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Some Current Educational Procedures as Applied to the Problems of Dental Education

Robert Wilkinson McNulty
Loyola University Chicago

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SOME CURRENT EDUCATIONAL PROCEDURES AS APPLIED
TO THE PROBLEMS OF DENTAL EDUCATION

by

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A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Arts
in
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INTRODUCTION

In reviewing the evolution and development of any progressive movement, we may expect to find that the amount of study conducted in its behalf is directly proportionate to the age of the movement and to its importance to those whom it may concern. From the early ages there has been a desire and an effort on the part of man, as a civilized being, to improve himself. The desire of the human being to grow has manifested itself in a gradual development in the social being, in the moral ideals, and in the intellectual capacities of man. Concurrently with this desire for growth has sprung up an increasing interest in education, for there has evolved the realization that one of the results of education is the well-rounded and developed man.

Understanding that for ages the human has considered education as important, we may expect to find, and do find, that many problems have arisen and have been studied by those interested. Early education consisted chiefly in a knowledge of philosophy, the arts, and the classics; but, as the degree of civilization continued to grow and the interests of people began to expand, there developed new types of activities for which training became necessary. Out of this growth and expansion there came the need for the different branches of the healing art, resulting in the modern development of the various types of health service, of which dentistry is a part.

It is quite obvious that, if the development of educational procedures in general has not been wholly free from complications, some complexities of a similar nature must be expected to appear in the development of dental education. Research in dentistry may be classified as being of two kinds; namely, that which has reference to dental education, and that which has to do with the science of dentistry as a profession. A review of dental literature reveals the fact that little of scientific research has been done in dentistry which bears strictly on the educational side. This may be explained by the fact dental education, as such, is comparatively new. History shows that as a part of the healing art some of the branches of dentistry were practiced before the birth of Christ. It is not known by what means those who attempted to relieve others afflicted with dental disorders received their training. As the practice of the profession developed through the ages, there arose problems which required better training and more advanced knowledge. In the early seventeenth century we find that men interested in the correction of dental maladies placed themselves under preceptors for training purposes. There was developing a keen interest in the practice of the profession, but as yet no organized effort with respect to dental education. However, as the demands of the people increased, making greater skill and knowledge necessary, there was felt a growing need for the provision for the training of

dental practitioners. As a result, the first dental school was established in Baltimore, Maryland, in the year 1840, not one hundred years ago. While dental education has not had the advantage of a long and careful period of development, it has grown to such extent that there are now thirty-nine dental schools in the United States and Canada. Besides the fact that dentistry as a science is, comparatively speaking, in its infancy, there is another reason why so little of a research nature has been undertaken in the field of dental education. Dentistry is a science which requires much in the nature of exact knowledge and, in addition, a marked technical ability, and it is the latter with which the profession has seemed to be most concerned. A great many problems have been studied in an effort to improve the practice of the profession from its technical and biological aspects. However, educational problems are continually pushing themselves to the fore, and there are opportunities for a great deal to be done in this line of endeavor. Dental educators and administrators are cognizant of the existence of their educational problems, a fact manifested by the existence of organizations which have as their aim the promotion of higher standards in scholastic and administrative procedures. Reference is made here to the American Association of Dental Schools, represented by the dental educational institutions of the United States and Canada; and the Dental Educational Council, composed of an equal repre-

sentation from members of the American Association of Dental Schools, The American Dental Association, and the National Association of Dental Examiners. In addition to these organizations, the Carnegie Foundation for the Advancement of Teaching has aided in the cause of dentistry and dental education, as evidenced by the publication of Bulletin Number Nineteen, Dental Education in the United States and Canada.

In making a study of the problem as stated in the title of this paper, it is the desire of the author to survey common procedures and research methods in various fields of non-professional education and to attempt to point out where some of the results, if applied to dental education, might react to advantage in the training of future dentists. To the knowledge of the author, little study of a like nature has been accomplished. Yet it is apparent that the experiences and findings of research workers in other branches of education should be of some value to administrators and faculty members in the field of dental education.

The survey of studies includes only those concerned with non-professional education, and it is well that a clear understanding be established as to what is meant by non-professional as contrasted with professional or semi-professional education. The author intends that non-professional education should include that branch of training which has for its aim the broad development of the individual, with no attempt to prepare him

for a particular vocation in life. Professional education has for its purpose the preparation of the student for a particular walk in life, and the applications will be considered only so far as the dental education is concerned.

The genesis of educational problems begins when the individual first enters school, and develops as the level of training advances. However, since dental students are of a more mature type, being generally from eighteen to twenty-five years of age, it has been deemed best to include only those contributions of non-professional education which deal with the level of the high-school student, the liberal arts student, and the university student. In non-professional education the many phases of administration, the art of teaching, the teachers themselves, and the students have been subjected to investigations of many types. While there may be some who would contend that so much has been done that there is a marked confusion, and that so much has been injected into education as to exclude many of the fundamental essentials, many of these studies have unquestionably resulted in contributions of real value, and the attempt has been made to include only those studies which seem to have a practical application to dental education.

A consideration of all of the specific problems which have been studied in education would not, for the purpose of this treatise, be of practical value. A great deal of research has

been conducted the result of which has been of value only to the particular field of education in which the problem has been carried out. Since it is the desire of the author to include those problems in which there is a possibility of an application to dental education, after careful study of the many types of procedures and research in education, only certain of these have been dealt with. It has been the aim of the writer to make general rather than specific statements of the various problems included under each topic, and to attempt to portray what the more recent findings are in relation to the problem under consideration. Although qualitative results are of the greatest value to education, there will be, however, an effort to show quantitative results, and by the use of the more tangible conclusions drawn from the findings the author hopes to make applications to the particular type of professional education to which reference has already been made.

Realizing that the opinions of many are of greater value than the ideas of one of rather limited knowledge and experience, the general fields to be discussed were selected by means of a questionnaire submitted to a representative group of well-known dental educators. The questionnaire included a list of twenty fields which had been studied in non-professional education, and each individual was asked to select those which he believed might be of practical value if applied to dental education. An effort was made to secure judgments from an equal

number of individuals who were administrators, teachers of the basic sciences, and teachers of clinical subjects in dental education. The fields which these persons believed to be of most significance and to be included in this discussion are:

1. Administration
2. The Curriculum
3. Examinations and Marking Systems
4. Efficiency of Instruction
5. Individual Differences
6. Aptitude Testing
7. Methods of Research

In the compilation of the bibliography, much concern was given to the type of material to be included. Volumes have been written covering each of the selected fields. In order to make his selection as judicious and impersonal as possible, the author based his choice upon the opinions of graduate students and teachers in graduate schools of non-professional education. In this way, the author was able to secure the most recent and relevant literature.

Having devoted some years to the study of dentistry and to the training of dental students, the writer is vitally interested in anything that may be an improvement in dental education. It would seem evident that the experiences of students in allied fields would contribute something that may be of benefit in the preparation of dental students. In the hope that such may prove

the case, the writer was prompted to make this study.

CHAPTER I

ADMINISTRATION

With the rapid growth of the American college and university there has been an increasingly large number of problems arising in connection with the principles and techniques of administration. A few decades ago a college of a few hundred students was considered a large institution, and there existed only a small number of scattered universities with an enrolment of a thousand students. Administration at this time offered few difficulties, as the curricula were in most cases limited to instruction in liberal arts, endowments were relatively small, practically no professional training was offered, and instruction in technology and the sciences was slight or may have been entirely lacking (20:v).

At the present time an entirely different condition exists. Enrolment has increased to such an extent that there are now approximately a thousand institutions with student bodies averaging nineteen hundred students. Such a condition has resulted in a need for greater financial support, and we find the average incomes and endowments of these institutions to be in excess of \$2,000,000(20:vi). In addition to this there has been a general increase in the scope of the subject matter being taught, resulting in the evolution of the university, with its diversified course of instruction including from three to a dozen more divisions than the original instruction in liberal

arts (20:vi).

As the universities and colleges continued to grow and the number of complexities increased in connection with entrance requirements, with curricula, with the co-ordination of the work of various departments and schools, with finance and endowment, with the methods of instruction, and with the teacher problem, courses of instruction in administration have been initiated in many of the more progressive educational institutions. These courses have been inaugurated to meet the needs of those who are actively engaged in administrative work; for those who are preparing for such activities; and for those persons who are members of boards of control or faculties who are vitally interested in the continuance and development of their institutions (20:v).

While the courses offered in administration vary with the many universities, the fundamentals taught are essentially the same and may be discussed from the following aspects; namely,

1. Administrative organization
2. Fiscal administration
3. Academic administration
4. Personnel administration
5. Student administration.

Administrative Organization.

The usual organization of the administrative force of an American college of university is on the principle of cen-

tralized authority, responsible to a group of individuals not actively engaged on the campus and known as the Board of Regents, the Board of Governors, or the Board of Trustees (20:17). The members of these boards are usually appointed, the manner of appointment and tenure of office depending upon what general control under which the institution is functioning. The terms of office of the individuals usually terminate at different times, so that at no time does an entirely new personnel assume the duties of the board. Great care is exercised in the appointment of the members of the board, the necessary qualifications for the office being high standing in the community, prominence in some special vocation, and an enthusiastic and intelligent interest in the cause of higher education (20:18). The board is usually organized as an individual unit, having a president, vice-president, secretary, and treasurer, and depending upon its size may function by means of committees and sub-committees. The chief duties of the board are legislative, the members being responsible for the wise guidance and control of the institution (20:20).

The president of the modern university is usually appointed, and his duties are twofold; namely, the training of the students of the institution and the wise expenditure of its funds. Present trends in education require that a president be one who has gained reputation as a scholar, who has been active in educational research, who has the ability to deal successfully

with people, and who is honest and straight-forward - not dictatorial, but still direct and courageous (20:23-25).

The business affairs of the university are usually conducted by the bursar or auditor. The academic bookkeeper of the university is known as the registrar, whose duties are to keep the grades of each student so that they may be conveniently found and examined, to prepare statements which will show the relative status of each student, and to issue, on the basis of academic progress, recommendations for degrees (20:26).

The president of the institution, if it be a university, must be assisted in the selection of the personnel and in the administration of faculties and student bodies by a dean of each division. The dean acts as a president of his own particular division and must possess qualifications similar to that of the president of the university.

Other officers of administration are the deans of men and women, the statistician, executive secretary, secretary to the president, heads of departments, graduate manager of athletics and other student activities, and the alumni secretary (20:25-27).
Fiscal Administration.

In order to function properly it is necessary that an educational institution be possessed of necessary funds. The available sources of funds are many, the most common being the state, student fees, benefactions, endowments, business activities of the institution, and certain educational foundations.

The appropriation and dispensing of the funds of a university present a very significant division of administration, and most institutions have a separate administrative division devoted to finance (20:77). The person at the head of this department is usually known as the bursar, auditor, or comptroller, and where there is a separate administrative division of finance, the responsibilities of the bursar's office are (20:78):

1. Accurate accounting of all income and expenditures
2. Preparing the annual or bi-annual budgets
3. Purchasing
4. Operation and maintenance of the physical plant
5. The financing and supervision of the erection and equipment of buildings.

A careful analysis of the duties of this division of administration makes it obvious that the division must be efficiently organized, and that the responsibility for the various activities must be delegated to well-qualified individuals.

Academic Administration.

From an academic viewpoint the types of instruction offered may be divided into three different types; namely (20:197),

1. Instruction on the campus
2. Instruction off the campus

3. Experimental or research investigations.

The oldest of the above three types of instruction and by far the most prevalent is that offered directly in the school. Here the direct responsibility of administration rests upon the deans of the colleges and the heads of departments, the actual instruction being given by faculty members of different ranks, as professor, associate professor, assistant professor, and instructor (20:199). The organization of the modern university for instructional purposes may be outlined as follows (20:198-9)

1. The University

A. The College

1. The department, as

- a. Philosophy
- b. Modern language
- c. Chemistry
- d. Education, etc.

B. The School

Organized as the college but requiring two or more years of collegiate work for entrance, as in the professional divisions.

The function of the second division of instruction of the university is to carry to various people some of the courses offered on the campus, and is known as extension service.

Many universities have highly organized systems for this type of service, the responsibility being vested in a director of

extension, who takes the rank of the deans of the colleges and schools, and who utilizes the services of the various faculty members of the other divisions in so far as he is able to do so (20:202). The most common types of extension service are extension courses, correspondence courses, radio courses, lectures, visual education, and general correspondence (20:203).

Experimental and research investigations in the progress of education have resulted in the establishment and growth of Graduate Schools in the modern university. The organization of the administration of the Graduate School is different than that of the undergraduate school, in that the dean and faculty members usually hold positions in relevant departments of the undergraduate division (20:218). The faculty members are chosen on a basis of interest in, and accomplishment of, original and scientific investigation and research. The outstanding reasons for the emphasis of graduate work are to fill the vacancies that occur in the teaching staff and advance research in the field in which the graduate student is primarily interested (20:220-21). Many of the larger institutions, in order to strengthen the influence of their faculties, have limited the teaching load of some teachers so that they might carry on research studies (20:221).

Instructional Administration.

The concerns of instructional administration cover the following items: (1) entrance requirements, (2) enrolment or

registration, (3) methods of instruction, (4) supervision of instruction, (5) student study, (6) curricula, (7) and grading and examinations.

The problem of the criteria upon which to base entrance requirements is one of the first to confront instructional administrators. At present there are two factions of thought as to who should go to college; namely, (1) those who believe that the college should train up a race of intellectual leaders, making entrance requirements highly selective, and (2) those who believe that the college should train the largest possible number for intelligent citizenship (20:227). The administrator who has to do with the entrance of students should determine in his own mind which of these two trends of thought is dominant in his institution.

At the present time, the American colleges permit entrance on some one of the following plans (20:231-65):

1. On the certificate plan, by which the entrant presents a certificate of graduation from an approved secondary school.
2. On the examination plan, by which the entrant is subject to examinations which are formulated, given, and graded by the institution.
3. On a basis of tests which are supposed to measure native intellectual ability.
4. On a basis of achievement in the secondary school, only

those who rank in the upper one-third or one-half of the graduating class being admitted.

5. On a basis of character qualifications, only those being admitted who are able to present character recommendations from former principals and teachers. Those who use this plan also consider past scholastic records and native capacities.
6. On a basis of maturity, vocational experience, and psychological examination.

In the university of large enrolment the administrators are called upon to face the many problems of enrolment or registration. The student is required to make a choice of the many fields of endeavor open to him, and, being relatively immature, is unable to do so wisely unless he has sound advice. Many colleges appoint members of the faculty as consultants for the student, the disadvantages of which system are those of divisional interests, limitations of personal knowledge, and limitations of time (20:266). The modern trend in this direction is to not only appoint faculty advisers, but in addition to employ other means, such as a trained personnel working with a vocational officer, the institution of freshmen week, a wider scope in the choice of subjects during the first year, and orientation courses (20:268-78).

After the student has gone through the procedures of admission and enrolment, the question arises as to how he shall

be instructed in his various courses. Several methods of instructing students in collegiate work are prevalent, the most important of which are (20:279):

1. The lecture method
2. The recitation method
3. The laboratory method
4. The lecture-quiz method
5. The lecture-demonstration method
6. The tutorial or preceptorial method
7. The study-work method
8. The project, unit, or case method
9. The seminar method.

The type of instruction to be used for each individual subject must vary; and methods of instruction are based upon the nature of the subject being taught, the cost of the particular method as compared with others, the possibility of personal contact between the teacher and student, and possibility of the loss of interest by the student through the use of an incompetent method (20:282).

Following a consideration of the methods of instruction, educators have deemed it wise to consider the supervision of instruction. Supervision of the methods used is important for three reasons; namely, (1) the lack of training in methods of teaching on the part of faculty members; (2) the rate of turnover among faculties; and (3) the number of young and

inexperienced teachers and assistants used in practically all educational institutions (20:321). There is a growing demand that teachers be trained in the profession of teaching, the amount of training desired varying with the level at which the teacher is employed. There has always existed the thought that one who has achieved the level of intelligence necessary for the Master's or the Doctor's degree is capable to efficient teaching, but this is not always a fact, since the work of the individual has been intensively conducted in a limited field and he has had no particular training insofar as methods of teaching are concerned. Individuals responsible for administration realize the need of supervision of instruction, and the present trend is toward a definite means of selecting faculty members who have shown interest in how to teach (20:328-30).

Of no less importance than the problem of the teacher and his training is that of the student and his methods of study. It is just as vital to an institution that its students know how to study properly as that its teachers teach correctly. Many institutions are attempting to solve this problem by having the students with low entrance marks meet with faculty members assigned to this duty, the purpose of the meetings being to give the student a systematic course in how to study and to attempt to solve the problems of the individual student insofar as study habits are concerned. In addition some students are required to review literature which deals with

study problems (20:334).

The problems of curriculum construction, of the recognition of individual differences among students, and of grading and examinations are of such importance in instructional administration that they will be discussed in subsequent chapters. Faculty Administration.

The various problems of faculty administration begin with the selection of the teaching staff. In the modern American university the task of selecting teachers is a responsibility of the president, who must make careful inquiry into the qualifications of a particular individual for a particular position. That the responsibility is one of weight is well portrayed by a statement made by Lindsay and Holland; namely, "the type of faculty member and student, their morale and their accomplishments, determine the excellence of an institution of higher learning more definitely than any other set of factors" (20:407).

The prevalent methods used in locating prospective candidates are (1) by personal contact, (2) by observing the contributions of candidates to professional literature and their activities at conventions of learned societies, (3) by knowledge supplied by deans of graduate schools, and (4) through the medium of the teachers' agencies (20:408). In the final selection and ranking of available prospects, the president has these criteria on which to base his choice; literary or scientific contributions as a measure of the candidate's standing in

the academic world; the amount of training the individual has had; the amount and type of experience the prospect has had; traits of personality, such as appearance and honesty; and social and personal relationships possessed by the individual (20:410). The necessity for care in the choice of faculty members cannot be overemphasized, primarily because of the value of the material with which they work, namely, the student (20:412).

The question of salaries of teachers is one which has been given serious study by those engaged in administration. The usual practice is to compensate the individual in accordance with the rank which he holds in the faculty organization. While salaries vary with different institutions, the instructor usually receives for his services from \$1,200 to \$2,500 per year; the assistant professor from \$1,800 to \$3,500 per year; the associate professor from \$2,400 to \$4,500; and the full professor from \$2,800 to \$5,000 (20:413-15). These salaries are based upon full-time service. Beyond the rank of the full professor is the department head, whose salary is from \$500 to \$3,000 higher than that of the full professor; the deans, who usually receive from \$3,500 to \$8,000; and the president, whose salary varies between \$5,000 and \$25,000 per year (20:416-17).

The salaries as listed above do not afford the recipient adequate opportunity for provision for old age, and as a result there have sprung up in our institutions systems of insurance

and pensions. The chief insurance and pension agency for college teachers in America is subsidized by the Carnegie Foundation for the Advancement of Teaching and is known as the Teachers' Insurance and Annuity Association of America (20:438). The insurance is provided by deducting a small percentage of the instructor's salary, to which is usually added a like sum by the university. These sums together meet the cost of the annuity contracts, by the terms of which the individual is paid a certain amount either monthly or annually after having reached a certain age.

Another important factor in faculty administration is the question of the teaching load which must be carried by the faculty member. The teaching load is referred to in terms of comparable teaching hours, such a basis being necessary in that the clock hours spent in the instruction of classes by different methods represent unequal units of labor on the part of the faculty member (20:443). On a basis of work required for both the hour spent with the class and the necessary preparation required for such, the recitation hour is regarded as a unit, or 1; the lecture hour, $1\frac{1}{2}$; and the laboratory hour, $\frac{1}{2}$ (20:445). The maximum standard recognized by most institutions is a teaching load of fifteen comparable hours per week, and is usually assigned to the individual of low academic rank (20:446). As the individual advances in rank the tendency is to lower his teaching load.

Upon the president of the university rests the responsibility for the efficient training of its students, thus making him the chief officer of student administration. To properly discharge this responsibility he must have (1) proper student morale, (2) the co-operation of the student body, and (3) the assistance of various subordinate officials (20:487). The modern president has found that this may be accomplished best by efficient organizations within the student body, by a careful supervision of these organizations, and by the judicious administration of different specific phases of student life and activities, such as health, religion and morals, social life, and vocational and educational guidance (20:498-526).

Applications.

Most modern schools engaged in the preparation of students for the practice of dentistry are integral parts of the larger educational institutions known as universities. Under such organizations the plans of administrative organization are specified by the body in charge of the administration of the university. The same may be said concerning the fiscal administration of the dental school, the chief duty of the administrators of the dental school in this respect being to submit a yearly budget for the proper functioning of their particular division. Inasmuch as the university controls the organization and fiscal activities of the dental school, these phases need no discussion for the purpose of this study.

However, there are administrative problems which are peculiar to the dental educational institution itself. Some of the procedures which have proved of value to non-professional education and by which dental education might profit are:

- (1) An investigation as to the entrance requirements a prospective student should present in order to be accepted. At the present time there is a divided opinion among dental educators as to entrance requirements. There are some who contend that one year of college work, including a prescribed number of hours in related sciences, is sufficient. Others believe that the incoming student should possess a more thorough cultural background, a contention which adds another year of college work for entrance. Where dental schools demand either of the above two requirements, certain subjects are included in the predental curriculum; namely, English, chemistry, biology, and physics. However, there has been no study, insofar as dental education is concerned, as to why these subjects are to be preferred rather than some other college subjects. It would seem that a study of the relation between the subjects of collegiate work and those of the dental school would be profitable. It could be determined by such an investigation, for instance, whether physics should be preferred as a predental

subject to some other subject which is not now required, or vice versa.

- (2) A better understanding of the student before being admitted to the dental school.

In most dental schools the plan by which a student is admitted is by presentation of evidence which shows that he has completed his pre-professional education and has received satisfactory grades. Little effort is made to gather information concerning his native intellectual ability by means of standardized tests; his previous civic and moral status is given little consideration; and students of all ages and of all kinds of previous experience are admitted on the same basis. Since educators are of the conviction that the type of student in a school determines, to a great degree, the standard of the institution, dental schools should attempt to gather an accumulation of evidence about its incoming students, rather than be satisfied by evidence of mere scholastic attainments.

- (3) Helping the student in methods of study.

Many educators are of the belief that a number of failures may be traced to the fact that students do not know how to study. As a consequence various means have been devised to educate the student in this respect.

When a student has been admitted to a dental school, he

is confronted with a type of curriculum and with experiences with which he has never been in contact. Here, if never before, he is in need of advice as to systematic study. This may well be taken care of by the individual teacher, who could devote the beginning hours of his course to methods of study in the particular subject and to a discussion of what the study habits of the student should be.

(4) The institution of a system of student advisers.

Besides being unaware of systematic study habits, the dental student is confronted with other experiences which are new to him. Dental schools may provide for a proper solution of student difficulties by assigning a small group of students to each faculty member, to whom they may go for counsel. Such procedure leads to a more personal contact between faculty and students and a better understanding of the student by his teachers. In addition to this, an adviser is suggested for each of the classes. His duties would be to act as a counselor in the activities of the class as a whole and to promote a wholesome spirit and morale among its members.

(5) A consideration of the methods of instruction.

A review of literature dealing with non-professional education reveals that several methods of instruction

are employed. In the dental school only a few of these are made use of, chiefly the lecture method, the recitation method, and the laboratory method. Other methods than these have been found more efficient in certain fields of non-professional education, and dental education may also profit by their use. The lecture-demonstration method, the project method, and the seminar method, seem particularly appealing in teaching the clinical phases of dental education.

(6) More supervision of instruction.

Those employed in instructional administration contend that, whatever method is used to impart knowledge, supervision of its use is important. Because each dental school has in its faculty a number of teachers who are not trained in methods of instruction and who are relatively young and inexperienced, supervision of instruction may be very seriously undertaken by instructional administrators. Only in exceptional cases should the beginning dental teacher be given charge of a class of dental students, and in all cases it is suggested that the head or assistant head of the department in which the instruction is being offered assume the duty of supervision. By this means, provided the supervisor is familiar with methods of teaching, younger teachers may be developed in the

proper channels of efficient instruction.

- (7) Training of dental teachers in the principles of pedagogy.

It has been stated that one of the reasons for instructional supervision is that there are many dental teachers who are not trained in methods of teaching. This is evidenced in a statement by Geis, who avers that "most of the teachers have been selected without reference to teaching experience and having only a casual interest in their duties as instructors, make no particular effort to improve their ability and rarely seek instruction in a teachers college. That teaching is a profession for which adequate training is desirable does not seem to be recognized by dental faculties" (11:141). Those engaged as dental teachers, as well as the dental schools, must realize that they are now a part of two distinct professions, the dental and the teaching, and to function more efficiently, should provide for training in instruction. The dental school may either assign a lighter teaching load to the beginning teacher, thus affording time for teacher-training in schools where such instruction is given, or employ the services of one who is familiar with the technique of teaching to give courses to its faculty members.

- (8) Establish graduate schools for the training of teachers.

Another means which non-professional education has found profitable in teacher training is the participation of its teachers in a phase of research which is related to the field of instruction in which the teacher is engaged. Such a plan may be well considered by dental educators. While the plan offers no additions to the knowledge of teaching methods, it gives the instructor a deeper insight in his own subject and may prove to be a means of developing new methods and techniques. The activities of dental faculty members in research not only add to the prestige of the school, but fortify the teacher in his own field.

- (9) The establishment of extension courses.

A rather recent establishment of non-professional education is the practice of taking education to the people. It is suggested that such may be given thought by dental schools for the benefit of its graduates. A plan worthy of consideration would be to send one or two teachers of a particular phase of dental practice to selected centers, where graduates could convene and be informed of methods and techniques which have been developed since graduation.

Weekly lectures could be given, the number to be determined by the importance and intricacy of the phase to be covered. Such a plan could be executed for those graduates who have located in communities where it is difficult to keep in contact with latest developments. It is not suggested that any work of this nature be carried on by correspondence.

In concluding the discussion and application of problems of administration, it may be said that the responsibility for administration in dental schools falls upon a very few individuals. In order to function properly they should be familiar with phases of education which have to do with their school. Thus, in addition to being familiar with the problems of dentistry as a profession, dental administrative executives should have a knowledge of the art and science of education.

CHAPTER II

THE CURRICULUM

One of the most important problems confronting the institution of higher learning has to do with the formation of a satisfactory curriculum. Webster defines curriculum as "a specified, fixed course of study." As applied to education, Bobbitt maintains that "it is that series of things which children and youth must experience by way of developing abilities to do the things well that make up the affairs of adult life; and to be in all respects what adults should be" (4:42). Primarily, the curriculum of any school is based upon the aims or objectives of the institution. While one may suspect that the various changes in the aims of education would be followed by corresponding changes in the curricula, alterations have always been tardy and seldom have complete changes been made (8:3). Charters holds that the slow response of curricular changes to the changes in the aims of education may be accounted for, the reasons being that (1) those who have set the aims of education have considered more the ideals derived from a fixed course, with not so much attention to the activities of the individual, (2) the chief objective of the curriculum has been to give the student a broad, superficial knowledge instead of more useful and practical information, and (3) school administrators have placed over-emphasis on the theory of transfer of training when the curricula have been criticized as lacking

practical information (8:4). However, in the modern trends of education, demands are made that the course of study include both ideals and activities; that the aims of education be toward usefulness rather than general knowledge; and that extreme caution be used in emphasizing the value of transfer of training (8:4). Such requirements of a curriculum are in accord with the modern contention of educators that life itself is based upon activities and that the chief function of education is to prepare its students to perform properly the activities which are to be met in life situations, or in the words of Bobbitt, "to prepare men and women for the services of every kind which make up, or which ought to make up, well rounded adult life" (3:7).

In the construction of a curriculum it would seem evident that the first necessary step is to determine the major objectives of that particular type of education (8:102). In order to do this the curriculum-maker must give careful consideration both to the ideals and to the activities involved in the situations as they will be met in life. In other words, it is not only necessary to know what is being done, but it is also necessary to know what should be done. As Charters has observed, if the aims are stated in terms of ideals only, there is a gap between the objective and the curriculum, while if stated only in terms of activities the means of choosing the proper method of carrying out the activities are lacking (8:11).

When the curriculum-maker has before him what the individual ought to do in order to cope with the situations of human experience, then he knows the things for which the individual should be trained. It is first necessary, then, to discover the activities which should go to make up the life of the individual, and in addition to learn the abilities and personal qualities necessary to properly carry out these activities (3:8). In order to discover the broad range of activities involved in life, or a particular phase of life, a method which has been in use for a long time and has proved to be satisfactory is activity analysis. A more formal type of activity analysis is that known as job analysis. It should be noted that the analysis of a situation, in order to determine the activities involved, will result in either a list of duties performed by the individual or in a list of methods to be employed in the performance of these duties (8:37). Charters outlines four methods of making a job analysis, and they are as follows (8:38-40):

1. Introspection.

By the use of this method, the activities are stated and outlined by a person who is familiar with the duties of the job which is to be analyzed. Such a method is dependable to a degree, but it is necessary that not only one, but many who have worked on the job, be asked to state the duties involved. Even then this method

may show some fallacies and it should be supplemented by one or more other methods.

2. Interviewing.

When employing the interview method of analysis, the interviewer seeks a list of duties from one who is working on the job. These duties, as given by the individual, are copied and returned to the worker for correction. Other workers are consulted independently and as the various duties are compiled, a rather dependable list may be secured. When a composite list has been completed, it is given to one who is thoroughly familiar with the job so that additions and corrections may be made.

3. Working on the job.

In order to obtain information concerning the various activities of a job by this method, the analyst works on the job in order to become familiar with its requirements. While such a scheme has its advantage in that the worker is able to analyze the job better than one who has been employed for some time, careful interviews are deemed more advisable because of the time required to become thoroughly familiar with the work.

4. Questionnaire.

In many cases the analyst is called upon to make use of a written questionnaire in order to determine the

activities involved. The continued use of the questionnaire, however, has caused it to fall into disrepute because (a) it is extremely difficult to fill out properly a written questionnaire, (b) the person who asks the question may have different conceptions than the one who answers it, (c) the sender may misinterpret the answers, (d) the number answering the questionnaire may be too small to be representative of the group to which it was sent, and (e) those who answer the questionnaire may not give exact information (8:133-4).

The analyst, in all instances, should attempt to secure a complete list of the activities of the job which is under consideration. While this may be done by one of the above four methods, additional activities may be obtained by approaching the analysis from the viewpoint of the difficulties encountered in performing the various duties. The list may be further strengthened by an analysis of the mistakes or errors made in carrying out the performance of the job (8:39-40).

It has been stated that one employed in the construction of a curriculum must give consideration both to the activities and ideals involved in the objectives of education. The activities may be determined by analysis, but it is more difficult to scientifically evaluate ideals. Ideals may be said to be traits which are not possessed, but are being worked toward

by one who wishes to acquire the qualifications necessary in a given situation (8:45). In order to determine what the ideals are which prevail in any type of education, one may make use of any one or all of the following methods (8:44-47):

1. From a list of the activities, determine which ideals are best for proper performance.
2. The ideals are first selected by faculty opinion and the activities then chosen which may best carry out these ideals.
3. A list of ideals are prepared by a group of teachers and each of the teachers is asked to determine which of the ideals should be stressed upon one pupil. This will determine a list of ideals which should be stressed upon all pupils. Such a method is known as individual character analysis.

In the determination of the major objectives of education one must consider the analysis of two different schools of instruction; namely, the vocational and the non-vocational (8:48). The former has for its purpose the preparation of the student for a particular activity in life, while the latter places emphasis on the type of training which an individual should possess regardless of his vocation and has little regard for any specific or individualized training. It has been realized, however, that one who is applying himself to the acquisition of a vocational education will meet life situations

which will require training other than that which is strictly vocational. Such activities as those peculiar to the individual as a citizen, aesthetic interests, social relations, intellectual interests, and physical recreations have nothing to do with professional training (8:48). Consequently, the school which is interested in training its students for a vocation must consider both its vocational objectives and its extra-vocational objectives and the curriculum must be constructed from an analysis both of the duties of the vocation and of the activities found in extra-vocational interests (8:48).

Having determined the major objectives of education and analyzed these into the various activities and ideals, one constructing a curriculum must determine which subjects should be used in instruction. Since there is a great variety of subject matter, and a large amount of material is to be found in each variety, it is necessary to select that which is of the greatest relative importance. Three conditions exist which make this selection necessary; namely, (8:63-4):

1. Some things, while important, may be taught better outside of the school. Bobbitt declares that "all education should proceed upon the assumption that nothing should be done by the schools that can be sufficiently well accomplished through the normal process of living" (3:35). Preparation to meet life situations of many kinds are cared for more efficiently in the home, the

church, and through social intercommunication.

2. The most important material should be taught in order that it may be given within the time allotted for education. Most branches of education specify a given time for completion of their curricula, and the importance of material must determine whether or not it is to be included or omitted.
3. Selection of important material must be considered on a basis of the relative difficulty of learning it. Since some important facts may be learned easily, while others are more difficult to master, the time spent should be dependent not only upon use, but upon difficulty as well.

The criteria by which the material of greatest relative importance may be chosen are (8:65-8):

1. Use

The use which a particular type of material is to be to the individual is most important in the determination of its inclusion.

2. Quantitative results

The value of the material may be easily determined when it is possible to secure quantitative measures.

3. Consensus

When absolute measurement is not possible, the opinion of the majority may be accepted.

4. Expert opinion

Because of special training and wide experiences, the opinions of a group of experts may be used in the selection of important material. Studies of current curricula investigations reveal the fact that expert opinion has had very strong influence as a standard of selection.

The next step in the construction of a curriculum is that of placing the important material as selected in the proper place, so that it may be of most value to the learner. The consideration to be taken in this step is, of course, the level of intelligence to which the learner has progressed. It is obvious however, that in the collection of important material, there will be included more than can be cared for adequately in the time allotted and some material which can be better learned outside the school. It then becomes necessary that a decision be made as to what should be taught within the confines of the school. When this has been determined, the worker must select that material for which time will permit efficient teaching. When the material which is to enter into the makeup of the curriculum has finally been selected, it should be arranged in proper instructional order in accord with the psychological nature of the learner (8:102).

In concluding a discussion of curriculum construction Charters lists seven rules; namely (8:102):

1. Determine the major objectives of education by a study

of the life of man in its social setting.

2. Analyze these objectives into ideals and activities and continue the analysis to the level of working units.
3. Arrange these in the order of importance.
4. Raise to positions of higher order in this list those ideals and activities which are high in value for children but low in value for adults.
5. Determine the number of the most important items of the resulting list which can be handled in the time allotted to school education, after deducting those which are better learned outside of school.
6. Collect the best practices of the race in handling these ideals and activities.
7. Arrange the material so obtained in proper instructional order, according to the psychological nature of the children.

In illustrating the application of these rules Charters reports a study made by Strong, of the construction of a commercial engineering curriculum for executives (8:292-7). A job analysis was made which involved six different parts, as follows:

1. The duties of the position - what the executive did.
2. The essential qualifications - what he ought to know in order to perform these duties.
3. The qualifications not essential but of value - what

the executive thought he ought to know in order to handle his job better.

4. The route to the job the official himself had pursued.
5. The probable line of promotion.
6. Recommendations and notes of any kind.

Having collected the data by job analysis, all items which pertained to any one particular subject were tabulated. In this way the function of each subject was determined and the objectives stated for which each department should be held responsible. The material collected was referred to the departments which dealt with each of the subjects. Committees from the departments were asked to organize or reorganize their courses to meet the objectives as revealed by the job analysis and to report their findings. The content of each course was then determined, the time devoted to each, and the proper sequence established. "The study has been carried through all stages from job-analysis to schedule-making" (8:297).

Charters outlines a plan for the reorganization of a course of study within a school by its faculty as follows (8:155-7):

1. The study should be placed in the hands of a steering committee made up of representatives from each subject and one or more from the administration. The duties of the steering committee are, (a) to determine plans of procedure, (b) to determine the desires of the faculty and the ideals to be developed, and (c) to pass upon the

adequacy of the subject material.

2. A chairman of each of the subject committees should hold membership in the steering committee.
3. The subject committee should be composed of teachers of the subjects and teachers of other subjects.
4. The subject committees should determine the objectives of the subject in relation to the major objectives of the school system, as laid down by the steering committee.
5. The revision of the subject should be placed in the hands of those who teach it.
6. Reports on revision should be made by the teachers to the subject committees.
7. There should be a committee on co-ordination to collect a group of projects and multi-problems.
8. Revision should not be a side issue, but chairmen of all committees should be given adequate time to efficiently function.

By the use of a plan such as this, with whatever modifications may be rendered necessary by circumstances, it can be seen that valuable work may be done in the investigation of individual subjects. By undertaking the revision of the several subjects within a school program, there occurs eventually a revision of the whole plan, and the work involved in the smaller problems is usually more thoroughly, carefully, and con-

scientifically done (8:157).

Applications.

Throughout the relatively short life of dental education a number of changes have been made in curricula. These have been brought about by changes in the aims of dental schools. Originally the dentist was intended to be a person whose chief duty was to do restorative work of a technical nature. With this as an aim the first dental schools required an attendance of two terms of six months each. As new methods and techniques were devised, the duration of the courses was lengthened and later another year of study was required. With the advance of research in the technical and biological phases more material was added to the curricula, until dental schools began to require an attendance of four terms of eight months each. Coincident with the requirement of longer attendance, entrance requirements were made more stringent.

At the present time there is great need for research in the field of the dental curriculum. Dental educators seem to be divided in their opinions as to the amount of material necessary for preparation for dental practice. There are those who contend that sufficient material can be offered in a three-year period, while others maintain that in order to include enough important subject matter four years of work are necessary. Today some dental schools are operating on a three-year basis, while others require four years of attendance. Both schools of

thought recognize the chief objective of dental education as being the preparation of the student for health service and attempt to adjust their curricula to meet this objective. The materials which have been added to dental curricula have not been subject to any research activity as to their need and ultimate value, but have grown by accretion based upon the opinions of a few interested administrators.

In order to adjust the dental curriculum to the satisfaction of dental educators, the reconstruction may be accomplished through the sort of scientific investigations which have been undertaken by those interested in non-professional curricula, as:

1. A determination of the aims of dental education

It is not to be supposed that the aims of dental education can be included in one definition. The aims should be to prepare the student to meet life situations, which includes not only those situations involved in professional work, but as well the situations which the dentist must meet as a social being in relation to professional life.

2. An analysis of the activities involved in dental practice

Herein lies a great need in the reorganization of the dental curriculum. The construction of a curriculum for a profession should be approached by discovering

the activities and problems of the profession and these should be described with great definiteness (9:31).

Nobbs states that "the method of job analysis as applied to the professions represents an attempt to analyze the actual work of practitioners in order to determine what they must know and what they must be able to do" (23:88). The problem of job analysis in dentistry seems to be in determining who is able to give correct information as to the activities of the dentist, not only what he should know, but what work he should be able to accomplish. No doubt in this respect many individuals must be consulted: the dental teacher, the practitioner himself, the public health worker, the physician, and the patient, and very likely others.

The practitioner is unable to give adequate information because his experience is individual. Information gained from the teacher is likewise incomplete because he is not familiar with the duties and problems of the practitioner (9:35). A compilation of activities as given by a group of people will include more nearly a complete list of what the dentist should know and do.

3. A selection of subjects on a basis of importance and their co-ordination

As stated previously, the addition of subjects to the dental curriculum has been through the process of

accretion. As a result of an activity analysis, the time devoted to relatively important and unimportant subject matter can be properly adjusted. At present dental schools do not know, for instance, whether too much or too little anatomy, chemistry, physiology, pathology, or even clinical experience is being given to meet the needs of the dental practitioner. The curriculum should also be constructed with a view toward coordination of subjects. For this purpose proper sequence is necessary. A dental teacher may well instill the idea in his students that his course is not an independent and individual study, but one which is given at a particular time in order that the education which the student receives therein may be useful and is to be applied in the assimilation of subject matter which is to follow. This may also be accomplished by meetings within the departments and by counsel between department heads, at which times the scope of material taught could be discussed.

4. A determination of how much and what of a cultural education should be offered

Dental education is interested in more than the development of the dentist. It is also interested in his development as a man insofar as his professional life is concerned. Some cultural work should be included in the

dental curriculum, but only that which is necessary as discovered by the activity analysis of the practice of dentistry.

5. The revision from time to time of individual subjects
While there seems to exist a need for a general reorganization of the dental curriculum, valuable work may be accomplished by investigation of individual subjects within the curriculum. This may be necessary for two distinct reasons: (1) in many instances the individual teacher overestimates the importance of his subject; and (2) in some cases the teacher is not familiar with the needs of the dental graduate. A scientific study of the individual subjects may not be a means of adjusting a particular subject wholly to the activities of the practitioner, but does act as a means of keeping the subject matter within the desired scope. If the revision is made from time to time, it will also provide for the inclusion of new methods and techniques and for the exclusion of personal opinions in favor of objective facts. Revision of individual subjects represents a smaller undertaking than a complete reorganization and is usually more carefully and thoroughly done. By this means it may be possible to make a revision of the whole school program.

CHAPTER III

MARKING SYSTEMS AND EXAMINATIONS

Marking Systems

While examinations and marking systems seem to be a universal custom and are almost as old as the scheme of education itself, it is within recent times that they have been subjected to any considerable amount of discussion or investigation. The chief cause for doubt as to the advisability of the systems commonly used has been the publication of studies which revealed great unreliability and variability in the marks given examination papers by teachers (26:4). Odell cites as an example a study made by Starch and Elliott, in which one examination paper was submitted to one hundred fourteen teachers. Each was to grade the paper independently of the others, the passing mark in this case to be 75. When the results had been reported, it was revealed that the following distribution of marks had been given (26:6):

Marks	Number
90-94 -----	2
85-89 -----	7
80-84 -----	11
75-79 -----	26
70-74 -----	13
65-69 -----	18
60-64 -----	17

Marks	Number
55-59 -----	8
50-54 -----	5
25-49 -----	7

Other studies were conducted and it was even shown that if the same teacher marked a paper a second time, the results would vary (26:6). Such revelations as the above presented to educators problems which recently have been subject to extensive investigation.

It has been shown that grading systems are peculiar to American institutions of higher learning. Under the European system the student receives no grade, but either does or does not pass a course (20:357). The existence of these standards has raised the question as to whether marks should or should not be given, and advantages have been found in each practice. However, if a grading system is to be used, its ideal requirements are fairness, facility in use, and facility in administration (20:361). While there are some disadvantages to a grading system, the advantages advocated seem to carry much weight. These advantages as cited by Odell, in a review of a report by Wood, are as follows (26:111):

I. Pedagogical

(a) Grades contribute to a student's education by

1. Requiring effort to answer questions
2. Requiring him to perform the tasks used in deriving

his grades.

3. Forcing him to study in view of prospective examinations
4. Causing a wholesome competition as related to the grades of fellow students.

II. Administrative

- (a) Grades inform parents or guardians of the educational status of the student.
- (b) Grades give information as to the fitness of the student for higher schooling.
- (c) Grades reveal the relative standing of students, determining to whom credit, degrees, or honors should be given.
- (d) Grades furnish reference to be used in research, in comparing the efficiency of different school systems, of different instructors, of methods of instruction, and of different subject matters.

While there is a wide diversity of opinion as to what factors should be considered in determining the marks to be given to students, it is the common practice for each individual school to adopt a set of definitions or specifications to guide its teachers and to state how much weight should be given each consideration. Statements indicating the many factors which teachers consider in granting grades are (26:114):

1. Final attainment at the end of the semester or term

2. Attitude toward work
3. Degree of interest manifested
4. Amount of effort put forth
5. General intelligence
6. Character and personality
7. Amount of improvement manifested
8. Quality of work done
9. Quantity of work done
10. Ability to do subsequent work in the same subject
11. Amount of initiative shown
12. Seriousness of purpose
13. Degree of preparation or study by the student
14. Final examination
15. Daily class work
16. All written work
17. Combinations of oral work, written work, and examinations in various proportions.

There has also been some degree of discussion as to what weight should be placed upon the value of the various activities of the student. Odell recommends, as a general rule, that a single final examination should count for not less than 10% or more than 25% of the final grade; that all written tests should count for not less than 25% or more than 50% of the final grade; that oral class work from day to day should count for not less than 33 $\frac{1}{3}$ % of the final grade; and that class work from day to

day, both oral and written, should never count for less than 50% of the final grade (26:129).

A study of the details of marking systems has shown that in 281 high schools in Illinois there are almost 100 different systems of markings in use (26:133). Until very recently the percentile system was the most prevalent, but the present trend is toward the use of letters having a range in numerical value. Odell recommends the use of a marking system of five or six symbols, preferring the beginning letters of the alphabet and including two failing marks, one to be given to the student who comes fairly close to passing, the other to be given to the student who fails badly (26:138). The symbol system of grading is to be preferred, for if a teacher attempts to mark too finely there is likely to be great unreliability of the marks.

A question which has received much consideration with regard to grading systems is whether or not the grades given should approximate a given frequency distribution. Basing their contention upon the fact that most human traits and activities follow the normal frequency curve, there are many who argue that scholastic grades should be based upon this curve, and many educational institutions have adopted this system, especially in cases where the classes are made up of a relatively large number of students. Odell maintains that "there should be such a distribution adopted in each school or school system, ordinarily the latter, which should serve as a general guide to

teachers in assigning marks" (26:150). He recommends that in a grading system using four symbols that grade frequency should conform to one of the following distributions (26:155):

A	B	C	D
7	43	43	7
10	40	40	10
11	39	39	11
15	35	35	15

Slight variation from the system adopted is permissible, it being intended that the plan be used as an approximate or general guide. A general compilation of the systems being used show the distributions to be A's, 5 to 20 percent; B's, 25 to 50 percent; C's, 25 to 50 percent; and D's and E's combined, 5 to 20 percent (26:157).

Examination Systems

Inasmuch as students' grades are generally conceived as being an outgrowth of examinations, problems concerning marking systems have led to research in the matter of examinations. In order to make marks more valid there has been the contention that examinations prepared by the regular teacher should be replaced by standardized tests. "A standardized test in the most limited sense is any test which has been given to a large enough number of pupils of a given age, grade, or other homogeneous group so that the results are fairly adequate indications of what achievements are actually being attained by such

pupils in general" (26:8).

There are those who claim that examinations should not be given, and they support these claims by saying that (26:10-11):

1. Examinations are injurious to health.
2. The content covered encourages cramming, factual memorizing, and acquiring items of information, rather than careful and continuous study, reasoning, and other higher thought processes.
3. Examinations become objectives in themselves, the student believing that the chief purpose of study is to pass examinations.
4. Examinations encourage bluffing and cheating.
5. Examinations develop habits of careless use of English and poor handwriting.
6. The time used for examinations can be more profitably used otherwise for more study, recitation, review, etc.
7. The results of instruction in the field of education are intangible and cannot be measured.
8. Examinations are unnecessary, the teacher being able to rate the students without them.

These arguments have been contested pro and con, and the general conclusions arrived at would seem to indicate that there is a place in the educational system for examinations. Those who would use standardized tests rather than those prepared by the teacher offer these arguments (26:19-27):

1. The standardized tests make available a norm, or the average achievement of a group in the same grade, age, and mental ability.
2. They are usually constructed by persons more expert in the subject matter and in the principles of test construction than is the average teacher.
3. They are more objective, reliable, and valid.
4. Through purchase, they save time devoted to preparation and scoring or grading.

In answer to these arguments, those who would employ teacher-constructed examinations contend that (2:27-30):

1. Examinations can be adapted to the local courses of study, to points of emphasis of individual teachers, and to the needs of individual classes and pupils.
2. Satisfactory standardized tests do not yet exist in all subjects.
3. Standardized tests involve undue expense.

The result of the controversies over the two types of examinations has led to the conclusion that "a well rounded testing program includes the use of both of these forms of measuring instruments" (26:31).

Numerous purposes have been given which examinations should serve, the following list being those outlined by Odell (26:35):

1. The measurement of pupil ability and accomplishment
2. The diagnosis of pupils, especially of those doing un-

satisfactory work

3. The measurement and improvement of teaching efficiency
4. The provision of opportunities for learning
5. The motivation of pupil study and other mental activities
6. The determination of standards or goals of attainment.

Since examinations are intended to serve the purposes as stated, it is necessary that they possess certain essential or desirable qualities, such as (26:40-58):

1. Objectivity - a competent person should be able to definitely determine what is right and what is wrong.
2. Reliability - they should measure accurately what they are supposed to measure and include as much of the subject matter as possible.
3. Validity - they should measure what they are intended to measure.
4. They should be easy for the teacher to give and score, and easy for the pupil to take.
5. They should provide for economy of time of both teacher and pupil.
6. They should be sufficiently interesting and stimulating to call for the pupils best efforts.
7. They should rarely contain "catch questions."
8. They should yield norms of pupil achievement.
9. They should never be used as a penalty or punishment,

but as a regular school routine.

10. They should be constructed and administered so as to discourage bluffing and guessing.
11. The questions should be clear and definite.
12. If an examination is to cover the whole course, it should test knowledge of the chief principles and facts, as well as their relationship, application, interpretation, etc.
13. The questions should approach the subject from various phases and measure various abilities.
14. Examinations should be short and frequently given, not long and infrequent.

In the preparation of good examinations the teacher must consider these suggestions (26:59-64):

1. Validity may be secured
 - (a) By a careful inspection and analysis of the test itself
 - (b) By comparison of results secured with those from similar tests.
2. More questions than will be needed should be prepared in advance and laid aside for a few days. They should then be given careful consideration to discover weaknesses and methods of improvement.
3. Suitable material for examinations should be accumulated from time to time.

4. It is sometimes desirable to repeat, in a different form, questions which have been used in a previous test.
5. Form, length, and detail should be considered.
6. The testing program should include a number of short tests of either the conventional or new type, and some longer ones.
7. Timing should be exact, the student being required to begin and stop at specified times.

While tests should require study on the part of the teacher as to their proper construction, they are of little value if they are not properly administered. Odell offers the following instruction in test administration (26:64-80):

1. The students should be encouraged to formulate their answers before beginning to write.
2. A complete copy of the examination should be in the hands of each pupil.
3. The corrected papers should be returned and discussed with the pupils.
4. The test should have been so constructed as to make cheating of no avail and all effort should be made to make cheating without being detected as difficult as possible.
5. In some way the students should be informed as to their standing with respect to the rest of the class.

Examinations should not only be properly constructed and

administered, but in addition they should be scored correctly. The teacher must decide whether each question of the test should be rated equally or whether the weighting should be done on a scale of relative importance and not difficultness (26:81-86). In scoring the test (26:86-96):

1. The answers should be most carefully scored.
2. The teacher should write out the correct answers before beginning correction.
3. One question should be handled and scored at a time; question number 1 in all papers, then number 2, etc.
4. A pupil's mark in a given subject should be based upon his ability and achievement in that subject and should not depend upon his ability to spell, write, punctuate, capitalize, etc.
5. Marks are more reliable if a committee system of marking is employed.
6. The teacher should not know whose paper is being marked.
7. If the papers are to be returned, all mistakes should be clearly marked.
8. All scores should be changed to a definite marking system.

As previously stated, there are many qualities which good examinations should possess, and it was pointed out that one of the most important was reliability. In fact, many of the qualities of good examinations are dependent upon whether or not

the test accurately measures whatever it does measure. In discussing test reliability Symonds states that (33:73-87):

1. The greater the number of items in a test, the more reliable the test.
2. The longer the time a test occupies, the greater its reliability.
3. The narrower the range of difficulty of the items of a test, the greater the reliability.
4. A test evenly scaled is more reliable than a test that has gaps in the scale of difficulty of its items.
5. If the answer to one item is suggested in another item, or the meaning of one item depends upon another item, reliability is reduced.
6. The more objective the scoring of a test, the more reliable is the test.
7. Inaccurate scoring reduces reliability.
8. Chance in getting the correct answer to an item is a factor in test reliability.
9. The more homogeneous the material of a test, the greater its reliability.
10. The more common the experiences called for in a test are to the members taking the test, the more reliable is the test.
11. The same test given late in the school year is more reliable than when given early in the year.

12. A test containing material not covered in class or in the text book is less reliable.
13. Catch questions lower reliability.
14. Length of questions, choice of words, sentence structure, and directions effect reliability.
15. Speed in taking a test effects reliability.
16. Accuracy in taking a test effects reliability.
17. Proper incentive increases reliability.
18. Accidents, illness, worry, etc., effect reliability.

In contrast to standardized examinations, there are the different types of tests which are constructed by the teacher. These may be conveniently classified as being of two types, the traditional, discussion, or essay type, and the new type or objective tests. "The term discussion, traditional, or essay is applied to a written examination of the type in common use for many years, the kind in which the pupils are asked to discuss, explain, describe, summarize, or do something else which requires the writing of sentences, paragraphs, or longer units" (26:22). Objective tests, commonly known as the new type of examinations possess the features "that the student responses called for are very short, being check marks, underlinings, crosses, figures, single words, or other responses which require a minimum of writing, and that they generally possess rather high objectivity" (26:22). There are some who point out that the advantages possessed by the essay examinations are superior.

The more recent trends, however, are that in a complete testing program efforts are being made to determine under what conditions each is most valuable and to select the type of test accordingly (26:176).

Proponents of the traditional examinations claim these advantages for this type (26:176-9):

1. They are more easily constructed.
2. Teachers are more familiar with their construction and use.
3. They are better tests of reasoning and other thought processes, memory excepted.
4. They can be more easily and directly adapted to various kinds of subject matter.
5. They give training in ability to organize and express ideas.

Objections given to the new type examination are (26:180-3):

1. They encourage guessing.
2. They encourage dishonesty, it being easier to cheat upon them.
3. They tend to confuse the pupil as to what he really knows.
4. They do not resemble life situations.

On the other hand, those who would make use of the new type examinations offer as argument (26:183-203):

1. They are more reliable.
2. They are more valid.
3. They are preferred by students.
4. They lead pupils to acquire exact and detailed knowledge.
5. They are more easily and correctly scored.
6. Results reveal satisfactory norms.
7. Bluffing is more difficult.

The chief objections to the essay or discussion tests are
(26:197-200):

1. They discourage systematic and worth-while review.
2. They do not test the achievements of pupils whose powers of expression are poor.
3. They frequently test speed of writing to an undesirable extent.
4. They require as much attention to language and handwriting as they do to the subject matter.
5. They do not test the rate of a pupil's response or thinking.

The essay or discussion type of examination is the older type and the kind with which most teachers are familiar. There is less knowledge, however, of the tests of the new type and before beginning the use of these, it is essential that the teacher familiarize himself with the different aspects of each type. The different kinds of objective tests, as outlined by

Odell, are (24):

1. Recall Exercises

Each question is answered by a single word or expression.

2. Alternative Exercises

Some of the statements given are true, some are false.

The false statements are checked, while the true are not touched.

3. Statements to be Corrected

False statements are corrected by crossing out the words making them incorrect and supplying correct words in their places.

4. Simple Completion Exercises

Statements are made, the essentials being omitted.

These are supplied by the student.

5. Completion Exercises with Suggested Answers

Statements are completed by inserting a word from a list printed after the question.

6. Multiple-answer Exercises with One Correct Answer

Several answers are given to a statement, the student being asked to underline the best.

7. Multiple-answer Exercises with Varying Degrees of Merit

From a list of given expressions the student is asked to underline the best statement.

8. Multiple-answer Exercises with One or More Correct

Answers

The student is asked to underline all of the expressions given, which make true statements when taken with the rest of the sentence.

9. Compound Multiple-answer Exercises

The student underlines one expression in each line which is closely connected with the expression given in the first line.

10. Multiple-description Exercises

Three or four paragraphs are written describing a certain thing. The student checks the best description.

11. Multiple-reason Exercises

A statement is made and several reasons are given. The student checks the correct, all correct, or most correct answers.

12. Matching Exercises

A right and left column are supplied, one of which is numbered. The student places the number before the word or phrase in the column not numbered, which is associated with the word or phrase in the numbered column.

13. Definitions

The student is required to give clear and concise definitions.

14. Same or Opposite Exercises

Words are presented in pairs. The student marks them

S if they have the same meaning or O if the meaning is opposite.

15. Distinguishing Exercises

The student is required to clearly indicate the distinction between two words.

16. Complete or Partial Enumerations

The student is asked to enumerate facts.

17. Opposites

A group of words are presented and the student must supply the opposites.

18. Genus-species Tests

The species is given and the student asked to supply the genus.

19. Connected Terms

The student underlines all the words in the parenthesis in some way connected with or related to the word preceding the parenthesis.

20. Disconnected Terms

The student crosses out one or more words in the parenthesis not closely related to the word preceding the parenthesis.

21. Arrange-in-order Exercises

The student is asked to arrange facts in order, from highest to lowest degree or the reverse.

22. Identification Exercises

A drawing or picture is presented. Certain parts are numbered and the student must place the proper number before descriptive words printed in a column below. On the descriptive words are numbered, the numbers to be written in the proper places in the drawing.

23. Abbreviations, Symbols and Formulae Tests

The student is asked to write formulae, or with the formulae or abbreviations given, he must write their meanings.

24. Classification Exercises

The student crosses out the one or more words unlike or of a different class than the majority of words in that line.

25. Analogies With No Suggested Answers

An analogous statement is made and the student is asked to supply the essential analogy, which has been omitted.

26. Analogies With Suggested Answers.

An analogous statement is made, several words being supplied which might be the essential analogy. The correct one is underlined.

It is interesting to note that some of the examinations of the New York Regents and of the College Entrance Examination Board now consist of new-type tests and that several of the new type tests are used in the School of Civil Engineering at Columbia University (26:433). To a certain extent the new-type

tests are being used in professional courses, as in education, engineering, medicine, library work, and law. In such instances the new-type examination is not replacing the essay examinations, but rather being used along with it in the testing program (26:435). In the new plan of college education recently undertaken by the University of Chicago the new-type examination is used extensively. Under this system the student is entirely freed from routine requirements and is permitted to progress as rapidly and as far as his interest and capacity will permit (5:265). In determining whether or not a student should be passed from one college division to a higher one, three or four types of examinations are given: the new type of multiple-choice and short-answer test, the essay or discussion type, the problem type, and when necessary the oral examination (5:268). The examinations are framed and administered by an examining board, whose responsibility it is to see that the examinations demand no more than the required level of achievement (5:269). An analysis of this program reveals that both new type and traditional examinations are used and is a type of program which educators believe to be the most efficient.

Applications

Although investigations concerning grading and examination systems are of relatively recent origin in non-professional education, the writer has been unable to discover literature indicating that any consideration has been given this field as

a problem in dental education. As a general procedure, the type of examinations used in dental schools is of the traditional variety, an essay or discussion examination consisting of from five to fifteen questions, and the work of the student is graded principally upon the results of the examinations. Since those interested in non-professional education have found that advantages are to be derived from the use of other procedures, the writer suggests that this field be considered for study in dental education. With respect to grades and marking systems it may be of value,

- (1) If each individual dental school adopt definite specifications as to what a grade should indicate. Under present conditions a comparison of the grades of an individual student in the different subjects is hardly possible. The dental teachers each have a different conception as to the meaning of a grade, some marking the student on a basis of the results of final examinations, others take into consideration the results of written tests, quizzes and oral work, while still others include along with these results the character and personality of the student, the initiative and seriousness manifested, the quality and quantity of work completed during the course, and many other factors. Under such circumstances it can be seen that a student who receives a C grade in one

subject may easily receive an A grade in another. And yet if the same basis were used in granting the grade, this student may receive a B grade in both subjects. It is thought that if a uniform basis can be agreed upon that better comparisons of grades may be made.

- (2) If all dental schools adopt a universal grading system. As in non-professional education, there exists in dental education a number of grading systems. Thus a student who maintains an average grade of B in one school may rank with the C student in another school, even though it is evident that in the individual student the level of intelligence is the same. A common grading system would react to advantage in instances where a student wished to transfer from one dental school to another or in any other cases where transcripts of records were necessary.
- (3) If a study be made of grade distributions in dental schools.

The literature indicates that there are some values to be derived from a study of the distribution of grades. One value in such a study is the revelation that some courses are unreasonably easy while others are unreasonably difficult. In some cases this has been found to be due to poorly conceived standards on

the part of individual instructors. In other cases changes need to be made in the content of courses in order to make them more substantial or to simplify them as the case may be. So far as the present writer is aware, there have been no published studies of the distribution of grades in dental schools. It apparently would be useful to make such studies. The results could be discussed in faculty and staff meetings, thus affording the instructor the opportunity to analyze his own situation and to adjust his course and grades accordingly.

Concerning examinations the writer makes the following suggestions:

- (1) That consideration be given to the construction of standardized tests in dental subject.

Standardized tests in non-professional education have been used in comparing the achievements of students in one school with those of the students of the whole educational system. They may be of even more value in dental education, in that a review of dental curricula reveals the fact that there is a wide diversity of time required in identical subjects. By the use of standardized tests it may be shown that some schools are requiring too much time for a sufficient knowledge of the subject at hand. If the results of standardized

tests in dental education were published, norms would be obtained. A study of these norms would permit each dental school to determine wherein its weaknesses existed.

- (2) That the examinations of each department be discussed by a departmental and central committees before being submitted to the students.

Teacher training includes within it a training in examination construction and administration. Since it has been suggested that dental instructors give consideration to teacher-training, it is necessary that the subject of examinations be included. A discussion of examinations by departmental committees should be of value in that it would (1) reveal the nature of the material which has been covered in each of the courses, (2) avoid repetition in related subjects, although it is admitted that this is sometimes necessary, and (3) motivate the teacher not only in better teaching methods but in more study in examination construction. It is further suggested that value may be derived by submitting the questions of examinations to a committee composed of department heads. Such a procedure may have its value in revealing the existence or lack of coordination between the various departments of the dental school.

- (3) That dental schools make use of a balanced examination system composed of both traditional and new-type examinations.

This suggestion does not carry with it the idea that dental schools completely abandon the traditional type of examination. However, in such subjects where more objective evidence is required to prove the achievements of the students, the new-type examination should be used. The use of the objective test may prove of worth in such subjects as chemistry, anatomy, histology, bacteriology, physiology, and other of the fundamental sciences. In many dental subjects the advance of the student is to be judged by reasoning power and practical applications. In such instances the traditional examination would seem more ideal and is suggested for such courses as clinical diagnosis and applications, therapeutics, surgery, etc.

- (4) That the new-type examination be used for its diagnostic value. The diagnostic nature of new-type tests has interested the educator, and the evidence appears to indicate that some tests do indeed serve this purpose and that as a result individual deficiencies can sometimes be corrected. If any benefit of this kind is to result from the new-type tests in dental education, it would appear that the point of attack

should first be the earlier courses, in order that deficiencies may be corrected before it is too late. Perhaps the best way of arriving at an idea of where to strike first would be to consider the courses that cause most trouble in the junior and senior years. For example, in the experience of a certain dental school, students may fail most frequently in the subject of therapeutics, which is based on a foundation of knowledge in chemistry, physiology, and pathology. In such an instance it is suggested that an attempt might be made to construct tests in therapeutics which would indicate whether a student's difficulty consisted in poor preparation in chemistry, physiology, pathology, or a combination of the subjects.

CHAPTER IV

EFFICIENCY OF INSTRUCTION

One of the many problems confronting those interested in general education is that which has to do with the efficiency of teachers. As in any other profession or occupation the services of the teachers vary in their value to the school, and for some time educators have been investigating ways and means of determining the efficiency of the individual instructor. In the past, and even at present in a great number of instances, such evaluation has been left to the personal opinion of a few administrators. Such a plan has caused some dissatisfaction among the teachers of school systems because by such a procedure the results have not been based wholly upon objective evidence and the existence of the personal equation has led to a lack of harmony. The present trend is to attempt to create a fair scheme of evaluating teachers' services which is based upon factors which can be measured. While it is hardly possible that a scheme can be invented which will be satisfactory to each individual instructor, one which can be applied to the majority will be of great value.

The value of an individual teacher's service is directly proportionate to the desired effects produced on the person who receives the instruction. Moss holds that "the teaching efficiency of any instructor may be considered to vary directly with the desirable changes produced in the students by

his teaching" (22:40). Trabue further exemplifies this by stating that "the efficiency of instruction is in direct proportion to the success of the learning that is taking place in the pupils. The only convincing proof of successful school work must be found in the increasing achievements of pupils when meeting recognized tests of ability" (35:18). From these statements it is evident that there must be means of measuring what the students have acquired. This may be done by the use of standard tests, which attempt to portray general results and endeavor to show the correlation between different subjects. In order to conclusively prove that learning has taken place, it is necessary to compare the learner's ability before he was taught with his ability after having received the instruction (35:19).

In devising a plan for measuring the value of the services rendered by an instructor, it is first necessary to determine what the attributes of a superior teacher are. Frank states that there are three types of teachers namely (10:484),

- (1) Those who make no attempt to improve their method of instruction and who display so little interest as to look upon teaching as merely a job
- (2) Those who are always looking for better methods and try to teach better every year. The instructor of this type regards teaching as a profession.
- (3) Those who teach well, and by experiment and research

develop new methods and new principles. Their contributions are not only in new methods of teaching, but may be articles in periodicals and books, essays, and lectures. To this type of instructor teaching is an art.

The last of the three types is, of course, the most desirable and should be the ideal toward which each teacher strives. In an investigation conducted in Washington, D.C., to determine who superior teachers were in order to plan promotions and salary adjustments, a superior teacher was classified as "one who renders superior services to the children whom she teaches, to the school in which she teaches, to the local community which she serves, and to the District of Columbia as a whole. A superior teacher is one who possesses broad scholarship, who is thoroughly familiar with present day educational theory and practice in the line of work which she teaches, who is doing constructive educational work of the highest order in carrying out the established program in the school where she teaches, who is actively and constructively promoting the educational welfare of the community in the vicinity of her school, and who participates in the improvement of education in the District of Columbia as a whole" (2:259). It will be seen from an analysis of this definition that the teacher has an obligation to the student, to the institution in which he is teaching, to the community and state, and to the

teaching profession and the good teacher is the one who most successfully meets these objectives.

The determination of the value of a teacher's services presents a very practical phase in the administration of a school system. The efficiency of the educational system is reflected in the efficiency of the teachers and measurement is essential (1) in determining in an individual the qualities necessary for successful teachers, (2) for the improvement of teachers already in service, and (3) in applying the results to the determination of promotion and dismissal (6:9). In general there are two methods used for this measurement namely, examination and rating. Examinations are given to fulfill three distinct purposes (6:11):

1. To determine entrance into service
2. To control promotions either in salary or positions
3. To stimulate continued study on the part of the teachers.

It is not to be supposed that examinations are to be considered the sole basis of judgement, but are to be used in connection with other means, as well as with the accomplishment of the teacher in the classroom.

The methods used in the rating of teachers are usually (6:14-21):

1. The general impression method

This is the method by which the rating rests upon the judgement and opinions of one or two of the administra-

tive personnel. The judgements are not controlled by any outline of factors, definitions, or rules and the way is not specified. Because of the entrance of personal equation this system is a rather loose one.

2. The analytical method

The analytical method involves four different types of ratings. They are:

(a) Descriptive reports involving a written statement by the supervisory officer.

(b) A series of questions are asked. In a study reported by Ballou, the type of questions asked were (2:260).

(1) With controlling emphasis on the subject you teach and explicitly pointing it out, discuss the most important objectives to be realized by efficient instruction and supervision in your line of work.

(2) State briefly the most important developments in present day educational theory and practice related to your line of work.

(3) Write the names of those who are recognized leaders in the United States making important professional contribu-

tions to your line of work, viz.,

- a) writing articles or books,
- b) making suggestions or recommendations that have led to improvements in courses of study,
- c) writing textbooks or library reference books which have improved the content of the subject matter.

3. A report blank on the qualities of successful teaching

4. Definite numerical values are given to the various qualities and subtractions are made from the maximum value of any quality in proportion to the deficiency.

Of the above two methods, the analytical is the more scientific and therefore is to be preferred. Rating scales, which call for judgments based upon objective evidence of the quality of work done, are now in use in many school systems. To be of value these scales must include a list of terms in which the various aspects of teaching efficiency shall be specifically expressed. These terms must be made exact by definition and standardization and there must be an efficient method of recording the judgement (6:40). While many types of rating scales have been devised, the fundamental qualities touched upon by the more valuable ones are (10:485-90):

1. Training

The best trained teacher is usually the most valuable.

The type and kind of training as referred to the job at hand must be the criteria for measurement.

2. Teaching experience

Both the kind and amount of experience should be given consideration and an important factor is the school in which the experience was gained.

3. Teaching ability

Objective evidence of ability may be had by questions, as follows:

- (a) Do pupils reach the objectives of the course given?
- (b) Has the teacher convinced his pupils that he has taught them well?
- (c) Is the teacher actually prepared to teach the subject?
- (d) Is the teacher of the modern, progressive type and has he shown a strong professional interest?
- (e) Is there evidence that this teacher has a high professional standing?

4. Teaching load actually carried

The load should be compared with the average load of other teachers, the fact being considered that there should always be a maximum load.

5. Extra-curricular activities

Faculty members render service to the school when they lend their presence at extra-curricular activities.

6. Contributions to the standing of the school in the past three years

A teacher renders service to a school when he gives the school publicity through his own worthwhile activities.

7. Contribution to educational theory or practice

Contributions to education may be added to through the activities of the teacher as an author, an inventor, a curriculum worker, etc.

8. General business of running the school

The activities of the teacher in executive, committee, clerical, and advisory work adds to his value.

9. Guidance and placement activities.

The worth of a teacher may be judged, to an extent, by his ability to advise and place students, either graduate or undergraduate.

An example of a good rating scale, as given by Pererson and Cook, is (28:328-9):

RATING SCALE FOR GENERAL EFFICIENCY

	A	B	C	D	E
A. Personality					
1. Personal appearance-----					
2. Voice-----					
3. Cooperation-----					
4. Initiative-----					
5. Tact-----					
6. Health-----					
7. Loyalty-----					
8. Enthusiasm-----					
9. Self-control-----					
10. Poise-----					
B. General preparation					
1. Academic preparation					
(a) Command and use of English-----					
(b) Grasp of subject matter-----					
(c) Handwriting-----					
2. Professional preparation					
(a) Mastery of general principles and methods-----					
(b) Mastery of special method-----					
C. Professional attitudes					
1. General interest in work-----					
2. Favorable attitude toward criticism--					

RATING SCALE FOR GENERAL EFFICIENCY (CONTINUED)

	A	B	C	D	E
3. Effective response toward criticism-----					
4. Interest toward pupil activities-----					
5. Understanding of pupil attitudes-----					
6. Cooperation with teachers and administration-----					
D. Teaching qualities					
1. Definiteness of aim-----					
2. Selection of appropriate subject matter-----					
3. Skillful organization of material---					
4. Careful daily preparation-----					
5. Instruction related to pupil interests and experiences-----					
6. Use of illustrative material-----					
7. Originality and variety of devices--					
8. Skill in directing and supervising study-----					
9. Proportion of pupils attentive and responsive-----					
10. Phrasing and facility in questioning-----					
11. Clearness and reasonableness of assignments-----					

RATING SCALE FOR GENERAL EFFICIENCY (CONTINUED)

	A	B	C	D	E
12. Provisions for individual differences					
(a) in assignment-----					
(b) in recitation-----					
13. Drill-economical, efficient, interesting-----					
14. Skill in preparing and conducting tests-----					
E. Management					
1. Smoothness and economy of routine---					
2. Promptness and accuracy of reports---					
3. Discipline without friction-----					
4. Neatness and cleanliness of room----					
5. Care of light, heat, ventilation----					
F. Results of teaching					
1. Pupil achievement in subject matter-----					
2. Pupil attitudes and ideals-----					
G. Extra-curricular activities					
1. In relation to the school-----					
2. In relation to the community-----					

After the foregoing discussion as to the methods used in measuring the efficiency of instruction, it is interesting to

note some of the conclusions which have been reached by those using the methods. Through an investigation conducted by Taylor, he was able to state that (34:169):

1. It was possible to make a more detailed analysis of the relationship between estimates of teaching ability and the measured achievements of the pupil taught.
2. Teacher influence on relative class achievement was found.
3. Ratings are to some extent indications of the merit of a teacher.

In attempting to discover the correlation between the various qualities required of a teacher and his general merit, Boyce found that the technique of teaching and the results obtained were most closely related to general efficiency (6:67). In this study teaching technique included (6:68):

1. Definiteness and clearness of aim
2. Skill in habit formation
3. Skill in stimulating thought
4. Skill in teaching how to study
5. Skill in questioning
6. Choice of subject matter
7. Organization of subject matter
8. Skill and care in assignment
9. Skill in motivating work
10. Attention to individual needs.

Results shown included (6:68):

1. Attention and response of the class
2. Growth of pupils in subject matter
3. General development of pupils
4. Stimulation of community
5. Moral influence.

Interesting information was revealed in an investigation conducted by Moss, who studied the efficiency of instruction in chemistry. He states that (22:46-48):

1. There is a tendency for the teaching efficiency to decrease as the size of the class increases over thirty or forty.
2. The degree of the instructor - Ph.D., M.A., B.S., seems to have little effect on efficiency.
3. If the rank of the teacher has any effect on efficiency, professors show a tendency to be more inefficient than either the associate professors, assistant professors, or instructors.
4. That after eleven years of experience there is a tendency for teaching efficiency gradually to decrease.
5. The effect of the teaching load, measured in terms of the number of hours per week taught, would indicate greatest efficiency from instructors teaching fourteen to eighteen hours per week.

Applications

The maintenance of a teaching staff comparable to the best is not the interest of any one branch of education, but should be the aim of all. It has been stated previously that the standard of a school is determined primarily by the type of its students and the efficiency of its teachers. This, of course, applies to the dental school and a staff of superior teachers would be an invaluable asset. There are many teachers in dental education who are looked upon as examples and from whom other teachers may pattern their ideals in order to be more successful, but as far as the writer has been able to determine there has been no scientific endeavor to ascertain what qualities exist in the superior dental teacher which lend toward his success. Hence, it may be suggested that:

1. An attempt be made to find out what the necessary qualities are for the successful dental teacher and a measuring scheme based upon these be formulated. In this respect it is very likely that the qualities necessary for successful dental teaching are essentially the same as those required in other branches of education. Hence the rating scale described by Peterson and Cook may be used as a basis, with the addition of certain objective factors peculiar to the art of dental teaching and the omission of other factors which do not seem to be particularly applicable.

The scheme for measuring the efficiency of dental instructors should not, however, be based wholly upon a rating scale. Another thing to be taken into consideration is the activity of the individual instructor outside the confines of his class. His participation in the literature pertaining to dental education, in lectures, in meetings of an educational nature, and his knowledge of current literature, practices, and prominent writers in his particular line of endeavor are factors upon which efficiency may be based.

2. That the devised measuring scheme be used for the improvement of all teachers in service.

Anything which may add to the efficiency of teaching within a given school would be an aid in raising the standards of the school in that the improvement is reflected in the accomplishments of the students. It is believed that a measuring scheme, as suggested, would be a means of improving dental teaching by creating within the instructors a desire to rank high in the scale.

Such a scheme would furnish greater incentive for the teacher to give more careful thought to his methods of teaching and to compare them with the methods used by others. The plan would encourage participation, both oral and written, in affairs having to do with dental education, and of extreme importance, would cause more

serious thought as to the effects of individual practices upon the students from a viewpoint of both growth in subject matter and moral influence. It must be admitted that even with the use of the proposed plan, the application of the results obtained must be the responsibility of a few administrative executives. However, when the results are based upon objective measurements and not upon personal opinion, there is more possibility for improvement and less chance for dissatisfaction in a staff of teachers.

CHAPTER V

INDIVIDUAL DIFFERENCES

While it has been known for a long time that differences exist between one individual and another, it is within a comparative short period that educators have realized the importance of these differences in relation to the training of students and their preparation for future occupations. The present-day conception of education is one which holds that everyone should be educated and as a result education has been made compulsory. Consequently, there has been disclosed a wide variety of characters within the student population. The existence of these differences has led to a great deal of research on the part of administrators and teachers, the purposes of the studies being to discover how the differences are to be accounted for and analyzed, and to determine the best means of taking care of the situation. At the present time many school systems employ experts whose duty it is to classify students on a basis of deviation of traits and to work out plans to fulfill the need for differentiation of instruction and curricula for varying ability. Hildreth holds that in the process of learning, students differ primarily in (1) method of learning and (2) time required to learn (15:89). Interesting studies have been made in attempting to determine the causes of differences among individuals. Jordan lists the causes as (18:87):

1. Differences due to sex
2. Differences due to race
3. Differences due to maturity
4. Differences due to ancestry or family
5. Differences due to environment.

Within a given group most of the individuals concerned will cluster fairly closely about the central tendency of the entire group (15:88). Those who do not, will vary to a greater or lesser degree from the center of distribution and the farther an individual stands from the center, the more exceptional he is. An exceptional student is "one whose mental and physical personality deviates so markedly from the average standard as to cause a special status to arise with respect to his educational treatment and outlook" (15:89). Hildreth contends that there are three major types of deviates, as follows (15:90):

1. Deviates classified on the basis of learning capacity - the subnormal, the gifted, and individuals with special talents, capacities, and defects
2. Deviates classified on the basis of behavior - the nervous or unstable, the truant, the delinquent, the antisocial, and speech defectives
3. Deviates classified on a basis of physical defects - the student with sensory defects, physical deformities, toxic conditions, endocrine imbalance, epilepsy,

paralysis.

Analysis of the classification would reveal that there is an overlapping of the different groups and it is possible that an exceptional student may belong to all groups.

A further classification of the exceptional student has been made on a basis of learning capacity. This classification includes (1) the subnormal student, (2) the gifted student, and (3) the individual with special talents, capacities, and defects (15:90).

From various studies made of the subnormal student, the following has been observed (15:91-2):

1. The subnormal student is unable to make the average progress in school within the allotted time.
2. He has difficulty in comprehending and using meanings, and in dealing with abstractions.
3. Because he wishes to escape competition, he is more apt to miss classes.
4. He is more apt to show delinquency than does the normal student.
5. He will exercise less foresight than the normal student, being unable to see the future results of his actions.
6. He is less apt to profit by his mistakes.
7. There is usually evidence of deficiency in motor control, and this is slowly, if ever, overcome.
8. His vocabulary is limited and articulation and sentence

structure are poor.

9. He has a short attention span and exercises poor judgment.
10. He lacks aggressiveness and is overdependent upon others.
11. He deals with concrete experiences better than with abstractions.

The subnormal student is one who is very frequently misunderstood and usually there is no effort to analyse the case in an attempt to discover causes. However, it is possible that such students may become successes rather than failures in life, but only by proper understanding and suitable training (15:92).

Studies of differences in students have resulted not only in finding the characteristics of the subnormal, but the traits of the gifted students as well. The gifted student, as compared with the average or normal student (18:94-6)

1. Is superior in height and weight
2. Learns to walk and talk earlier
3. Is superior in all fields of accomplishment
4. Is more likely to be queer, nervous, or erratic
5. Is more honest and trustworthy
6. Is more mature in his interests
7. Is superior in character and temperament
8. Does not tend to become mediocre, but tends to maintain

his superior status

9. Originates in families where fathers are professional men, clerical workers, or business executives
10. Has more distinguished persons among his relatives
11. Knows more than he can do
12. Makes better use of freedom to pursue his own interests
13. Needs less drill, routine, and repetition, and suffers under too much enforced discipline
14. Should specialize later than the dull child, since his possibilities for successful achievement in a wide variety of fields is greater.

Since, as a result of the studies of subnormal and gifted children, their various traits have been ascertained, educators have been interested in determining methods of detecting the exceptional students. The individual who is an extreme variant is very easily detected, but there are those students who might be termed borderline cases and whose deviations are less extreme. The identification of such cases usually requires the services of an expert, who may make use of one or all of the following methods (15:107):

1. Questionnaires filled out by teachers and administrators
2. Examination of pupils
3. Interviews and conferences with parents and pupils
4. Observation of the individual's behavior under

ordinary circumstances.

While educators have realized the importance of determining the traits of those deviating from the normal and have used methods of various kinds in deterring the exceptional student, they have given equal consideration in making provisions for the training of students on a basis of individual differences. There has arisen a new conception in education that the schools should not attempt to equalize the students by providing equal amounts of opportunity, but should provide such opportunity as will meet the needs of the individual student (18:111). By giving the same educational treatment to all, it would seem that an attempt is being made to eliminate individual differences in students, a result which is not at all possible, and a procedure which exaggerates rather than eliminates differences. The methods used to care for these situations have been many, but the underlying principle in all methods is to make some adaptation of the amount or quality of the work carried to the ability of the student.

The first methods devised with the idea of permitting the student to progress in accord with his needs or ability were those of placing the students into homogeneous groups. By this scheme the slower students, by additional effort, were enabled to finish the course at the same time as the others. The more recent trends are to make plans of classification in order to enable each individual student to progress at his own

individual rate, as a result of which there has been a differentiation rather than an equalization of the educational progress of pupils. The objections to homogeneously grouped classes as listed by Hildreth are (15:190):

1. Ability grouping is a form of educational determinism.
2. The pupils may recognize the kinds of groups in which they are placed.
3. Such grouping is undemocratic.
4. The dull need the stimulation of the bright.
5. Students often learn as much from their bright classmates as they do from the teacher.

A plan for caring for the individual needs of the students which has been in use for several years in a public school system enrolling about four thousand students has been reported by Hildreth. In its essentials it is as follows (15:194-6):

1. Exceptionally gifted or deficient pupils are placed in separate groups. Selection of the pupils is based upon educational and intelligence tests, and opinions based on general observation. The criteria upon which the classification of pupils may be based are (15:184-5):

- (a) the pupils probable rate of mental development
- (b) the level of mental maturity
- (c) the predicted progress

- (d) the level of achievement reached
- (e) chronological age
- (f) social and emotional maturity
- (g) psychological maturity.

At suitable intervals surveys of intelligence and achievement of the entire student body are made. The highest and lowest ten percent of the classes are reexamined by individual intelligence tests.

2. The rest of the students remain in regular classes.
3. The rate of progress varies with the particular group, it being either faster or slower than the normal, and the curricula are adjusted to meet the needs of each group.
4. The pupils in regular classes may be further classified and placed in either the group of gifted pupils or sub-normal students.
5. In the scheme of classification there are no hard and fixed rules, changes and adjustments being made as occasions arise.

The use of the above outlined plan has had beneficial results in that (15:196)

1. There has been a greater retention of average students in school, resulting in better life preparation.
2. The number of retarded students in the average classes has been reduced.

3. It has proved to be a time saver for the talented student.
4. There has been a homogeneity of pupil capacity in regular classrooms.
5. There have been fewer failures of promotion.
6. There is a greater possibility for individual instruction.

Other plans have been evolved, the fundamental principles of which are similar. The methods of instruction in the classified groups obviously must differ. In discussing the modification of learning exercises for the gifted group, Herriott states that (14:15):

1. The amount of drill should be reduced.
2. The amount of review should be reduced.
3. The number of illustrations should be reduced.
4. More abstract theory should be taught and there should be more teaching by means of principles.
5. More excursions and field trips should be made for observing principles and theories in practice.
6. Pupil reports should be employed to a great extent.

By analogy, in dealing with the subnormal child, the modifications of learning exercises should be the reverse of that outlined for the gifted student.

Odell has made a study of plans now in use by high schools which attempt to care for differences in students. He states

that (25:4-13):

1. The most common plan is to allow superior pupils to carry more than the regular amount of work and requires inferior pupils to require less.
2. In some schools, sections are organized according to student ability. The bases of classification are intelligence and achievement tests, school marks, teachers' estimates of ability and capacity, and various combinations of these.
3. In other schools, groupings are made in recitation sections according to student ability.
4. Some schools grant credit according to school marks.
5. Other schools use the work-unit system, which provides for individual instruction.
6. Another plan being used is that which breaks up the work of the year into shorter units.
7. In some cases, grades are based on quantity as well as quality of work done. According to this plan the same work is pursued by all members of the class, but there are certain extra requirements which must be done by pupils to earn marks above the average.
8. Some provide special periods for taking care of individual differences.
9. Others use summer and outside work for the same provision.

10. Still others make use of supervised study to care for differences.

There are today three outstanding types of curricula being used by educators in an attempt to meet the abilities of individual students. These are the Dalton Laboratory plan, the Winnetka plan, and the system recently inaugurated at the University of Chicago. The Dalton plan is one which attempts to give the student a cultural background and at the same time to provide him with experiences which will prepare him to meet life situations. This is done by conducting the school as a community, the essential condition of which is freedom for the individual to develop himself (27:18). Under the Dalton plan each student is classified as to ability, and for each a maximum curriculum is drawn up (27:35). The student accepts the work assigned for his class as a contract, the curriculum being divided into jobs and the time allotted to each contract is one month. The working day is divided first into a laboratory period where students are permitted to work out in their own way the studies included in the curriculum. This permits the pupil to finish the work in which he is interested in a shorter time than required and allows him to spend more time on those subjects in which weakness exists (27:41). The rest of the day is spent in group conferences with the teachers for oral lessons, at which time problems of special difficulties are brought up and discussed. The features of this plan are

that each student should progress at his own rate and that each should be allowed to organize his method of working as he thinks best (27:37).

The Winnetka plan of education is one which originated and is being used in the Winnetka, Illinois, public school system. The plan as described by Washburn is as follows (36:37-50): The curriculum is divided into two parts, one consisting of those knowledges and skills which should be like - known by all students, the other consisting of stimuli and opportunities for creative work under social conditions. The technique whereby each student is permitted to progress at his own rate consists of three steps; namely,

1. The objectives are specifically stated and each child is expected to reach mastery of each objective.
2. Materials of instruction are self-instructive and self-corrective.
3. Diagnostic tests have been prepared, the purpose of which is not for grading, but to indicate wherein the individual needs assistance.

Recitations are eliminated, giving way to individual explanation and diagnostic tests and to group and creative activities. The principles guiding the plans are: "Every child has a right to master those knowledges and skills which he will probably use in life; every child has a right to live naturally, happily, and fully as a child; human progress depends on the development of

each individual to his full capacity; and the welfare of human society requires the development of a vital social consciousness in each individual" (36:50).

A more recent plan for caring for differences in abilities is the one inaugurated by the University of Chicago and placed in operation in 1930. The essentials of the plan insofar as individual differences are concerned are described by Hutchins, as follows: (17:8):

1. Class attendance is not required.
2. Syllabi of courses and sample examinations are printed.
3. Great flexibility is permitted in the method of preparation.
4. All the student has to do is prepare himself for the examination in his courses. There are no current written examinations or written papers and the student may take a comprehensive examination at any time he believes himself ready for it.

Applications

There is no doubt that dental educators have realized for a long time that some students are able to assimilate subject matter and to progress more rapidly than others. Even though rather strict standards have been employed in the selection of the students, there has always been and always will exist differences in the abilities of individual students. And yet most modern dental curricula are based upon the

assumption that all students are able to progress at the same pace and to learn the same amounts. American dental schools almost uniformly require exactly three or four years for the attainment of the dental degree and no thought is given to the fact that some students may possibly finish all of the required work in an acceptable manner in a shorter period of time. On such a basis the prime objective of the student becomes a desire to finish a minimum requirement and to go no further. If he ranks in the lower one-third of the class he is continuously exerting undue energy in an effort to maintain an average grade and thereby preventing efficient intellectual growth. If he rates as a superior student there is the temptation to meet only that which is required, and if able to resist this temptation he is retarded in his efforts and held back because the poor and average students are unable to maintain his pace. With a view toward more efficient instruction, as has resulted from experiments in providing for individual differences in non-professional education, the writer believes that dental education may profit by:

1. Grouping dental students on a basis of individual capacities. In order to execute this plan it becomes necessary to formulate criteria upon which the groupings are to be based. For this purpose, it is suggested that use be made of a standardized psychological examination, the progress of the student during the first four to six

weeks of the course, and the results of personal interviews with the teachers. By employing these standards the class may then be divided into a lower, middle, and upper third. There should exist a certain flexibility in placing an individual student in any one of the three groups as the case may require.

2. Providing for individual differences in the students after the groupings have been determined.

For the purpose of making such provisions it is suggested that different methods be used in the first two and the junior and senior years. Let us first consider the curriculum of the first two years. At this time the attention of the student is directed toward knowledge of the sciences related to the practice of dentistry. Under such circumstances it may be possible for the teacher to organize his subject matter so as to permit rates of progress based upon the student's ability. Of course a minimum standard of accomplishment must be maintained and this could be reached in the lower third of the class by more detailed instruction on the part of the teacher, using constant repetition and drill. The middle third of the class would likely reach the minimum requirement in a shorter time and a little correlated work of an advanced nature may be added. To the upper third of the class, such a scheme would offer particular advantages.

The student of this class would not be retarded by the efforts of those less capable and a great deal of added material could be introduced in his course. It is believed that such a procedure applied to freshmen and sophomore students would raise the standards of all three groups.

The method suggested in providing for differences in junior and senior students is the institution of what has been termed honor courses. During these years of instruction the major portion of time is spent performing practical clinical operations, of which in current practice a student is required to complete a definite minimum. Some students are able to accomplish this in the allotted time, while others finish the requirement at a much earlier date. It is suggested that the student who satisfactorily finishes his work at an early date be called upon to choose a phase of dentistry in which he is primarily interested, for the purpose of advanced study. This may be accomplished through the media of additional clinical work, intensive reading, or research of a technical or biological nature. In any instance supervision and discipline should be limited and the student permitted to work at his own desired pace.

The recommendation that dental educators attempt to provide

for individual differences in students does not presuppose a shorter or longer period of preparation for those of lower or higher rank. The intention of the suggestion is the organization of the curriculum so as to permit instructional loads commensurate with the student's ability in order to bring about a higher standard of efficiency in instruction and student achievement.

CHAPTER VI

APTITUDE TESTING

For many years there has been an effort on the part of educational psychologists to discover the general laws or principles of mental activity. In the beginning, experimental psychologists had little interest in the problems related to the modern science of mental testing, their efforts being concerned with the simple rather than the more complex mental processes (16:8). However, as the problems of mental testing became more intricate and students in the field became more numerous, there developed efficient types of intelligence tests. In 1905 Binet and Simon published their collection of tests designed to determine the native intelligence of school children (32:137). From the many improvements and revisions of these tests has grown the idea that in reality they do not measure general intelligence but "the 'general intelligence tests' are in reality tests of scholastic aptitude; i.e., a kind of general average of the various aptitudes for learning the different school subjects" (16:19).

A consideration of aptitude testing must clearly contain within itself a definite meaning of what an aptitude is. Webster defines an aptitude as "a natural or acquired disposition or capacity for a particular purpose, or a tendency to a particular action or effect." An aptitude test, according to Langlie is "a measure of special native and acquired capacities

to achieve" (19:659). Hull defines an aptitude test as "a test designed to discover what potentiality a given person has for learning some particular vocation or acquiring some particular skill" (16:50).

Historically, the first group of psychological tests were individual tests. There have been devised, however, in recent years, other forms of tests which may be submitted to groups. At present there are many considerations of tests which are used for aptitude measurement. Some of these are (16:60-110);

1. Tests for general scholastic aptitude

These tests are of a type of a general or universal intelligence test by means of which the various types of attitudes of an individual may be separately forecast.

2. The number of test units employed in test batteries

Since most aptitudes are of such complexity that a single test will rarely suffice in making a useful prediction, batteries of tests are practically the universal form of aptitude tests at the present time.

3. Miniature tests and tests of abstract traits

(a) Miniature tests are those which attempt to duplicate all in one test the essential activities of the occupation.

(b) Tests of abstract traits are those which are designed to isolate and measure separately the component traits supposed to constitute the

determiners of success in the aptitude in question.

4. Apparatus and non-apparatus tests

These tests are made on a basis of whether or not apparatus is used. In the former, some type of apparatus is used to test the subject in the necessities of occupation, while the purely verbal tests of the oral type exemplify the latter.

5. Individual and group tests

This grouping is made from the point of view of the number of subjects that may be tested by a single examiner at one time.

6. Time-limit and work-limit tests

The time-limit test is one in which the amount of work done by the subject is limited to a certain time.

The work-limit test is one in which a specific amount of work is to be done and the time required for completion is noted.

7. Tests of motor efficiency

These tests have been devised and standardized for the purpose of measuring physical and motor capacities.

8. Tests of character and temperament.

These tests have been evolved with the invention of measuring the great variety of character traits.

In addition to the various types of aptitude tests, students of educational psychology have probed into other

approaches to aptitude prognosis which are regarded as signs. Some of the signs which are used in determining aptitudes are (16:110-155):

1. Physiognomy and phrenology
2. Character judgements based on photographs
3. Blond and brunette colorings as signs of temperament
4. Character judgements based on seeing the subjects in person
5. Convex and concave profiles
6. Dimensions of the head
7. The endocrine glands
8. The shape of the hand in the revelation of character
9. Revelation of character through the handwriting
10. Chemical composition of the urine as an indicator of temperamental traits
11. The relation between character traits and chemical constituents of the blood
12. Heart rate and blood pressure as signs of aptitude.

Since it is evident that single tests are never adequate for definitely detecting inward dispositions or capacities and because aptitudes are made up of a complex of abilities, it becomes necessary to devise for a particular type of study or occupation, a battery of tests. Much thought and study has been given to the construction of test batteries, which are not a random aggregation of tests but are tests devised in a scien-

tific manner. The method by which a scientific battery of tests may be constructed may be portrayed in six definite steps (16:231):

1. Make a careful psychological analysis of the activity or vocation under which the investigation is being carried out. The purpose of this analysis is to discover what traits or characteristics of human behavior lead to success or failure in this field. There should be available for this analysis a number of people in various stages of training, with a wide range of aptitude in the vocation.
2. Select a preliminary battery of tests which will measure the various pivotal traits emerging from the aptitude analysis as probably significant.
3. After having tested the tests and discarded the useless ones - administer the preliminary battery of tests to a large number of individuals who are about to start training in the aptitude under question, but who have not as yet had any actual experience in it.
4. Secure a quantitative determination, which is called the criterion score, of the final aptitudes or vocation proficiencies of a trial group of subjects after they have finished their training.
5. Check the test scores of the trial subjects as secured in step three, against their criterion scores as secured

in step four. Those tests which show coefficients feebly related to the criterion should be discarded.

6. Determine the relative value and importance which should be given the surviving tests.

While there seem to be great possibilities in the realm of aptitude testing, there are many pitfalls, both in the compilation of the tests and in their administration. Hanna contends that aptitude tests, to be workable and efficient should be based upon the following standards (13:258-60):

1. An elastic and up-to-date analysis and standardization of work situations must serve as a background.
2. The translation of job functions into human specifications must not neglect work attitudes, driving power, and such like, in preference to aptitudes.
3. The technique for discovery and measurement of these essential human qualities must be sufficiently inclusive and reliable, being human as well as statistical.
4. Standards for the administration of test technic for the interpretation of test results require the attention and skill of well equipped specialists.

Having defined aptitude and its testing, and discussed the types of tests and signs and the evolution of a battery of tests, it would seem propitious to outline the elements of a scientific aptitude test recently given to a group of research students at one of our large universities. These elements were

(38:529-30):

1. Clarity of definition
2. Suspended vs. snap judgement
3. Experimental bent
4. Discrimination of values in selecting and arranging experimental data
5. Detection of fallacies and contradictions
6. The ability to reason
7. Accuracy of systematic observations
8. Inductions, deductions and generalizations
9. Accuracy of understanding and interpretation
10. Caution.

While aptitude testing, as such, is in comparative infancy, and there are some who maintain that training tests, or "measures of achievements and experience" (19:659) are more efficient in determining latent capacities, the future seems to hold much in store for the development of ability to measure success or failure in the measurement of natural capacities.

Applications

Literature relative to the testing of latent capacities seems to indicate that in certain subjects tests have been devised which have proved of considerable aid in determining in advance which beginning students are likely to succeed and which are likely to fail. The matter of aptitude testing seems to be one of the procedures of nonprofessional education which dental

education has begun to give some thought, as evidenced by the fact that at recent meeting of the American Association of Dental Schools several of the essayists have given the subject some little consideration. A test applied to beginning dental students would be of distinct advantage to the dental school and to the student and the writer advocates that:

- (1) A battery of scientific tests be constructed with a view toward attempting to determine in the beginning which of the students are and which are not capable of successfully completing the required training. At the present time it is doubtful whether there are many individuals who have both a knowledge of the requirements of a dental student and scientific experience in the construction of aptitude tests. It would seem wise that such a battery of tests be constructed by a group of persons, some of whom are familiar with the activities of the dental student, the others having had actual experience in the formation of prognosis tests. Such a procedure would add to the scientific aspect of the work. It must be understood, however, that until there is actual proof that the test accomplishes that which it is supposed to do, it will be entirely tentative and experimental and should not be used in the deflection or deletion of any students. To be of practical value it would seem that an aptitude test

for dental students should attempt to check two different types of capacities. The first of these is the aptitude of a student for the abstract reasoning needed in the theoretical courses in the dental school. Such a test, supplemented by a study of the student's previous high-school and college record and a consideration of his progress in the various dental courses supplies an accumulation of evidence which becomes a stable basis of estimate. The second type of ability to be measured by the dental aptitude test would be that which has to do with the technical skills demanded in dental training. Technical work on models and on living tissue demands hand-eye coordination, motor skills, and craftsmanship, the possession of which is not universal. A student may rank high in a test of general learning ability and not be fitted for the technical work, or the reverse may be true. It would appear that good prognosis tests of technical skill should include tasks similar to those which the student will be called upon to perform in his actual training, placing emphasis on real manipulation and construction in advance of any teaching.

- (2) A study of progress in pre-dental and dental subjects be made attempting to discover whether or not these in themselves are of prognostic value.

To the knowledge of the writer, the application of such a study has never been made. It may be that progress in certain studies may indicate whether or not a student possesses the ability to succeed. For instance, this type of study may reveal that students who have low grades in a particular group of subjects are universally poor risks. An investigation of this sort and its applications could be made at once, using the grades of past students for the study, while the construction of a proven aptitude test would require a considerable period of time.

The ability to predict the success or failure of dental students would be of inestimable value to the dental educator. When a dental institution accepts its students, certain responsibilities are assumed and if the students themselves do not possess the capacities to grasp the instruction given, the school finds it impossible to fulfill its responsibilities. An aptitude test of proven worth would eliminate this difficulty.

CHAPTER VII

METHODS OF RESEARCH

Coincident with the progress of education there have developed many complexities and problems, the solution of which has been necessary that the advance might be rhythmic in its progression. The endeavor to investigate and to correctly answer these issues has resulted in the evolution of the institution of higher learning and of scientific methods of analysis, known to the educator as research. While it is somewhat difficult to find a clear and precise definition of research, it is generally agreed that the result of the investigation should be a law or truth. In establishing a definition of research, Schmidt works toward the determination of which laws or truths should be excluded by the definition to be given. He states that it is necessary to exclude laws or truths arrived at by chance; to exclude the study of problems which one might solve without resorting to some body of organized truth; to exclude a mere collection of facts; to exclude the mere acquisition of that which has already been said by others; and to exclude that which one might develop through his own efforts without recourse to other objective evidence (30:1-3). With these criteria in mind, Schmidt defines research as being, "an orderly and purposeful attempt, in the field of philosophy, the arts, or science, to discover, extend, or verify a law or truth by a process involving original thinking and the exploration of

evidence" (30:3).

With the realization that deficiencies exist in their everyday procedures, educators have built up certain methods in attempting to correct these difficulties. While the manner of portraying these methods differ in many cases, the essential sequence of procedure as cited by Good is characteristic. These steps are (12:78),

1. Selecting the field, topic or subject for research
2. Surveying the field to apprehend the research problem
3. Developing a bibliography
4. Formulating or defining the problem
5. Differentiating and outlining the elements in the problem
6. Classifying the elements in the problem according to their relation (direct or indirect) to the data or evidence
7. Determining the data or evidence required on the basis of the elements in the problem
8. Ascertaining the availability of the data or evidence required
9. Testing the solvability of the problem
10. Collecting the data and information
11. Systematizing and arranging the data preparatory to their analysis
12. Analysing and interpreting the data and evidence

13. Arranging the data for presentation
14. Selecting and using citations, references, and foot-
notes
15. Developing the form and style of the research
exposition.

A study of this manner of procedure discloses the fact that the first step is the selection of a problem. The research worker, realizing the existence of a difficulty in his particular field, feels the necessity of a solution and the origin of the problem takes place. While many suitable problems may be found in any general field and there is an opportunity for choice, the worker must consider the purpose of the problem in making his choice. Almack states that a student may select a problem because its solution enables him (1:35-6):

1. To satisfy a personal interest or curiosity
2. To furnish a basis for confirming some earlier study,
or a basis for some future study
3. To meet a social need
4. To serve a utilitarian purpose.

While one engaged in research work may realize the purposes which the problem should serve, much time and study are required in a worthwhile selection. The student must keep in mind the various criteria by which the subject is to be judged. These standards as outlined by Schmidt are (30:6-11):

1. The problem must not be a duplication of that which has

already been done in a scholarly manner by another.

2. The subject should require original thinking.
3. The subject should require the exploration of evidence.
4. The subject should be conceived as a problem.
5. The problem should be solvable.
6. The problem should be sufficiently substantial.
7. The problem should not be too large.
8. The problem should be delimited and analyzed into its elements.
9. The problem should be the outcome of thought and reading.
10. The subject should be of interest to the worker.
11. The problem should have a sufficiently abundant literature.

Having considered these criteria in the tentative selection of the problem, the next step in the procedure is a preliminary survey of the literature of the field. This is necessary in order to ascertain what has already been investigated on the problem or closely related problems. In addition it may suggest other subjects which might be investigated, sources of data, methods of attack, techniques to be employed, and possible mistakes to be avoided (29:29).

After the general problem has been given due consideration and the fact established that it is justifiable and is not a duplication of the scientific work of another, an analysis and delimitation of the subject must be made. This is necessary

in order to insure effective collection, organization, evaluation, and interpretation of data and prevents the mistake of including too much in the problem (29:23).

Educators are in general agreement that there are four distinct types or methods of research; namely, the philosophical, the historical, the survey, and the experimental. When the problem for investigation has been definitely stated and defined, one of the above methods must obviously be appropriate as a means of attack. The philosophical method is one which has little regard for the observation of phenomena, and one by which new laws or truths are derived from the observation of facts of every day occurrence which cannot be contradicted or laws which already have been established (30:21). It embraces such knowledge as logic, metaphysics, ethics, psychology and theodicy (30:22).

The historical method is used in an attempt to discover the truth concerning some past event or events by the accumulation and interpretation of evidence (30:26). This method is one which at first sight might seem easy, but difficulties arise when the thought is advanced that it includes not only data of a secondary source, but also involves the interpretation of primary data. In addition to this, the worker is confronted with the possibility of unreliable, prejudiced, or incomplete data.

The survey technique differs from the historical in that the evidence explored pertains to the present rather than to the

past; its purpose is to determine what is happening (30:31). In its present status the survey is usually applied to institutions and to political units, such as schools, churches, cities, counties, and organizations. In this type of research it is very easy to merely accumulate a mass of data and the worker must be sure of the existence of a research problem (30:33).

In the experimental type of research, once the problem has been formulated, an hypothesis is set up and put to test by experiment (1:151). Observations are made under controlled conditions in an effort to observe the influence of a certain factor or factors upon some other factor or factors. The aim of the person conducting the experiment is to arrive at a generalization; a truth stating that when certain things happen the results will be constant if the experiment be repeated either by himself or by others.

Inasmuch as good research work includes not only original data compiled by the student, but a survey of the literature of the field as well, methods of bibliographical procedure are essential. A preliminary examination of the literature has been previously made to avoid duplication and to justify the research, but at this point the working bibliography as compiled comprises the material directly and indirectly related to the study (1:223). Everything which may be considered as pertinent material needs careful perusal and the good worker is prepared at all times to make note of any items which he thinks will have a reference to

his particular problem. The care with which each reference is examined depends upon its relativity to the question at hand and its probable helpfulness. The worker must be acquainted with the sources from which his bibliography may be obtained and in this regard nothing is more essential than the knowledge of the use of a library (1:225). While there are many library classifications and notations, the worker should be familiar with those particular ones from which the bulk of the material is to be gathered. In the compilation of literature, educators find that good bibliographies are judged by three standards (1:226-7):

1. While hardly possible that it be absolutely complete, it should be the aim of the worker to include everything of pertinent value.
2. Accuracy is another essential of a good bibliography. Undoubtedly others will have occasion to read a report of the work, and the reliability of the reference is not only a feature which is pleasing, but a basis upon which the reliability of entire work may be judged.
3. The convenient use of a bibliography requires effective and comprehensive organization. The organization of the items in all respects should be uniform, the references to all books and articles being made in the same manner. The worker must be trained to work independently in the utilization of sources of material,

as the card catalog, bibliographies, indexes, and other reference guides.

A vital problem to one engaged in research work is the ability to read quickly and gain from the item being perused the maximum comprehension (30:20). In addition to being able to evaluate and read material, the student should have a well organized and systematic means of taking notes. The efficient compilation of a bibliography depends much on an orderly system of reading, and talking and filing notes (30:20).

The review of literature makes it necessary that there be some method of citing the references or sources. The authority for any important statement, whether it be fact or opinion, should be cited. All necessary data on a reference, as the name of the author, the exact title, and the pages referred to, should be tabulated. At the present time there are two accepted methods of making citations (29:55). The use of footnotes is the older and more widely used system and requires the mastery of various rules with regard to its use. The other plan is to cite the references in the body of the pages of the manuscript, placing the citations in parentheses or brackets immediately following the statements which they are intended to support.

Data in research work may be collected either by personal investigation or by means of the questionnaire (29:34). The most scientific method is by personal investigation, as this adds to the scientific aspect of the work. The means available

for personal investigation are correspondence, interviews, examination of needed sources, and the actual administration of an experiment or experiments. In collecting data through personal investigation the worker has many techniques of which he may avail himself, such as thorough analyses, many types of experimental procedures, historical facts, the interview, legal statutes and decisions, survey techniques, test construction, observation, job analysis, and case study. To be scientifically effective, the questionnaire should be given careful and considerate study as to its construction and design and the fact predetermined that the returns will contain the specific data which the worker is attempting to secure.

A very important consideration which confronts the research worker is the classification, organization, and interpretation of the data which he assembles. All data should be organized and classified into its regular sequence and importance.

Honesty and accuracy are of prime consideration and there is no place for the preconceived ideas and opinions of the author. The ability for accurate deductions and honesty in reporting what is found are characteristics of good research. Schmidt states that the interpretation of data is to a large extent determined by the technic adopted in the research work, and offers the following suggestions for interpretation of research data (30:68-74):

1. Check all fundamental assumptions.

2. Know the constituents of the thing being studied.
3. Examine all possible factors and causes.
4. Challenge the validity of the data.
5. Treat quantitative data statistically.

Schmidt also lists a number of errors to be avoided in interpreting results of research. These are (30:74-77):

1. Errors due to dishonesty
2. Errors due to bias
3. Errors due to faulty preparation
4. Errors due to faulty data
5. Errors due to statistics.

The last item of procedure that the research worker must consider is the written report of his work, known as the thesis. He must now make known what his contribution is and this justifies the appearance of his report in a definite typed or published form (37:186). A well-written report possesses the following characteristics, as outlined by Schmidt (30:82-84):

1. It is written to a scientific audience.
2. It is impersonal and modest.
3. It avoids the oratorical, the ornate, and the poetical.
4. It presents its data effectively.
5. It is well documented.
6. Quotations are used judiciously.

In general the divisions of a good outline of a research report are (30:85):

Title page, vita, preface, table of contents, list of tables, list of figures, introduction, body chapters of the thesis, conclusions, appendices, bibliography, and index. The purposes of the title page, vita, table of contents, lists of tables, and figures, appendices and index are explained by their titles. The introduction should contain a clear statement of the problem with its delimitations, a review and summary of related investigations, definitions of terms, an explanation of the methods of attack, and the probable value of the work. Following the introduction, there is a chapter of extensive and comprehensive review of the literature relative to the question under consideration. The next logical discussion in the body chapters of the report is a detailed explanation of the method by which the data were secured. The conclusions include a brief review of the work from the problem through the establishment of the principle. The purpose of the conclusion is to present, (1) a summary, (2) a statement of the contribution, (3) a statement of limitations of the study, and (4) suggestions for further investigations in the same field (1:263). The concluding section of the report consists of the bibliography. The annotation of each item should contain a short description of the item or any part of it which relates to the project (37:138). The items should be conveniently arranged, preferably in alphabetical order by authors. This facilitates verification of references to a reader of the report and is of assistance to those who may wish

to use the bibliography for further references in related fields.

Applications.

That phase of dental research which has to do with the investigation of technical procedures and biological principles has recently become quite popular within the dental profession. This is evidenced in the fact that at a recent meeting of The International Association for Dental Research over one hundred reports were read dealing with different types of investigations. However, none of the problems of dental teaching were covered by the investigators and dental literature concerning research in principles and procedures of dental education is rare. Because dental education does have its problems, which are fundamentally the same as those which have been faced in other fields of education, and dealing with administration, the art of teaching, the teachers themselves, the students, and the subject matter to be taught, it is suggested that administrators of dental schools make use of those types of research which have been of definite aid in solving some of the questions relative to non-professional education. In order to do this, however, it becomes necessary that:

- (1) Those members of dental faculties who possess the inherent capabilities, familiarize themselves with the principles and tools of scientific educational research. That dental educators are cognizant of the fact that

educational problems do exist is manifested by the fact that each year in the meetings of the American Association of Dental Schools, papers are presented which deal with principles and procedures of non-professional education. However, the readers of these essays, because they are engaged in nonprofessional fields and are not familiar with dental education, are unable, in most instances, to make definite applications to dental teaching. While these contributions are of great value, the writer is of the conviction that they would be more profitable if discussed by one who has had the experience of dental teaching and in addition is familiar with the technique of educational research.

- (2) Having become acquainted with scientific research procedures, dental teachers attempt to solve some of the problems existing in their particular fields. The present trend of research within dental faculties is of a technical or biological nature and not much in educational work is being done. While there may be some who would contend that so much has been done in non-professional education that there is marked confusion, and that so much has been injected into education as to exclude many of the fundamental essentials, the author believes that some of this

research work may prove beneficial to dental education. Although such work may be very efficiently done by others, there is little doubt that the applications referred to in some of the previous chapters of this paper would be of more practical value if investigated by dental teachers who have been trained in research techniques. Caution should be taken that the investigations be conducted by teachers who are particularly adapted to such work and that too much is not included as to encourage an indifference to teaching.

- (3) Dental schools establish graduate schools for the fortification of their teachers and the advance of the dental profession. The graduate school in non-professional education became a necessity when its students began to think and to work independently of its teachers. It is only natural that those engaged in dental study should assume these attitudes. With regard to the dental teacher it may be said that participation in research work in his own field of endeavor supplies him with a better foundation in his subject and gives him more confidence in presenting his material. In addition, it develops his power to think independently, creates an attitude of open-mindedness, skepticism, and tolerance and has a beneficial influence on the students. Concerning the graduate student, it

it is evident that the lack of aptitude naturally excludes some from study of a research nature and the first consideration should be the selection of the type with essential abilities. When a student has been accepted in the graduate school he should be given proper advice and guidance. Whenever possible the adviser should be one who has knowledge of the profession and its needs in research and in addition has had training in the methods of scientific investigation. In many cases such a combination is not available, and the writer suggests that such courses in research techniques as offered in the department of education in most university graduate schools not only shall be available to the graduate student in dentistry, but shall be required when practicable.

The graduate student in dentistry, as in other branches of education must be made cognizant of the characteristics of scientific research; he must be aided in the selection of worthwhile problems for investigation; he must be taught to read the literature of his major field in order to justify his investigations; he must be trained to delve into the past, explore the present, or to carry on experiment, and his power to think independently must be developed; he must be scientific in his analyses, realizing that

a truth is a truth, a fact is a fact, and must be so reported, regardless of what his own ideas and opinions are or might have been. When dental educators are able to produce students who are able to conform to these principles, they may expect to find improvement in dental education and in the end, an advanced dental profession.

CONCLUSIONS

In the foregoing pages the author has attempted to outline some of the current procedures of non-professional education and to show where some of these principles, if applied to dental education may be of advantage. It is realized that the discussion afforded each of the topics is limited, for much more could be said concerning each one and an individual who would attempt to undertake the solution of any particular phase will find that there is an abundance of literature to be had relative to the subject. To a reader it may seem that the number of topics discussed is also limited, but the writer, in choosing these, attempted to include those which had to do with applications to dental training. Certainly there is a distinct place in dental education for such phases of training as character education, educational guidance, extra-curricular activities, school health problems, and many others, but in view of the average age of the beginning dental student it may be supposed that this training has been given consideration in the previous education of the student. However, the dental teacher is obligated to continue these phases of education, not in specified courses of study, but by action and example.

The applications as suggested are a matter of opinion and one who is familiar with the experiences of dental teaching will realize that some of the results of research in behalf of non-professional education should be applied at once to dental

education, while other findings, although of some value, may be permitted to remain dormant until the more important applications have been attempted. The suggestions which the author believes would be of most value to dental schools and should be given immediate attention are:

1. Training of dental teachers in the art of teaching
2. Supervision of instruction
3. Consideration of methods of instruction
4. A curriculum based on the needs of the dental practitioner, with an attempt to bring about greater coordination between individual subjects
5. A study of the meaning of grades and a marking system, and the construction of a well balanced examination program
6. The selection of students on a basis of past performance and the results of a scientifically constructed test of capacities
7. Graduate education and research both in dental science and dental education.

Other thoughts which have been offered may be just as important but the author believes that investigations should be directed first toward the topics of the above outline.

An analysis of the suggestions as made by the author will show that some phases will require research investigation, while other applications may be made without any previous study. It

is suggested that the following be subject to research study in order to justify their use:

1. A study of the relation between dental and collegiate subjects to determine what studies should be included in predental work
2. The construction of a satisfactory dental curriculum
3. An investigation concerning grade distribution in dental schools
4. The building of standardized tests in dental subjects and the results of their use
5. The formation of a satisfactory scheme for evaluating instruction
6. The formation of a proved scientific aptitude test for beginning dental students

To a reader of this paper it may appear that there is something wrong with dental education. The writer has not intended to create this impression. In fact, dental education is to be commended on its progress during its relatively short period of existence. The ideals of dental teaching may be compared with the moral ideal of the human, always receding and enlarging and never reached. One interested in dental education is always able to comprehend and imagine thoughts, principles, techniques and skills which are higher than the present level.

It is realized that should any one dental school attempt to make use of the suggested applications at one time a rather

chaotic condition would be the result. If investigations are to be made, they should be considered one or two at a time and in different schools. In this manner, through publication of the results obtained, all dental schools would benefit. The writer is of the conviction that the path to improvement in dental education lies in the participation of its teachers and administrators in extensive study and research in education as applied to their own particular field of endeavor.

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The thesis "Some Current Educational Procedures as Applied to the Problems of Dental Education", written by Robert Wilkinson McNulty, has been accepted by the Graduate School of Loyola University with reference to form, and by the readers whose names appear below with reference to content. It is, therefore, accepted as a partial fulfilment of the requirements of the degree conferred.

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May, 1932

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