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The Dominant Tendency of the First Recognition

— A Psychological Element or Process Related to Learning —

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I. Purpose of Research

Dealing with various subjects in each field of technological education, and elucidating the mechanism of learning and the mechanism of recognition, we have been making a series of experimental and substantial inquiries with a view to the improvement of the process of learning and evaluation. Our researches have especially been made into the results produced on the effectiveness in learning by the structures (or process) of learning. In such experimental and substantial researches as these, there appear in the results the effects of various influences of psychological function. In fact, it is presumed that the recognition is achieved as a result of the synthesis of such psychological function.

Here in this paper this writer would like to report on what is taken to be one of such psychological functions which he calls "the dominant tendency of the first recognition."

II. Method and Result of the Research

What this writer calls "the dominant tendency of the first recognition" was noticed in the results of the experimental lessons to be described as follows :

1. Experimental lessons with the electric iron

a. Outline of the method

The subject of the lesson was the electric iron. The structure of the contents of the learning was classified by the order of learning what this writer calls "the three elements composing technology"—purpose (or function) [P], ground (or principle) [G] and method (or mechanism) [M]. According to the order of learning of such elements, the classes were divided into the four different groups as follows : The first group learned the lesson in the order of P-M-G (PMG structure), the second group learned in MGP structure, the third group in PGM structure, and the fourth group learned the lesson faithfully to the textbook (Contrast group), thus each class forming one group with its own structure of the contents of the learning which is different from the structure of any other group. (See Bibliography 1 for the detailed descriptions)

b. Results

As space is limited in this paper, the results are summarized as shown in Table 1 by picking out the related parts out of the original table (Bibliog. 1).

As is shown here, in the learning processes with MGP strueture and PMG structure, where the learning of the mechanism (method, M) preceded that of the principle (ground, G) in reference to the same substance used as the heat-generating substance (heater), the sum of the answers which called the substance the nichrome wire, or the electrothermic wire was more than 87% not only after learning M, but also after learning G. While in the

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Table 1. Effect of the structure of the contents of the learning upon the contents of the learners' memory
—Achievement of the experimental lessons with the electric iron—
[Problem : What is the device used in the electric iron as the heat-generating substance?]

(Structure of contents of the learning) Group / (Structure of memory) Answer	Contrast 24 pupils	MGP 23 pupils		PMG 24 pupils		PGM 25 pupils	
		After M	After G	After M	After G	After G	After M
Nichrome wire	20 (83.3%)	22 (95.7)	20 (87.0)	18 (75.0)	21 (87.5)	3 (12.0)	4 (16.0)
Electrothermic wire	0 (0)	0 (0)	0 (0)	3 (12.0)	0 (0)	1 (4.0)	0 (0)
Heat-generating substance (heater)	1 (4.2)	0 (0)	0 (0)	3 (12.5)	0 (0)	0 (0)	4 (16.0)
Conductor	0 (0)	0 (0)	1 (4.3)	0 (0)	0 (0)	1 (4.0)	2 (8.0)
Conductor with resistance	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (48.0)	11 (44.0)
Heat-generating substance with resistance	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (8.0)	2 (8.0)
Metal with great resistance	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.2)	0 (0)	0 (0)
Resisting substance	0 (0)	1 (4.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
No answer	3 (12.5)	0 (0)	2 (8.7)	0 (0)	2 (8.3)	6 (24.0)	2 (8.0)
Total	24 (100)	23 (100)	23 (100)	24 (100)	24 (100)	25 (100)	25 (100)

learning process with the PGM structure where the learning of the principle preceded the learning of the mechanism, the sum of the answers which called the substance the conductor, the conductor with resistance, or the heat-generating substance with resistance reached as high as 60% not only after the learning of G, but after the learning of M.

In this way, when the learning of the principle preceded, the total learning tended to be recognized and memorized in accordance with the principle (or theory). On the contrary, when the learning of the mechanism preceded, the learning as a whole tended to be recognized and memorized in accordance with the mechanism (or material). In other words, what was learned earlier tended to be recognized and memorized more dominantly.

2. Experimental lessons with the body of the 4-cycle engine

a. Outline of the method

With the body of the 4-cycle engine as the subject for the lessons, we conducted the experimental lessons in four different groups which were classified as such by the order of the learning of the elements of the contents : purpose, or function (P), ground, or principle (G), method, or mechanism (M). Thus the

structure of the contents of the learning for each of the four groups was as follows by the order of the presentation of each element mentioned above : the MGP structure, the PMG structure, the GMP structure, and the PGM structure. (See Bibliography 2 for the detailed descriptions.)

b. Results

(1) The original table (on page 16 of Bibliography 2) is not presented here. In the groups with the PGM and GMP structure in which the learning of the ground preceded that of mechanism, we got the answers related to the content of their ground-learning—the piston is pressed down with the one-ton power, when the piston had a diameter of 62 mm and the explosive pressure applied to the piston was 35kg/cm^2). On the other hand, in the groups in which the learning of the mechanism preceded that of the ground none of such kind of answers were noticed

As is shown here, when the learning of the ground preceded, we noticed a tendency that the learners showed a better recognition and memory concerning the ground. In other words, the content of the learning studied first tended to be recognized and memorized more dominantly.

(2) In this paper the results are summarized as shown in Table 2 by picking out the related parts out of the original table (on page 19 of Bibliography 2).

Table 2. Items difficult for understanding in pupils' learning
—Results of the experimental lessons with the body of the 4-cycle engine—
[Question : State the items you had difficulty to grasp in the learning of the body of the 4-cycle engine.]

(Structure of contents of the learning) Group / Answer (item)	MGP 24 pupils		PMG 21 pupils		GMP 24 pupils		PGM 24 pupils	
Mechanism of the carburator	0 (0%)	3 (10.7)	8 (18.6)	8 (18.6)	5 (18.5)	5 (18.5)	7 (16.7)	7 (16.7)
Interior of the carburator	3 (10.7)		0 (0)		0 (0)		0 (0)	
Indicator chart	5 (17.9)		5 (11.6)		0 (0)		8 (19.0)	
Others	16 (57.1)		26 (60.5)		22 (81.5)		18 (42.9)	
No answer	4 (14.3)		4 (9.3)		0 (0)		9 (21.4)	
Total	28 (100)		43 (100)		27 (100)		42 (100)	

The question here was asked about the item which was hard to grasp in this learning.

In the MGP-structure group, in which the learning of the mechanism preceded that of the ground, no pupils mentioned "the mechanism of the carburator" as a difficult item (while in all the other groups with other structures a good number of pupils mentioned it as a difficult item). Even with the number of the answers which mentioned "the interior of the carburator" as a difficult item combined, it was less than the numbers given by any of the other groups. On the other hand, in the GMP-structure group, in which the learning of the ground preceded that of the mechanism, no pupils mentioned "the indicator chart"

which was studied in relation to the ground. From these results it is presumed that the content studied first tended to be recognized and memorized easier than the content studied later.

3. Experimental lessons in the mechanism of transmission of power in the bicycle

a. Outline of the method

With the mechanism of the transmission of power in the bicycle as the subject for the lesson, the experimental lessons, were conducted in four groups, each differing in the order of the structure of the contents of the learning : the G・M + P structure in which the study of the ground, or principle in this case, concerning the moment of rotation (G) preceded the combined study of method or mechanism (M), and the purpose, or function (P) (M+ P) ; the G + M+P structure in which G, M and P were studied interrelatedly ; the M+P・G structure in which the learning of M+P preceded that

Table 3. The results produced on the effectiveness in learning by the structure of the contents of the learning
—Results of the experimental lessons in the mechanism of the transmission of the power in the bicycle—
[Problem 1. Why is more power needed with the greater gear-ratio, and less power needed with the smaller gear-ratio?]

(Structure of the contents of the learning) Group / Answer (Structure of contents of momory)			Contrast group		Experimental groups					
			M+P 23 pupils		G・M+P 20 pupils		G+M+P 22 pupils		M+P・G 24 pupils	
Answers related to the moment of rotation	correct answers	(a)*	0	0 (0%)	1	6 (30.0)	0	2 (9.1)	0	1 (4.2)
		(b)	0		0		1		0	
		(c)	0		1		0		1	
		(d)	0		1		0		0	
		(e)	0		3		0		0	
		(f)	0		0		1		0	
	wrong answers	(g)	0	0 (0)	0	0 (0)	1	2 (9.1)	0	0 (0)
		(h)	0		0		1		0	
	Subtotal		0 (0)		6 (30.0)		4 (18.2)		1 (4.2)	
Other answers			22 (95.7)		14 (70.0)		17 (77.3)		23 (95.8)	
No answers			1 (4.3)		0 (0)		1 (4.5)		0 (0)	
Total			23 (100)		20 (100)		22 (100)		24 (100)	

*The descriptions of the contents of (a) to (h) in the table are as follows :

(a) The greater the gear-ratio is, the smaller becomes the radius of the smaller gear. Thus a greater power is needed.

(b) The greater the gear-ratio is, the smaller becomes the smaller gear, if the size of the big gear remains the same. And the smaller gear is small, the distance from its center to the chain becomes smaller. Thus a greater power is needed.

(c) The smaller the distance from the center of the smaller gear to the chain is, the greater power is needed. Thus the greater the gear-ratio is, the greater power is needed.

(d) As "the balance" needs the greater weight with the smaller distance from the center, so, if the size of the gear is the same, the greater the gear-ratio is, the smaller becomes the distance from the center of the smaller gear to the chain, and the greater power is needed.

(e) As in the case of "the wheel and axile (or its theory)" the smaller the radius of the smaller gear is, the greater power is needed, so the greater the gear-ratio is, the greater power is needed.

(f) The greater the gear-ratio is, the smaller is the radius of the smaller gear, as is shown in the case of the seesaw, and the greater power is needed.

(g) The illustration of the relationship between the radius of the gear and the power needed is given. However, it states that the greater the radius is, the greater power is needed.

(h) The illustration was given in which a comparison is given to the "balance." However, it showed the wrong understanding of the relationship between the pedal side and the rear wheel side.

of G; and the learning with the textbook which was taken to be almost equivalent to the M+P structure. (The detailed descriptions are found in Bibliographies 3 and 4.)

b. Results

In this paper the related parts have been extracted from the original table (in Bibliographies 3 and 4) to summarize the results in the form of Table 3.

According to this table, the answers related to the moment of rotation were quite a few in the G·M+P group in which the learning of the ground preceded that of the mechanism, while very few answers of this kind was noticed in all the other groups.

As shown here, when the learning of the ground preceded other elements of the contents of learning, we noticed a growing tendency to recognize and memorize the ground well.

4. Experimental lessons concerning the relationship between the pressure of the gaseous body and the molecular movement

a. Outline of the method

The learning of the pressure of the gaseous body and the molecular movement in a junior high school science lesson was taken as the subject matter. The experimental lessons were conducted in four groups, in each of which a different process was given to explain the relationship between the pressure of the gaseous body and the molecular movement in the complex experiments by the use of the model experimental implements as is shown below.

The first group studied the lesson, following the process given in the textbook, that is, in the order of the scale, the box, and the model—by using first the scale (the pupils checked the size of the deflections of the pointer by changing the time distance or the number of the steel balls which fall on the counter scale), and next the box (the steel balls were put in a shallow-bottomed box, which, in turn, was shaken to the right and left to investigate the difference in the degree with which the steel balls crash against the walls in two cases—when the steel balls were collected on one side in the box by putting the partition-board in the middle of the box, and when no partition-board was put in the box), and then a special model experimental implement. By changing the order of the

Table 4. The influecne exerted by the order (process) of the experiment in the complex experiment upon the effectiveness of the learning
—Experimental lessons concerning the relationship between the pressure of the gaseous body and the molecular movement—

[Problem 2. We changed the number of the steel balls in our experiment to investigate the relationship between the capacity and pressure of the gaseous body by the use of the model experimental implements, To what change is it correspond in the actual gaseous body?]

Group (Process of execution of experiment) / Answer (Structure of recognition·memory)	Contrast		Experimental							
	S-B-M* 40 pupils (II-2)**		M-S-B 37 pupils (II-3)		B-S-M 40 pupils (II-1)		M-B-S 40 pupils (II-4)		Total	
(a) Pressure	8	10 (25.0%)	7	7 (18.9)	3	4 (10.8)	4	6 (15.0)	22	27 (17.5)
(b) Pressure & capacity	1		0		1		0		2	
(c) Pressure & temperature	0		0		0		1		1	
(d) The power with which the molecules crash against the wall	1		0		0		0		1	
(e) The pushing power of the gaseous body	0		0		0		1		1	
(f) To increase the number of the molecule in a certain capacity (that is, to make the density higher)	1	10 (25.0)	0	13 (35.1)	2	18 (48.6)	0	20 (50.0)	3	61 (39.6)
(g) The number of the molecule	8		12		16		17		53	
(h) The molecule of the gaseous body	1		0		0		3		4	
(i) The molecule of smoke	0		1		0		0		1	
(j) Other answers	17 (42.5)		15 (40.5)		12 (32.4)		11 (27.5)		55 (35.7)	
(k) Cannot understand	1 (2.5)		0 (0)		1 (2.7)		0 (0)		2 (1.3)	
(l) No answer	2 (5.0)		2 (5.4)		2 (5.4)		3 (7.5)		9 (5.8)	
Total	40 (100.0)		37 (99.9)		37 (99.9)		40 (100.0)		154 (99.9)	

* S : scale, B : box, and M : model.

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learning, the second group carried on the experiment with the model-scale-box process, the third group with the box-scale-model process, and the fourth group with the model-box-scale process. (For the detailed descriptions see Bibliography 4.)

b. Results

In this paper the related parts are extracted from the original table (on page 148 of Bibliography 4) to summarize the results in the form of Table 4.

According to this table, in the groups with the scale-box-model process and the model-scale-box process, in both of which the experiment with the scale preceded that with the box, we had more answers connected with the pressure of the gaseous body in relation to the contents of the experiment with the scale, or the concept derived from the experiment. On the contrary, in the groups with the box-scale-model process and the model-box-scale process, in both of which the experiment with the box preceded that with the scale, we had more answers connected with the number of the molecules of the gaseous body in relation to the contents of the experiment with the box, or the concept derived from it.

In this way we found a dominant tendency of the recognition and memorization of the contents and concept of the preceded experiment.

As is shown in the results of these experimental lessons, we noticed "the tendency, in the learning of a subject matter, to recognize and memorize more dominantly the learning given first or earlier in the learning process." The present writer called this tendency "the dominant tendency of the first recognition" and wishes to make further investigation on it.

III. Summary

Up to now we have been conducting a series of experimental and substantial inquiries into the influence of the structure of the contents of the learning upon the effectiveness of learning. In some of these experimentat lessons we found that "in the learning of a subject matter, there was a dominant tendency of the recognition and memorization of the learning which was given first or previously in the order of teaching." Calling this tendency "the dominant tendency of the first recognition," the present writer wishes to pay more attention to it and make further research on it.

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