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An evaluation of their high school physics course by 1948-50 graduates of Great Falls High School Great Falls Montana

John Stefanoff
The University of Montana

AN EVALUATION OF THEIR HIGH SCHOOL PHYSICS COURSE BY 1948-50 GRADUATES OF GREAT FALLS HIGH SCHOOL, GREAT FALLS, MONTANA

by

JOHN J. STEFANOFF
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James E. Short
Chairman of the Board of Examiners

W. P. Clark
Dean of the Graduate School

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CHAPTER I

INTRODUCTION

It is not unusual for a teacher to ask his students to appraise his course, but the results are seldom published. Infrequently is the evaluation made after the students have gained further insight into the values of the course by subsequent experience.

I. THE PROBLEM

Statement of the problem. The purpose of this study was to obtain information which would be useful in improving the physics course of Great Falls High School through an evaluation of the course based largely on the opinions of the physics students who were graduated in the classes of 1948-1950, inclusive. The study was undertaken with the assumption that student opinion and reactions are valid to use as criteria in judging the values of courses and the suitability of teaching procedures. Weaknesses in this assumption will be pointed out as evidence appears for substantiation of such criticism.

Importance of the study. This study recognizes that the physics course exists in the high school curriculum because it serves the needs of the students. The extent to

which the course meets the needs of those students is the only justifiable measure of whether it should be retained or revised. Recognition is also made of the fact that the course is always open to improvement and change, especially in a society which must be considered dynamic in nature.

> No subject of science study is regarded as "finished" in its organization, each being a more or less acceptable present stage in that subject's educational uses. Ways for improvement have been found. Their use must continue.[1]

In addition to providing criteria for evaluating the extent to which the course meets the needs of the students, the study should provide student suggestions for improvement of the course through change of emphasis on materials, techniques, and subject matter.

The existence of a world situation which requires a change in the "normal" pattern of life suggests that the needs of students today may be seriously affected by this situation. Through this study, it was hoped, that some insight would be gained into the "influence of military demands" on student needs from the course.

Future plans for teaching in this field could entail continuation of the present course, revision of the present

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[1] Henry, Nelson B., "Science Education in American Schools," Forty-Sixth Yearbook of the National Society for the Study of Education, Part I, p. 295.

course, the addition of a general course, or the combination of the latter two. The study had its final value in contributing information which could be of help in determining which of the above plans would be most desirable.

Limitations of the study. The evaluation of the course was based upon student opinion which involves certain inherent faults. Some opinions may have been affected by prejudices separate from the points under consideration. Some students may have hesitated to register their real opinion. The following statement indicates the value of student opinion in evaluating an instructional program:

> The student, as the recipient of instruction, stands in a peculiarly strategic position to make functional and pertinent appraisals of general and specific aspects of the instructional program to which he is subjected.[2]

The investigation of the needs for revision in the physics program to meet the needs of those who did not enroll in the course was beyond the scope of this study. A separate study may be desirable for examining the physical science needs of the students who did not enroll in physics.

Furthermore, no attempt was made to arrive at the exact needs of the individuals. The opinions expressed by

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[2] Greene, J. E. and Findley, W. G., "Evaluative Procedures for the Improvement of Instruction," Educational Record, 30:33-44, January, 1949.

the students were used, instead, to evaluate the extent to which the needs were met.

Other limitations of the study include:

1. Limitation on sampling. The study includes only those students, who completed the course and graduated in the classes of 1948-1950, inclusive, with available addresses. Some of the students could not be contacted because of incorrect or unavailable addresses.

2. Limitations on scope. Generalizations from this study may not be applicable to any other school due to the differences in student needs between the schools. The scope of this study was purposely limited to a particular group from Great Falls High School.

3. This study represents an evaluation of a curricular offering in the light of the student's estimates of needs at a particular time and therefore should not be interpreted as a final solution. Recognition of the changing needs of students should serve to remind teachers of the need for continual or repeated evaluation of the school curriculum.

II. DEFINITIONS OF TERMS USED

Materials. Throughout the report of this study, the word "materials" shall be interpreted as including the

physical devices employed in the various techniques used in the course for instructional purposes, such as workbooks, reference books, films, charts, etc.

Physics course. Since this investigation was conducted in only one school, the term "physics course" shall have reference to the course as taught in Great Falls High School during the years covered by the study. Exceptions to this usage shall be indicated by reference. A general description of the course follows the review of related studies.

Respondents. To simplify discussion, the word "respondents" shall be used in referring to the graduates of Great Falls High School who completed the course in high school physics and responded to the questionnaires.

Students and graduates. The words "graduates" and "students" shall be used interchangably throughout much of this report in referring to the physics students in different situations.

Techniques. The term "techniques" shall refer to the procedures or methods employed for instructional purposes.

Units. The "units" of the course, as used in this report, shall have reference to those topics commonly found

in high school physics books under the heading of: mechanics, heat, magnetism and electricity, sound, and light.

III. PROCEDURE AND SOURCES OF DATA

Most of the information used in the study was obtained through the use of the questionnaire. Copies were prepared and mailed to students who completed the physics course and graduated in the classes of 1948-1950, inclusive. Some of the students could not be contacted because of incorrect or unavailable addresses.

In the questionnaire, student reactions to the subject matter of the course and the various instructional procedures were sought along with certain factual data. The study also covers student opinion as to the values of the course to the students. Suggestions were solicited for improving the course. A copy of the questionnaire may be found in the appendix of this report.

The results of the questionnaires were tabulated and summarized. Additional information relating to the students was obtained from the permanent school records of Great Falls High School.

IV. ORGANIZATION OF REMAINDER OF THE REPORT

Following a review of previous related studies and a general familiarization with the physics course of Great Falls High School, a discussion of the results was in order. To simplify the discussion, the items have been divided into several categories. Each will be considered in turn.

1. Extent of coverage
2. Status of the respondents
3. Respondents' applications of physics
4. Respondents' ranking of the units of the course
5. Respondents' rating of the emphasis placed on various techniques
6. Respondents' suggestions
7. Influence of military demands
8. Analysis of findings
9. Summary and conclusions
10. Recommendations

CHAPTER II

REVIEW OF PREVIOUS RELATED STUDIES

An extensive search of available literature was carried on by the investigator for the purpose of finding similar studies. A great number of articles have been written upon the subject of science curriculum, but relatively few were found which directly pertained to this study. Several follow-up studies were found which dealt, at least in part, with the science curriculum. One article treated student opinions of college general education science courses.[3]

However, the only study available, which investigated student appraisal of classroom procedure in high school science, was conducted with graduates of the Kearny Junior-Senior High School of San Diego, California.[4] This study included groups that had been in chemistry and physics classes. Although the article treated student opinion of classroom procedures, its primary purpose was to study the

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[3] Bullington, Robert A., "A Study of Student Opinion of College General Education Science Courses," Science Education, 34:73-77, March, 1950.

[4] Miller, Miles M. and Dresden, Katharine, "Current Approaches in the Teaching of Science," School Science and Mathematics, 49:359-365, May, 1949.

effects of utilizing current materials regularly in physics and chemistry classes upon desired outcomes. The only factor rated by the students in this study was the emphasis placed upon classroom activities. Some values may be gained from this study by other schools, but much remains to be learned about student evaluations, especially through a study within the school under consideration. There is question of validity in applying the results of such a study to another school. The results of a study in one school may be somewhat useful for comparative purposes in another school, however.

Limitations of the studies.

1. Very few studies on student evaluation of science courses are available.
2. The only studies available in this field have to do with science in general rather than physics alone.
3. Only one study was found which dealt with student evaluation of classroom procedures in high school science. This study did not evaluate factors other than classroom procedure.
4. No studies were available which treated the evaluation of high school courses in physics specifically.
5. No studies were available which evaluated the physics classes of Great Falls High School.

The above limitations are supported, in part, by another study which states: "To the writer's knowledge,

little has been published concerning evaluation of methods of instruction through student opinion."[5]

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[5] Bullington, loc. cit.

CHAPTER III

DESCRIPTION OF THE PHYSICS COURSE

Although the physics course offered during one year varies from the course of any other year, there was enough uniformity, during the three years under study, to justify considering the course a near constant. The subject was offered to any student, in the junior or senior year of high school, who desired to enroll in the class.

The design of the course content varies little from the "standard course" of most high schools. In a report on his study of the organization of physics courses, Beauchamp[6] said:

> Courses in physics present a marked contrast to the courses in biology and general science. The topics in all the courses were classified easily under the headings: mechanics, heat, magnetism and electricity, sound, and light.

The unit, which is sometimes included in physics courses as "modern physics", was included in the other units of the course under study.

The enrollments in the classes varied from twenty-five to thirty-two students. Each class was in session for

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[6] Beauchamp, Wilbur, "Instruction in Science," United States Office of Education Bulletin, 1932. (No. 17, Monograph No. 22. Washington, D.C.: United States Government Printing Office, 1933), p. 35.

a fifty-minute period during each of the five "week days." One unit of credit was allowed for satisfactory completion of the course while no credit was allowed for only one semester of work.

The following techniques and aids were used for instructional purposes:

1. Lectures and discussion
2. Textbook
3. Other books
4. Problems
5. Scientific thinking
6. Laboratory experiments
7. Projects
8. Films and charts
9. Testing
10. Demonstrations
11. Workbooks
12. Current science

Each of these was employed in proportions suited to the subject matter being covered in so far as resources and time were available. Scientific thinking, as used here, refers to a specific technique which was utilized in the classes. The expression is not used in its general sense. Current science involved the study of "present day" science through

the use of bulletin board materials, radio and newspaper items, and current periodicals. Reference books and current periodicals were not in abundance largely due to existing school policy. The course did not include a separate or longer period for laboratory experiments.

CHAPTER IV

PRESENTATION OF FINDINGS

Extent of coverage. The study was intended to cover as many of the graduates of the classes of 1948-1950, inclusive, as possible. Only those students who completed the course were considered. The total number of students who were within this group numbered one hundred and fifty-two. Addresses for fifty of these students could not be located through the following means:

1. Addresses taken from the school records
2. Telephone directory
3. Telephone information center

Of the one hundred and two questionnaires mailed to students, sixty were completed and returned at the time of the writing of this paper. Twelve of the questionnaires were returned by the same time because the addressee had moved and could not be located by the postal officials. Although some of the remaining thirty questionnaires may be returned for the same reason subsequent to the writing of this paper, there is some reason to believe that other factors may help to explain the incomplete return.

The questionnaire was worked out using the criteria

established by Romine[7] and through the examination of numerous questionnaires in other fields. One of the features included in the questionnaire, as the result of the investigation, was a return deadline date. There is considerable reason to believe that some of the graduates failed to return the questionnaire because they received it after the indicated date. The investigator learned immediately prior to the writing of this paper that some of the graduates, who were in the military service, had been moved from their former addresses at about the deadline date. Delay in forwarding the mail would result in the above condition. The same situation may have affected those graduates in college where mail was sent to their home address.

However, some of the graduates may have failed to return the questionnaire for other reasons. Almack[8] reports that a return of 50 percent is normal, while a return of 75 percent can be realized only under exceptional conditions. Trow[9] states, "usually a third to a half of the persons circulated do not answer." The return of two-thirds

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[7] Romine, Stephen, "Criteria for a Better Questionnaire," Journal of Educational Research, 42:69-71, September, 1948.

[8] Almack, John C., Research and Thesis Writing (Boston: Houghton Mifflin Company, 1930), p. 216.

[9] Trow, William C., Scientific Method in Education (Boston: Houghton Mifflin Company, 1925), p. 101.

of the questionnaires mailed seems to fall within the limits of reasonable expectancy.

Status of the respondents. The determination of the status of the respondents seems to be a logical step in the investigation of how well a course meets the needs of students. The data in Table I indicates that 73.3 percent of the respondents in this study continued their education in college while 20 percent of the group were in the military service, and only 6.7 percent were included in all the other groups.

The questionnaires also reveal that five of the 12 respondents in the military service had been in college prior to entering the service and four of the remaining 7 indicated their desire to continue in college upon leaving the service. Of the entire group of respondents in the study, 88.3 percent indicated in some way that they desired to continue their education in college. This fact indicates that the class was quite "selective of college students." Because most of the respondents were in the college group, a better understanding of the needs of this group should be gained by examining information as to what college courses were taken by the respondents and in what colleges were they enrolled.

The number of respondents enrolled in the various

TABLE I

STATUS OF THE RESPONDENTS, BY NUMBER AND PERCENTAGE

Status	Number	Percent of total
Attending College	44	73.3
Attending other schools	1	1.7
Employed, full time	2	3.3
Military service	12	20.0
Others	1	1.7
Totals	60	100.0

TABLE II

ENROLLMENT IN VARIOUS COURSES OF RESPONDENTS ATTENDING COLLEGE, BY NUMBER AND PERCENTAGE

College course	Number	Percent of total
Engineering	7	14.3
Industrial science	5	10.1
Law	2	4.1
Liberal arts	20	40.8
Medicine	4	8.2
Nursing	4	8.2
Science	7	14.3
Totals	49	100.0

college courses are shown in Table II. Although the largest enrollment in any single course was found in the liberal arts field, 55.1 percent of the respondents in the college group were enrolled in courses related to the sciences. (This percentage does not include those respondents in the liberal arts program who were earning majors or minors in any of the sciences.) A total of 44.9 percent of the respondents in the college group indicated that one or more physics courses were included in their curriculum. (The two percentage values, given above, are not exclusive of each other.)

A large number of different schools were attended by this group as shown by Table III. More respondents attended Montana State College than any other single school. Twenty of the respondents attended schools which are not operated by cities or states, seventeen attended schools of higher learning operated by the State of Montana, and a total of twenty-five attended schools within the State of Montana. Of the forty-nine respondents who attended college, 12 attended schools affiliated with the College Entrance Examination Board.[10]

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[10] College Entrance Examination Board, "Changes in Terms of Admission to the Member Colleges for 1950," Supplement to the 1949 Handbook, 1949, 105 pp., and "Terms of Admission to the Member College," Handbook, 1949, 1948, 287 pp.

TABLE III

NUMBER OF RESPONDENTS ATTENDING VARIOUS COLLEGES

College	Number who attended
Carleton	1
Colorado State	1
Colorado, University of	4
Dartmouth	2
Denver, University of	1
Great Falls College of Education	8
Grinnell	1
Harvard University	2
Idaho, University of	1
John Hopkins University, The	1
Massachusetts Institute of Technology	1
Michigan, University of	1
Minnesota, University of	1
Montana State	10
Montana State University	6
Northern Montana	1
Northwestern University	1
Principia, The	1
Reed	1
Washington, University of	3
Wooster, College of	1
Total	49

The second largest group in the study was composed of the respondents in the military service. Their relationship to the study will be presented from two points of view. One consideration relates specifically to their needs in the military service while the other relates to their needs if they were allowed to follow their chosen pattern of life. The first of these will be treated separately later in the paper. The second consideration will be presented with the evaluations by the respondents as a whole.

Because all of the three other groups constitute only 6.7 percent of those in the study, no attempt will be made to separate their evaluations from the other respondents. The small sampling in each group does not lend itself to statistical treatment.

Respondents' applications of physics. In the questionnaire the graduates were asked to give instances where they had made applications of physics. Only a sampling of the different applications was attempted, however. For those who continued their education in schools, the course had various uses. The respondents, who enrolled in courses directly related to physics, found some uses through the understanding of related principles. For the twenty-two respondents, who had one or more physics courses in their college curriculum, the high school physics served in a

preparatory function. Some of the respondents entered colleges where physics was an entrance requirement. Some respondents entered colleges where College Entrance Board Examinations were required and, in some of these schools a physics examination was included. Fifteen respondents, or 30.6 percent of the college group, received a college scholarship. Nine of the respondents indicated that physics was of help in earning the scholarships. Two National Honor Scholarships and three United States Naval Reserve College Program Scholarships were included in this group. Some of the scholarships were awarded partially or entirely on the basis of the results of examinations involving physics.

The responses to a question, asking for applications of various principles of physics, are tabulated in Table IV. Although the applications are listed in order of frequency of mention, the question was not intended to determine the frequency of all of the various uses of physics, but rather to obtain a sampling of some of the applications mentioned at will by the graduates. More references were made to applications related to mechanics than to any other field. Electrical applications of physics followed in frequency. Only one application was listed which directly relates to the study of sound. The items in the table are not mutually exclusive, but are listed as the respondents gave them, in

TABLE IV

RESPONDENTS' APPLICATIONS OF VARIOUS PRINCIPLES OF PHYSICS, IN ORDER OF FREQUENCY OF MENTION

Applications	Frequency of mention
General electrical	13
Of leverage principles	13
General mechanical	6
Better understanding of surroundings	4
General discussion ability	4
Artificial lighting	4
Of humidity and ventilation information	3
In driving an automobile	3
Photographic	3
Making work easier	2
Buoyancy	1
Computing height from "g" and "t"	1
Infra-red light	1
Navigation	1
Refrigeration	1
Sound	1
Metric system	1

order to preserve individual ideas. Many of the items listed have various inferences for the teaching of physics.

In response to another question, forty-four respondents indicated that the physics course was of more value to students who plan to go to college while eleven respondents answered that the course was of more value to students who do not plan to go to college. Five of the students thought that the course was of equal value to both groups.

Respondents' ranking of the units of the course. As mentioned previously in this report, the topics studied in most high school physics courses can be classified under the headings of: mechanics, heat, magnetism and electricity, sound, and light.[11] The unit on magnetism and electricity will be referred to by the heading of electricity.

In the questionnaire, the graduates were asked to rank the five units of the course from one to 5 in decreasing order of difficulty, of importance, and of interest to them. The rankings, on the basis of the three factors, are shown in Table V. To arrive at a rank order for each of the three factors in the table, the numbers per ranking were weighted in inverse order of ranking. The weighted rank

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[11] Beauchamp, loc. cit.

TABLE V

NUMBER OF RESPONDENTS RANKING THE VARIOUS UNITS OF PHYSICS IN ORDER OF IMPORTANCE, OF DIFFICULTY, AND OF INTEREST, BY NUMERICAL RANKING

Units	Ranking as to importance				
	1	2	3	4	5
Mechanics	28	11	8	2	4
Heat	4	9	15	15	10
Electricity	20	18	8	7	4
Light	2	12	15	22	4
Sound	0	9	8	7	31

Units	Ranking as to difficulty				
	1	2	3	4	5
Mechanics	14	11	9	5	15
Heat	2	13	13	14	10
Electricity	30	6	5	3	9
Light	8	9	11	14	9
Sound	2	12	14	14	11

Units	Ranking as to interest				
	1	2	3	4	5
Mechanics	15	11	5	9	14
Heat	1	5	18	16	14
Electricity	21	12	12	6	4
Light	13	12	12	10	6
Sound	6	13	8	11	16

order of importance of the various units was: mechanics, electricity, light, heat, and sound. The weighted rank order of difficulty was: electricity, mechanics, light, heat, and sound. The order of interest by weighted rank was: electricity, light, mechanics, sound, and heat. Attention should be given to the range of variations in Table V. A considerable range of individual interests among the respondents is indicated by the table. Notice should also be made of the variation between rankings as to importance and interest, which may not have been anticipated.

Respondents' rating of the emphasis placed on various techniques. The evaluation by the respondents of the various techniques used in the physics course was obtained through the use of the questionnaire and is shown in Table VI. The items in the table are arranged in order of increasing dissatisfaction of the respondents. Only two of the techniques, current science and other books, received more than a majority of ratings which did not indicate proper emphasis. Both of these items were rated as under-emphasized by most of the respondents who registered dissatisfaction. Four other techniques were rated as either over-emphasized or under-emphasized although the majority rated them as properly emphasized. Lecture and discussion, scientific thinking, and demonstrations were rated as

TABLE VI

RESPONDENTS' RATING OF EMPHASIS PLACED ON VARIOUS CLASSROOM TECHNIQUES IN THE PHYSICS COURSE

Techniques	Emphasis		
	Under	Proper	Over
Testing	6	45	5
Films and charts	11	39	6
Textbook	6	39	11
Laboratory experiments	11	37	9
Projects (individual)	12	35	9
Lecture and discussion	18	33	5
Problems	12	33	11
Scientific thinking	22	32	2
Demonstrations	20	30	6
Workbooks	6	28	22
Current science	24	27	5
Other books	28	24	2

under-emphasized while workbooks were considered as over-emphasized. The table indicates that there is some disagreement among the respondents on the rating of the various techniques.

Graduates were also asked to check the technique which they found most interesting and the one which they liked least. The lecture and discussion technique was rated as the most interesting while the workbook was rated as the least liked technique.

Respondents' suggestions. The following activities were tabulated from the replies of the graduates to a question asking for suggested activities in the physics classes.

1. More emphasis on relationships to everyday life
2. More advanced electricity
3. Medical applications of physics
4. Discussion of late developments resulting from physics
5. More emphasis on basic principles
6. More use of the slide rule
7. Cover less material
8. Essay questions
9. More class time
10. More emphasis on color of textiles
11. More on Diesel engines
12. More of practical electricity training

13. Separate laboratory periods

14. More work with resultants

15. Study harmonic motion

Although the activities are listed in the order of frequency of mention, they were obtained primarily in hope of gaining any new ideas that the graduates had for improving the course.

In an optional section at the end of the questionnaires, the graduates were asked to volunteer any suggestions which they felt would improve the services of the physics course. The suggestions are presented in order of frequency of mention in Table VII. Although some of the suggestions are conflicting, the fact that they were volunteered may represent a stronger expression of real need. Two items were mentioned most frequently. One of these suggested that the school curriculum should include an advanced physics course for those planning to attend college and a more general course for other students. The other suggested that more time should be spent on basic principles in preference to other activities. The first suggestion was reenforced by the replies to a question asking the graduates if they thought that a separate more general course should be offered for students not planning to attend college. Thirty-six of the respondents replied yes while 23 replied no.

TABLE VII

RESPONDENTS' VOLUNTEERED SUGGESTIONS
BY FREQUENCY OF MENTION

Suggestions	Frequency of mention
Offer an advanced course and a general course	8
More time on basic principles	7
More individual work	3
Require a year of physics for graduation	3
More time for the course	3
More time on topics relating to civilian defense	2
More daily tests	2
More essay questions on tests	2
Mathematics requirements for entrance	2
More problems	2
Separate laboratory periods	2
Require general science of all freshman	1
More visual demonstrations	1

Influence of military demands. From this study, it was hoped, that some insight would be gained into the "influence of military demands" on student needs from the course. One fifth of the respondents in the study were in the military service. This represents a sizable part of the total group when consideration is given to the fact that the group does not include any of the girls in the study. While it may have been desirable to obtain an even larger sampling of this group, there seems to be some significance to the information obtained.

As mentioned previously, five of the 12 graduates in the military service had been in college prior to their entry into the service and four of the remaining 7 indicated their desire to continue in college upon leaving the service. One of the other respondents had attended a radio school prior to entering the service.

In addition to an examination of the needs of this group through a study of all of the respondents, an attempt was made to obtain some information as to the values of physics to those in the military service specifically. All but one of the respondents in this group either entered a technical training school in the service or earned a technical rating by examination. In reply to the question asking what specific value physics had been to them in the

military service, three replied that physics helped them in passing technical qualifying exams and in their school work, eight replied that physics helped them in earning a technical rating, and one replied that physics helped him in electrical and mechanical work.

The uses of physics presented above seem to be substantiated by the "United States Navy Occupational Handbook." The publication recommends physics as a prerequisite school subject for thirty-one of the 62 Navy general service ratings.[12]

Analysis of findings. The statistical data obtained through the questionnaire as to status of the respondents is believed to be quite accurate. The information relating to the applications of physics was based on the status of the respondents and upon the ability of the respondents to recognize the applications in everyday life. The former was quite tangible while the latter along with all evaluations involved personal error in judgment. Some of the errors were enumerated previously in the paper.

The findings as shown in Table IV[13] tend to support

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[12] Bureau of Naval Personnel, United States Navy Occupational Handbook (Washington 25, D.C., November, 1948), pp. IX-X.

[13] Table IV, p. 23.

the allocation of time in class and of space in the textbook. Weaver[14] found the space allocated to the various units of physics in twelve textbooks to average as follows:

Mechanics	36 percent	Magnetism and electricity	24 percent
Heat	15 percent	Modern physics	6 percent
Sound	6 percent		
Light	13 percent		

The respondents listed more applications of physics related to mechanics than any other specific field. Electrical uses followed in frequency while the least number of references were made to sound. The rankings of the units of the course as to importance, by the respondents, falls into an order which closely corresponds with the time allotted for the units in the textbooks.[15] There was only a slight discrepancy in the relative values of heat and light.

In a report on a similar study of physics and chemistry classes, Miller and Dresden[16] found that the students desired more demonstrations, current periodicals, and discussions than had been offered them. These three techniques were also rated as under-emphasized in Table VI.[17] The

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[14] Weaver, J. F., "The Distribution of Emphasis in Ten Physics Tests and in Twelve Physics Textbooks," Journal of Educational Research, 29:42-55, September, 1945.

[15] Table V, p. 25.

[16] Miller and Dresden, loc. cit.

[17] Table VI, p. 27.

agreement between the two studies on these factors helps to substantiate the validity of student evaluations. It also points to the fact that there is considerable uniformity in physics courses offered in different schools.

The suggestions for activities served as an outlet for any ideas which the respondents felt should be included in the course. Free-will suggestions for improvement of the course were considered extremely valuable because they resulted from the initiative of the student rather than a choice among offered possibilities.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Statement of the problem. The purpose of this study, as stated in Chapter I, was to obtain information which would be useful in improving the physics course of Great Falls High School through evaluation of the course largely on the basis of the opinions of the physics students who graduated in the classes of 1948-1950, inclusive.

Procedure. Most of the information used in the study was obtained through the use of the questionnaire. Copies were prepared and mailed to students who completed the physics course and were graduated from Great Falls High School in the classes of 1948-1950, inclusive. The total number of students who were within this group numbered one hundred and fifty-two. Addresses for fifty of these students could not be located. Of the one hundred and two questionnaires mailed to students, sixty were completed and returned while twelve were returned because the addresses could not be located. The remaining thirty questionnaires had not been returned at the time when this paper was written.

In the questionnaire, student reactions to the subject matter of the course and the various instructional

procedures were sought along with certain factual data. The study also covers student opinion as to the values of the course to the students. Suggestions were solicited for improving the course. A copy of the questionnaire may be found in the appendix of this paper.

The results of the questionnaires were tabulated and summarized. Additional information relating to the graduates was obtained from the permanent school records of Great Falls High School.

Summary and conclusions. The following information has been summarized from the study:

1. Status of the respondents. Of the respondents in the study, 73.3 percent were in college, 20 percent were in the military service, and only 6.7 percent were included in all of the other groups. An additional 15 percent of the whole group, who were in the military service, had been in college or indicated a desire to attend college upon leaving the service.

    a. In the college group, 55.1 percent enrolled in curriculum related to the sciences, exclusive of liberal arts students with science majors or minors. One or more physics courses were included in the curriculum of 44.9 percent of the college group. (The two percentage values are not exclusive of each other.)

    b. Twenty-one different colleges were attended by the respondents: three of the schools were in Montana. However, twenty-five of the 49 respondents attended colleges in Montana. Twelve respondents attended colleges which required College Entrance Board Examinations.

2. Respondents' applications of physics. A great variety of applications of physics were given by the respondents.

   a. The high school physics course served as a college preparatory course for twenty-two college students whose curriculum included one or more physics courses. The high school course was an entrance requirement in some of these schools.

   b. Some of the respondents, who were enrolled in college curricula related to science, made indirect use of physics through understandings of related principles.

   c. Twelve of the respondents in college were required to take College Entrance Board Examinations. A physics examination was included for some of the schools.

   d. Fifteen of the respondents earned college scholarships. Nine of this group indicated that physics was of help in obtaining the scholarship.

   e. The respondents offered a variety of applications in everyday life.[18] Applications relating to electricity and mechanics were mentioned most frequently while only one application relating to sound was given.

   f. Forty-four of the respondents rated the course as being of more value for college students than for noncollege students while eleven gave the opposite rating. Five of the respondents thought that the course was of equal value to both groups.

3. Respondents' ranking of the units of the course.

   a. The weighted rank order of importance of the various units was: mechanics, electricity,

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[18] Table IV, p. 23.

light, heat, and sound.

b. The weighted rank order of difficulty was: electricity, mechanics, light, heat, and sound.

c. The weighted rank order as to interest was: electricity, light, mechanics, sound, and heat.

4. Respondents' rating of the emphasis on various techniques. Only two of the techniques, current science and other books, received more than a majority of ratings which were not considered properly emphasized. Both of these items were rated as under emphasized by the majority of respondents who registered dissatisfaction.

   a. Lecture and discussion, scientific thinking, and demonstrations were rated as under emphasized while workbooks were considered as over emphasized by a number of respondents although the majority rated them as properly emphasized.

   b. The lecture and discussion technique was rated as the most interesting while the workbook was rated as the least liked technique by a plurality of respondents.

5. Respondents' suggestions. The respondents offered a variety of suggestions for improving the course.[19]

   a. Thirty-six of the respondents felt that a separate more general course should be offered for those students who do not plan to attend college while twenty-three opposed the idea.

6. Influence of military demands.

   a. Five of the 12 respondents in the military

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[19] pp. 28-30.

service had been in college prior to their entry into the service and four of the other 7 indicated their desire to continue in college upon leaving the service.

b. The following specific values of physics in the military service were listed: Three respondents stated that physics was of help in passing qualifying exams and in school work, eight stated that physics helped in earning a technical rating, and one replied that physics helped in electrical and mechanical work.

Recommendations. In the light of the information which has been presented in this study, the following recommendations appear to be justifiable:

1. Because the information brought out by this study indicates that the respondents are satisfied in general with the course, the study does not provide justification for any major changes in the course.

2. The college preparatory functions of the course should be examined and strengthened in line with the percentage of students who continue on to college.

3. The general educational values of the course should be preserved and improved.

4. About the same divisions of time should be continued among the units of the course.

5. More current periodicals and reference books should be made available and utilized in the class.

6. Further evaluation should be made of the adequacy of emphasis on lectures and discussion, scientific thinking, and demonstration.

7. The possibility of over-emphasis on workbooks should also be further investigated.

8. Especially under the present world conditions, information and guidance should be made available for all students in the high school for planning a program that considers the value of understanding the principles of physics. Those students, who may enter the military service, should be informed as to the uses of physics in the service.

9. A study of the physical science needs of those students who do not enroll in physics is suggested. The possibility of offering a more general course in addition to the present course should be considered.

10. A similar evaluation study every few years is suggested along with a continuous follow-up study of all high school students.

11. This study does not lend itself to broad generalizations and therefore should not be used in that way.

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APPENDIX

Great Falls High School
Graduate Survey
Physics Department

In the interest of obtaining information which will be of value in improving the physics course offered to future students, would you please complete this questionnaire? Your sincere and objective answers will be greatly appreciated. All information will be treated strictly confidential. Please return by May 31.

J. J. Stefanoff

Name_____ Present Address_____
(Street and Number)
Married Girls_____
(Write maiden name here) City State
Date_____ Date of High School Graduation_____
(present)

I. If employed full time--permanent position please state:
   1. Nature of work_____
      (Stenographer, electrician, etc.)

II. If you have had any further education since graduation please state:
   1. Name of school_____
      (Deaconess School of Nursing, etc.)
   2. Course taken_____
      (Mechanical engineering,etc.)
   3. Number of months in attendance_____
   4. Does your curriculum include one or more courses in physics? Yes____No____

   If you are attending school on a scholarship, state:
   5. Type of scholarship_____
   6. Was high school physics of any help in earning the scholarship? Yes____No____

III. If you are in the armed forces, please answer the following questions:
   1. Would you have entered college had you not entered military service? Yes____No____
   2. What specific value has physics had to you in the military service?_____

IV. 1. In column A, check one rating for each part which best describes your evaluation of the emphasis that was placed on that part. In column B, check the part which you found most interesting. In column C, check the part which you liked least.

Part	A Under	B Proper	C Over
a. Lecture and discussion			
b. Textbook			
c. Other books			
d. Problems			
e. Scientific thinking			
f. Laboratory experiments			
g. Projects (individual)			
h. Testing			
i. Films and charts			
j. Demonstrations			
k. Workbooks			
l. Current science			

2. The units which were studied in the physics course are listed in the following table. Rate the units from 1 to 5 in decreasing order of difficulty, of importance, and of interest to you. (The most difficult would be rated "1")

Units	Importance	Difficulty	Interest
a. Mechanics			
b. Heat			
c. Electricity			
d. Light			
e. Sound			

3. Do you think Physics is more important to the student going to college than to the student not planning to go to college? College____Noncollege____
4. Do you think a separate more general course should be offered for students not planning to attend college? Yes____No____
5. Please give an illustration where you used in everyday life something which you learned in physics._____
6. What activities would you have included in physics class that would have made the subject more practical for you?_____

V. Optional: If you wish to make any suggestion which you think will improve the services of the physics course of Great Falls High School and thus help future graduates, we should be very grateful if you will do so. You may write on the back or attach a sheet of your own.