the three subject matter areas, a "t" test of means of SIPQ scores between the two conditions proved to be not significant and the null hypothesis was accepted.

Discussion

The major conclusion of this exploratory investigation is that class size, as a variable, affects the teaching and learning situation. Due to certain concessions necessary to experiment in a field setting and necessary assumptions regarding achievement measures, it was impossible to separate sufficiently the full effects of class size on instruction and learning and motivation outcomes. However, awareness of the importance to teaching of manipulations of class size (with the attendant schedule shifts) was increased.

The differences between teachers could account for the findings of better achievement in English in the experimental school, same achievement level in physics, and better achievement in the control school chemistry. Differences of this kind could be called the "between" teacher differences. Between teacher differences could reflect several other variables like, (1) a difference in capacity, (2) a difference in knowledge, understanding, and skill in the particular subject, (3) a difference in knowledge, understanding, and skill in teaching, (4) a difference in amount of experience, (5) a difference in kind of experience, or (6) a difference in willingness to work as hard as necessary to insure that every student learns as much as he can. Differences of another kind might be called the "within" teacher differences. Within teacher differences might reflect other variables such as, (1) capacity to adapt method of teaching to the exigencies of a particular situation, or (2) tolerance to stress and strain. If a teacher's ability to cause students to learn so much knowledge, understanding, and skill in a particular subject is the sum of all of these and perhaps other possible kinds of variables, then just controlling, in future experimentation, for the gross, observable teacher differences or balancing them out might not be sufficient. However, the practical controlling by matching or, preferably, by balancing is to be desired in the immediate next steps in empirical investigation of teacher effects on learning, whether it be in large, small, or standard size groups.

The differences between the subject matter areas could be the reason why the results were so disparate. Perhaps an advanced high school English class for seniors is one in which the objectives are rather broad and flexible. Details like punctuation, grammar, or proper choice of word may not need to be of great concern. Therefore, the students can be concerned with ideas and concepts at a level where communication is more certain.

A course in high school physics may have both specific and broad objectives. Because it is the only course of its kind in most high school schedules and not one of a sequence of courses, in all probability it is necessary to make it extremely comprehensive. Similarly, high school chemistry must also be considered a comprehensive course. It is probable that applications of knowledges and skills gained in chemistry are much fewer and more difficult to arrange than those in physics and senior English. Large group instruction might have made senior English a more interesting and vital class to the students and made physics and chemistry difficult to comprehend sufficiently. Because this exploration did not provide, in its design, tests of sufficient warranty of the assumptions made about the similarity of objectives, materials, and teaching of Regent's courses, nothing can be said of their real effects. However, all of these kinds of variables need to be considered in future empirical testing of the effects of non-standard size and scheduling versus standard size and scheduling on achievement and motivation.

The initial differences in intelligence, achievement, and WRL scores in the student populations were slight. Although the effects of these differences on the dependent variable were statistically controlled by the analysis of covariance, they probably would not have proven different from chance had they been tested by the design. However, students do differ in ability, achievement, motivation, and in other ways. If practical experimentation is desired on the effects of large group-small group versus standard size group instruction, these differences should be taken into account. For example, students of high ability may be able to learn sufficiently well under more class size conditions than students of low ability.

Recommendations

In the present exploration, an attack on the problem of class size was attempted. The results obtained would indicate that considerable more sophistication about the important variables needs to be gained before more productive experiments can be designed.

The following are recommendations for design variables if class size differences are to be studied:

(1) Size. If practical information regarding the most efficient size of a class is needed then what is presently being practiced and what might be desired ought to be considered. Students learn by themselves, in small groups, in medium size groups, and in large groups. So, perhaps these four different sizes of learning units should be studied: one student, two to 14, 15 to 39, and 40 to ___. (The units are arbitrary and can be altered if necessary).

(2) Subject. Probably the best delineation of a subject could be made if it were to be especially constructed or artificial. A unit on a number system to a base other than the common ones might be devised or, if this is

impossible, something like the geography of a non-existent island might be devised. This unit ought to be short so that explicit objectives, as operational as possible, could be developed; so that a comprehensive objective test could be constructed; so that teachers might be willing to try to learn it and teach it; and so that it could be accomplished in a reasonable time with students in a school setting. In other words, the unit ought to be: of sufficient scope and depth so that differential learning would obtain; sufficiently easy so that teachers could teach it; easily and completely evaluated, and; short. Because scheduling has been mentioned previously as a variable, it should be noted that for the next steps in investigation of size of class, it may be left out. The initial unit should be short enough to accomplish in one session.

(3) Teacher. Because of the possibility of many kinds of teacher differences (as discussed earlier) affecting learning outcomes, the teacher as a variable should be limited as much as possible. Perhaps a start could be made with one teacher teaching the selected subject unit in both ascending and descending order of size units averaging the learning accomplishment for like size units. Analysis of variance (with random assignment of

students) would be an appropriate statistical method. The next step might be to have several teachers study the subject unit and take the comprehensive test. Different levels of teacher learning might then be arbitrarily set so that partial answers to some of the questions posed in the earlier discussion might be obtained. The effects of age, sex, training, and experience might become evident in these different levels when they are applied to the experimental subject-size teaching task.

(4) Other variables. Random assignment of students would take care of student differences at any particular level or set of levels but the kind of student ought to be considered carefully before the subject unit is constructed. The most serious consideration is that the stipulated responses to the stimuli of the subject unit be in the response repertoires of the students. That is, if there are physical responses like drawing a certain kind of figure or sequences of figures, the physical development of the student needs to be considered. If there are verbal responses then there should not have to be any blocking because of previous experience or achievement of the students. The classroom setting should be constant over the size units

and the time of day and week ought to be as closely approximated over the size units as possible. The directions and explanations given the teachers and students ought to be carefully constructed and administered in a similar fashion to all of the participators. It might even be possible to give teachers variable, specified units of time to plan for the presentation of the subject unit. In other words, the next steps ought to include consideration of all of the foregoing variables and every attempt should be made to approximate learning laboratory conditions as closely as possible.

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APPENDIX NO. 1

EXAMPLES OF SCHEDULE DIFFERENTIATION

EXAMPLE OF SCHEDULE DIFFERENTIATION Appendix 1

Non-standard

	Periods	M	T	W	Th	F
English 12	1 2	110 students for 90 minutes	X SEMINARS 8-12 students for 45 minutes	110 students for 90 minutes	X SEMINARS 8-12 students for 45 minutes	X SEMINARS 8-12 students for 45 minutes

Supplemental information:

1. At least 4 individual student conferences with teacher during the year.
2. Independent study projects.
3. Seminars spread throughout schedule (Each student scheduled once a week in group of 8-12)
4. Lay reader
5. Library and seminar rooms for resources and independent study.
6. Reciprocal teaching for special areas in both small and large groups.
7. Outstanding resource people available to large group without difficulty innate in five repetitive classes.

Standard

		M	T	W	Th	F
English 12	1	25 students for 40-45 minutes	Same	Same	Same	Same

2

EXAMPLE OF SCHEDULE DIFFERENTIATION

Non-Standard

	Periods	M	T	W	Th	F
Physics	$\frac{1}{2}$	XX	60 students in large group instruction for 90 minutes	XX	60 students in large group instruction for 90 minutes	Physics Laboratory 90 minutes - Group of 10-12

Supplemental Information:

1. Other double period laboratories spread through week's schedule.
2. Usually different instructors in laboratory. (Team teaching).
3. Laboratory also provides time for small group instruction.
4. Encouragement of independent study-science projects.

Standard

		M	T	W	Th	F
Physics	1	25-30 students 40-45 minutes	Same	Same	Same	Same
	2	1. One single period laboratory some time during the week (usually same instructor)				

EXAMPLE OF SCHEDULE DIFFERENTIATION

Non-Standard

	Periods	M	T	W	Th	F
Chemistry	1 2	75 students in large group instruction for 90 minutes	XXX	75 students in large group instruction for 90 minutes	XXX	Chemistry laboratory 90 minutes - Groups of 10-12

Supplemental information:

1. Other double period laboratories spread through week's schedule.
2. Usually different instructors in laboratory (team teaching).
3. Laboratory also provides time for small group instruction.
4. Encouragement of independent study-science projects.

Standard

		M	T	W	Th	F
Chemistry	1	25-30 students 40-45 minutes	Same	Same	Same	Same

2

1. One single period laboratory some time during the week. (Usually same instructor)

Master schedule set-up for large group instruction including those in the experiment, other large groups and alternating classes.

Periods	M	T	W	TH	F
1 – 45 min. 90 minutes 2 – 45 min.	English 12 110 students — Math 11 (Regular class size) (Advanced Juniors in Physics	Physics 60 students — Public Speaking (Regular class size)	English 12 110 students — Math 11	Physics 60 students — Public Speaking	Cit. Ed. 12 70 students 45 min. seminars throughout week — English Seminars (45 min.) and Science Laboratories
3 – 45 min. 90 minutes 4 – 45 min.	Chemistry 125 students — Problems in Democracy (regular class size)	World History 60 students — American History 120 students	Chemistry 125 students — Problems in Democracy	World History 60 students — American History 120 students	Seminars in History subjects — Laboratory in Science areas

APPENDIX NO. 2

OBSERVER'S CHECK SHEET

PITTSFORD CENTRAL SCHOOL

OBSERVER'S GUIDE SHEET

Varying Size Group Instruction Program

Observer______________________________ Observation #__________

Room #__________ Date__________________ Time__________________

Number of Students________________

General organization of group (circle predominant nature of group)

Teacher leader, student leader, discussion, panel,
independent work, sub-groups, other (specify)

If organization changes during class, note here

COMMENTS

1. How would you judge the pace of instruction?
   very fast   fast   moderate   slow   very slow

   How appropriate was the pace with respect to
   materials?   Students?

   a) quite appropriate______________________________
   b) appropriate______________________________
   c) somewhat appropriate______________________________
   d) inappropriate______________________________

2. What references were made (specifically or by implication) to other portions of the Varying Size Group Program?

3. From what resources were student contributions drawn? (example - library, home, research, large group presentation)

4. What approximate percentage of time of the seminar is

   teacher oriented?______________

   student oriented?______________

5. The following procedure seemed unusual:

TYPES OF ACTIVITY (order in which activity happened and time spent)
(Items left blank indicate no evidence during this observation)

I Introductory & transitional activities

- Preparatory remarks ____ ____
- Teacher summary
  - periodic ____ ____
  - at close ____ ____
- Student summary
  - written ____ ____
  - oral ____ ____
- Other (describe) ____ ____

II Kinds of teaching-learning activities

- Lecture ____ ____
- Discussion
  - between teacher/class ____ ____
  - within class ____ ____
- Student panel ____ ____
- Demonstration ____ ____
- Dimulation ____ ____
  - role playing ____ ____
  - by entire group ____ ____
- Buzz groups ____ ____
- Show of hands ____ ____
- Instruction in note-taking
  - library use ____ ____
  - other skill ____ ____
- (List ____________________)
- Review ____ ____
- Use of blackboard ____ ____
- Solving preframed problems
  - by group ____ ____
  - individually ____ ____
- Drill ____ ____
- Cautionary remarks
  - re ideas ____ ____
  - re mechanics ____ ____
- Practice of critical thinking
  - questioning of subject material
  - by students ____ ____
  - by teacher(Answer eliciting) ____ ____
  - evaluation of ideas ____ ____
  - problem solving ____ ____
- Testing ____ ____
- Interpreting test ____ ____

III Related activities outside of this meeting

- Assignments
  - giving ____ ____
  - clarifying ____ ____
  - checking ____ ____
- Research
  - library use ____ ____
  - other references ____ ____
- Individual projects ____ ____
- References to other type instruction in this course (large/small group) ____ ____

IV Resources used

- Records, tapes ____ ____
- Slides ____ ____
- Local "experts" ____ ____
- Film
  - Introduction ____ ____
  - showing ____ ____
  - follow-up ____ ____

APPENDIX NO. 3

SELF-INITIATED PROJECTS QUESTIONNAIRE

SELF-INITIATED PROJECTS QUESTIONNAIRE

On the following pages you will find a list of possible outside school activities which you might choose, or would like to choose because you find them interesting and enjoyable.

For each activity indicated, you should select the one term that best describes how often you do this activity. For this same activity you must also select the one term that best describes how often you would like to do this same outside school activity. The five possible descriptions for each after-school activity that you do or would like to do are:

1 - Very often (v.o.)

2 - Often (o.)

3 - Sometimes (s.)

4 - Seldom (sel.)

5 - Never (n.)

The numbers representing each description are listed beside each outside activity. To describe how often you do each activity, circle one of the numbers at the left of the activity. Then, to describe how often you would like to do this same activity, circle one of the numbers at the right of the activity.

I do: v.o.	o.	s.	sel.	n.		I would like to: v.o.	o.	s.	sel.	n.
1	2	3	4	5	Read a novel	1	2	3	4	5
1	2	3	4	5	Discuss a book I have read with someone	1	2	3	4	5
1	2	3	4	5	Watch a sports event	1	2	3	4	5
1	2	3	4	5	Make models of autos, airplanes,etc.	1	2	3	4	5
1	2	3	4	5	Draw pictures about what I see	1	2	3	4	5
1	2	3	4	5	Play on a school sports team	1	2	3	4	5
1	2	3	4	5	Visit a public library (Unassigned)	1	2	3	4	5
1	2	3	4	5	Observe people doing some activity	1	2	3	4	5
1	2	3	4	5	Ask people questions about what they are doing	1	2	3	4	5
1	2	3	4	5	Write short stories or poems	1	2	3	4	5
1	2	3	4	5	Participate in group discussions about school	1	2	3	4	5
1	2	3	4	5	See a movie	1	2	3	4	5
1	2	3	4	5	Discuss politics with someone	1	2	3	4	5
1	2	3	4	5	Try to solve math puzzles, cross-word puzzles, etc.	1	2	3	4	5
1	2	3	4	5	Read a newspaper	1	2	3	4	5
1	2	3	4	5	Play a musical instrument	1	2	3	4	5
1	2	3	4	5	Visit the library to obtain a novel to read	1	2	3	4	5
1	2	3	4	5	Write a letter to a friend	1	2	3	4	5
1	2	3	4	5	Play a sport with a friend or a group	1	2	3	4	5
1	2	3	4	5	Sing with a vocal group	1	2	3	4	5

I do: v.o.	o.	s.	sel.	n.		I would like to: v.o.	o.	s.	sel.	n.
1	2	3	4	5	Read about famous people in history	1	2	3	4	5
1	2	3	4	5	Try simple science experiments	1	2	3	4	5
1	2	3	4	5	Read an interesting magazine article	1	2	3	4	5
1	2	3	4	5	Play challenging games such as checkers, chess, charades and twenty questions	1	2	3	4	5
1	2	3	4	5	Participate in a school dramatic activity	1	2	3	4	5
1	2	3	4	5	Listen to music by myself	1	2	3	4	5
1	2	3	4	5	Work on a scrapbook which contains material I am studying in school	1	2	3	4	5
1	2	3	4	5	Read a foreign language	1	2	3	4	5
1	2	3	4	5	Attend a play	1	2	3	4	5
1	2	3	4	5	Read a book review	1	2	3	4	5
1	2	3	4	5	Enter a contest - puzzle, writing, photography, etc.	1	2	3	4	5
1	2	3	4	5	Do work in photography	1	2	3	4	5
1	2	3	4	5	Work on a collection - insects, rocks, stamps, etc.	1	2	3	4	5
1	2	3	4	5	Build scientific equipment - ham radio, telescope, etc.	1	2	3	4	5
1	2	3	4	5	Read a scientific journal	1	2	3	4	5
1	2	3	4	5	Read a literary journal	1	2	3	4	5
1	2	3	4	5	Discuss a theory with friends	1	2	3	4	5