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Directionality as a Sequence Effect in Programmed Learning of a Verbal Concept

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DIRECTIONALITY AS A SEQUENCE EFFECT IN PROGRAMMED LEARNING OF A VERBAL CONCEPT

69

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INTRODUCTION

Thirty years ago Sidney Pressey (1926) published an article describing an apparatus for presenting multiple choice questions which gave the student immediate feedback regarding the correctness of his response to the questions. Although this device was intended to be a "testing machine" rather than a "teaching machine," it is often generously designated the status of being the first teaching machine. Pressey's machine had little impact upon the educational world and for a generation teaching machines were all but forgotten. In the 1950's B.F. Skinner began the modern movement to automate education. Psychologists, but as noted by Bugelski (1964, p. 208) "not necessarily as psychologists" have been largely responsible for the recent excitement about teaching machines.

Although sundry types of devices have been designed for presentation of programmed material, the material, itself, probably has not received the attention it warrants. Many aspects of programming are based upon apriori reasoning with only limited benefit of supportive research. A potential programmer has few resources to which he can turn when constructing a program and this problem becomes particularly acute when he becomes concerned with the sequence of his program.

Skinner (1954) has provided a theoretical basis for programmed instruction through an application of contingencies of reinforcement and successive approximations. He emphasizes the use of electrical or mechanical devices so that reinforcement for the right answer will be immediate, and so the learner can progress at his own rate. The gradual elaboration of complex patterns of behavior and the maintenance of the behavior in strength is achieved through the succession of a large number of very small steps with reinforcement contingent upon the accomplishment of each step. Skinner did not, however, provide specific guidelines for a programmer to use in developing a program. Evans, Homme and Glaser (1962) attempted to provide guidelines for programmers in the form of the "RULEG" system. The RULEG system is a plan by which a programmer may organize his material into two classes, rules and examples; these rules and examples are then organized into frames and modified until a satisfactory sequence is developed. Although this system may be of use in designing short sequences, it provides little direction for the organization of an overall program.

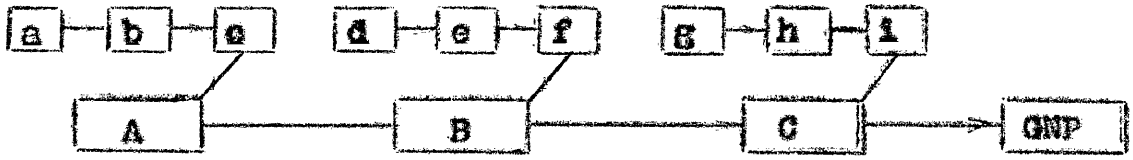
Some investigators have raised questions regarding the effects of altering the sequence of programmed materials. A self-instructional geometry program was developed by Levin and Baker (1963) and was presented in a standard and random order to two matched groups of eighteen second grade public school children. It was

concluded that the data provided no support for the contention that item sequence is an important variable in self-instructional programs. These authors felt that the order of presentation may not be an unimportant variable in all cases. Further dissection of sequences was recommended as a means of describing and comparing sequential structures of programs. In a similar study Roe, Case and Roe (1962) also found that the sequence of items had no significant effects, and felt that sequencing of items may be a function of variables such as length of program, information content of items, and individual learner differences.

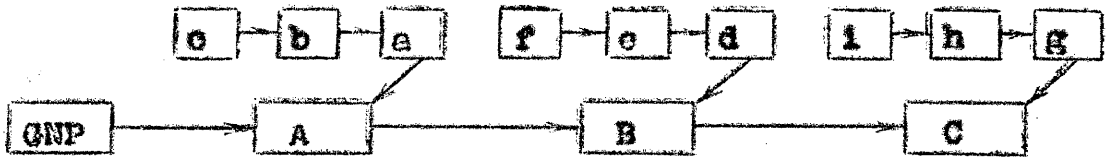
In a recent study (Newton and Hickey, 1965) it was pointed out that if a sequence was even moderately complex, it may be necessary to learn several independent subconcepts in the process of learning the program, and even-though there may be no apriori basis for arranging the subconcepts, their arrangement may effect the efficiency of the overall learning or retention. Three variables were considered in this study. Order was the first variable to be considered and was defined as "the placement of a subconcept relative to other subconcepts being learned". A program intended to define Gross National Product (GNP) was composed of three subsequences: one defining the concept of consumption spending, another defining the concept of investment and a third subsequence

defining terms which were basic to the understanding of the program. Any of these could be learned first, second or last. The second variable considered in that study was "the effect of applying whole or part learning procedures to inclusion of subconcepts in the program". Part learning could take place if all of the subconcepts were learned first while "whole learning" could occur if the subconcepts were presented as they were needed in the overall program. This variable was manipulated by adjusting the position of the two subconcepts of investment and consumption spending with respect to the concept of GNP.

The direction of the program was the third variable to be considered. A principle or rule may be presented before the meaning has been developed or the principle may be developed gradually. This variable can be manipulated in two ways; it can proceed toward or away from the statement of the major principle or it can also be an indication of the directionality within the subconcepts. Such a programmed sequence is presented graphically in Figure 1. A concept, such as GNP, may be composed of several subconcepts which we can call A, B and C and each subconcept is also composed of groups of frames which are sequential and are represented by lower case letters. GNP can be presented first in the program followed by A, B and C (in any order or position) or it may come at the end of the program after the A, B and C sub-sequences.



(a) Over-all directionality toward the definition of the major concept and subgroup directionality in the original sequence.



(b) Over-all directionality beginning with the definition of the major concept and subgroup directionality reversed.

Fig. 1. Graphic illustrations of the variables of sequence directionality.

In a similar manner the groups of items comprising each subconcept may be directed toward the major definition of that subconcept in an a-b-c sequence or the directionality could be altered by reversing the presentation in a c-b-a sequence.

In the study by Newton and Hickey these two variables of directionality were confounded into one. When GNP was defined at the beginning of the program the subconcept directionality was also reversed and, when the concept of GNP was at the end of the program, the sub-sequences were also directed toward the definition of the subconcept.

The concept of directionality is not peculiar to programmed instruction. Wittrock (1963), for example, was concerned about the effects of providing a varying amount of direction. Direction, in this case, referred to the amount of help in the form of rules or answers to problems and did not specifically refer to programmed learning in which this can be controlled by the placement of rules or definitions with reference to the overall sequence. It was found, however, that an intermediate amount of direction produced the greatest retention and transfer, while the "maximum" amount of direction produced the greatest initial learning. The minimum direction group was least effective on initial leanring, retention and transfer. Haslerud and Meyers (1958) had previously found that transfer was better with principles that were

independently derived even though learning had been better when the rules had been given. Applying these concepts to programmed instruction, Gagné and Brown (1961) found that "Guided Discovery" tended to result in better performance than the same program in a "Rule and Example" sequence or a "Discovery" sequence.

It is difficult to compare the results of the above three studies other than to state that there were differences in performance and retention on learning tasks when the amount or type of direction was varied. Although the study of Newton and Hickey did not use "direction" in exactly the same context as the above studies, the use was similar in that under one condition of directionality the rule was presented first before the meaning or generality had been developed while in the other condition, the learner developed the rule gradually which is similar to learning by "discovery".

In the study by Newton and Hickey (1965) three variables, order, position, and directionality (overall directionality confounded with subconcept directionality) were manipulated in a program designed to define Gross National Product (GNP). Three measurement criteria of: time to complete the program, number of errors made on the program, and the scores obtained on a test administered immediately afterward were considered. It was found that error scores were insensitive to variations in the program. An inter-

action effect between position and directionality and a triple interaction was found in the test scores. Both position and directionality main effects were evident for the time scores as well as an interaction between order and position. Thus, it was found that the relationship between a program and its effectiveness may not be a simple one and many variables must be considered in determining a program's effectiveness.

This study is a modification of the above research. Two major changes were made, however; (a) the variable of order was collapsed since it did not appear to have as great an effect as the other two variables and the program was counterbalanced to compensate for this effect; (b) the variable of directionality was reclassified as one variable of overall directionality and a second variable of within subconcept directionality.

METHOD

Subjects

All subjects were volunteers from introductory psychology courses at the University of Omaha. Every student in an introductory psychology course is requested to participate in two hours of experimental or research activities, but the student can decide for what experiment he cares to volunteer. Each of ninety-six students was randomly placed in one of twelve experimental groups using one of twenty-four programs. Twenty-four programs were necessary in order to counterbalance for the order variable previously noted. The subjects ranged in age from eighteen years to forty-three years with a median age of nineteen years. Fifty-one of the subjects were men and forty-five were women. No age or sex was disproportionately represented in any of the twelve groups. Although no previous enrollment in a college economic course was considered a prerequisite for this experiment, four individuals who had taken previous college economics courses participated in the experiment and could not be included in the analysis. Thirteen other students failed to complete the program during a fifty minute class period and one student failed to follow directions and was also excluded. Therefore, one hundred and fourteen students participated in the experiment, but only the results of ninety-six were included in the analysis. No experimental condition was disproportionately represented among these individuals.

Materials

A fifty-nine frame constructed response program was used under all experimental conditions with only the sequence being changed for each experimental condition. The sequences were typed and arranged in booklets, 5½ x 8½ inches in size. The horizontal format used by Holland and Skinner in the Analysis of Behavior (1961) was used in order to minimize the subjects' opportunity to look at the answers before they had written their responses on answer sheets. Copies of the program and the answer sheet are presented in Appendices A and B.

The program was extracted from the portion of the Entelek (1963) economics program which dealt with GNP. Newton and Hickey had made some modifications so that each program element was defined alone and was not dependent upon some preceding sequence. These modifications were retained in this experiment and no further alterations were made. The definition of GNP used in this program contains four basic clusters of frames. The cluster involving GNP itself requires thirteen frames and ties together all of the other terms. Fourteen frames composed a unit of definitions basic to all of the subconcepts. The two subconcepts of consumption spending and investment both required sixteen frames. A third subconcept, government spending was not utilized in the Newton and Hickey study due to its complexity and length.

This subconcept was also excluded in this study.

The ten-item multiple choice test designed by Newton and Hickey to use as a measure of teaching effectiveness was included in this experiment. The test provides information other than that available from an analysis of the program and gives an indication of the amount of transfer which may result from the program. A copy of this test is also included in Appendix C.

Design

The twelve experimental conditions generated a 2 x 3 x 2 factorial design. Overall directionality had two levels; the program either started with the thirteen frames defining GNP or terminated with these frames. There were three levels of the position variable. Position was determined by the placement of the two subconcepts of consumption spending and investment relative to the cluster of basic definitions. Both concepts could be learned first followed by the definitions; both could be learned after the basic definitions were learned; or one concept could be learned prior to learning the basic definitions with the other concept learned afterwards. The third variable was that of subconcept directionality. The subgroups could be defined in their original sequence, or the independent parts of the sequence could be rearranged, in this case, reversed. Thus, if a subconcept sequence was originally composed of parts a, b and c, in its reversed

form, its components would be presented in a c, b, a sequence. One exception to this pattern was made in the subgroup defining GNP where a part composed of a single frame was found not to be independent of the preceding frame. Instead of reversing the sequence composed of parts j, k, l, m, n the altered form was in the sequence, n, m, k, l, j which meant that only a single frame was not reversed with respect to the others.

The variable of Order was collapsed but the programs were counterbalanced to account for its possible effects. In other words, if the subconcept of consumption spending was presented first on one pro ram, it would be counterbalanced by presenting the subconcept of investment first on its counterpart. The program is presented in outline form in Appendix D and the sequences of the twenty-four programs in Appendix E.

Procedure

All subjects participated in the experiment during a period in which they had no scheduled classes. The number of subjects in a session varied from one to twenty; two subjects were tested individually and there were several small groups composed of two to five individuals. A tape recording was used to present the instructions and the illustrations noted by the instructions were drawn on the blackboard in front of the room. A copy of the instructions is included in Appendix F. When a

subject completed a program, the program and answer sheet were collected and the multiple choice test was immediately provided. The sessions were proctored to make sure that the subjects followed the directions, worked independently and handed in their programs immediately after completion so as not to effect the time scores.

RESULTS

The performance of the twelve groups were compared on the basis of three criteria: the number of correct responses on the multiple choice test, time, in minutes, to complete the program and number of erroneous responses on the program. The mean scores of all the groups are presented in Table 1 for these criteria. It should be noted that the means obtained on this data are comparable with those previously obtained by Newton and Hickey. There was a tendency, however, for the subjects in this study to require slightly more time in completing the program (difference of means 2.10 minutes), but to make fewer errors (difference of means 2.69) and score slightly higher on the test (difference of means .76). A comparison between the two studies would be of little value since different variables were under consideration.

It is possible that a certain amount of subjectivity could be present in determining the number of errors made on the program. This was avoided to a large extent by counting an answer incorrect in most cases if it was not identical to the one required in the program. There was a total of fifty-nine frames with one hundred eight responses. The responses, rather than the frames, were tabulated for errors; thus, making it possible for a subject to make several errors in one frame. This, in addition to the stringent scoring, produced high error

TABLE 1

Mean Scores for the Three Performance Criteria

Overall Directionality	Subconcept Directionality	Criterion	Position of Subconcepts: Both at start of program	One at start of program	Both at end of program
GNP defined at end of program	Subconcept directionality unaltered	Test	5.88	5.50	7.38
		Time	36.50	37.75	38.13
		Errors	23.88	24.38	24.38
	Subconcept directionality reversed	Test	6.50	5.75	5.63
		Time	40.25	36.88	37.75
		Errors	26.63	24.50	27.25
GNP defined at beginning of program	Subconcept directionality unaltered	Test	5.88	6.50	7.13
		Time	38.63	36.13	34.13
		Errors	29.13	21.38	23.75
	Subconcept directionality reversed	Test	7.73	6.50	5.75
		Time	37.75	37.63	40.63
		Errors	22.50	18.75	25.75

scores, but, hopefully, insured scoring reliability. Analysis of the error scores revealed no significant difference at the .05 level. These results are consistent with those obtained by Newton and Hickey and investigations using random sequences (Levin & Baker, 1963, Roe, Case & Roe, 1962). The Analysis of Variance for the error scores is presented in Table 2.

TABLE 2

Summary of Analysis of Variance of Error Scores

Source of variation	df	MS	F
A (overall directionality)	1	63.38	1.02
B (position of subconcepts)	2	106.76	1.72
C (subgroup directionality)	1	1.50	.02
AB	2	50.67	.82
AC	1	112.66	1.81
BC	2	44.29	.71
ABC	2	39.89	.64
within cell	84	62.09	
Total	95		

When test scores were subjected to analysis, no significant differences among main effects were evident. There was, however, a significant interaction effect between position and directionality within subconcepts ($F=4.15; p < .05$). Mean scores for this criterion are presented in Figure 2 and a summary of the analysis in Table 3.

TABLE 3

Summary of Analysis of Variance of Test Scores

Source of variation	df	MS	F
A (overall directionality)	1	5.05	1.36
B (position of subconcepts)	2	1.26	.34
C (subgroup directionality)	1	.17	.05
AB	2	1.87	.50
AC	1	1.04	.28
BC	2	15.39	4.15*
ABC	2	.94	.25
within cell	84	3.71	
Total	95		

* Significant at the .05 level

Such a relationship between position and within subconcept directionality is difficult to explain. When subconcept directionality was unaltered, transfer was best when both subconcepts were at the end of the program, and when subconcept directionality was reversed, transfer was best if both subconcepts were at the beginning of the program.

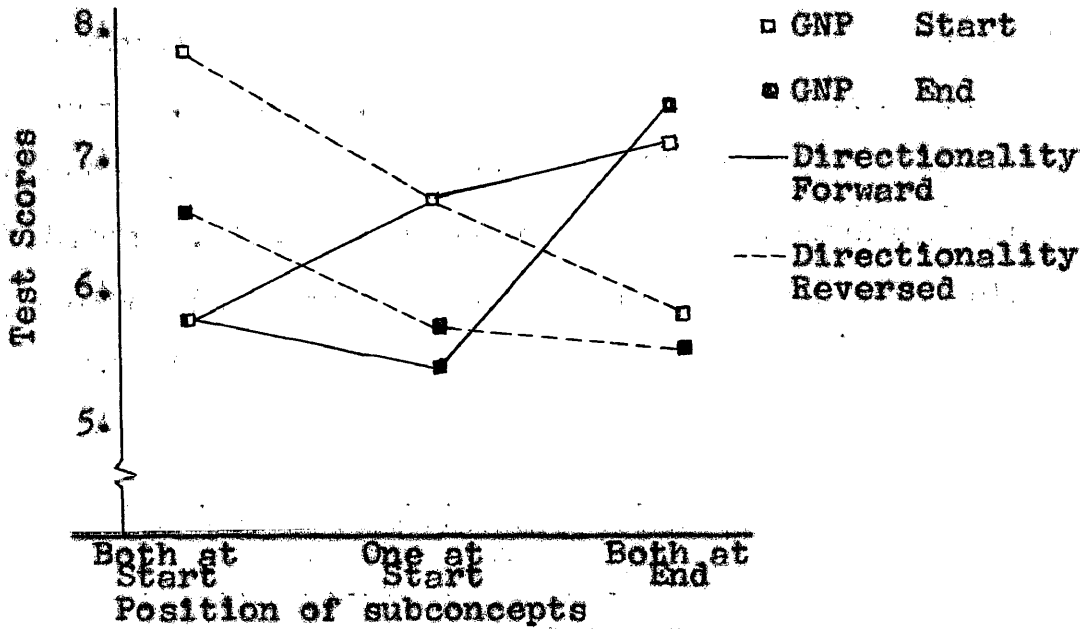


Figure 2. Test scores as related to program sequence variables.

Since the test was short and its reliability is undetermined, one must also consider this as a possible source of variance which could account for the results. It should be noted, however, that Newton and Hickey also found an interaction effect between "directionality" and position. One could surmise that subconcept directionality accounted for the relationship rather than overall directionality.

The study of Haslerud and Meyers (1958) implied that independently derived principles are more transferable; this would account for the positive effects of position and subconcept directionality at the end of the program, but the same effect is evidenced if both subconcepts are at the beginning of the program and subconcept directionality is reversed. Learning psychologists have long been aware of interference effects occuring between the time when something is learned and when it is recalled (eg. Hunt, 1961); these effects may possibly also take place within the learning material in conjunction with specific items rather than items at random. In other words, content of a programmed sequence may determine a relationship, but these relationships may be extremely subtle and complex.

This study failed to find a triple interaction effect, but since this study did not manipulate the variable of "order" and directionality has already been accounted for in terms of subconcept directionality, one would not anticipate such an effect.

TABLE 4

Summary of Analysis of Variance of Time Scores

Source of variation	df	MS	F
A (overall directionality)	1	3.76	.13
B (position of subconcept)	2	11.29	.40
C (subgroup directionality)	1	61.76	2.20
AB	2	.30	.01
AC	1	14.26	.51
BC	2	15.30	.55
ABC	2	67.17	2.39
within cell	84	28.05	
Total	95		

Time scores were not found to exhibit any significant effects of the manipulated programs. Newton and Hickey (1965) had obtained both position and directionality main effects as well as an interaction between order and position. None of these effects were large, however, and the failure of these effects to be manifest may be due to a large within cell or experimental error variance in the present study.

DISCUSSION

The results of this study lend support to previous research (Levin & Baker, 1963; and Roe, Case & Roe, 1962) which implied that manipulations of a programmed sequence had little effect upon a learner's performance. On the other hand, the results also support previous conclusions that directionality was a variable affecting transfer of a verbal concept (Newton & Hickey, 1965; Wittrock, 1963 and Haslerud & Meyers, 1958).

Hunt's (1961) conclusions that interference effects may be related to the position of an instance within a series of instances defining a concept was supported. The results were not clear, however, as there was no position main effect and only when an interaction with subconcept directionality was considered did this "interference effect" become apparent. Actually, the effect was similar to what is observed in a serial position curve in rote memorization; the closer the subconcept definitions were to the beginning or end of the program, the higher the measure of transfer. Overall directionality failed to produce a significant effect, but the data suggest that under certain circumstances this may have an effect on transfer. When the length of the program is changed or when two programs are compared, the phenomenon of directionality would depend upon the length of the program as well as the number of subconcepts involved;

in other words, it would be difficult to distinguish between subconcept directionality and overall directionality.

Gagné and Brown (1961) and Newton and Hickey (1965) found that time to complete the program was a sensitive measurement criterion, but in this study, time was found to be an insensitive index. Newton and Hickey had previously found that the order in which the subconcepts were placed to each other produced an interaction effect with position, and the fact that the order variable was not considered in this study may have contributed to the error variance.

Research has inconsistently shown that the sequence of programmed material may have an effect upon how a program is learned or how it is transferred. Certainly, more extensive and conclusive research is needed in this area. Just as a machine must be tested under varying conditions in order to determine its optimal efficiency before it is mass produced, so must a program be tested to determine its most efficient sequence and design. This study constitutes only a small step in that direction with a single programmed sequence, but tends to emphasize the importance of such research before materials are placed on the market. Every day new programmed materials are developed and unless efficacious programs are produced, programmed instruction will lose its status among consumers and, consequently, an educational tool may be lost.

SUMMARY

In a previous study, Newton and Hickey (1965) considered the effects of three variables upon a programmed sequence defining Gross National Product. The three variables were: (a) order, or the placement of one concept with respect to another; (b) position, or the location of subconcepts with respect to the overall program; and (c) directionality or whether a program proceeded to or from the major concept or subconcept. Directionality could be defined in terms of the entire program or in terms of directionality within subconcepts. Since these two variables were confounded into one variable of directionality, the intent of the present study was to separate the two and examine their possible effects.

An attempt was made to replicate the experimental conditions of the study by Newton and Hickey. The same program, answer sheet, instructions, scoring criteria and tests were used. Two changes were made: (a) the variable of Order was collapsed and controlled through counterbalancing and (b) the variable of directionality was divided and treated as one variable of subconcept directionality and a second of overall directionality.

The results were analyzed by a 2 x 3 x 2 factorial design. There were no significant differences among means for error scores and time scores. Therefor, as indicated by scores on a test administered immediately after the

program was completed, was sensitive to manipulations of the program. An interaction effect between subconcept directionality and position was significant at the .05 level. This relationship appeared to be complex and not clear cut. The need for further research was emphasized as research is lagging behind commercial construction of programmed materials and the consequences may have grave effects upon future usage of programmed instruction.

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APPENDIX A

Let's say you want to buy a particular good--for example, a ball point pen. First you, as the buyer, must agree to pay the ____ asked by the seller.

1

price

When you and the ____ have agreed on a ____, then you may exchange your ____ for the pen.

2

seller
price
money

Swapping money for goods is just one kind of exchange. Let's consider another situation. Suppose you offer your services as a sales clerk in ____ for a wage.

3

exchange

When the ____ of the service, in this case you, and the ____, in this case the store, agree to exchange your work for wages, you have taken part in a market transaction.

4

seller
buyer

A market exists when a ____ and ____ agree on terms of ____for a good or service.

5

buyer
seller
(or reverse order)
exchange

What is exchanged for an agreed upon price may be either a ____ or a ____.

6

good
service
(or reverse order)

Whenever a buyer and seller have agreed upon a ____, and an ____ takes place, there is a market.

7

price
exchange

In any case, to have a market we must be able to identify four characteristics:
1. A____ and ____ must agree to
2. ____ a
3. ____ or ____ for a given
4. ____.

8

buyer, seller (or reverse order)
exchange
good, service (or reverse order)
price

Before Mr. Buyer can exchange his money for a product, he must agree to pay the ____ asked by the seller.

9

price

Suppose that the product in question is a $3900 automobile. Only when the buyer and ____ agree on the ____ will they make the exchange.

10

seller
price

Since the buyer and seller have engaged in a market transaction, the price upon which they agree is called the ____ price.

11

market

In the case of Mr. Buyer and the automobile, the ____ price is $3900.

12

market

If consumers purchase 10,000 ball point pens at a market price of $1.00 each, the market value of all the pens equals the price of each ____ (multiplied or divided?) by the quantity purchased, or $_____.

13

multiplied
10,000

If 1000 business firms each purchase a new delivery truck at a market price of $4000 apiece, the market ____ of all the 1000 trucks is ***.

14

value
$4 million

Drinking a coke on a hot afternoon at the ball park satisfies your thirst. As a matter of fact, all goods and services that we buy are sold to ____ some need of everyday living.

15

satisfy

The goods and services that we buy to ____ the ____ of everyday living are called consumer goods and services.

16

satisfy
needs

Dobson's Hardware Store supplies consumers with goods such as hardware and floor covering. These are examples of ____ ____.

17

consumer goods

Dobson's Hardware Store will also perform services for its customers, such as sharpening lawnmowers and installing linoleum. These are examples of consumer ____.

18

services

A gasoline station sells gasoline which is a consumer ____, and also makes repairs which is a ____ ____.

19

good
consumer service

Thus, consumer goods and services are those goods and services which ***.

20

consumers buy to satisfy the needs of everyday living

29

Just as businesses spend money, consumers must spend ____ to buy consumer goods and services.

21

money

Let's consider not just the money spent by one consumer, but the money spent for consumer goods and services by **** (your words).

22

all consumers (or equivalent expression)

Although individual consumers provide examples, ultimately we are concerned with all the *** purchased in one year by all ***.

23

consumer goods and services
consumers

The total amount of money spent by all consumers in one year to buy all the *** supplied by all businesses is called consumption spending.

24

consumer goods and services

The amount of money spent by *** in one year to buy the *** produced by *** is called ***.

25

all consumers
consumer goods and services
all businesses
consumption spending

"Spending" and "consumption spending" do not mean the same thing. Let's examine the important differences between the terms "spending" and "____ ____."

26

consumption spending

It is necessary that spending be for (1) consumer goods or services (2) produced this year, for the money spent to be classified as ____ ____.

27

consumption spending

30

Suppose that you pay $400 for an antique clock. Is your $400 an amount of consumption spending? ____.

28

no

If Mr. Dobson buys a new delivery truck for his hardware store, would this be classified as consumption spending? ***.

29

no

Thus, only when money is spent for consumer goods that have been *** is it classified as ***.

30

produced this year
consumption spending

Mr. Dobson of Dobson's Hardware Store reasoned that it takes money to make money. He decided that he could increase sales and thus make more money, if he purchased a delivery truck. The truck would serve two purposes:
1. permit the ____ of consumer goods purchased at the store
2. increase ____ and thus make more money.

31

delivery
sales

All items, like Mr. Dobson's truck, are called capital goods if businesses buy them for the (1) production, (2) ____, or (3) ____of consumer goods or services.

32

sale
delivery

Mr. Dobson's new truck is a ____ good because it is necessary for the ____ of goods purchased at Dobson's to the consumers.

33

capital
delivery

An ice cream machine is a ____ good in the ice cream business because it is necessary for the ____ of ice cream.

34

capital
production

To take care of his expanding business, Mr. Dobson also purchased a new cash register. The cash register is a ____ ____ because it is necessary for the ____ of consumer goods and services.

35

capital good
sale

Thus, capital goods are those bought by *** because they are necessary for the ____, ____, or ____ of consumer goods and services.

36

businesses
production, sale, delivery
(any order)

Just as consumers spend money, businesses must spend ____ to buy capital goods.

37

money

Let's consider not just the money spent by one business, but the money spent for capital goods by ***.

38

all businesses
(or equivalent expression)

Although individual businesses provide examples, ultimately we are concerned with all the *** purchased in one year by ***.

39

capital goods
all businesses

The total amount of money spent by businesses in one year for all *** is called <u>investment</u>.

40

capital goods

Thus, the amount of money spent by *** in one year for *** is called ____.

41

all businesses
all capital goods
investment

"Business spending" and "investment" do not mean the same thing. Let's examine the important differences between the terms "business spending" and "____."

42

investment

It is necessary that spending be for (1) capital goods (2) produced this year, for the money spent to be classified as ____.

43

investment

For example, Joe Hauler buys a second-hand truck for his small delivery services. The $1500 that he paid for the truck *** (would/would not) be classified as investment.

44

would not

Suppose that Company A spends $4000 to buy stocks and bonds issued by Company B. By our definition, is Company A's $4000 an investment?

45

no

Thus, only when money is spent for capital goods that have been *** is it classified as ***.

46

produced this year
investment

If manufacturers of consumer goods purchase 1000 lathes at a market price of $5000 each, the market value of the 1000 lathes is ***.

47

$5 million

Let's assume that $2000 and $5000 lathes are the only two kinds produced and sold to businesses in one year. If 1000 of each kind are sold, the total amount of investment, $2 million plus $5 million, equals the total ____ ____ of all the lathes produced that year.

48

market value

Of course, the $2 million plus $5 million of investment that we computed as the ____ ____ of all lathes, is just an example.

49

market value

The total amount of ____ by business in one year is a measure of the total ____ ____ of all capital goods purchased in one year.

50

investment
market value

We are concerned with the fact that the total amount of ____ ____ is a measure of the total ____ ____ of all consumer goods and services purchased in one year.

51

consumption spending
market value

The amount of government spending in one year is a measure of the market value of the ____ and services purchased by the ____.

52

goods
government

The Gross National Product in one year is equal to the total market value of all capital goods purchased in one year by businesses, all the consumer goods and services purchased in one year by consumer and all goods and services of any kind purchased ____ ____ ____ by the government.

53

in one year

For example, the Gross National Product (GNP) in 1952 was $480,000,000,000.00. That's right, $480 billion - equal to the market value of all consumer goods and services, $280 billion, plus the ____ ____ of all the capital goods purchased by business, $60 billion, ____ the market value of all the goods and services purchased by the government, $***.

54

market value
plus
140 billion

Note that in our example, we determined GNP by ____ together three different sums of money spent in ____ year. They are
1. consumption _____
2. investment _____
3. _____spending

55

adding
one
spending
spending
government

The sum of these three kinds of spending is Gross National Product, obtained by adding together: (1) ____ spending, (2) ____, and (3) spending by the ____.

56

consumption
investment
government

Now that you have an idea of how we compute GNP, complete this example for 1963.

consumption spending	$250 billion
investment	40 billion
government spending	120 billion
***	***

57

GNP (Gross National Product)
$410 billion

In other words, the sum of ____ ____, ____ and ____ ____ is called ***.

58

consumption spending
investment
government spending
gross national product (GNP)

35

Now it's your turn to define GNP. Using your own words, construct a definition of Gross National Product from what you have learned so far.

59

The sum of consumption spending, investment and government spending is called Gross National Product (GNP).

APPENDIX B

Name _____ M or F

Age _____ Fr. So. Jr. Sr. (Circle One)

Have you had a course in Economics in college? Yes or No

Book A B C D E F M N O P Q R
AA BB CC DD EE FF MM NN OO PP QQ RR (Circle One)

Starting Time _____

1.	
2.	7.
3.	8.
4.	9.
5.	10.
6.	11.

12.	20.
13.	21.
14.	22.
15.	23.
16.	24.
17.	25.
18.	26.
19.	27.

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54.

47.

55.

48.

56.

49.

57.

50.

58.

51.

59.

APPENDIX C

Name_____

TEST FOR EXPERIMENT ON CONCEPT FORMATION (Part II)

1. If a French merchant sells ten bottles of wine for twelve francs each, the market value of this wine that he has sold is: (a) the advertised price (b) ten francs (c) undetermined, since we do not know his cost (d) 120 francs (e) undetermined since we have not been told how to change from francs to dollars.

2. The total amount of money spent by all consumers in one year, to buy all consumer goods and services supplied by businesses is called: (a) conspicuous consumption (b) value level (c) total annual market (d) all of the above (e) none of the above.

3. If Mrs. Perkins buys a freezer so that she can save money by buying meat in quantity, then: (a) both the freezer and the meat are consumer goods (b) the meat is a consumer good, but the freezer is a capital good (c) the freezer is a consumer good, but the meat is not (d) both freezer and meat are capital goods (e) classification of these as consumer goods or capital goods depends upon the price she pays for them.

4. Investment is defined as all the money: (a) spent by businesses in one year for capital goods (b) put "back into the business by all businesses in one year (c) spent in one year for stocks and bonds (d) spent in one year for stocks and bonds, plus all money placed in savings accounts (e) spent in one year by businesses for capital goods and services.

5. Which of the following would be classified as consumption spending? (a) $2200 spent this year for a 1963 used car for private use (b) $2200 spent for a 1963 new car for business use (c) $.05 spent yesterday afternoon in the OU bookstore for a candy bar (d) all of the above (e) both a and c, but not b.

6. The amount of investment spending for a particular year is determined by: (a) adding together the market value of all goods and services purchased that year (b) adding together the cost of producing all capital goods that year (c) adding together the market value of all capital goods purchased that year (d) adding together the market value of all capital goods purchased that year and subtracting maintenance costs (e) totaling transactions on the stock exchanges for that year.

7. The market price of goods or services is: (a) the advertised price (b) the price that assures the seller a fair profit (c) the price upon which the buyer and seller agree (d) the cost plus taxes (e) none of the above are correct.

8. Which of the following would be classified as investment? (a) $5000 spent by a lawyer for stock in IBM (b) $5000 spent by a major user of IBM machines for stock in IBM (c) $5000 spent by a business firm for an IBM machine to keep records of sales (d) $5000 spent by IBM for bonds of a company making similar equipment (e) all of the above.

9. A market exists whenever: (a) a buyer and a seller agree on the terms of exchange for goods or services (b) a seller advertises goods or services for sale (c) people are willing to purchase a product (d) a particular location is designated for the exchange of goods or services for money (e) all of the above are correct.

10. Which of the following would be classified as capital goods? (a) 10,000 reusable glass milk bottles purchased by a dairy in order to deliver its milk (b) a new oven purchased by a bakery (c) a small printing press bought by a grocery store to print advertisements (d) all of the above (e) both b and c but not a.

APPENDIX D

The following is a description of the program in terms of its basic units. These units were retained in order to utilize the positive benefits of programmed instruction in the forms of cueing, fading, etc. If these units were not retained the frames would be randomized and would bear little resemblance to programmed material. They are presented below with the over-all Directionality toward the definition of Gross National Product; the position is "both at end" in relation to Definitions, and Subconcept Directionality is unaltered.

I. Definitions (frames 1-14)

- a. market (frames 1-8)
- b. market price (frames 9-12)
- c. market value (frames 13-14)

II. Consumption Spending (frames 15-30)

- d. consumer goods and services (frames 15-20)
- e. consumption spending (frames 21-25)
- f. consumption spending versus spending (frames 26-30)

III. Investment (frames 31-46)

- g. capital goods (frames 31-36)
- h. investment (frames 37-41)
- i. investment versus business spending (frames 42-46)

IV. Gross National Product (frames 47-59)

- j. market value and market price (frames 47-49)
- k. market value and investment (frame 50)
- l. market value and consumption spending (frame 51)
- M. government spending (frame 52)
- n. GNP (frames 53-59)

APPENDIX B

Using a 2 x 3 x 2 factorial design, twelve experimental groups were necessary, but since this experiment is also counterbalanced to control for "order" effects, twenty-four experimental groups were generated. These variations are listed below in terms of the codes used to identify the sequences when the material was presented. The code was inconsistent and served no other purpose than for identification.

subconcept directionality unaltered					subconcept directionality altered				
A	I	II	III	IV	M	IV	III	II	I
B	II	III	I	IV	N	IV	I	III	II
C	II	I	III	IV	O	IV	III	I	II
D	I	III	II	IV	P	IV	II	III	I
E	III	II	I	IV	Q	IV	I	II	III
F	III	I	II	IV	R	IV	II	I	III
AA	IV	I	III	II	MM	I	II	III	IV
BB	IV	III	II	I	NN	II	III	I	IV
CC	IV	III	I	II	OO	II	I	III	IV
DD	IV	I	II	III	PP	I	III	II	IV
EE	IV	II	III	I	QQ	III	II	I	IV
FF	IV	II	I	III	RR	III	I	II	IV

In order to counterbalance for order, each subconcept of Consumption Spending (II) was counter-balanced with a subconcept of Investment (III). Thus, A and D, B and E and C and F were counterbalanced for the "Order" variable.

APPENDIX F

INSTRUCTIONS TO SUBJECTS

Note: These are accompanied by appropriate sketches on the blackboard.

"You will be taking part today, in an experiment on how people learn. Each of you will be given a short lesson in economics and then a very brief quiz to find out how much you learned. You will all be learning the same things, but each one will learn them in a little different way. We want to find out what the best way of learning is, and that is what this experiment is all about. Your lesson in economics will be taught to you by a new method, the same sort of method used in teaching machines. It is very simple, but is a little bit different, so pay close attention to directions."

"Now look at the example on the left side of the blackboard. It says, "Patrick Henry, a great American patriot, said 'Give me liberty or give me _____'." You know that the missing word is 'death'. That is just the way your lesson will go. There will be a series of statements and each one will have a blank to be filled in. All you have to do is to figure out the right word. You will write the word down, and then turn the page over to check to be sure that you did have the right word. Look at the next page shown on the board. The word 'death' is shown directly in back of the first question. Just to the right of it is the next statement. Let's read it. "Patrick Henry was born in the year _____." You probably don't know the answer. If that is the case, guess. You would write your guess, and in fact, all your answers, on your answer sheet. Then, turn the page over and find the right answer. If your guess is right, fine. If not, cross it out and write the correct answer underneath it. Notice the sample answer sheet on the board, where this has been done."

"Remember, if you don't know what to write down, guess. Write your answer on your answer sheet, not in your lesson booklet--I repeat, not in your lesson booklet. If your answer is wrong, correct it before going on. Note that in the example, you have been reading horizontally across the top of the pages, instead of going down the page. This is just to help you not to look at the answers before you have written them down. When you get to the last page, turn back to the first, and start in on the second row. The questions are numbered and all you have to do is to follow the numbers."

"Oh yes, the number of blank lines will tell you the number of words to use. But sometimes you will see three stars, or asterisks, in place of the blank lines. This means that we are not telling you how many words are in the answer. There may be one word, or there may be an entire sentence. Do you have any questions before we actually begin with the lesson?"