The Effect of Promotion Rates on School Efficiency

LEONARD P. AYRES, PH.D.,
DIRECTOR, DIVISION OF EDUCATION, RUSSELL SAGE FOUNDATION

Five years ago 84 out of each 100 children in the elementary grades of 16 of our large cities were promoted at the end of the school term. Last year 88 out of each 100 children in the same 16 cities were promoted at the end of the school year. There is abundant evidence that a similar general increase in promotion rates is taking place throughout the country. Since this affects the school lives of thousands of our children, school officials are confronted by the problem of finding out in what ways and to what degree it affects the children and the schools.

If we were considering problems of business or transportation, the general principles involved would seem quite simple. If a train making regular trips between two far distant cities runs at less than its normal rate of speed, it will take more than the normal amount of time to cover the distance. Similarly in a school system the average per cent of promotion can be turned into terms of time so as to tell us how long it will take the average child to complete the eight grades of the elementary course if he stays to do it.

TIME REQUIRED TO COMPLETE EIGHT GRADES

If every child in a school system should complete a full grade and be promoted at the end of every school year, the impossible ideal or normal rate of 100 per cent of promotions would be attained and the average child would complete eight grades in eight years. If only 80 per cent of the children are promoted at the end of each year, the average rate of progress is $\frac{4}{5}$ of the normal and hence the average child will require $\frac{5}{4}$ of eight years, or ten years to complete the course. This computation, like all the following ones, is based on the assumptions that the promotion rate applies equally to the children throughout the course, that none die, and none leave before finishing.

If we can compute by the simple process indicated that a promotion rate of 80 per cent applicable to all the children means that the average child will take 10 years to complete eight grades, we can figure by the same method what other promotion rates mean in terms of the time required to complete the course. The results are presented in column A of the table and section A of the diagram.

The Size of the School Plant

Suppose that conditions require our railroad train to transport a given amount of merchandise each year. It is clear that in proportion as the speed of the trips is reduced extra cars will have to be added to carry the load.

The same principle applies to our school systems. The community hands over to the schools a new crop of children each year and they all have to be accommodated. In proportion as their rate of progress through the grades is reduced, the size of the school plant, the amount of equipment, and the number of teachers must be increased. If the average rate of promotions is 80 per cent, or $\frac{4}{5}$ of the normal, the size of the school plant required to accommodate the children must be $\frac{5}{4}$ or 125 per cent of the theoretic normal. When this is translated into terms of dollars, the results for even a small city are impressive. Figures showing the effect of different promotion rates on the size of the school plant are presented in column B of the table. The same data are shown in graphic form in section B of the diagram.

Number of Failures per 1,000 Children

When we say that the promotion rate is 90 per cent, we mean that of each 1,000 children 900 are promoted and 100 fail of promotion. In a system having annual promotions there are seven promotion times before graduation in the eight years of elementary schooling. If during this entire period the average promotion rate were always 90 per cent, 100 out of the 1,000 children would fail at each of the seven promotion periods and there would be 700 failures among the 1,000 children in the eight years.

In a similar way the corresponding number of failures may be computed for each promotion percentage, because each time we drop the rate by one per cent, there will be 70 more failures among

the 1,000 children during the eight years. Following this method the number of failures among each thousand children in eight years has been computed for each promotion percentage from 100 down to 60. The results are presented in figures in column C of the table and illustrated in section C of the diagram. These data are an index of the degree to which the children are being trained in the habit of failure.

Promotions and Repeaters

The child who is not promoted does the work of the grade over again. He is a repeater. But the number of children in each thousand who repeat grades during eight years of school life is not the same as the number of repetitions, for one child may repeat grades several times. The number of children who will repeat grades one or more times during eight years at any given constant promotion rate may be computed by constructing a grade distribution for a hypothetical school system in which 1,000 children enter and are steadily promoted annually at, say, an 80 per cent rate, none die and none drop out.

Thus the first year there will be 1,000 children in the first grade. Then 80 per cent of them are promoted and the second year there will be 200 of them left to repeat the first grade and 800 will go on to the second grade. In the third year the promotion rate of 80 per cent again applies to all of them and as a result 40 are left in the first grade, 320 are in the second grade, and only 640 have gone on to the third grade.

By repeating these computations we can carry our thousand children through eight years of elementary schooling and find out how many have not repeated grades and how many have. By the same method we may ascertain the corresponding figures for each promotion rate. The data showing the number of children in each thousand failing and repeating grades in the course of eight years of elementary schooling at each promotion rate from 100 per cent down to 60 per cent are shown in column D of the table and section D of the diagram. These figures are an index of the number of children who are trained in the habit of failure.

Promotions and Over-Age Children

All children who are above the normal ages for their grades are over-age for one or both of two reasons: either they entered

school late or they made slow progress. If we eliminate the first cause by assuming that all the children begin school at the normal age of from six and one-half to seven years, we may compute for each promotion percentage the number of children in each thousand who will be over-age at the end of eight years. Since low promotion rates mean slow average progress, one of the results will be the production of over-age children just as inevitably as a slow speed for a train carrying perishable merchandise will result in an increased proportion of damaged goods.

By means of hypothetical age and grade tables, the percentage of over-age children resulting from each promotion percentage from 100 to 60 has been computed. In every case these computations are based on the propositions that 1,000 children enter school each year at the age of six and one-half to seven years, the promotion rate is constant for eight years, no children die and none drop out, and the count of over-age pupils is made on the last day of the year before promotion. The results are presented in column E of the table and section E of the diagram.

Annual and Semi-Annual Promotions

School administrators often speculate as to the results of changing from a system of annual promotions to a semi-annual one. From a purely mathematical point of view the answer is that the change has no effect whatever on the average progress rate of the children. If, for example, 80 per cent of all the children are promoted every time, it makes no difference in the average progress of the whole group whether the promotions take place once a year or ten times a year. But while the average progress of the children is not changed, their distribution through the different grades is materially affected.

If 100 children are promoted annually at a steady 80 per cent rate for eight years, we shall find them at the end of that time distributed through the grades as follows:

Grade	Children
4	3
5	11
6	27
7	38
8	21
Total	100

If the promotions take place semi-annually instead of annually, the distribution of these 100 children at the end of the eight years will be as follows:

Grade	Children
5B	3
6A	10
6B	19
7A	26
7B	24
8A	14
8B	4
Total	100

The difference between the two distributions is marked. Under the annual system 21 children have completed the eighth grade while, under the semi-annual system, only four have completed it. On the other hand the annual system has left three children in the fourth grade while the semi-annual one has left none lower than the 5B grade. The annual system has carried more children through on schedule time but left more far back in the grades, while the semi-annual system has carried fewer all the way through but left fewer badly retarded. The annual system has bettered conditions for the few while the semi-annual one has bettered them for the many. The difference between the two results may be more clearly seen if we picture the resulting distributions by representing each child in the fourth grade by a figure "4," each one in the fifth grade by a figure "5" and so on for those in the other grades. This gives us a distribution under the annual promotion system as follows:

DISTRIBUTION BY GRADES OF 100 CHILDREN AFTER EIGHT YEARS OF ANNUAL PROMOTIONS AT A CONSTANT RATE OF 80 PER CENT. EACH DIGIT REPRESENTS ONE CHILD AND ITS DENOMINATION SHOWS THE GRADE THE CHILD IS IN

			77777777	
		6666666	7777777777	8
	5	6666666666	7777777777	8888888888
444	5555555555	6666666666	7777777777	8888888888
(three)	(eleven)	(twenty-seven)	(thirty-eight)	(twenty-one)

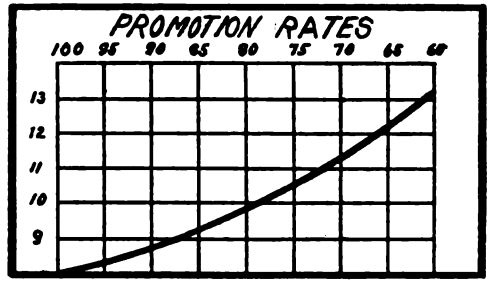
In a similar way the results of the semi-annual system at the same rate may be represented as follows:

DISTRIBUTION BY GRADES OF 100 CHILDREN AFTER EIGHT YEARS OF SEMI-ANNUAL PROMOTIONS AT A CONSTANT RATE OF 80 PER CENT. EACH DIGIT REPRESENTS ONE CHILD AND ITS DENOMINATION SHOWS THE GRADE THE CHILD IS IN

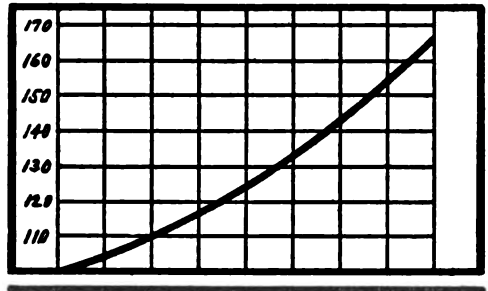
			7			
			77777	7777		
		6666	77777	77777		
		66666	77777	77777	8888	
	66666	66666	77777	77777	88888	
555	66666	66666	77777	77777	88888	8888
B	A	B	A	B	A	B
(three)	(ten)	(nine-teen)	(twenty-six)	(twenty-four)	(four-teen)	(four)

EFFECTS OF DIFFERENT ANNUAL PROMOTION RATES IN A SCHOOL SYSTEM IN WHICH 1,000 CHILDREN ENTER EACH YEAR, NONE DIE, AND NONE DROP OUT

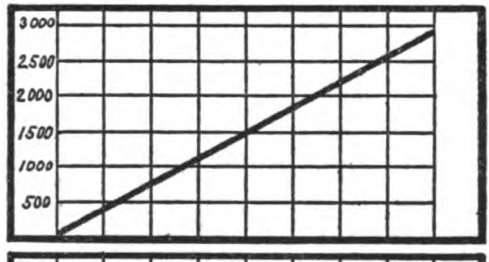
Promotion rate	A Years required for average child to complete 8 grades	B Per cent of normal size required for school plant	C Failures among each 1,000 children in eight years	D Children in each 1,000 failing in eight years	E Per cent of children above normal age for grades
100	8.00	100.0	0	0	0
99	8.08	101.0	70	68	3.4
98	8.16	102.0	140	132	6.7
97	8.24	103.0	210	192	9.9
96	8.33	104.1	280	249	12.9
95	8.42	105.2	350	302	15.9
94	8.50	106.3	420	352	18.7
93	8.60	107.5	490	398	21.4
92	8.69	108.6	560	442	24.0
91	8.78	109.8	630	483	26.4
90	8.89	111.1	700	522	28.8
89	8.98	112.3	770	558	31.1
88	9.09	113.6	840	591	33.3
87	9.19	114.9	910	623	35.4
86	9.30	116.2	980	652	37.4
85	9.41	117.6	1050	679	39.4
84	9.52	119.0	1120	705	41.2
83	9.63	120.4	1190	729	43.0
82	9.75	121.9	1260	751	44.8
81	9.87	123.4	1330	771	46.4
80	10.00	125.0	1400	790	48.0
79	10.12	126.5	1470	808	49.5
78	10.27	128.2	1540	824	51.0
77	10.38	129.8	1610	840	52.4
76	10.52	131.5	1680	854	53.7
75	10.66	133.3	1750	867	55.0
74	10.81	135.1	1820	878	56.2
73	10.95	136.9	1890	890	57.4
72	11.10	138.8	1960	900	58.6
71	11.26	140.8	2030	909	59.7
70	11.42	142.8	2100	918	60.7
69	11.59	144.9	2170	926	61.7
68	11.76	147.0	2240	933	62.7
67	11.94	149.2	2310	939	63.6
66	12.12	151.5	2380	945	64.5
65	12.30	153.8	2450	951	65.4
64	12.50	156.2	2520	956	66.2
63	12.70	158.7	2590	961	67.0
62	12.90	161.2	2660	965	67.8
61	13.11	163.9	2730	969	68.6
60	13.33	166.6	2800	972	69.3



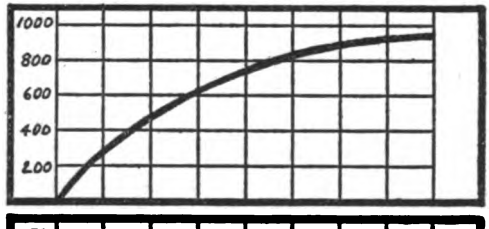
A. Years required for average child to complete eight grades at each promotion rate from 100 to 60 per cent.



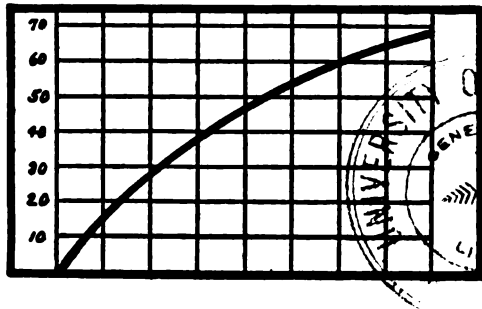
B. Per cent. of normal size required for school plant at each promotion rate from 100 down to 60 per cent.



C. Failures among each 1,000 children in eight years at each promotion rate from 100 down to 60 per cent.



D. Children in each 1,000 failing in eight years at each promotion rate from 100 down to 60 per cent.



E. Per cent. of children above normal age for grades at each promotion rate from 100 down to 60 per cent.

The two figure-diagrams illustrate clearly the characteristic differences between the results of the two systems. Under the annual system more children have completed the course but more are seriously retarded. Under the semi-annual system fewer have completed the course but fewer are seriously retarded.

By employing the methods outlined in the preceding sections, other comparisons between the effects of annual and semi-annual promotions may be made. These comparisons show that when all other factors are equal, semi-annual promotions result in lower percentages of over-age children than do annual promotions. Under semi-annual promotions more children fail but each failure is less serious than under the annual system.

Validity and Application of the Computations

Six sets of computations have been presented. Five of them are designed to show the effects of each promotion rate from 100 per cent down to 60 per cent in

A. Years required for average child to complete eight grades
B. Per cent of normal size required for school plant
C. Failures among each 1,000 children before completing eight grades
D. Children in each 1,000 failing before completing eight grades
E. Per cent of children above normal ages for grades.

There are several reasons why the results are not absolutely valid. In each case one hypothesis on which the computations are based is that none of the children leave the system through death or elimination. Now in point of fact some children die in every school system and some leave without completing the course. The second factor is far more important than the first for relatively few die while very many drop out. In general children in city schools remain in the elementary grades about eight years. If at the end of that time they have nearly or quite completed the course, they are apt to continue to the high school. If they have not, they are apt to leave school never to return.

For this reason the figures presented in columns A, B, and E are fairly trustworthy only when applied to conditions in the six lower grades. They do not apply so truly to conditions in the two upper grades for those grades are largely made up of the survivors who remain after large numbers of the slower pupils drop out.

For practical purposes the comparative studies of annual and semi-annual promotions are probably the least valuable of those presented. In actual application the semi-annual promotion system not only has the advantage shown here of carrying the great bulk of the children forward more consistently, but the further one of giving the brighter children more opportunity to complete the course on schedule time, while at the same time penalizing the slower ones less severely.

What a Change of One Per Cent Means

The importance of small changes in promotion rates may be best illustrated by figuring the results of a change of one per cent, say for example from 80 per cent to 81 per cent, in the promotion rate in the elementary schools of a small city. Let us suppose that 1,000 children enter the elementary schools each year, the annual per capita cost for schooling is $40, and the buildings, grounds, and equipment have a value of $200 per child.

Under these conditions, the change in the promotion rate from 80 per cent to 81 per cent will have the following results: The time saved by each 1,000 children if they complete the elementary course will amount to 130 years of schooling, which means a saving of $5,200 annually. The plant required to accommodate the children will be decreased by about $25,600 worth, and the salaries of four teachers will be saved. The number of failures among the 1,000 children during eight years of school life will be reduced by 70, while the number of children failing during that period will be lessened by 19. The number of over-age children in the grades will be reduced by 220. These figures strikingly illustrate the importance of even the smallest changes in promotion rates.

Summary

1. Small differences in promotion rates have seriously important results, both human and material.

2. As the promotion rate falls, the time required for the average child to complete the course increases.

3. The lower the promotion rate, the larger must the school plant be to accommodate the children.

4. For each per cent that the promotion rate falls, there are 70 more failures among each 1,000 children in eight years of schooling.

5. As the promotion rate falls, the number of children failing in the course of eight years rapidly increases.

6. The lower the promotion rate, the higher will be the percentage of over-age children.

7. The annual promotion system tends theoretically to carry more children through the course on schedule time than does the semi-annual system but it leaves more of them seriously retarded.

The figures and diagrams that have been presented impressively illustrate the great importance of small differences in promotion rates. In its educational significance, a 75 per cent rate is an entirely different matter from one of 80 per cent and this again is not at all the same as one of 90 or 95 per cent. Every change of even one per cent either up or down is reflected by great and far reaching consequences in terms of dollars, teachers, plant, equipment and children's time. Most important of all, it has its very great effect on the degree to which the children are trained in habits of success and failure.

Some Publications on Measurements in Education Issued by the Division of Education, Russell Sage Foundation*

No. 61. THE RELATION OF PHYSICAL DEFECTS TO SCHOOL PROGRESS.
A statistical study based on 6708 cases. 9 pp.

No. 107. THE BINET-SIMON MEASURING SCALE FOR INTELLIGENCE: SOME CRITICISMS AND SUGGESTIONS.
A critical study of these tests and suggestions as to their adaptation to our conditions. 11 pp.

No. 108. THE IDENTIFICATION OF THE MISFIT CHILD.
Data from a study of the age and progress records of school children in 29 cities. 11 pp.

No. 110. THE RELATIVE RESPONSIBILITY OF SCHOOL AND SOCIETY FOR THE OVER-AGE CHILD.
Data from a study of the age and progress records of school children in 29 cities. 6 pp.

No. 112. THE RELATION BETWEEN ENTERING AGE AND SUBSEQUENT PROGRESS AMONG SCHOOL CHILDREN.
Evidence from three investigations of the problem "What is the best age to send a child to school?" 9 pp.

No. 113. A SCALE FOR MEASURING THE QUALITY OF HANDWRITING OF SCHOOL CHILDREN.
A quantitative study of legibility. (Report 5 cents. Scale 5 cents.) 16 pp.

No. 116. THE MEASUREMENT OF EDUCATIONAL PROCESSES AND PRODUCTS.
An account of the development of the quantitative method in education. 9 pp.

No. 124. A COMPARATIVE STUDY OF PUBLIC SCHOOL SYSTEMS IN THE FORTY-EIGHT STATES.
Fifteen tests of educational efficiency and accomplishment. 32 pp. (Price 15 cents.)

No. E 126. THE SPELLING VOCABULARIES OF PERSONAL AND BUSINESS LETTERS.
An analysis of 2000 letters. 16 pp.

No. E 128. PSYCHOLOGICAL TESTS IN VOCATIONAL GUIDANCE.
Analysis of the problem, with brief sketch of the progress already made towards its solution. 6 pp.

No. E 130. THE EFFECT OF PROMOTION RATES ON SCHOOL EFFICIENCY.
A method and tables for measuring differences in the effects of promotion rates. 12 pp.

* A charge of five cents a copy is made for these publications unless otherwise specified.