The Encyclopedia of Education

The ENCYCLOPEDIA of EDUCATION

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SAFETY EDUCATION

Accidents are one of the most serious social and personal problems facing our nation. They rank fourth among the causes of all deaths and first among the causes of death in the age group from one to 44. Specific causes of accidental fatalities and injuries include motor vehicle accidents, fires, burns, drownings, poisonings, falls, and accidents with firearms. It is, therefore, most essential that young people become familiar with the hazards of modern living and learn how to live safely in their environment.

One of the best ways of combating the accident problem is a high-quality safety education program in the schools. Strong administrative leadership in such programs is essential for developing a safe school environment and ensuring that safety education is part of the total school program. Effective teaching by properly trained teachers is necessary to influence every student to protect himself and others from potential dangers in all circumstances and develop the proper habits, knowledge, skills, and, most important of all, attitudes for safety.

An effective safety education program conveys certain basic concepts to the student: (1) Accidents waste time, money, and life, but most of them can be avoided. (2) Accident prevention is not the task of a few people but the responsibility of many. (3) Safety enables the individual to enjoy adventure without the hazards of accidents. (4) Safety is related to physical and mental health and requires adjustment to the situation, not just perfunctory behavior. (5) There will be a reduction of accidents when man accepts greater responsibility for his acts, when he takes fewer foolish risks, and when there are more effective environmental controls. (6) In order to prevent accidents, it is necessary to know how they occur.

Guidelines for planning a safety program are provided in the Safety Charter for Children and Youth, developed by a joint committee representing seven departments of the National Education Association, the Society of State Directors for Health, Physical Education, and Recreation, and the National Safety Council.

Instructional patterns and techniques. The teaching methods used for safety education are governed by the ultimate objectives of the program. The primary objectives are to teach correct behavior and provide a wide variety of experiences which will enable the student to make wise decisions when the possibility of injury arises. There are three specific patterns of instruction that may be used: (1) direct teaching, (2) correlation, and (3) integration.

Direct teaching is used in two basic situations. First, it is used in courses concerned exclusively with safety, which, like history or chemistry, are distinct subjects in the curriculum. Second, it is used when a teacher of another subject—such as social service or health education—includes one or more units on safety in the regular course. The direct teaching method is most appropriate at the junior and senior high school levels, where subjects are compartmentalized.

Correlation involves the use of other curricular areas as vehicles for safety education. In the elementary grades, for example, where the teacher has the same pupils most of the day, it is possible to incorporate safety education into other areas.

Integration is a radical departure from the other two patterns. Instruction revolves around a central theme or objective and relates parts of the subject to the whole. Thus, all of the instruction supports a single purpose.

In many instances a combination of patterns of instruction may be used, or safety instruction may be centered around student organizations

and activities—such as student safety councils, safety patrols, and student government.

The instructional techniques used in teaching other subjects can also apply to the teaching of safety. The traditional approaches of discussion, lecture-discussion, reading assignments, and demonstrations are often used. A problem-solving approach to discussion is particularly effective; this involves the presentation and analysis of a real problem which culminates in a conclusion or solution. Dramatizations (in the form of pantomimes, playlets, role-playing, and debates) and oral presentations by panels or individuals are useful techniques.

Various outside activities promote student interest and involvement. These include individual or class projects to compile information, collect objects, or construct materials and surveys and inspections of the school, home, or community, involving the scientific investigation and study of specific problems. The teacher can utilize the resources of the community by taking the class on a field trip or inviting an outside speaker to the school.

The choice of instructional techniques depends on various factors: the nature of the students; the teacher's personality, competence, and background; the time allotment; the materials available; and the administrative organization of the school.

Many instructional techniques can effectively use audiovisual materials. Fortunately, there are excellent audiovisual materials—such as films, slides, records, tape recordings—dealing with various aspects of accident prevention. Sources for these materials include national, state, and local educational agencies, college and university audiovisual departments, insurance companies, automobile manufacturers, and motor clubs. Audiovisual materials are usually provided at no cost to the school.

Content. The basic areas which safety education should deal with are (1) traffic safety—for pedestrians, drivers, bicyclists, and motorcyclists, (2) safety in sports and recreation, (3) home safety, (4) disaster procedures, and (5) safe use of firearms and other equipment.

Traffic safety. Traffic safety is an increasingly complex problem. Over half of the people in the United States are licensed drivers, and more than three million young people reach the driving age each year. There are 25 million bicyclists, 90 percent of whom are children. Because of the great number of motor vehicles on the streets and highways and the increasing traffic congestion in the cities, accidents involving pedestrians are becoming more frequent. Traffic accidents are the leading cause of death among children. For these reasons, traffic safety is obviously one of the most important concerns of safety education programs in the schools.

Education in traffic safety involves instruction not only in the proper use of the automobile but also in sound pedestrianism, bicycling, and motorcycling. Every student should be given the opportunity to develop the habits, skills, knowledge, and attitudes essential to the intelligent use of streets and highways.

Various studies of the pedestrian accident problem have illustrated that a sound education program can be effective in promoting pedestrian safety. A well-organized program requires the cooperation of the community, particularly law enforcers, traffic engineers, safety councils, and various public information media and provides learning experiences that lead to an understanding of safe pedestrian practices. A list of safe practices could serve as a starting point in developing a pedestrian education program. One such list is *Pedestrian's Rights and Duties Listed in the Model Traffic Ordinances* (National Committee . . . 1968), a guide for sound pedestrianism that was developed over a period of years by the National Committee on Uniform Traffic Laws and Ordinances in Washington, D.C.

Formal instruction in traffic safety should be started the day a youngster begins school for the first time and should be integrated into or correlated with everyday learning activities in the elementary and junior high schools. At these levels the objective of traffic safety education should be to help reduce deaths and injuries from traffic accidents by developing in the student (1) a sense of responsibility for the safety of himself and others while going to and from school; (2) recognition and understanding of situations involving traffic hazards; (3) understanding and appreciation of the work of police officers, school traffic safety patrols, adult crossing guards, traffic engineers, and others concerned with safety, and recognition of the need to obey them; (4) understanding of the meaning and need for obeying various aids to safety along streets and highways —such as signs, signals, and road markings; (5)

habitual use of the safest route to and from any area; and (6) understanding of the causes of traffic accidents and knowledge of what is being done to reduce them (Office of Superintendent of Public Instruction 1963).

The particular traffic safety program in high schools is commonly called driver education. It is usually a separate course but can also be integrated with other subjects—such as health education or social and physical sciences.

The recommended high school driver education course is divided into two phases. The classroom phase consists of learning experiences centered on classroom instruction. The second phase, usually known as the laboratory or practice driving phase, provides actual driving experience on the streets and highways or on an established driving range, using a dual-control automobile.

The recommended minimum time allotment is 30 clock hours for the classroom phase and six hours for actual driving experience. The practice driving requirement can be partially fulfilled by the use of driving simulators and the driving range. Best results are obtained when the student is taught by a teacher who has met state certification and other requirements.

The increasing use of the bicycle as a means of economical transportation, recreation, and developing and maintaining physical fitness has added to the traffic safety problem. Bicycle accidents are annually responsible for a considerable number of deaths and injuries, particularly of young people. Since the great majority of bicycle riders are school-age children, the problem of bicycle safety should command the serious attention of students, parents, and schools. Teaching bicycle safety in the elementary schools would be an appropriate method of preventing accidents and also providing basic training for future motor vehicle operators.

Because the bicycle is considered a vehicle by state laws, it is necessary that bicycle riders abide by motor vehicle regulations. Nationwide statistics show that three of every four bicyclists injured in a bicycle–motor vehicle collision were violating some traffic law or safety practice, and one of five bicycles involved in accidents had some mechanical defect. Therefore, bicycle safety programs should be primarily concerned with teaching traffic laws, safety practices, and proper maintenance of the bicycle.

An effective bicycle safety program would assist in reducing accidents by helping students to (1) understand traffic regulations that apply to cycling; (2) develop habits, knowledge, attitudes, and skills conducive to safe cycling; (3) acquire knowledge necessary to maintain the bicycle in safe operating condition; and (4) acquire skills necessary to operate a bicycle on streets and highways at all times and under all conditions. Learning experiences should be provided whereby bicyclists can achieve these objectives. Useful resources for teachers include the publication *Model Traffic Ordinances*, which states the regulations for bicycles, and information provided by the Bicycle Institute of America and the National Education Association's Commission on Safety Education, which deals with selection and maintenance of bicycles and with correct techniques of riding.

The use of motorcycles for transportation, touring, and sport has reached a new peak in this country in recent years, and the number of motorcyclists is growing every year. This development has been accompanied by a sharp rise in accidents involving these vehicles. During the 1960's the number of motorcycle driver deaths increased from about 700 a year to more than 2,000.

Because the motorcycle appeals to younger people and because this group has the greatest number of deaths and injuries, there is undoubtedly a need for a systematic instructional program for beginning motorcyclists. Many motorcycle accidents seem to stem from the same causes as automobile accidents. Since all states now provide high school driver education programs for beginning automobile drivers, similar programs could be developed for motorcyclists. Because of the close relationship of motorcyclist to motorist and the need for mutual understanding, it is desirable to correlate motorcycle safety with regular driver education programs. Researchers at State University College at Oswego, N.Y., organized a meaningful program for motorcycle driver education and demonstrated that this program brings beneficial results (Dunn 1967).

Areas which could be included in a motorcycle safety program are familiarization with the motorcycle, laws and rules of the road, motorcycle operation (including instruction on controls, proper riding habits, and maintenance; skill exercises; and road tests in traffic), accidents and traffic hazards, and the psychology of motorcycle riding. Excellent teaching materials are available

from the Motorcycle Scooter Allied Trades Association and from most motorcycle companies. Universal Underwriters Insurance Company provides an excellent guidebook for motorcycle driver education instructors.

Safety in sports and recreation. Various studies have shown that the majority of school accidents occur in the physical education or athletic programs. Obviously, this type of activity exposes students to more dangers than normal classroom activities. Nevertheless, safety education programs can do much to increase safe participation.

All too often a factor contributing to accidents, particularly at the elementary school level, is that many classroom teachers must teach physical education without adequate preparation and competence. Sometimes they do not even have the help of specially trained supervisors. Studies reveal that poor leadership is directly responsible for many accidents in athletics. A thoroughly competent recreation leader, coach, or instructor can minimize or eliminate most of the conditions that are likely to cause accidents.

Four basic requirements, understood and practiced by well-prepared and professionally trained leaders, will go a long way in providing safe participation: (1) understanding the hazards involved in each activity, (2) removing unnecessary hazards, (3) compensating for hazards which cannot be removed, and (4) creating no unnecessary hazards. Since no teacher or coach can watch every participant every minute, it is important that participants be made to follow these basic requirements and to understand the importance of developing individual responsibility for their own safety.

In recent years greater emphasis has been placed on the subject of safety in physical education by the American Association for Health, Physical Education, and Recreation. The association holds national conferences on accident prevention in physical education and athletics and has developed the textbook *Accident Prevention in Physical Education and Sports.* The National Safety Council and the American Medical Association have also demonstrated much interest in this area.

Another important reason for the schools' responsibility to provide instruction for safe participation in sports is that millions of people engage in sports and recreational activities outside of school. Since swimming and many other types of water activities are so popular, safety education programs should be concerned with swimming ability. Although the American Red Cross, YMCA, Boy Scouts, and other organizations have done a great deal in promoting and conducting education programs in water safety, drownings still rank high in accidental deaths, particularly among young people. There is an increasing number of drownings in backyard swimming pools, especially of youngsters under five years of age. Of the millions who frequent beaches each summer only a small percentage are skillful swimmers capable of handling themselves and others in the hazardous situations they may encounter.

There is unquestionably a need for expanded school programs in swimming safety. Every physical education program in the public schools should emphasize developing good swimming and diving ability; the schools must go beyond the point of teaching youngsters to swim only well enough to expose them to danger.

Boating is an increasingly popular water sport, enjoyed by approximately one-fourth of all U.S. citizens. Lack of proper training causes it to be a hazardous activity. Factors contributing to the dangers of boating are inexperience in boating, inability to handle oneself and others in a water emergency (often due to poor swimming and lifesaving abilities), unsafe or unsportsmanlike behavior, and unsafe condition of the boat (for instance, poor mechanical condition, overloading, or lack of life preservers).

The American Red Cross and the Coast Guard Auxiliary have aided immeasurably in reducing the deaths, accidents, and injuries that occur annually as a result of unsafe boating. However, boating education programs in the schools, minimum and maximum age limits for boaters, and required licensing of operators are still much needed.

Skin and scuba diving, water-skiing, and snow skiing also attract millions annually. The dangers of these sports are minimized if the participants are well trained by expert instructors. Organizations conducting these activities and manufacturers of equipment have developed rules and regulations for safe participation. These are useful for safety education programs in schools where many students participate in these activities.

Home safety. Despite the feeling of security many people have in their own homes, the problem of home accidents is one of great magnitude. More than twice as many injuries occur each year

in home accidents as in motor vehicle accidents, and accidents in the home account for nearly twice as many fatalities as do accidents at work.

An analysis of home accidents reveals that most are caused by human failings, environmental hazards, or a combination of both. Like many other accidents, home accidents result from inadequate knowledge, insufficient skill, and faulty attitudes. Therefore, any safety education program should attempt to overcome these inadequacies by helping students to recognize and understand the many hazards in and around the home, develop a sense of responsibility toward safeguarding themselves and others against the possibility of home accidents, gain skills required to perform household tasks safely, and acquire safe, orderly habits in all home activities.

Home safety instruction should start early in life, primarily as the responsibility of parents. But schools should continue this instruction by integrating or correlating home safety with other school subjects, by teaching specific home safety units in subject areas—such as home economics, health education, and vocational education.

It is also possible to combat home accidents through student organizations, service clubs, and health departments, and the various communications media (radio, television, newspapers, magazines, and motion pictures).

Disaster procedures. Additional areas that should be given adequate time in a safety education program are preparations for civil defense emergencies and natural disasters such as tornadoes, floods, blizzards, explosions, hurricanes, and earthquakes.

Fire prevention and protection should be an integral part of any safety education program. Analysis reveals that destructive fires are fundamentally the result of carelessness or failure to understand and recognize fire hazards. Deaths, injuries, and property damage can be greatly reduced if people are taught proper methods of fire prevention.

Certain aspects of fire prevention can be taught in almost any academic course or extracurricular activity. Areas which should be considered are (1) the causes of fires—smoking, matches, electricity, heating units, explosive materials, rubbish and other flammable materials, lightning, and construction faults; (2) procedures to use when escaping from a fire; and (3) fire-fighting procedures, including use of fire extinguishers.

Since panic is often a cause of tragedy in school fires and other disasters, instruction and practice in how to behave in emergencies is necessary. Disaster drills of all types need to be organized and conducted frequently in schools, college and university dormitories, fraternity and sorority houses, and other types of housing facilities. Disaster procedures should be known by all school personnel, including new students, new teachers, and substitute teachers. It is the responsibility of the school administrator to establish, define, and assign fire drill responsibilities to certain staff members and see that all school personnel are thoroughly familiar with fire drill and fire prevention procedures.

Safe use of firearms and equipment. Instructions in the proper use of firearms, explosives, and fireworks should also be included in safety education. The National Rifle Association of America in Washington, D.C., and the Shooting Arms and Ammunitions Manufacturing Institute in New York City provide excellent resource materials for these areas.

Another area which should be a component of the safety education programs in rural schools is the safe use of farm equipment. Since accidents in agriculture account for a considerable number of the deaths from industrial accidents, it is obvious that farmers must be trained in the proper use of equipment. Because the safety practices established for farming must be self-enforced, every farmer must fully understand the many hazards that surround him, the need for precautions, and the value of working safely. Education and training are the only feasible means of achieving this goal.

Coordination. Before a sound, comprehensive program of safety education can be achieved, all school personnel should be firmly convinced of the importance of such a program. The administrator should be thoroughly familiar with all school safety policies and codes and should see that they are strictly enforced. A concerned administrator may appoint a safety coordinator or supervisor, charged with administering and coordinating the school's safety policies, developing curricula, helping to improve instruction, establishing school and community relationships, and evaluating the program. Effective safety education programs and prudent enforcement of necessary safety precautions can help students to eliminate painful and costly accidents and can help boards

of education, teachers, and school administrators to avoid liability suits for student injuries.

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SAMPLING PROCEDURES

"Sampling" generally refers to the process of selecting a small part or specimen of something in order to determine some quality or characteristic of the whole. Statistical sampling techniques similar to those used in opinion polling, market research, and census operations have been widely adopted for use in educational administration and research. There are many ways in which sampling may be applied to educational purposes—for example, selecting participants for an experiment designed to evaluate a new method of teaching reading; conducting studies of the costs of school transportation under varying conditions; selecting items to be included in an achievement test or developing norms for a standardized test; or determining the degree of parents' participation in and attitudes toward a home-school program. In these and many other areas appropriate sampling techniques can enhance the usefulness of statistical information employed in decision-making.

The statistician distinguishes between a measure —such as a mean, a percent, or a correlation coefficient—for an entire population or universe and one from a sample. A sample measure is called a statistic, while a measure for an entire population is known as a parameter. The purpose of most sampling is to estimate an unknown parameter (often practically unavailable) from a statistic. This process is known as statistical inference.

Sample design is the determination of how many elements in a population are to be sampled and where and how they are to be selected. Precision and efficiency are two important requirements of good sample design which must be taken into consideration. It is important in using sample results to have information on sampling error—estimates of precision which determine how far off the statistic will be from the parameter.

Probability sampling is the technique most often used to yield the required degree of precision at minimum cost (or, conversely, estimates with maximum precision at a fixed cost). Accurate measurement of sampling errors, using known mathematical models, depends upon the knowledge of the probability with which each individual is included in a sample as well as upon the particular sample plan. The advantages of probability sampling are that the precision of the sample results may be evaluated objectively and the efficiency of various types of sample designs may be compared.

Sample design. The simplest type of probability-sampling plan is the simple random design. This involves the selection of n persons such that each possible combination of n persons has the same probability of being selected. This procedure may be carried out in several ways. One common method is the use of a table of random numbers, from which a random sample can be selected if, prior to sampling, all people in a file or listing of the entire population have been arbitrarily assigned serial identification numbers.

There are several reasons why the unrestricted random-sample design is not always the best method. Under certain conditions other sample designs yield more precise results (smaller sampling error) for a given-size sample or are more economical because they yield results just as precise with the use of a smaller-size sample. Simple random sampling is not possible or not feasible if lists of individuals do not exist or if such lists are incomplete. For geographic areas as large as a state, lists are usually not available for such groups as students, parents, school board members, or teachers, and frequently not even for schools and classrooms. Often lists are available, but not in such form as to permit simple random sampling; for instance, samples of families taken from random samples of student registration cards would not really be random because of the duplication that would occur in families with more than one child in school.

One modification of random sampling is the stratified-random sampling design. This method is particularly useful if the population is divisible into discrete strata such that a characteristic under

consideration differs considerably among strata but is similar among elements within a given stratum. For instance, in a sample study of school finance, school districts were categorized by size and by type of district, since it was known that there is considerable difference in financial matters among districts of different types and sizes. In surveys of adult public opinion on schools, it has been found useful to stratify school districts by neighborhood because there are great differences in voter opinion and attitude toward education in the different socioeconomic areas of a school district.

Systematic sampling is a technique commonly used in selecting elements for a sample. This technique requires a roster or frame listing all individuals in the universe from which the samples are to be taken. Systematic sampling was used, for example, in a study comparing the achievement of fifth-grade pupils in two groups of schools in a large city. A table of random numbers was used to obtain a sample of 25 schools from each group. Using information recorded in a data-processing center, a computer was programmed to print out a list identifying every tenth fifth-grade pupil in the sample schools. This technique is known as multistage or cluster sampling, since initial selection is undertaken by groups (clusters) of individuals rather than by individuals themselves. First, schools were selected by random methods, and then pupils within schools were selected. Thus, the selection of this sample involved two stages. From the randomly selected clusters of pupils (each cluster in this case being a school), subsamples of pupils were taken. Stratification, as in the form of stratified random sampling, is often combined with some form of cluster sampling.

Cluster sampling may involve more than two stages. For example, a sample of classes of students in a state may be selected by first sampling counties, then subsampling school systems within the counties, then schools, and finally classrooms within the schools. Generally, cluster sampling is less efficient than the simple random design. Only if the variance within clusters is greater than the total variance is cluster sampling more efficient than unrestricted random sampling.

Goals. The more orderly the sequence of decisions that are made in order to secure information about a population, the more useful will be the sampling theory. This means that whether sampling is being done for the purpose of administrative action or for research, good sample design depends initially upon the clear specification of the goals of the survey. It is considerably easier to use statistical theory advantageously if the population to be sampled, the particular information to be obtained, and the required precision of results are clearly specified. The statistical theory of survey design is difficult to apply unless these requirements are met. For instance, if the objectives of a survey were as ambiguous as "to find out what the public in a school district thinks about the school system," the statistician could not be specific in determining the types of estimates to be used and the plan for selection of the sample.

Estimation. The plan for selecting elements in sample design is governed by such considerations as precision (how close the statistic is to be to the parameter) and the state of the population to be studied, as well as by the nature of the parameter which is to be estimated from the sample and how that parameter is to be determined. A very important principle in the application of probability sampling is that the determination of sampling error depends upon both the type of estimate to be used and the particular sample selection scheme.

Suppose, for instance, that in a simple random sample of fifth-grade pupils in a city school system, the average grade score in reading is found to be 4.3. In this case a simple arithmetic mean obtained from the sample (the statistic) could be used to estimate the arithmetic mean for the whole population (parameter). It is fairly simple to compute a standard error of the sample mean which can give a good clue to how far the sample mean is likely to be from the mean for all fifth-grade pupils. The standard error of a sample mean is a measure of the spread or deviation of a hypothetical, infinite number of such sample means from the population mean. Formulas for this are contained in most elementary statistics texts.

It is unlikely that the simple random method could be used to arrive at the above reading average. It would not be practical to assemble a random sample of pupils, since this would almost certainly result in a few pupils from each of several schools and classes being selected to take the test. Practical considerations require selection

by classes (clusters) or by schools and neighborhoods (strata). If cluster or stratified sampling procedures are used, it is necessary to make various adjustments in order to derive the best estimate of the population mean. These adjustments usually entail weightings of means from sample strata (or other segments used). For instance, if a sample of ten is to be taken from each of two strata but the population of one is twice that of the other, the mean from the first is counted (weighted) as twice that of the second in arriving at the mean for the two strata combined. This complicates the determination of the sampling error, so that elementary textbook methods are no longer appropriate.

The technique used for estimating an average (a mean) is similar to that required for estimating certain other parameters. In order to anticipate the outcome of a referendum related to school-district organization, a house-to-house canvass was made and percentages were used. Since stratification was involved, using different subsample sizes in proportion to the makeup of the population, weightings were necessary to estimate accurately the percents for the total population. Likewise, complex methods were required to estimate the sampling error.

Census-type surveys are usually concerned with estimating total numbers. A sample of high schools in a state might be taken in order to anticipate the number of seniors who intend to enroll in public community colleges in a given year. One method of estimating the total is to multiply the total number of community college–bound seniors in the sample by the ratio of the total number of high schools to the number used in the sample. For instance, if 2,000 seniors in the sample are intending to attend community college and there are, in total, ten times the number of high schools as in the sample, 20,000 is the estimate for the total. Again, this is cluster sampling and might best include stratification. Here weightings as well as complex precision measures would be required.

Ratio estimates are sometimes useful in estimating totals. In the previous example, the total number of seniors in the state might be known and be on record. The sample could be used to produce an estimate of a ratio of seniors planning to attend community college to all seniors in the sample. When this ratio is applied to the total number of seniors in all high schools, the result will be the estimate sought.

Error measurement and precision. There is a sampling distribution—that is, a theoretical distribution of all possible sample statistics—for each statistic. Many of these distributions are known or can be approximated for a given sample design. The simplest, best understood, and most frequently applicable distribution is the normal distribution. Much of the normal distribution can be described with two measures: the arithmetic average (mean) and the standard deviation (a measure of variation or dispersion).

For example, it is known that the IQ is "normally" distributed. This being the case, all possible samples of IQ's, of a certain minimum size, from a population would also be normal. Moreover, with a simple random sample of 100, it is possible to estimate the standard deviation of the population and of the distribution of sample means—the standard error of a sample mean. Under these conditions, the formula used for the standard error of a mean is the population standard deviation divided by the square root of the number of elements in the sample. If in the example given the standard deviation of the sample elements is found to be 16, then a good estimate of the standard error of all such possible sample means would be 1.6. If sampling is stratified, this fairly straightforward relationship becomes more complicated.

As noted previously, the kind of estimate to be made and the characteristics of the population bear heavily on the choice of sampling plans. The number of elements, or cases, to include in a sample to meet precision requirements must be determined. If the above formula is reversed, it may be seen that the number of elements in the sample is the variance (the square of the population standard deviation) divided by the square of the desired standard error of the mean. If, for instance, it is desired to tolerate only a 1.0 standard error of the sample mean, with a population standard deviation of 16 (or variance of 256), a total of 256 cases is required.

The layman is inclined to look for dependability of sample results in terms of the percentage of the population sampled. However, this percentage matters very little in most situations. In general, for a given degree of precision the greater the heterogeneity in a population, the more sample cases are needed; the more homogeneity in a population, *the fewer cases are needed.*

For the most part, the characteristics of sample

means are applicable to such other statistics as percentages. It should be necessary to sample more pupils when the frame or population is all grade levels, K–12, than when the frame or population base is just one grade. This would also be the case for chronological age, reading achievement, and other measures which are developmental in nature. The group of all children in a school system is a heterogeneous mixture of levels of development. There are great variations in ability and achievement level within grades in a school, but when there is greater homogeneity, fewer cases are required in samples.

Sample design becomes complicated when the objectives of the sample include several measures or characteristics of the population. If advance information consisting of several measures exists about the population and this information is used in planning the sample, sample size may be determined by what is considered the most important measure, or sample size may be determined for each measure and the largest sample taken.

There are various methods—including the use of a confidence interval or rejection region—by which the sampling error is used to determine the precision of a sample statistic. These devices are usually derived from a standard error and its relationship to a distribution. A confidence interval is a range of values within which, with a stated degree of confidence (probability), lies the parameter being estimated. If the sample is intended to test a hypothesis concerning a parameter—for example, the hypothesis that the average age of a group of pupils is more than or less than a given value—a rejection region may be employed. A rejection region is a range of values which, should the sample statistic be contained within it, would force the hypothesis to be rejected.

Samples of ten test scores, each with 95 percent confidence intervals, were computed to demonstrate the theory behind such intervals. The population mean was known to be 69.0. One sample provided an interval (a range of values) of 60.8–77.2; a second sample provided an interval of 65.0–81.3; and a third, an interval of 63.7–80.1. In each case there was a range within which the parameter, the population mean, lay. Five percent of such samples had intervals in which the population parameter was not located. Although it was not certain that any particular interval derived from a sample would contain the parameter, there was considerable (95 percent) confidence in that possibility.

Summary of procedures. Although there can be no simplified standardization of procedures for sampling, several steps are normally followed. These include: (1) the determination of the appropriate sample design, taking into account the precise objectives of the study or survey, the precise population to be studied, the information to be collected from the sample, and the required degree of precision; (2) the preparation of such things as instruments, tests, forms, and schedules; (3) the administration of instruments or collection of data; (4) the follow-up, when necessary, to minimize the effect of nonresponse and bias; (5) the treatment of data using appropriate formulas for estimation of parameters; and (6) the computation of sampling errors or confidence intervals by proper methods to determine their statistical significance.

Procedures to be avoided. There are numerous examples of samples that are not fair samples. Very often the subjects for a study are chosen, as a matter of convenience, from the nearest or most readily available school or class. Such a choice is not likely to be representative of the larger population which is the real object of study, so the investigator is logically restricted to conclusions which concern only the sample itself; in such cases no generalization whatever is justified. Such gratuitous samples, sometimes referred to by statisticians as chunks, form the bases for much research in fields like archaeology, history, and medicine, where the investigator must draw his conclusions from whatever items are conveniently available.

Other types of nonrandom and nonprobability samples include the purposive (or judgment) and quota samples. In education situations, a supposedly representative sample of students has often been handpicked by someone well enough acquainted with them to select typical individuals. Such sampling results in what is called a purposive or judgment sample, since its accuracy depends upon the judgment of the selector. The quota sample is sometimes used in opinion polling and in social and economic studies. A sample is selected in such a way that there is a given number of individuals in the sample from each of several categories—for example, age, economic status, and geographic location—so that the sample will be a sort of miniature of the universe on these variables. Such nonprobability samples

may be necessary when it is not feasible to select individuals on a random basis or when the advice and assistance of a competent statistician is not available. Ordinarily, handpicked, haphazard, and hit-or-miss samples should be avoided.

Pitfalls which should be avoided in sampling include the following:

(1) The use of designs which are inefficient or designs for which the degree of efficiency cannot be determined, such as nonprobability samples;
(2) Failure to randomize where the inference depends upon randomization;
(3) The use of designs which seriously restrict the populations to which the results can apply;
(4) Sampling from one population and generalizing to one or more other populations;
(5) The use of improper formulas—that is, inappropriate distribution functions—for the determination of precision;
(6) Sampling more elements or individuals than necessary for the accuracy required, making the sample inefficient;
(7) Proper use of sample methods but lack of consideration of errors other than those of sampling—for example, errors of nonresponse, errors of measurement, errors in the preparation of estimates, errors caused by the change of population characteristics with time, clerical errors, and errors of processing.

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SAUDI ARABIA

In 1931 the Saudi Arabian government assumed direct responsibility for education when it established the Directorate General of Education in the Ministry of the Interior. However, by 1953, when the directorate was converted into the Ministry of Education, only one secondary school was in operation. Until that time, education was almost exclusively the preserve of the Muslim imams and sheikhs who administered the religious (kuttab) schools, which taught everything the educated Arab needed to know: the Koran and the proper intonation of its passages, classical Arabic, Islamic law, and the traditions of Muhammad. Today, however, the tremendous growth of modern education runs parallel to the spectacular growth in oil revenues.

Structure, organization, and administration. All public education is under the direct administration and supervision of the Ministry of Education. The minister is assisted by the deputy minister and the High Council of Education. The council includes a director of financial affairs and members of a technical advisory board known as the Bureau of Counselors. The council, presided over by the minister or deputy minister, decides on general educational policy, teacher appointments, curriculum, textbooks, and finances. The country is divided into 21 educational districts, each of which is headed by a director responsible for implementing the ministry's policies and programs locally. An inspector assists him in the supervision and administration of the schools in each district.

There are, in effect, two parallel educational systems in Saudi Arabia. The religious system administered by a body of Muslim educators offers a largely traditional education from primary school to the Shari'a colleges and the Islamic University. Although the kuttab school is disappearing as an educational institution, even in rural areas, the tradition of rote learning fostered in them still persists to some extent and retards modern education by placing emphasis on the uncomprehending memorization of facts rather than on the creative application of knowledge. Of greater importance is the modern educational system established since the mid-1950's, a system based on that in the United States. Modern Saudi schools still stress Islamic studies and classical Arabic in order to preserve the social and

religious heritage of the country, but they also offer courses in science, mathematics, and liberal arts. The teaching of classical Arabic helps to preserve the country's Islamic heritage as a strong guiding force for the young; but the Saudi leadership, realizing that much of the information about modern technology is in English, has placed great emphasis on the study of English as a second language. In some primary schools the study of English is begun as early as the third grade; in other primary schools it does not begin until the fifth grade.

Curriculum. All education in Saudi Arabia is free to those who request it, although an increasing number of private schools parallel the public schools in curriculum and textbooks.

Primary education. Primary education lasts six years; successful graduates receive a primary education certificate, a prerequisite to admission to intermediate schools. The curriculum is standardized throughout the country. Over a six-year period, 60 percent of a pupil's classes are devoted to religious studies and classical Arabic and 25 percent of his classes are in arithmetic and general science. The remainder of the time is devoted to history, drawing, handicrafts, and physical education. The tremendous spurt in the number of children enrolled in primary schools (from 24,000 in 1950–1951 to 260,586 in 1965–1966) has strained the physical and human resources of the country. The government's crash program to build 100 primary schools a year has been moderately successful, and the number of primary school teachers rose from 943 in 1950–1951 to 11,558 in 1965–1966. The Ministry of Education established special summer courses in 1954 to train primary school teachers, and now more than 50 percent of the nation's primary school teachers are Saudi Arabs. The remaining teachers at all levels are hired mainly from neighboring Arab countries; however, some teachers come from as far away as Great Britain and the United States. The government hopes that by 1975 almost all teachers (except in special fields at the university level) will be Saudi citizens.

In 1960 the government made its first budgetary appropriation for the education of women. Until that time the education of girls had been conducted in private girls' schools or on a tutorial basis. The government has subsidized private schools where necessary to raise them to the standard of public education. Coeducation on the primary level is becoming more common and is increasing on higher levels of education as well, except in Islamic schools. The curriculum in girls' schools is essentially the same as in boys' schools, and the educational standards are identical. Girls study such practical subjects as cooking, needlework, home economics, and dressmaking in addition to the regular academic courses.

Intermediate education. In 1958 intermediate education was largely separated from secondary education because of the urgent need to provide primary school teachers, clerks, typists, and workers with a variety of technical skills for business and industry. College-bound students take a combined six-year intermediate-secondary school program; students selected for agriculture, commerce, industry, construction, and primary school teaching are placed in four-year vocational programs providing technical skills and practical knowledge in lieu of theoretical knowledge and more advanced education. Another intermediate-school alternative is the Dar al-Tawhid School, established in 1943 to enable students to specialize in Islamic studies. The first three years of the five-year program are devoted to the study of the social sciences with emphasis on Arab culture and Islam. The final years are devoted to the spiritual values of Islam and to the mastering of classical Arabic. Graduates go on to the Shari'a colleges and study Islamic jurisprudence, Arabic literature, or Arab history.

Secondary education. Since 1958, secondary education has been expanded, although at a slower rate than other levels of the educational system, in order to elevate the general educational level of the country and to provide increased opportunities for capable students to pursue higher education at home or abroad. There are three distinct secondary programs: the Dar al-Tawhid School, primary-school and intermediate-school teacher training, and college preparatory. The majority of secondary school students enroll in the college-preparatory program. The three-year curriculum is divided after the first year into literary and scientific tracks. Both tracks emphasize religious studies, classical Arabic, English, and French, with the balance devoted to social sciences in the literary track and to mathematics and natural sciences in the scientific track.

Higher education. Although a sizable number of Saudi students go abroad each year for higher education, there are four universities in Saudi

Arabia: Riyadh University, Islamic University, King 'Abd al-'Aziz University, and the College of Petroleum and Minerals. The minister of education is ex officio head of Riyadh University, but the actual responsibility for its administration is vested in the rector and the council of the university. The Islamic University in Medina is under the control of the grand mufti; the College of Petroleum and Minerals is an autonomous institution under an independent board of trustees although administratively attached to the Ministry of Petroleum and Mineral Resources.

Riyadh University, founded in 1957, has seven faculties: arts, sciences, commerce, education, agriculture, pharmacy, and engineering. The last was established in 1962 with the aid of UNESCO and the United Nations Special Fund. A school of medicine opened in 1969 at Riyadh University in collaboration with the University of London. The program of study in each faculty lasts four years, after which students chosen for postgraduate study are usually sent abroad on government missions. The language of instruction is usually Arabic; however, technical and scientific subjects are usually taught in English because more than 50 percent of the faculty is non-Saudi.

King 'Abd al-'Aziz University was opened in 1967 by a group of private citizens. A small institution, it provides instruction in both English and Arabic. The Islamic University was established to ensure the education of Muslim scholars and to ensure the propagation of Islam. It has a secondary school and a college with a traditional religious curriculum emphasizing the traditions of Muhammad, the Koran, Islamic law, and Islamic history.

The College of Petroleum and Minerals, a unique university, is an attempt to meet the country's future requirements for highly qualified technical and scientific personnel who can bridge the gap between Western-inspired technological education and the underdevelopment of Saudi Arabia's human resources. The curriculum is highly technical, and English is the sole language of instruction. All freshmen are required to take five hours of English a day in addition to courses in chemistry, physics, mathematics, shopwork, typing, and library usage. Classes are small. The college is staffed by an international group of professors who join the students in a Western-oriented program of extracurricular activities which include play reading, foreign-language and book-discussion clubs, and sports. The College of Applied Engineering, opened in 1969, offers five-year courses in chemical, civil, electrical, and mechanical engineering. Students are given an initial year of preparatory study and language training, a three-year program of courses, and a year of supervised industrial experience.

Adult and special education. Adult education has been of great concern in Saudi Arabia, where 90 percent of the population is illiterate. The Ministry of Education has constructed about 550 schools for adults, and more than 34,800 adults enroll each year. On the recommendation of UNESCO, the Ministry of Labor and Social Affairs has established the Vocational Training Center in Riyadh to train unemployed Saudi workers in such selected basic skills as carpentry, bricklaying, and painting in three-month to nine-month programs.

Extensive industrial training and general educational programs are provided at all levels of instruction by the Arabian-American Oil Company. These programs are independent of government control but are integrated into the fabric of Saudi Arabian society and government educational efforts.

In order to educate the deaf, dumb, and blind, the government has opened seven Al-Nur Institutes (institutes of light). The program follows the basic curricula of the primary and intermediate schools but is adapted to the needs of the physically handicapped. After completing an intermediate-school education the student receives vocational training in such skills as weaving and wicker-chair repairing which will enable him to become a productive member of society. In the late 1960's more than 850 students were trained annually in these institutes.

Trends and problems. Helped by its bountiful oil revenue, Saudi Arabia is rapidly overcoming the physical obstacles to educational development. New schools, institutes, and universities are being constructed faster than they can be staffed with competent people. Teacher-training institutes are beginning to relieve many of the personnel shortages, and the country expects to have universal primary education by 1971. The government has clearly identified the major problem areas and is liberally using government scholarships to

finance the training of students abroad in priority fields for which they cannot be trained in Saudi Arabia. There is still a need for attitudinal changes and for discontinuance of rote learning. There is concomitantly a need for a more empirical, less pedantic approach to science instruction. The country desperately needs more medical education. It also needs to train skilled petroleum engineers and petrochemical scientists for the development of Saudi Arabia's petrochemical industries. These are the obstacles which time and the will to change can overcome.

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SCHEDULING

A schedule is a timetable of class meetings that should help to achieve the purposes of a school. The provisions of a schedule will reveal the school's basic philosophy and its views on psychology, curriculum, and methodology. If the schedule does not reflect the school's educational objectives, serious problems will result from the incongruity.

There are two fundamental types of schedules: conventional and flexible. Each type has its advocates. In practice, conventional schedules are more common than flexible schedules. In theory, flexible schedules are considered by many educators to be the best way to provide a balance of control and freedom for staff and students.

Conventional schedules. Administrators and teachers are well acquainted with conventional schedules on all levels of education. These schedules include periods of a predetermined length which are organized in a rigid sequence with little or no variation from day to day. In secondary schools, laboratory courses are sometimes scheduled for a double period, but almost all other courses meet five days each week for one period a day.

Flexible schedules. A flexible schedule provides more variation in the school program than is possible in a conventional arrangement. However, flexibility is sometimes difficult to achieve because every schedule has to meet the demands of the curriculum and allow for limitations in time, space, materials, and personnel. The more variation possible in coordinating these factors, the more flexible the schedule can be. Although the specific arrangements are important, the success of a flexible schedule depends upon how well teachers and students can make use of the varied opportunities provided by such a schedule.

Basic definitions. There are several key terms which must be understood if the concept of flexibility in scheduling is to be meaningful.

A variable schedule is made up of a variety of teaching-learning situations, such as large-group, small-group, laboratory, and individual-study activities, all of which may be scheduled for either long or short periods of time.

A flexible schedule consists of variable use by staff and students of the arrangement of time intervals. (A flexible schedule is really a variable schedule which is used effectively.)

Modules are time units of uniform length, usually 15 or 20 minutes each, which are added together to form long or short class sessions.

Block scheduling makes use of lengthy amounts of time, usually equivalent to two or three conventional periods or several modules, which the teachers can divide into large-group, small-group, and individual-study sessions according to student needs and curriculum demands.

In a system of side-by-side scheduling, two or more classes in the same subject or related subjects are scheduled at the same time so that teachers can work together or separately.

With rotation scheduling, the sequence of conventional class periods is rotated so that variations in the daily or weekly schedule can be made without changing the basic time unit.

Objectives. Flexibility for its own sake can provide some teachers and students with an escape from routine, but this escapism is seldom cited as a major objective of this type of scheduling. The usual reasons given by educators for building a variable, flexible schedule include the following:

(1) A flexible schedule develops the individualization of teaching and learning.
(2) It leads to such changes in the institutional arrangements for education as team teaching and a nongraded curriculum.

(3) It provides variations in class size and duration according to the specific needs of students and the purposes of the course.
(4) It provides large-group, small-group, and individual-study sessions.
(5) It provides students with opportunities to study subjects beyond basic requirements.
(6) It facilitates self-pacing and self-grouping of students.
(7) It provides unstructured time to encourage development of student self-responsibility.
(8) It provides unstructured time for teachers' planning sessions.
(9) It enables "extracurricular" activities to become part of the school day.

These reasons are often translated into formal objectives in schools which utilize flexible scheduling. Continuous in-service education programs for the teachers and administrators characterize these schools. Some of the objectives can be measured easily, but because some are attitudinal and abstract, many problems can arise. Any situation which can be interpreted as evidence that one of the objectives is invalid provides ammunition for those who prefer the conventional type of scheduling. Some school staffs believe with great faith that there can be no question about the advantages of flexible schedules, but there are many critics and skeptics who will need more proof than is available to date.

Elementary schools. There is some flexibility possible if two or more teachers use the conventional schedule in a cooperative way. Advocates of variable scheduling are certain that even greater flexibility will result if certain modifications are made. The necessity for teacher cooperation makes team teaching and flexibility in scheduling harmonious concepts.

For example, if side-by-side scheduling is employed, three teachers can form a team when they teach the same subject (such as social studies) on the same grade level at the same time. On Monday the teachers can combine their classes for large-group instruction. On Tuesday the three teachers can work as a team by providing small-group discussion time for each class. Each class can be divided into two groups for discussion.

The Monday or Tuesday pattern can be repeated on any other day, or a pattern can be established such as Monday-Thursday large group, Tuesday-Friday small group, Wednesday individualized study. Some teachers prefer a scheduled pattern, and others prefer to decide each day upon the activity to be used.

If a modular approach to scheduling is desired, a 45-minute period can be divided into three 15-minute modules. On some days all three modules will be used for large-group or small-group or independent-study purposes. On other days one or two of the three modules may be used for one purpose and other modules for other purposes.

If an expansion from one subject to two subjects is desired, language arts can be treated in a similar way in the period following social studies. A large-group session for three classes could be held in social studies from 10:30 to 11:15 A.M., followed by small-group sessions, two groups in each of the three classes, in language arts from 11:15 to 12:00.

There is great flexibility in this simple pattern. The teachers can repeat or change the model as needed. They can transfer students from one group to another and from one teacher to another without difficulty. They can assign reading and writing tasks to the majority of students for one module while the teachers hold conferences with students who need special attention.

If the teachers and the administration desire greater flexibility than the example provides in its present form, two major possibilities are open. First, two subjects, such as social studies and language arts, can be combined into a broader field, such as humanities. The three teachers can be assigned a block of time (1½ hours, or six modules of 15 minutes each) to be used as needed. The three teachers, working as a team, can present large-group instruction in humanities to all students from 10:30 to 11:00 A.M.; the hour remaining can be used for small-group discussion for four groups of students (two classes) with two of the teachers and individualized instruction for the other students under the guidance of the third teacher. The opportunities for variation are almost unlimited.

Second, a nongraded approach can be developed in a particular subject area or in a broad area, such as humanities. The same three teachers and their three classes can be organized to meet the ability and interest levels of the students, regardless of the designated grade level. In a limited sense, this opportunity to work on levels within a