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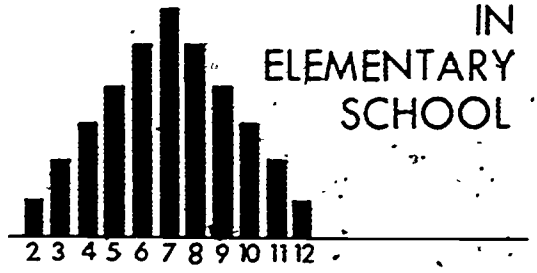
ABSTRACT

This pamphlet recommends that elementary-school teachers be provided with inservice courses which deal with probability concepts. The recommendations are based on the experiences of 120 teachers who taught probability in elementary school as part of a project of the National Science Foundation. The authors observe that probability is important enough to warrant a place in the curriculum, and that the number concepts involved in probability are already present in the elementary curriculum. A suggested outline of topics for an inservice course on probability is provided, together with detailed descriptions of three illustrative activities. (SD)

TEACHING PROBABILITY IN ELEMENTARY SCHOOL



For many years educators have been urged to introduce probability into the elementary school mathematics program. The 24th Yearbook of the National Council of Teachers of Mathematics has an excellent section describing a suitable program in probability. There are persuasive reasons for teaching probability in elementary school. Above all it is important and significant in the world in which we live. It influences our lives in countless ways. Without doubt we would be better off with some knowledge of the characteristics of chance events.

At the elementary school level, work with probability offers unlimited opportunities for the practice and reinforcement of basic arithmetic skills with whole numbers and fractions, estimation, counting, and tallying. The procedures used for organizing and analyzing data promote logical thinking. Probability encourages independent investigations and provides techniques for studying questions in social studies, science, and language arts.

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Background

The recommendations contained in this pamphlet are based on experiences of more than 120 teachers who taught probability topics to elementary school children as part of a project cooperatively sponsored by the National Science Foundation, the New York State Education Department, and ten New York school districts. In each of these school districts an outstanding educator coordinated the probability teaching project. The coordinators are listed below in the hope that educators interested in introducing probability into their elementary school program will contact them:

Richard Jardine, Westmoreland Road School,
Whitesboro, New York 13492
James Jordy, Cazenovia High School, Cazenovia,
New York 13035
George Lenchner, Union Free School District,
Valley Stream, 85 West Hawthorne Avenue,
Valley Stream, New York 11580
Donald Mills, Penn Yan Central School,
Penn Yan, New York 14527
Elaine Mintz, Plainedge Public Schools,
Bethpage, New York 11714
George Ropes, Edgemont Union Free Schools,
Scarsdale, New York 10583
Matthew Scaffa, Community School District 31,
211 Daniel Low Terrace, Staten Island,
New York 10301
Mary Teshara, Community School District 12,
708 East Tremont Avenue, Bronx,
New York 10457

Louis Scholl was project coordinator in Buffalo, New York, and Bernard Kessler was coordinator in the Chatsworth Avenue School, Mamaroneck, New York. They are no longer employed in these school districts. Elaine Mintz wrote the first draft of this pamphlet based on her own experiences at Plainedge, visits to other project schools, discussions at conferences, and reports received from project coordinators and independent evaluators.

Broad View of Probability in School Programs

Probability is important enough to warrant a place in school programs. Questions arise about where, how, how much? It is evident that senior high school students would profit from a serious mathematical course in probability. It would be extremely valuable as foundation training for many careers.

In junior high school the study of probability should be empirical, providing a rich store of fascinating problems for investigation.

In elementary school probability may be thought of as a motivating asset supporting the study of many basic arithmetic topics. It provides many realistic, practical applications for mathematics skills.

In-service Training of Teachers

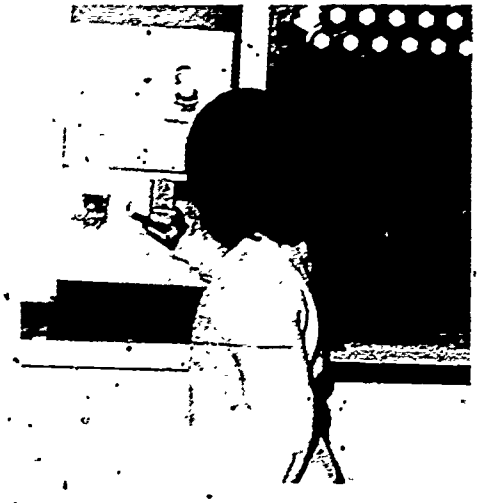
Teachers prefer an in-service course for learning how to teach probability as opposed to learning the subject from manuals and texts. The leadership of a knowledgeable, enthusiastic supervisor can contribute greatly towards the successful introduction of a new curriculum topic.

In-service training sessions should accompany rather than precede the implementation of the probability program. The subject should be approached on an intuitive level using various activities that teachers can use in their classrooms. A limited amount of formal mathematical theory may be presented in response to teachers' questions and intellectual curiosity. Watered-down versions of high school or college level courses cannot be expected to serve the needs of elementary school teachers. Teachers should be introduced to many appropriate games, puzzles, experiments, and concrete devices that can be used in the study of probability. Local statistics, local events, and, above all, the interests of children are the best sources of real probability problems.

Suggested Outline of Topics for an In-service Course

There are many possible sequences of topics for an in-service course in probability. The following is one of them:

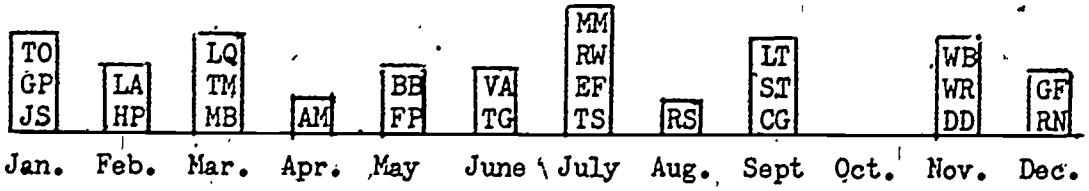
1. Thinking about chance - intuitive notions of probability
2. Using numbers to express probability
3. Collecting data - surveys, experiments, random sampling
4. Organizing data - tables, arrays, graphs, diagrams
5. Developing orderly methods for counting possible outcomes
6. Outcomes - complementary, equally probable, union, intersection
7. Binomial outcomes - Pascal's triangle
8. Conditional probability



Illustrative Activities

On the following pages are described a few sample probability activities. These will illustrate the kind of questions which can be examined, and the kinds of techniques which can be used.

MONTHS IN WHICH WE WERE BORN



Elementary school children attach great importance to birthdays, and will enjoy doing a project on the subject. The "bar graph" above was composed using the birthdays and initials of the students' names. On a classroom bulletin board it would be appropriate to use first names, or photographs. A subject like this is typical of the many available providing data from the lives of students which can be collected, tabulated, graphed, and analyzed. A major question is: "If we selected a student randomly, what is the probability that his month of birth is February?" Other questions arise: "Is the distribution of birth months typical?" As with most probability exercises this one supports other important parts of the mathematics curriculum - the study of the calendar. Who might have some practical use for this data about birth months?

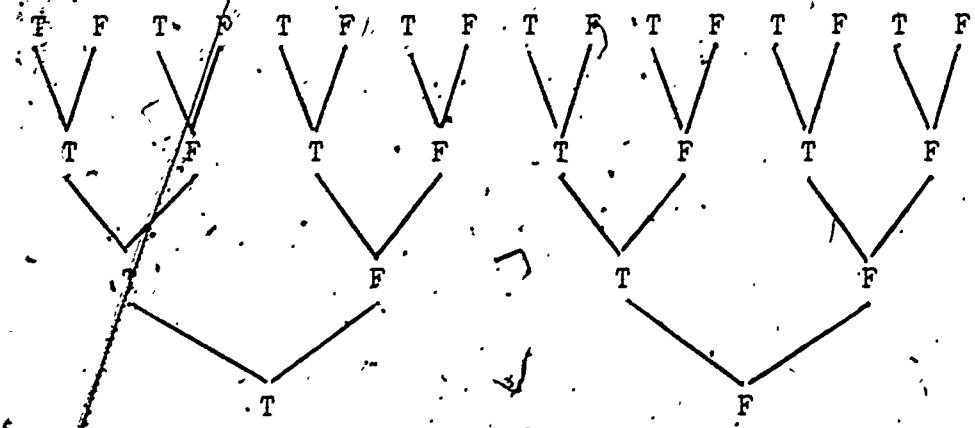
Intermediate grade students may look more deeply into the question of birthdays. Before investigating a topic it is a good practice to ask students to guess about probabilities. You may ask them to guess about the chance that at least two students in the class have the same birthday. They will be surprised to discover that there is a good chance (about 50%) that two students in the class have the same birthday (month and day).

If we surveyed 600 people, how many of them would we expect to have a birthday in March? How many of them would we expect to have a birthday on the 20th day of a month?

Project II:

Objective Tests

Objective tests are a familiar part of the school scene. The question of guessing comes up naturally, and can be related to a discussion of probability. Suppose we answered a four-question true-false test randomly. What is our chance of getting a perfect score? A tree diagram provides a means of visualizing the question:



There are sixteen different ways to answer the four questions. One of them, TTFF, gives a perfect score. The probability of getting a perfect score by guessing randomly is 1/16.

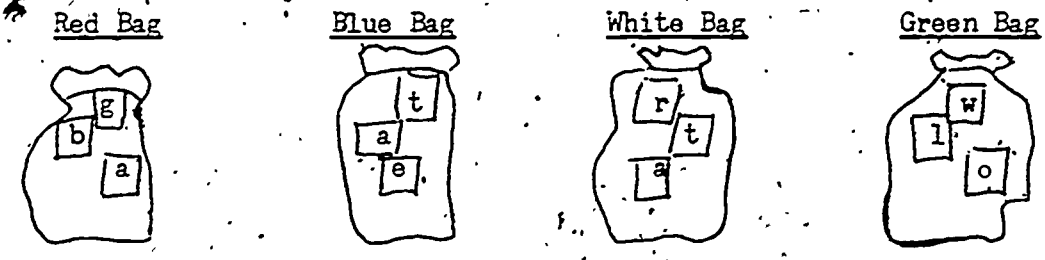
Project III:

THE PARTY GAME

A Primary Class Project

a) Collecting data - (An exercise such as the one below may be presented to the class in lieu of data from a survey.)

Scott's friends all played a game at a party. Each child picked a colored bag that had three letter cards in it. Then, he or she drew the letters out of the bag, one at a time, without looking. Scott wrote the letters down as each child drew them. If the order of letters made a real word, the child got a prize. The picture shows the letter bags. Under each bag, write all the ways the letters in the bag could be picked.



b) Organizing data and orderly counting methods:

gba	tae	rta	wlo
gab	tea	rat	wol
bag	aet	tar	low
bga	ate	tra	owl
agb	eat	art	lwo
abg	eta	atr	olw

c) Record each set of letters that spells an English word:

bag	tea	rat	low
gab	ate	tar	owl
	eat	art	

d) Predicting outcomes:

Which box would you want to pick letters from?

Summary

In conclusion it should be emphasized that the study of probability in elementary schools introduces few mathematical topics not already in school programs. Critical topics such as fractions, ratio, percent, and averages are supported and vitalized by probability. A recent research report from the National Assessment of Educational Progress urges schools to strengthen teaching of common fractions, decimal fractions, and percent. Probability can help you do this.

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