A COMPARISON OF THE STATISTICS CURRICULUM FOR CHILDREN AGED 5-11 IN BRITAIN, CANADA AND THE U.S.A.

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In Professor Barnett's introductory address to the First International Conference on Teaching Statistics, he discussed the significance of statistics in the education of the school child. He stated:

> . . . *statistics is a practical discipline for understanding the indeterministic world we live in and for solving the real problems in society from agriculture, through meteorology - from A to Z!* [p.7]

Pereira-Mendoza and Swift (1981) discussed the significance of statistics and probability in the school. They presented a rationale for teaching probability and statistics:

> *Even though the role of both statistics end probability in our lives is significant, it is not the only rationale for including them in the school curriculum. A model of a more complete rationale contains three components – utility, future study, end aesthetics.* [p. 2]

Given the significant role of statistics in education, a natural question to ask is what is currently taught in the elementary curriculum. An examination of textbook series and curriculum guides indicates that most contain "units" on graphing, prediction, and other statistical concepts. Thus, while there is abundant evidence that statistical concepts are included in programmes of study, if and when they are actually taught is a question that must be addressed. By obtaining information from supervisors of mathematics (or their equivalents) and classroom teachers, data collected should reflect the implemented curriculum, rather than the extended curriculum (Robitaille and Dirks, 1982) as outlined in guides, textbooks, etc.

This paper will concentrate on the role of statistics in the curriculum for the 5-11 age group. It is in the early years of schooling that the conceptual foundation is laid on which the secondary and tersary phases of a student's education are built. A brief overview of what and when certain topics are currently taught in the elementary schools in Britain, Canada and the U.S.A. is presented. The data are organized under the headings, Graphing, Tabulation, and Measures of Central Tendency and Dispersion; since at this level these are the major components of the programme.

Graphing

By age 12 virtually all students in these countries are familiar with four standard types of graph (Tables 1 and 2). It is clear from Table 1 that picture graphs and histograms/bar graphs were the initial graphs developed in school, with most respondents indicating that picture graphs were

introduced during the first or second year of schooling. Histograms/bar charts were generally introduced the following year. Pie charts and line graphs were introduced later in the programme. Many respondents commented that concrete materials were used to both develop and model these graphs. Although a majority of respondents saw graphing as a topic that is first introduced in mathematics, per se, other respondents suggested that graphing was initially introduced as a topic in social studies, science, or integrated into the curriculum through projects (Table 3). Integrated seems to be interpreted to mean that teachers introduce graphing at an opportune time. For example, if a student raised a question regarding a new type of graph they had seen in the paper, a book, or on television, this afforded an opportunity to develop the idea. It is significant to note that in Britain the percentage of teachers introducing graphing as a topic within mathematics is considerably smaller than the other countries. This could well be explained by the overall approach to mathematics stated in many responses. Individuals indicated that the age criteria was difficult to interpret since they saw mathematics as part of the overall development of the child, and the introduction would be an appropriate time for the child, rather than at a particular age.

Table 1

INITIAL INTRODUCTION TO GRAPHING – STUDENTS AGED 5-7
(Percent of students)

	Picture	Histogram/bar	Pie	Line
Britain	97	78	12	2
Canada	85	74	21	10
U.S.A.	87	67	24	18

Table 2

INITIAL INTRODUCTION TO GRAPHING – STUDENTS AGED 8-11
(Percent of students)

	Picture	Histogram/bar	Pie	Line
Britain	3	22	88	87
Canada	15	26	53	85
U.S.A.	13	33	75	79

Table 3

TOPICS USED TO FIRST INTRODUCE GRAPHING
(Percent of students)

	Math	Science	Social Studies	Integrated
Britain	48	2	15	35
Canada	71	7	0	22
U.S.A.	76	3	8	3

In their comments, many respondents stressed that the approach to graphing was informal with an emphasis on activities and the use of manipulatives to develop the concepts.

In addition to the question of when particular types of graph were first introduced, respondents were asked when students actually use data to develop their own graphs (either student generated or teacher generated data), and extrapolate from graphical data (Table 4). The results are fairly consistent for all three countries. Both British and Canadian respondents placed slightly more emphasis on having students draw their own graphs with student generated data before using teacher generated data, than did the U.S.A. respondents. Extrapolation from data is a later topic, with the development being left to secondary school in many cases. Furthermore, for many students the first introduction to graphing is through ready made graphs, rather than by drawing the graph themselves.

Table 4

GRAPHING AND EXTRAPOLATING FROM DATA
(Percent of students)

	Data provided by teacher		Data provided by student		Extrapolating from data	
	Students aged		Students aged		Students aged	
	5-7	8-11	5-7	8-11	5-7	8-11
Britain	44	39	71	29	17	56
Canada	65	28	75	24	23	51
U.S.A.	63	35	53	41	33	55

Tabulation of Data

Another major component of descriptive statistics is the making of tables and drawing inferences from tabulated data (Table 5). Tabulation of information is more commonly developed with older students, the reverse of the situation with respect to graphing. However, as with graphing, extrapolation from data is covered much later, with a substantial number of respondents indicating that extrapolation is left to secondary school. In practically all cases, tabulating data and extrapolation was introduced after the parallel experience with graphing.

Table 5

TABULATING DATA AND EXTRAPOLATING FROM DATA
(Percent of students)

	Data provided by teacher		Data provided by student		Extrapolating from data	
	Students aged		Students aged		Students aged	
	5-7	8-11	5-7	8-11	5-7	8-11
Britain	15	66	27	66	2	46
Canada	24	67	26	67	9	58
U.S.A.	30	64	27	62	16	60

Central Tendency and Dispersion

The third major component of the study dealt with questions concerning measures of central tendency and dispersion (Tables 6 and 7). Measures of central tendency are introduced to older students.

Table 6

FIRST INTRODUCTION OF MEASURES OF CENTRAL TENDENCY
(Percent of students)

	Mean		Median		Mode	
	Students aged		Students aged		Students aged	
	5-7	8-11	5-7	8-11	5-7	8-11
Britain	4	87	0	51	0	46
Canada	0	72	0	17	0	8
U.S.A.	4	85	4	63	6	57

Very few respondents indicated students in the 5-7 age group were introduced to these ideas. Although by age 12 most students are familiar with the concept of the mean, for many students the development of the median and mode are left to secondary school. This is particularly noticeable in Canada where only a small percentage of students are introduced to either median or mode.

Table 7

FIRST INTRODUCTION OF MEASURES OF DISPERSION
(Percent of students)

	Standard Deviation		Range	
	Students aged		Students aged	
	5-7	8-11	5-7	8-11
Britain	0	0	0	15
Canada	0	4	0	13
U.S.A.	0	11	5	37

Generally measures of dispersion are left until secondary school. While it might be expected that the concept of standard deviation would not be developed, it was surprising to find that range was not developed, even informally.

Summary

The data presented in this paper indicate that the statistical content does not differ substantially between the three countries. The major emphasis was on descriptive statistics involving graphing and tabulating data. With the exception of the mean, measures of central tendency and dispersion were generally not taught to students in this age group. The approach to teaching statistics in all three countries was informal, with many respondents stressing that manipulative aids were utilised to develop concepts. Furthermore, in all three countries approximately 50 percent of the respondents indicated that the initial approach to graphing was seen as a problem-solving activity, rather than as an attempt to teach graphing, per se.

It should be noted that the statistics programme in all three countries is relatively limited. However, many respondents noted that statistics has started to receive more attention in the past few years. Many Canadian and U.S.A. respondents stated that new programmes (or guidelines) were being considered or had just been adopted, and they expected that statistics would play a more significant role in the next few years.

In analyzing the comments it is reasonable to conclude that teachers see teaching statistics as an increasingly important component of the mathematics programme. The next few years will determine whether this expectation is met, and how programmes will expand to include different statistical concepts.

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