Experimental and Theoretical Analyses of Instructional Tasks: Reading, Discrimination, and Construction

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EXPERIMENTAL AND THEORETICAL ANALYSES OF INSTRUCTIONAL TASKS: READING, DISCRIMINATION, AND CONSTRUCTION

by

Satoru Shimamune

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirement for the
Degree of Doctor of Philosophy
Department of Psychology

Western Michigan University
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The effectiveness and efficiency of three kinds of workbooks were compared in teaching behavioral systems analysis to college students. Each workbook contained the same content but utilized different types of instructional tasks. The reading workbook had the definitions, and examples and nonexamples of the concepts to be taught, and the subjects were asked to read them. The discrimination workbook had the same definitions, examples and nonexamples, but the subjects were asked to work on discriminating the examples from the nonexamples. Feedback was given with regard to the correctness of the subjects' responses. The construction workbook had the same definitions of the concepts, but the subjects were asked to generate examples by themselves. Feedback was also given to those subjects.

A pretest and a posttest were administered, both of which included discrimination and construction test questions. The results showed that all workbooks were effective in producing significant differences between pretest and posttest scores. On the other hand, there were no significant differences between the pretest and posttest scores for the subjects who used no workbook (i.e., the control group). Furthermore, the discrimination and reading workbooks were significantly more effective than the construction workbook on the discrimination test questions; there were no significant differences among the workbooks on the construction test questions. The time the subjects needed to complete the reading workbook was significantly shorter than the time needed to complete either of the other two, with the construction workbook taking
the longest time to complete. Thus, the reading workbook was the most efficient among the three workbooks. These results suggest some limitations to the principles of programmed instruction.
ACKNOWLEDGMENTS

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Satoru Shimamune
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CHAPTER I

INTRODUCTION

Problems in Education

Educational crises in the United States has been increasing for many years. The Scholastic Aptitude Test score has fallen in both verbal and mathematical domains (National Center for Educational Statistics, 1991). The U.S. students ranked 12th among the 13 countries participating in the international mathematics testing (National Center for Educational Statistics, 1991). "About 12% of students drop out of school and only 47% of these dropouts can be expected to be employed" (Sherman, 1992, p. 28). Although "educational reform" seems to be one of the most frequently discussed social issues, a sizable improvement has not been observed.

Some researchers maintain that effective educational technologies can help end the crisis (Engelmann, 1992; Lindsley, 1992b). Such effective technologies are based on scientific data and usually are "behavioral, structured, fast paced, and require a high proportion of regular daily practice" (Lindsley, 1992b, p. 21). Examples are the personalized system of instruction (Keller & Sherman, 1974; Sherman, 1992), direct instruction (Becker & Engelmann, 1978), behavior analysis (Fantuzzo & Atkins, 1992; Lloyd, 1978), and precision teaching (Binder, 1988; Lindsley, 1992a). Programmed instruction is one such technology.
The Historical Background of Programmed Instruction

Skinner advocated the use of behavioral principles as embodied in programmed instruction and teaching machines (Skinner, 1968). Programmed instruction is defined as "carefully arranged sequences of contingencies leading to the terminal performances which are the object of education" (Skinner, 1965, p. 6). Principles of programmed instruction were originally based on extrapolation of behavioral principles found in experiments with non-human subjects (Flynn, 1970). In the 50s and early 60s, a number of studies had been conducted to validate the use of the behavioral principles in teaching. At the same time, a variety of teaching machines were developed and tested in schools (Hanson & Komoski, 1965; Kersh, 1965), the military (Glaser, Damrin, & Gardner, 1954), and industry (Shoemaker & Holt, 1965). Although some claim the extrapolation lacks empirical verification (Flynn, 1970), the principles of programmed instruction became established knowledge. For example, the material should be divided into "small steps" so sequenced that the desired behavior is successively approximated; the learner must make "active responses" to the material in each step; "immediate feedback" with regard to the correctness of the responses must be provided; and the learner must be allowed to progress of his or her "own pace" (Skinner, 1958, 1968).

Despite the extensive research, development, and applications of new teaching machines during the hay day of programmed instruction, they were never widely disseminated. Skinner believed personal computers to be the ideal teaching machines (Skinner, 1968). Today, even though modern public schools have adopted personal computers, few commercially available programs make use of the principles of instruction (Cook, 1983; Markle, 1990).
There were some reasons responsible for the failure of the dissemination of programmed instruction. One reason might be the difficulty of programming. Only the programmers with an extensive knowledge of science, especially behavior analysis, could develop quality programs, and there were no teaching materials available to teach how to develop effective instruction (Homme & Glaser, 1959). Another reason might be its relatively high costs. Producing programmed instruction is time consuming. The cost of developing a programmed course is estimated to be about 20 times as high as the cost of developing a regular textbook that covers a similar content (Mechner, 1965). Furthermore, the studies of the elements of programmed instruction failed to produce consistent results (Gilbert, 1959; Holland, 1965). For example, the small step programs have shown to be more effective than the larger step programs in some but not all settings (e.g., Coulson & Silberman, 1959). Requiring "active" or "overt" responding does not always produce significantly different learning compared to "covert" responding (e.g., Evans, 1965; Evans, Glaser, & Homme, 1959). With the failure to integrate such inconsistent data, relevant research by behavior analysts has declined to the point that there have been only a few publications in the entire history of the Journal of the Experimental Analysis of Behavior and the Journal of Applied Behavior Analysis.

While behavior analysts generally have ceased conducting research on programmed instruction, behaviorally-oriented educational psychologists have continued to develop "principles of instruction." For instance, the rule-example-practice strategy or "RULEG" system is one of the most frequently studied and applied methods of teaching concepts (Becker & Engelmann, 1978; Engelmann & Carnine, 1982; Markle, 1990; Markle & Tiemann, 1970; Tennyson & Park, 1980). In this strategy, the definition of a concept is presented first (rule), then examples and
nonexamples of the concept follow (example), and finally discrimination tasks are
presented (practice). "The learning of a concept" is defined as the "ability" to
discriminate newly encountered examples from nonexamples of the concept. For
instance, Miller and Weaver (1976) used this strategy to teach behavioral concepts such
as "reinforcement," "extinction," "discrimination," and "generalization." They
developed a programmed textbook in which each concept was taught with the definition
and discrimination tasks. The students who used the programmed textbook
outperformed the students who used a traditional textbook.

Also, educational psychologists have published textbooks to introduce the
technologies of teaching to practitioners including the rule-example-practice strategy.
For example, textbooks such as Theory of Instruction (Engelmann & Carnine, 1982)
and Designs for Instructional Designers (Markle, 1990) are written not as a scientific
book but as a guide book to help practitioners develop effective instruction. Thus, the
authors do not describe the experiments or theories on which the technology is based.
The goal of the textbooks is not to present or integrate scientific data. Instead, the
authors are intending to provide the technology of teaching to people who need it.

Current research on instructional technology conducted by educational
psychologists lacks a behavioral orientation and has become cognitive. Studies
published in such journals as the Journal of Educational Psychology and the Journal of
Educational Research show this trend. For instance, some researchers employ such
concepts as prototype development (Tennyson, Chao, & Youngers, 1981; Tennyson,
Youngers, & Suebsonti, 1983), production theory (Butterfield, Slocum, & Nelson, in
press), concept mapping (Hirumi & Bowers, 1991; Schmid, 1990), levels of processes
(Kunen, Cohen, & Silman, 1981), and structured knowledge (Stanners, Brown, Price,
& Holmes, 1983; Tennyson & Cocchiarella, 1986). Those cognitive theories are,
however, not integrated into a single theory, and the extent to which those theories contribute to further technological development is not clear. In order to understand how the principle of instruction works, behavioral analyses of programmed instruction seems in demand.

Behavior Analysis of Programmed Instruction

Recently, behavior analysts have worked on the theoretical and experimental analysis of verbal behavior such as rule-governed behavior (Blakely & Schlinger, 1987; Malott, 1989; Michael, 1986; Reese, 1989; Schlinger & Blakely, 1987) and stimulus equivalence (Hayes, Thompson, & Hayes, 1989; Kohlenberg, Hayes, & Hayes, 1991). For example, an important distinction has been made between "direct-acting" and "indirect-acting" contingencies (Malott, 1988, 1989; Malott & Malott, 1991). This distinction suggests that the simple extrapolation of behavioral principle (e.g., reinforcement) to some verbal-humans' behavior (e.g., voting in the presidential election) may be inadequate. Because most of the subject matter that we want to teach using programmed instruction involves verbal behavior, it appears that we can make use of newly developed behavioral theories and experimental findings to improve our knowledge of programmed instruction.

One such effort is found in Johnson and Chase (1981) who proposed a behavioral typology of verbal instructional tasks as an alternative to Bloom's taxonomy (Bloom, 1956). The typology is based on Skinner's functional classification of verbal behavior (Skinner, 1957). Table 1 summarizes their classification. Three subclasses of intraverbal response are proposed consisting of definition, example-identification and exemplification. In definition tasks, the learner is asked to state a definition of a
Table 1  
Typology of Verbal Instructional Tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echoic</td>
<td>Correctly repeat the following lines from Shakespeare's <em>Hamlet</em>. Be sure to copy my intonation closely.</td>
</tr>
<tr>
<td>Textual</td>
<td>Correctly pronounce the following medical terms:</td>
</tr>
<tr>
<td>Transcriptive</td>
<td></td>
</tr>
<tr>
<td>Copying</td>
<td>Correctly copy the following Chinese characters.</td>
</tr>
<tr>
<td>Dictation</td>
<td>Correctly spell the following names for laboratory equipment as I say them:</td>
</tr>
<tr>
<td>Intraverbal</td>
<td></td>
</tr>
<tr>
<td>Define</td>
<td>Define reinforcement.</td>
</tr>
<tr>
<td>Example identification</td>
<td>Say which of the following written scenarios is an example of positive reinforcement.</td>
</tr>
<tr>
<td>Exemplification</td>
<td>Give an example of reinforcement.</td>
</tr>
<tr>
<td>Tact</td>
<td></td>
</tr>
<tr>
<td>Example description</td>
<td>Describe the technical properties of the plant specimens on the laboratory test table.</td>
</tr>
<tr>
<td>Example identification</td>
<td>Say whether each of the following videotaped scenarios illustrates assertive or aggressive behavior:</td>
</tr>
<tr>
<td>Example component analysis</td>
<td>Identify at least three distinctive features of each of the wines in the goblets in front of you.</td>
</tr>
<tr>
<td>Combinations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Say whether this example illustrates reinforcement. If so, identify each defining feature. If not, identify the features that are present and change the example so that it illustrates reinforcement.</td>
</tr>
</tbody>
</table>

concept given the name of the concept (e.g., define reinforcement). In example-identification tasks, the learner is asked to discriminate examples from nonexamples (e.g., choose the example of reinforcement). In exemplification tasks, the learner is asked to generate examples given a concept name (e.g., give an original example of reinforcement).

This behavioral typology helps us analyze instructional tasks and define their objectives in terms of specific stimulus-response relations. We can identify the behavior and the circumstances under which the behavior should occur. For example, "understanding the concept of triangle" may be defined as (a) writing the definition of the concept (intraverbal; define), (b) naming a figure (tact), (c) drawing a triangle (intraverbal; exemplification), (d) selecting a triangle from other figures (intraverbal; discrimination), (e) stating differences between triangle and square (combination), and so on. The "understanding" and "learning" that psychologists have studied for so long may be conceptualized as those stimulus-response relations and their interrelations. For example, some may define "understanding" in terms of exemplification performance and ask such questions as, "Is the statement of the definition sufficient to generate exemplification performance?" "Does discrimination training help?" And, "Do we need direct training of exemplification?"

Terminal-response training--one of the principles of programmed instruction--is based on the functional independence between classes of behavior assumed by the instructional designers (e.g., Mager, 1988). The notion is also similar to Brethower and Smalley's (1992) "performance-based instruction". According to this rule, for example, if the objective of the instruction is defined in terms of exemplification, exemplification training is perhaps more effective than discrimination training, and vice versa. Chase, Johnson, and Sulzer-Azaroff (1985) demonstrated differences between
discrimination and two other tasks (definition and exemplification) in terms of the rate and accuracy of responding, and suggested functional independence between those subcategories of behaviors. However, there have been only a few such studies (e.g., Lamarre & Holland, 1985). Therefore, although the terminal-response training rule seems to be valid in theory, we need more empirical data to support it.

The Purpose of This Study

In this study, I attempted to (a) develop effective instruction, and in so doing, (b) collect data on a parameter of programmed instruction, and (c) offer a theoretical analysis of the data obtained. This study started with a practical problem--the difficulty of teaching a behavioral systems-analytic view. So, first, I developed the workbook. This phase included the revision of the content and the production and revision of teaching program. The workbook used in this study was the latest development of the process.

The type of instructional task was then selected as the focus of the experiment. Three kinds of workbooks were derived from the original workbook each of which utilized a specific type of instructional task to teach the same content. In the discrimination workbook, the subjects were asked to discriminate examples from nonexamples. In the reading workbook, the subjects were asked simply to read the same examples and nonexamples in the discrimination workbook. In the construction workbook, the subjects were asked to generate examples.

Practically, I was interested in finding which type of task was most effective and efficient. The effectiveness of the workbooks were defined as the amount of improvement from pretest to posttest scores. I also measured the amount of time the subjects needed to complete the workbooks to discern the efficiency of the workbooks.
If one type of the workbook could teach as well as another, then the one that took less
time to complete would be more efficient than the others. Further, I collected the
subjects' opinion about the workbooks to evaluate the social validity (Wolf, 1978).

Theoretically, I was interested in examining two rules of programmed
instruction: The active-response requirement and terminal-response training. The
requirement of "active" or "meaningful" responses in instruction is proposed by Markle
(1990). Although she does not offer an operational definition of the "active" response,
it seems to have two characteristics: First, it must have an overt response unit; and
second, the response form must not have a point-to-point correspondence with the
stimulus that evokes the response. For example, given a definition (e.g., "a file name
contains as many as eight characters"), filling out a blank (e.g., "a file name contains as
many as ______ characters") is called "copy" frame; it is not a "meaningful" response
because it does not meet the second criterion. An example of "meaningful" response in
this case would be to mark the correct file name given alternatives (e.g., "(a) DATA  (b)
123  (c) DATASUMMARY"). In this study, the reading and discrimination workbooks
were compared to examine the effects of the active-response requirement.

As I mentioned earlier, terminal-response training consists of the practice of the
same behavior as the objective of the instruction. In this study, the discrimination and
construction workbooks were compared to examine the validity of this rule. The
comparison was also meant to show the extent to which functional independence or
dependence exists between the behaviors required by different types of tasks. For
example, if discrimination and construction are functionally independent, the subjects
who used the discrimination workbook should score high on discrimination test items
and the subjects who used the construction workbook should score high on
construction test items.
Concerning the type of instructional task for concept training, educational psychologists have emphasized the use of discrimination tasks and less often recommended the use of exemplification tasks (Becker & Engelmann, 1978; Engelmann & Carnine, 1982; Markle, 1990; Markle & Tiemann, 1970; McCallum et al., 1987; Silbert, Carnine, & Stein, 1981). However, this emphasis may not be based on empirical data. I found no study that demonstrated the advantage of the discrimination task over the exemplification task on the same subject matter in a controlled setting. The emphasis on the discrimination task may be due to more practical reasons. For instance, the response form is limited in discrimination tasks (e.g., multiple choice), whereas it is hard to predict the form of the response in the exemplification tasks. Thus, it is easier to program specific consequences for each possible answer in developing discrimination tasks than exemplification tasks. Also, the learner's effort may be less in discrimination tasks than in exemplification tasks. Further, it may take less time to answer multiple choice questions than the questions that require writing (e.g., marking an alternative versus writing out an answer).

However, it is not clear that discrimination training always works. When desired terminal performance includes exemplification, some educational psychologists suggest providing direct training of exemplification (e.g., Silbert et al., 1981, pp. 471-479). I found no study showing that the transfer from discrimination to exemplification occurs naturally and reliably. Cognitive hierarchy theory does not support it either (Kunen, Cohen, & Slman, 1981). Therefore, if the objective of instruction includes exemplification, it seems safer to provide additional training in exemplification. In this study, the construction tasks that asked the subjects to outline organizational goals included exemplification to some extent.
Related to this issue, response mode was one of the topics frequently discussed in the early stages of programmed instruction. The response mode received attention because Skinner emphasized the use of constructed responses against Pressy's multiple-choice responses (Coulson & Silberman, 1959). Skinner (1968) argued that the learner must compose answers rather than select them from alternatives because we want to teach recalling and not recognizing. For instance, in a Spanish vocabulary training program, Skinner would use tasks in which the learner has to spell Spanish words given English words. On the other hand, Pressy would use multiple choice questions in which the learner has to select the correct Spanish words from alternatives. Skinner pointed out, without empirical support, that plausible wrong answers in the multiple choices could strengthen undesired forms of responses and result in high error rate. Pressy, on the other hand, argued that the wrong answers must be emitted to be extinguished.

The studies of response mode have produced inconsistent results (Holland, 1965; Tobias, 1973). Some studies showed that the constructed-response produced "more learning" than the multiple-choice mode. For example, Fry (1960), using a Spanish vocabulary program, showed the advantage for the constructed response when the subjects were asked to spell Spanish words on the posttest. However, he did not find a significant difference on the posttest items where the subjects were asked to choose from multiple alternatives. Some studies failed to find any significant difference between the two response modes. For example, Lawless (1975) found no significant difference between the constructed- and multiple-response modes in any of his four programs including verbal association, concept learning, discrimination, and chaining.

Holland (1965) pointed out that some of the research on the response mode were inconclusive because the responses required in the program were largely unrelated
to the content of the program. In other words, whether or not the subjects construct their responses does not make a significant difference if those responses are irrelevant to what is expected to be learned. For example, Holland (1965) "blacked out" most of the parts of the program which had resulted in no significance of overt responding and showed little change in the error rate; the learner could emit the required responses without the "blacked-out" parts of the instruction. In order to make a meaningful comparison between the response modes, the programmed instruction used in the experiment must be well designed. In this study, pretest and posttest were designed so that the stimulus-response relations required in the tests were taught in the workbook.

Finally, the results of the study to be reported here were analyzed using molecular-level task analyses. Theoretical analyses based only on behavioral principles applied at a molecular level might contribute to the understanding and development of effective instruction. Theoretical development can help integrate seemingly inconsistent data in a systematic way; and, as a result, it might help improve instruction. Hayes (1991) points out the importance of theoretical analysis which has been de-emphasized in the behavioral tradition. Knowing exactly how a technology works should help improve the technology. Because early theoretical analysis of programmed instruction was a simple extrapolation from the findings with non-verbal subjects, a theoretical analysis considering the role of verbal behavior seems necessary. Such an analysis is presented in the discussion section.
CHAPTER II

METHOD

Subjects and Setting

Fifty eight undergraduate students from Western Michigan University voluntarily participated in this study. Initially, 42 subjects were recruited from a senior level psychology course (Psychology 360\(^1\)) and randomly assigned to one of three experimental groups. However, two subjects used the construction workbook and did not answer the last two items on the posttest at all even though they had answered those items on the pretest. I decided not to use their data, and recruited two more subjects. Thus, I had 16 subjects with the construction workbook, but only data from 14 subjects are reported here. This part of the study took place in the winter semester of 1992. Fourteen subjects were recruited from other psychology courses (Psychology 250 and 570\(^2\)) and assigned to the control group. This part of the study took place in the spring session of 1992.

Rewards were provided for the subjects depending on their scores on the pretest and posttest. The subjects from Psychology 360 received 30 points for participation and one point for each correct answer on the pretest and posttest up to 40 total points. With 40 points, they could make up an absence in the course. The subjects from Psychology 250 and 570 received $10 for the participation and five cents for each

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\(^1\) PSY 360 is Concepts and Principles of Behavior Analysis.

\(^2\) PSY 250 is Abnormal Psychology; PSY 570 is Mental Retardation.
correct answer in the pretest and posttest up to $15 in total. The experiment was held in a classroom at the university. The proposal for this study was approved by the Human Subjects Institutional Review Board at Western Michigan University prior to the commencement of the study. The letter of the approval by the board is included in Appendix A. The subjects signed an informed consent form prior to participation.

Materials

Subject Matter

The design of goal-directed systems (Malott & Garcia, 1987) was the subject matter of the instructional program. The goal-directed systems design is a behavior systems-analytic model of organizational goals used to facilitate the accomplishment of ultimate goals of organizations. The model employs a top-down approach to outline the structure of organizational goals so that the accomplishment of every sub goals will lead to the accomplishment of the ultimate goal. The original workbook taught such concepts as "output/process/input chain," "top-down approach," "production," and "standards." One of the objectives of the workbook was to teach how to outline a structure of organizational goals; this was selected as the target performance in this study. The structure of organizational goals is outlined by following several rules such as "The final output is placed at the top of the outline," and "Lower goals are indented to the right."

Figure 1 shows an example of the outline designed for a hamburger shop. The final output of the organization ("Hamburgers sold") is accomplished by a distribution system that sells hamburgers to customers. The distribution system needs the hamburgers and customers as resources. The hamburgers are provided by a production
system that cooks hamburgers from raw materials. Finally, the raw materials must be provided to the production system by another distribution system that buys raw materials.

Development of the Original Workbook

The original workbook had been developed over a period of two years. Roughly estimated, it took about 560 hours of my time to develop four versions of instructional materials, each of which required three to four hours of the learner's time. Over 30 people used the materials and served as test users.

(Hamburgers sold)
  □ Distribution: Selling hamburgers.
    □ (Hamburgers cooked)
    □ Production: Cooking hamburgers.
      □ (Raw materials)
      □ Distribution: Buying raw materials.
        □ (Materials on sale)
    □ (Customers)

Figure 1. An Example of the Structure of Organizational Goals.

At first, the objectives of the instruction were defined according to Mager's (1988) strategy for developing instruction. This process included performing task analysis, identifying target population, laying out skill hierarchies, sequencing the units, conducting tryouts, and revising the material. The first two versions of the program were developed on the computer: The learners were provided with a computer-aided tutorial and job-aid with which they could create the outline of

1 560 hours = 10 hours / week, 14 weeks / semester, and 2 semesters / year.
organizational goals. Although those computer-based programs were successful to some extent, the overhead was too high due to the learner's need to learn computer operations. So, I transferred the program to a paper-and-pencil, workbook style.

At that time, the concepts and rules in the program were re-analyzed according to Markle's (1990) content analysis. Each concept was defined in terms of "critical" and "variable" attributes, and pairs of "minimally different" examples and nonexamples were generated. The critical attributes are the properties shared by the members of a concept. If an example lacks any of the critical attributes, the example is not a member of the concept. The variable attributes are the properties that can vary among the members of the concept. For instance, "triangle" has three critical attributes: It must have three lines, these lines must be straight, and it must be a closed figure. Other attributes such as color, size, and rotation are irrelevant or variable attributes. An example can take any value on these stimulus dimensions (i.e., a triangle can be red and small with the base line up). Minimally different nonexamples share all but one critical attribute of the concept. A minimally different pair consists of an example and a nonexample that are different only in one critical attribute. The presentation of such pairs has proven to be effective in concept training (Merrill & Tennyson, 1978; Tennyson, Steve, & Boiutwell, 1975; Tennyson, Woolley, & Merrill, 1972).

During the course of development, some concepts and rules to be taught have been changed and some new rules added. For example, "two alternating triads" (Malott & Garcia, 1987) was replaced with "output-process-input chains." "Rules" were replaced with "procedures," and "equipment" and "personnel" were added as the descriptions of "resources." Those changes were informally based on the test users' performance and feedback obtained from interviews.
The original workbook was the second version of the paper-and-pencil workbook. It had been revised through one-on-one testing with more than 10 test users. In other words, the first draft was administered to a user at a time, and I observed the user while he or she worked on the program. I made notes whenever the user had trouble, and the workbook was revised before the next test user. The final draft of the original workbook had 48 pages, and required approximately three hours to complete.

**Workbooks Used in This Study**

Three kinds of workbooks were produced from the original workbook (Appendices B, C, and D). Sixteen units were selected and reorganized into 24-page workbooks: The units taught how to outline the structure of organizational goals. These units included 11 concepts and rules. In the original workbook, each unit consisted of the definition of a concept or rule (or a set of concepts or rules) followed by practice. The practice required the learner to demonstrate either discrimination or construction; i.e., to select examples from nonexamples or to generate examples of the concept. The correct answers and explanations for likely errors were provided on the next page. The learners were asked to grade their answers and record the number of correct answers using what I call "self-grading box" (see Figure 2).

The three kinds of workbooks differed in the type of practice involved. In the reading workbook, the examples and nonexamples of the concepts were presented along with their rationale. No response other than reading was required. Figure 3 presents a sample unit from the reading workbook. In the discrimination workbook, the same examples and nonexamples were presented as practice. The subjects were asked to select the examples from nonexamples or label the examples, read the correct
Practice: Look at the example and the following two outlines carefully. Which is the correct outline of the organizational goals for a university book store? The book store buys books from a merchant and sells them to the student. You may go back to previous pages for definitions.

A.
(Books sold)
- Distribution: Selling books.
  - (Books)
    - Distribution: Buying books from a merchant.
    - (Books for sale)

B.
(Books sold)
- Distribution: Selling books.
  - (Books)
    - Distribution: Buying books from a merchant.
    - (Books for sale)
  - (Customers)

A B is the correct outline (circle one).

Because __________________________________________________________________________________

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer.
Did you get it right? Yes Excellent!
No Correct your answer.

Answers for Practice:
B is the correct answer. Every selling process must have "customers" as one of the main resources.

Figure 2. Sample Unit From the Discrimination Workbook.
**Example:** Look at the following example and nonexample. They are organizational goals designed for a university book store. The book store buys books from a merchant and sells them to the student. Read the comment to see what is wrong with the nonexample.

Example:

(Books sold)
- Distribution: Selling books.
  - (Books)
  - Distribution: Buying books from a merchant.
  - (Books for sale)
- (Customers)

Nonexample:

(Books sold)
- Distribution: Selling books.
  - (Books)
  - Distribution: Buying books from a merchant.
  - (Books for sale)

**Comment:** Every selling process must have "customers" as one of the main resources.

**Check List:**
1. Is the final output located at the top and defined as things or conditions? **Yes **No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes **No
3. Are lower goals right indented from higher goals and connected with line? **Yes **No
4. Does the outline end up with resources? **Yes **No
5. Are all processes defined as activities and labeled correctly? **Yes **No
6. Are all inputs the main resources for the process? **Yes **No
7. Are all the main resources necessary for the process defined? **Yes **No
8. Are all inputs and outputs main resources? **Yes **No

Figure 3. Sample Unit From the Reading Workbook.
Practice: Look at the example carefully and make an outline of organizational goals for a university book store. The book store buys books from a merchant and sells them to the student. You may go back to previous pages for definitions.

Now connect each level with lines.

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer.
Did you get it right? Yes Excellent!
No Correct your answer.

Answers for Practice:
(Books sold)

- Distribution: Selling books.

  - (Books)

- Distribution: Buying books from a merchant.

  - (Books for sale)

  - (Customers) <Didn't forget customers, did you?

Make sure that (Books) and (Customers) are at the same level. The lines must come from "Distribution: Selling books."

--- The Next Page ---

Note. The underline parentheses, which are designed to prompt correct responses, are gradually faded out in the workbook.
answers on the next page, and grade their answers. Figure 2 presents a sample unit. In the construction workbook, the subjects were asked to generate the examples, read the correct answers on the next page, and grade their answers. The correct answers consisted of the same examples used in the reading and discrimination workbooks. Figure 4 presents a sample unit from the construction workbook.

**Pretest and Posttest**

The pretest consisted of a job-aid and test questions (Appendix E). The job-aid included a worked-out example of the structure of organizational goals, rules and definitions for outlining organizational goals, and a check list to help outlining. The test questions were developed using four kinds of organizational settings consisting of manufacturing, retail, education, and human service. These organizational settings appeared in the workbooks but with different examples. For instance, one of the discrimination tasks in the pretest used an automobile company as an example of the manufacturing setting. In the workbooks, no automobile company example was used. Instead, other manufacturing settings such as furniture and toy manufacturing companies were used in the workbooks. The same job-aid and test questions were used for the posttest.

The test questions consisted of eight discrimination tasks and four construction tasks. Seven out of eight discrimination questions involved the structure of organizational goals that lacked a critical attribute (i.e., minimally different nonexamples). The subjects were asked to judge if each structure was correctly outlined and state the reason why the example was incorrect. The subjects had to specify the missing critical attribute. The construction test questions asked the subjects to outline organizational goals given a brief description of organizations. Figure 5
shows examples of the discrimination and construction test questions. Table 2 lists each test question's organizational setting and the missing critical attribute for the discrimination tests. Table 3 lists organizational settings used in the construction tests.

---

1. The following outlines present the structures of organizational goals designed for the organizations described below. Judge whether each outline is correct or incorrect. If you think an outline is incorrect, explain why the outline is incorrect.

A. Organization: The kitchen in Davis Hall buys raw material from distribution companies and cooks meals for the students residing in the dorm

(Meal cooked)

- Production: Cooking meals.
- Distribution: Buying raw materials.

This is **correct** / **incorrect** (circle one). If you circle incorrect, explain your answer.

---

2. For the following organizations, outline the structure of the organizational goals.

A. Organization: A SONY’s factory in Detroit gets parts from other factories and assembles them to produce televisions.

Outline the organizational goals here.

---

Figure 5. Examples of Discrimination and Construction Test Questions.

Evaluation Form

To assess the subjects' evaluation (the social validity) of the workbooks, a questionnaire was administered including 11 questions, that concerned, for example, difficulty and attractiveness of the workbooks. The questions are listed in Appendix F.
Table 2
The Composition of the Pretest/Posttest: Discrimination Test Questions

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Organizational Settings</th>
<th>Missing Critical Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Human service</td>
<td>Final output not as profits.</td>
</tr>
<tr>
<td>B</td>
<td>Retail</td>
<td>Logical sequencing; customers as main resources.</td>
</tr>
<tr>
<td>C</td>
<td>Retail</td>
<td>Logical sequencing; output of production system.</td>
</tr>
<tr>
<td>D</td>
<td>Manufacturing</td>
<td>Logical sequencing; output of distribution system.</td>
</tr>
<tr>
<td>E</td>
<td>Manufacturing</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Human service</td>
<td>Process as activity.</td>
</tr>
<tr>
<td>G</td>
<td>Education</td>
<td>Main resources.</td>
</tr>
<tr>
<td>H</td>
<td>Education</td>
<td>None; correct example.</td>
</tr>
</tbody>
</table>

Table 3
The Composition of the Pretest/Posttest: Construction Test Questions

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Organizational Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>B</td>
<td>Education</td>
</tr>
<tr>
<td>C</td>
<td>Education</td>
</tr>
<tr>
<td>D</td>
<td>Human service</td>
</tr>
</tbody>
</table>

The experimenter asked the subjects to fill out the evaluation form at the end of the session.
Dependent Variables

Primary Evaluation

A primary grader evaluated all the pretests and posttests according to the grading criteria, and the resulting scores served as a main dependent variable of this study. For the discrimination test questions, a correct response was defined as marking "correct" when the example is correct, or marking "incorrect" and specifying the missing critical attribute when the example is incorrect. For the construction test questions, seven criteria were used to grade an answer (Table 4). These criteria were covered by the check list included in the job-aid that the subjects could use when they were taking the tests. The check list was also included in the workbooks (see Figures 2-4). The number of the criteria graded as correct constituted the score for an answer. Thus, the score for an construction test question ranges from zero to seven. The primary grader was unaware of the experimental condition to which the test he was grading belonged, but he knew whether the test was the pretest or the posttest.

Reliability Measurement

An independent grader was employed to obtain a reliability measurement for the grading. The independent grader received the grading criteria and practiced grading using 10 randomly selected pairs of pretests and posttests. During the practice, when she did not agree with the primary grader, the primary grader explained it, and they reached agreement. After the practice, the independent grader graded 16 pairs of pretest and posttest that were randomly selected from the rest of the tests. Four pairs were selected from each experimental group and the control group. These samples constituted 29% of the whole tests. During the grading, the independent grader did not
see the primary grader's grading or talk to him. The independent grader was unaware of the experimental conditions. Neither did she know whether the test she was grading was pretest or posttest. The reliability of grading was calculated by dividing the number of agreements by the number of agreements and disagreements. Tables 5 to 7 summarize the results. Higher and consistent reliability over the questions was obtained for the discrimination test items. Relatively lower and more variable reliability over the grading criteria was obtained for the construction test items. Because the primary grader knew whether the test he was grading was a pretest or posttest, the scores between the primary grader and independent grader were compared. A 2 x 2 analysis of variance, test (pretest and posttest) by grader (primary and secondary), showed both the effects of the grader and the interaction between the test and the grader not to be significant; $F(1,1) = 0.00$, $p = .96$, and $F(1,60) = 0.04$, $p = .84$, respectively. Thus, the primary grader's evaluation is considered not to be biased by the knowledge of pretest and posttest.

Other dependent variables were also measured. The time the subjects needed to complete the workbook was measured to compare the efficiency of instructions. Also measured were the percentage of correct answers in the practice, the percentage of compliance with instructions, and the accuracy of self-grading in the workbooks. A second grader recorded these measurements for all the discrimination and construction workbooks. The second grader was one of the test users of the original workbook, but she had no knowledge about the experimental conditions of this study. No reliability observation was made for these measurements.
Table 4
Grading Criterion for the Construction Test Questions

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rules Checked in Each Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final output</td>
<td>The final output must be located at the top and defined as things or conditions.</td>
</tr>
<tr>
<td>Logical sequencing</td>
<td>The processes must be labeled correctly and placed in a logically correct order.</td>
</tr>
<tr>
<td>Connecting goals</td>
<td>All goals must be correctly connected with lines.</td>
</tr>
<tr>
<td>Indenting sub goals</td>
<td>Lower goals must be indented to the right.</td>
</tr>
<tr>
<td>Processes as activities</td>
<td>The processes must be defined as activities.</td>
</tr>
<tr>
<td>Inputs as things</td>
<td>All inputs for processes must be defined as things.</td>
</tr>
<tr>
<td>Main resources</td>
<td>All inputs and outputs must be the main resources. No personnel and equipment should be included.</td>
</tr>
</tbody>
</table>

Table 5
Percentages of Inter-Grader Agreement for Each Discrimination Test Question

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final output</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Logical sequencing: Customers</td>
<td>93.8</td>
<td>93.8</td>
<td>93.8</td>
</tr>
<tr>
<td>Logical sequencing: Production</td>
<td>93.8</td>
<td>93.8</td>
<td>93.8</td>
</tr>
<tr>
<td>Logical sequencing: Distribution</td>
<td>93.8</td>
<td>100.0</td>
<td>96.8</td>
</tr>
<tr>
<td>Indenting sub goals</td>
<td>100.0</td>
<td>93.8</td>
<td>96.9</td>
</tr>
<tr>
<td>Processes as activities</td>
<td>100.0</td>
<td>93.8</td>
<td>96.8</td>
</tr>
<tr>
<td>Main resources</td>
<td>87.5</td>
<td>87.5</td>
<td>87.5</td>
</tr>
<tr>
<td>Correct example</td>
<td>93.8</td>
<td>100.0</td>
<td>96.9</td>
</tr>
<tr>
<td>Mean</td>
<td>95.3</td>
<td>95.3</td>
<td>95.3</td>
</tr>
</tbody>
</table>
Table 6
Percentages of Inter-Grader Agreement for Each Construction Test Question

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>91.1</td>
<td>86.6</td>
<td>88.8</td>
</tr>
<tr>
<td>Education: Personnel training</td>
<td>85.7</td>
<td>91.1</td>
<td>88.4</td>
</tr>
<tr>
<td>Education: Golf lesson</td>
<td>91.1</td>
<td>88.4</td>
<td>89.7</td>
</tr>
<tr>
<td>Human service</td>
<td>91.1</td>
<td>93.8</td>
<td>92.4</td>
</tr>
<tr>
<td>Mean</td>
<td>89.7</td>
<td>90.0</td>
<td>89.8</td>
</tr>
</tbody>
</table>

Table 7
Percentages of Inter-Grader Agreement for Each Construction Grading Criterion

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final output</td>
<td>90.6</td>
<td>96.9</td>
<td>93.8</td>
</tr>
<tr>
<td>Logical sequencing</td>
<td>92.2</td>
<td>93.8</td>
<td>93.0</td>
</tr>
<tr>
<td>Connecting goals</td>
<td>89.1</td>
<td>85.9</td>
<td>87.5</td>
</tr>
<tr>
<td>Indenting sub goals</td>
<td>87.5</td>
<td>90.6</td>
<td>89.1</td>
</tr>
<tr>
<td>Processes as activities</td>
<td>87.5</td>
<td>84.4</td>
<td>85.9</td>
</tr>
<tr>
<td>Inputs as things</td>
<td>85.9</td>
<td>85.9</td>
<td>85.9</td>
</tr>
<tr>
<td>Main resources</td>
<td>95.3</td>
<td>92.2</td>
<td>93.8</td>
</tr>
<tr>
<td>Mean</td>
<td>89.7</td>
<td>90.0</td>
<td>89.8</td>
</tr>
</tbody>
</table>
Independent Variables

The kinds of workbooks (i.e., reading, discrimination, and construction) served as the independent variables of this study. More specifically, the independent variables were different sets of contingencies for the subjects' responses that each workbook provided. For example, the subjects with the reading workbook did not have to make "active responses," and even if they did, there were no programmed consequences for the response. On the other hand, the subjects with the discrimination workbook and the subjects with the construction workbook had to make "active responses"; the former in the form of discrimination, and the latter in the form of construction. Reinforcement and punishment were programmed; the subjects immediately graded their answers and found out if they made correct responses.

It should be mentioned, however, that these independent variables are a "package" of several confounding variables (Azrin, 1977). The workbooks had 11 units. Each unit had a different content. They also differed slightly in the forms of practice questions even within the same kind of workbook. For instance, some discrimination tasks required the subjects to select the example from a pair of example and nonexample. Other discrimination tasks required the subjects to label examples. Some construction tasks required the subjects to give an example of a concept. Other construction tasks required the subjects to outline the structure of organizational goals. Further, we have no way of knowing how the subjects were actually reacting to the workbooks. For instance, the subjects with the reading workbook could act like the subjects in the construction group. They could try not to see the examples and nonexamples, come up with their own example, and then see if they made the correct
answer. Skinner maintained that a good learner has acquired such a repertoire to get the most of even non programmed textbooks (Skinner, 1968).

The control group was added after the sessions for the three experimental groups were over. Originally, I intended to compare the effectiveness of the three kinds of workbooks. Although the results of the initial study showed all three workbooks produced a significant improvement from the pretest to posttest, little difference was found among the three types of workbooks. Therefore the control group became necessary to ensure that the changes in the test scores observed in the experimental groups were due to the independent variables and not to extraneous variables (e.g., repetition of the tests). The subjects of the control group did not use any workbook; they simply took the pretest and posttest.

Experimental Design

Both within-subjects and between-subjects designs were used. As I mentioned earlier, 42 subjects were recruited from one class and randomly assigned to three experimental groups in the initial part of the study, and then 14 more subjects were recruited from other classes and assigned to the control group in the second part. The effectiveness of the workbooks was assessed by comparing the pretest and posttest scores within subjects. The degree of the improvement from the pretest to the posttest was compared between the groups of the subjects.

Procedures

The experimental session took place in a classroom where the subjects independently worked with an experimenter present. First, the experimenter orally gave instructions to the subjects. He explained that they would take a test first, work
on the workbook, and take the second test. He explained that incentives (points or money) were depending on the scores on both tests. He also explained that the subjects would be immediately withdrawn from the study if he discovered cheating. Looking at somebody else's answers and looking at the correct answers before the subjects wrote their answers were explained as cheating. These instructions were used to maximize the effects of the independent variables by making sure that the subjects were following the instructions in the workbook. After the oral instructions, the experimenter distributed the pretests and the job-aid, and the session began. There was no time limitation on the tests. When the subjects finished the pretest, the experimenter gathered the pretests, distributed the workbooks, and recorded the time on the workbooks. The subjects then started working on the workbooks. Refreshment (e.g., coffee and juice) was provided in the room, and the subjects were allowed to take a break anytime during the workbook period, but no subject did. Instead, many subjects took a short break between the workbook and the posttest periods. When they finished the workbooks, the experimenter collected the workbooks, recorded the time, and distributed the posttests. When the subjects finished the posttests, the experimenter gathered the posttests and distributed the evaluation forms. When the subjects finished the evaluation forms, the experimenter dismissed them. The whole session took one and a half to three hours depending on the group to which the subjects were assigned.
CHAPTER III

RESULTS

The three types of workbooks were all effective in improving the scores, to a similar extent, from the pretest to the posttest. The subjects with no workbook (i.e., control group), on the other hand, showed no significant improvement. On the discrimination test items, the reading and discrimination workbooks were superior to the construction workbook. On the construction test items, there was no significant difference between the three workbooks. I will describe these results in detail in the following.

Discrimination Tests

Overall Scores

Overall performance on the discrimination tests increased significantly from the pretest to posttest for all three workbooks (Figure 6). Table 8 shows the t-test results. The improvement in the scores was significantly greater with the discrimination and reading workbook than with the construction workbook or with no workbook (i.e., control group). These differences were significant using Fisher's Least Significant Difference tests (Table 9). This latter result might seem to support the notion of functional independence between discrimination and construction; i.e., construction performance does not completely transfer to discrimination performance. However, a more molecular analysis is necessary to understand why the subjects with the construction workbook did not learn discrimination as much as the subjects with the
Figure 6. Overall Discrimination Performance.

Note. The Y-axis shows the mean number of correct answers on the eight discrimination test questions.

other two workbooks. Also, the results are counter intuitive to the principle of programmed instruction that emphasizes the "active response" requirement; the discrimination workbook was no more effective than the reading workbook. I will discuss these issues in the discussion section.

Table 8
The $t$-Test Results of the Overall Discrimination Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Improvement between Pretest and Posttest Scores</th>
<th>Paired-$t$</th>
<th>df</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>3.14</td>
<td>6.27</td>
<td>13</td>
<td>.00*</td>
</tr>
<tr>
<td>Discrimination</td>
<td>3.46</td>
<td>6.16</td>
<td>13</td>
<td>.00*</td>
</tr>
<tr>
<td>Construction</td>
<td>1.57</td>
<td>3.91</td>
<td>13</td>
<td>.00*</td>
</tr>
<tr>
<td>Control</td>
<td>0.14</td>
<td>0.49</td>
<td>13</td>
<td>.64</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.
**Individual Tasks**

Figure 7 presents the performance of each group on the pretest and posttest for each discrimination test question. In no case did the control group seem to produce improvement. In no case did the construction workbook seem to produce appreciably greater improvement than the discrimination workbook. In only one case ("Process as activity") did the construction workbook seem to produce greater improvement than the reading workbook, and only in two possible cases did the reading and discrimination workbooks seem to differ in their effectiveness ("Final output" and "Logical sequencing of distribution"), but these apparent differences may have been merely chance results. So, although the workbooks produced greater improvement on some test questions (e.g., "Final output") than others (e.g., "Logical sequencing of

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference</th>
<th>LSD t values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cntrl. vs. Cons.</td>
<td>1.71</td>
<td>1.69*</td>
</tr>
<tr>
<td>Cntrl. vs. Disc.</td>
<td>3.43</td>
<td>1.69*</td>
</tr>
<tr>
<td>Cntrl. vs. Read.</td>
<td>3.29</td>
<td>1.69*</td>
</tr>
<tr>
<td>Cons. vs. Disc.</td>
<td>1.71</td>
<td>1.69*</td>
</tr>
<tr>
<td>Cons. vs. Read.</td>
<td>1.57</td>
<td>1.27**</td>
</tr>
<tr>
<td>Disc. vs. Read.</td>
<td>0.14</td>
<td>1.27</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.
**Significant at the .05 level.

**Note.** Read. stands for the reading workbook; Disc. for the discrimination workbook, Cons. for the construction workbook, and Cntrl. for the control group.
production"), there seems to be no consistent interrelation between the type of workbook and the type of test question.

Construction Tests

**Overall Scores**

Overall performance on the construction tests improved significantly from the pretest to the posttest for all three workbooks (Figure 8). A paired t test for the control group resulted in no significant difference; $t(13) = 0.12$, $p = .91$. However, because this could be due to the relatively high performance of the subjects in the control group at the pretest, I excluded the subjects whose mean construction score on the pretest was 80% or higher\(^1\) (Figure 9). With these subjects' data excluded, the results remained the same; all three workbooks but the control group produced significant improvement (Table 10). Fisher's LSD test showed the degree of improvement was not significantly different between the three workbooks (Table 11).

These results indicate that the reading and discrimination workbooks were as effective as the construction workbook in teaching construction and do not support the notion of functional independence between the construction and discrimination performance. Namely, the subjects trained with discrimination tasks could perform on the construction test questions as well as the subjects trained with construction tasks. Discrimination seemed to transfer to construction. This result questions the importance

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\(^1\)There were 11 such subjects; six in the control group, two in the discrimination workbook, two in the exemplification workbook, and one in the reading workbook group.
Figure 7. Discrimination Performance on Individual Test Questions.

Note. The Y-axis shows the percentage of the subjects who answered correctly on the individual task.
Figure 8. Overall Construction Performance (All Subjects).

Figure 9. Overall Construction Performance (Selected Subjects).

Note. Data from the subjects who scored less than 80% on the pretest.
Table 10
The t-Test Results of the Overall Construction Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Difference</th>
<th>Paired t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>6.00</td>
<td>4.76</td>
<td>12</td>
<td>.00*</td>
</tr>
<tr>
<td>Discrimination</td>
<td>6.17</td>
<td>4.15</td>
<td>11</td>
<td>.00*</td>
</tr>
<tr>
<td>Construction</td>
<td>7.00</td>
<td>4.44</td>
<td>11</td>
<td>.00*</td>
</tr>
<tr>
<td>Control</td>
<td>-0.25</td>
<td>0.25</td>
<td>7</td>
<td>.81</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

Note. Data from the subjects who scored less than 80% on the pretest.

Table 11
Comparison of the Effects of the Workbooks on the Construction Tests:
Fisher's Least Significant Difference (LSD) Tests Results

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference</th>
<th>LSD t values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cntrl. vs. Cons.</td>
<td>-7.25</td>
<td>5.86*</td>
</tr>
<tr>
<td>Cntrl. vs. Disc.</td>
<td>-6.42</td>
<td>5.86*</td>
</tr>
<tr>
<td>Cntrl. vs. Read.</td>
<td>-6.25</td>
<td>5.77*</td>
</tr>
<tr>
<td>Cons. vs. Disc.</td>
<td>0.83</td>
<td>3.92</td>
</tr>
<tr>
<td>Cons. vs. Read.</td>
<td>1.00</td>
<td>3.84</td>
</tr>
<tr>
<td>Disc. vs. Read.</td>
<td>0.17</td>
<td>3.84</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.

Note. Data from the subjects who scored less than 80% on the pretest.
of the terminal-response training. Furthermore, the similarities in the results of the reading and discrimination workbooks again fails to support the requirement of active-responding.

**Individual Tasks**

The results of the analyses of performance on individual test questions are similar to the overall result and shown no obvious interrelations (Figure 10). Table 12 presents the \( t \)-test results. No group showed a significant improvement on task A, partially because of the relatively high scores on the pretest (i.e., ceiling effect). Three workbook groups produced significant differences in more than two of the remaining three test questions. The control group produced no significant difference.

**Table 12**

The \( t \)-Test Results of the Construction Performance on Individual Test Questions

<table>
<thead>
<tr>
<th>Group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>1.32</td>
<td>4.25*</td>
<td>3.97*</td>
<td>1.30</td>
</tr>
<tr>
<td>Discrimination</td>
<td>1.65</td>
<td>3.36*</td>
<td>8.12*</td>
<td>2.32**</td>
</tr>
<tr>
<td>Construction</td>
<td>2.06</td>
<td>1.38</td>
<td>4.15*</td>
<td>3.60*</td>
</tr>
<tr>
<td>Control</td>
<td>0.55</td>
<td>-0.55</td>
<td>-0.36</td>
<td>1.16</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.
**Significant at the .05 level.

**Note.** Data from the subjects who scored less than 80% on the pretest.
Figure 10. Construction Performance on Individual Test Questions.

Note. Data from the subjects who scored less than 80% on the pretest.
Individual Grading Criterion

The construction performance was also analyzed according to each of the seven grading criteria used in evaluation of the outlines the subjects generated (Figure 11). Each criterion concerns a concept or rule used in outlining organizational goals (Table 3). Because there were four questions in each test and each question was graded once for each criterion, the score ranges from zero (no point for the criterion) to four (points for all four questions on the criterion). Table 13 presents the results of paired t tests. All three workbooks produced significant improvements for four criteria ("Final output," "Processes as activities," "Inputs as things," and "Main resources"); no workbook produced significant differences for one criterion ("Logical sequencing"). There was also one criterion where only the construction workbook produced a significant improvement ("Connecting goals"), however this may have happened by chance. So, although the workbooks produced greater improvement for some criteria (e.g., "Processes as activities") than at others (e.g., "Logical sequencing"), there seems to be no consistent interrelation between the type of workbook and the type of grading criterion.

Workbook

Time Spent on the Workbooks

The subjects with the reading workbook spent significantly less time to complete the workbook, and the subjects with the construction workbook spent significantly longer time (Figure 12 and Table 14). Because the reading workbook was
Table 13

The t-Test Results of the Construction Performance on Each Grading Criterion

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Final output</td>
<td>2.74**</td>
<td>3.98*</td>
<td>3.77*</td>
<td>-3.00**</td>
</tr>
<tr>
<td>Logical sequencing</td>
<td>0.23</td>
<td>1.54</td>
<td>1.16</td>
<td>0.68</td>
</tr>
<tr>
<td>Connecting goals</td>
<td>1.10</td>
<td>1.63</td>
<td>3.56*</td>
<td>0.55</td>
</tr>
<tr>
<td>Indenting sub goals</td>
<td>2.50**</td>
<td>1.24</td>
<td>2.73**</td>
<td>2.65*</td>
</tr>
<tr>
<td>Processes as activities</td>
<td>2.98**</td>
<td>3.02**</td>
<td>4.71*</td>
<td>0.00</td>
</tr>
<tr>
<td>Inputs as things</td>
<td>2.54**</td>
<td>3.46*</td>
<td>4.53*</td>
<td>0.36</td>
</tr>
<tr>
<td>Main resources</td>
<td>3.77*</td>
<td>2.60**</td>
<td>2.55**</td>
<td>0.42</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.
**Significant at the .05 level.

Note: Data from the subjects who scored less than 80% on the pretest.

as effective as other two workbooks in teaching both discriminations and construction, it is the most efficient of the three.

The subjects who spent more time working on the workbook might have "learned" more. To examine this, a coefficient was calculated for the correlation between the time the subjects spent on the workbook and the amount of improvement in the scores from the pretest to the posttest for each type of test questions. A significant positive correlation was found only for the subjects with the reading workbook on the construction test questions (Table 15).
Figure 11. Construction Performance on Each Grading Criterion.
Figure 12. Time Spent on the Workbooks.

Table 14

Comparison of Time Spent on the Workbook Between Groups: Fisher’s LSD Test Results

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Mean Difference</th>
<th>LSD t Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read. vs. Disc.</td>
<td>13.1</td>
<td>13.30*</td>
</tr>
<tr>
<td>Disc. vs. Cons.</td>
<td>13.4</td>
<td>13.30*</td>
</tr>
<tr>
<td>Read. vs. Cons.</td>
<td>26.5</td>
<td>9.93**</td>
</tr>
</tbody>
</table>

*Significant at the .01 level.
**Significant at the .05 level.
Table 15

Correlation Coefficients Between the Time Spent on the Workbook and the Improvement in the Scores From the Pretest to the Posttest

<table>
<thead>
<tr>
<th>Type of Workbook</th>
<th>Type of Test Questions</th>
<th>Discrimination</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td></td>
<td>.13</td>
<td>.50**</td>
</tr>
<tr>
<td>Discrimination</td>
<td></td>
<td>-.04</td>
<td>-.27</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td>-.33</td>
<td>-.07</td>
</tr>
</tbody>
</table>

**Significant at the .05 level.

Error Rate in the Workbook Practice

One of the principles of programmed instruction is that instruction is best when error rate is low. Both the discrimination and construction workbooks generated low error rate (14.7% and 21.6% respectively, see Figure 13), though the difference was significant using a t test with arc-sign transformed data; t(26) = -2.35, p < .03. So,

Figure 13. Percentages of Errors in Workbook Practice.
the discrimination workbook seemed to have reinforced the correct responses more often than the construction workbook.

**Accuracy of Self-Grading**

The subjects made few mistakes in grading their answers. Out of 42 items, the discrimination workbook generated an average of 1.1 grading errors, whereas the construction workbook generated 1.9 errors. The difference was not significant; $t(26) = 1.38, p = .18$. So, the subjects' grading was valid in both workbooks.

**Compliance With Instructions**

However, the subjects failed to comply reliably with the instructions in the workbook. In the discrimination and construction workbooks, the subjects were asked to record on the "self-grading box" the number of correct answers in each unit and to use the check list for the outlining of organizational goals (see Figures 2 and 4). However, only on 55% of the occasions did the subjects with the discrimination workbook use the score sheet, whereas the subjects with the construction workbook used it 77%. This difference was significant using arc-sign transformed data; $t(26) = 2.2, p < .04$. The subjects with the discrimination tasks used the check list 56% of the time, whereas the subjects with the construction workbook used the check list 60%. The difference was not statistically significant; $t(26) = .35, p = .73$. The low frequency of compliance suggests that the workbooks did not completely control the subjects' behavior and thus may not have taught as much as they could have.
Subjects' Evaluation

In general, the evaluation of the workbooks was high. The mean of the overall evaluation (item #8) was 1.6 on a five point scale (1 = Good and 5 = Bad). Figure 14 shows the subjects evaluation on the items with the five point scale. There were no significant differences among the workbooks (Table 16).

Table 16

Comparison of the Subjects' Evaluation of the Workbooks:
The Results of One-Way Analyses of Variance

<table>
<thead>
<tr>
<th>#</th>
<th>F</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.21</td>
<td>2, 39</td>
<td>0.82</td>
</tr>
<tr>
<td>2</td>
<td>0.74</td>
<td>2, 39</td>
<td>0.49</td>
</tr>
<tr>
<td>3</td>
<td>1.37</td>
<td>2, 39</td>
<td>0.27</td>
</tr>
<tr>
<td>4</td>
<td>0.24</td>
<td>2, 39</td>
<td>0.79</td>
</tr>
<tr>
<td>5</td>
<td>0.25</td>
<td>2, 39</td>
<td>0.78</td>
</tr>
<tr>
<td>6</td>
<td>1.12</td>
<td>2, 39</td>
<td>0.34</td>
</tr>
<tr>
<td>7</td>
<td>0.23</td>
<td>2, 39</td>
<td>0.80</td>
</tr>
<tr>
<td>8</td>
<td>0.84</td>
<td>2, 39</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Figure 14. Evaluation of the Workbooks by the Subjects.
CHAPTER IV

DISCUSSIONS

Limitations in the Principles of Programmed Instruction

The results of this study failed to support two rules often recommended for developing programmed instruction--the active-response requirement and terminal-response training. The active-response rule says the instruction should evoke "overt" responding so the response can be reinforced. Therefore, the discrimination workbook should have been more effective than the reading workbook. The terminal-response training rule says direct training of the specific response we want to establish in the learner's repertoire is most effective. So, the discrimination workbook should have been more effective than the construction workbook for the discrimination tests, and the construction workbook should have been more effective than the discrimination workbook for the construction tests. The results of this study did not support these rules, with regard to the construction tests, and thus may suggest some limitations to the principles of programmed instruction.

The Active-Response Requirement

The results of this study did not support the necessity of active responding. No significant difference was found between the reading and discrimination workbooks. In other words, the requirement of active discriminative responding on the minimally different pairs of examples and nonexamples added little to merely reading them.
Similarly, other studies have failed to support the advantage of overt responding over covert responding (e.g., Evans, Glaser, & Homme, 1960).

Holland (1965) suggested that "overt" responding might be more effective only when the responses are relevant to the content of the program and when the error rate is low. In other words, the responses evoked in the instruction must be the ones used in the test (i.e., terminal-response training), and the responses must be evoked often enough to be reinforced. In this study, the stimulus-response relations used in the discrimination practice were similar to those required in the discrimination test questions; the test questions did not consist of something the subjects were not asked to respond to in the workbook. Also, a low error rate in the workbook practice was achieved. Therefore other explanations for the lack of a difference are needed.

The subjects who used the reading workbook might have emitted responses that consisted of more than just reading. They were college students who had been tested on definitions and examples in their educational history, and they knew they would be tested on the material in the workbook. The subjects may have tried to "remember" the examples and nonexamples by covertly saying them to themselves repeatedly and by imagining the outline of organizational goals. As Skinner (1968) suggested, some subjects might have even tried to read an example (e.g., "Cooking") first without looking at the label (e.g., "Production"), decide what concept the example belonged to, and then look at the label. The active-response requirement may not be significant to those who have such a repertoire. In other words, some subjects with the reading workbook may have emitted "active" responses although the responses lacked an overt component.

There were contingencies for carefully reading and emitting active but covert responding. In this study, course points or money were provided as an incentive
contingent on the scores on the pretest and posttest. The subjects knew that the more they "studied" the workbook, the more money or points they would receive. These contingencies might have supported the active but covert behavior described above. If there had been no such contingencies, the effects of the reading workbook might have been smaller. In other words, the active-response requirement may be more important to insure that the active responding is taking place when there are only weak consequences for "learning" the material. We need to investigate the relative effects of such contingency management compared to the effects of variables related to the instructional design.

Furthermore, the active-response requirement may have less impact than other variables in the instructional design. For instance, both the reading and discrimination workbooks had the same sequence of units and the same examples and nonexamples that had been carefully designed and revised. In other words, the comparison between the reading and discrimination books was not like the comparison between "traditional" and "programmed" textbooks. The requirement of active responding may make little difference when the material is well designed.

In summary, the active-response requirement may not be important when (a) the instructional material is well designed (e.g., good sequencing, many examples and nonexamples), (b) the learner has an extensive educational history, and (c) there are contingencies for acquiring the programmed repertoire and thus for effectively responding to the material.
Terminal-Response Training

The construction workbook did not produce significantly better construction than the discrimination or reading workbook. The terminal performance (i.e., outlining organizational goals) could be taught with the discrimination practice or even with the simple reading requirement. There are at least two explanations: (1) The construction workbook was not designed as well as the discrimination workbook, and/or (2) there are circumstances where training the terminal performance is not more effective.

There are at least four reasons for the construction workbook not appearing to be the most effective. First, the subjects with the construction workbook might have been more tired than the other subjects when they took the posttest. The mean amount of time needed to complete the construction workbook was almost twice that of the reading workbook. Also, the psychological effort (e.g., thinking hard) in outlining organizational goals seems greater than that of just reading the material or selecting examples from nonexamples. In support of this possibility, two subjects who used the construction workbook quit writing their answers during the posttest. So, it is possible that fatigue from using the exemplification workbook negatively influenced performance on the posttest. However, some research has shown that the constructed-response mode is more effective than the multiple-choice mode because the learners usually spend more time in finishing the program with the constructed response mode (Tobias, 1973). In other words, positive correlation can be found between the time spent on studying and the degree of "learning." This makes the fatigue interpretation somewhat problematic, but does not rule it out, especially because the results of correlation analysis between the time spent on the workbook and the amount of the improvement in test scores were inconclusive in the present study.
Second, the subjects’ correct responses in the construction tasks may not have been reinforced frequently enough. The construction workbook caused significantly more errors in practice than the discrimination workbook. The construction workbook was not designed, however, so that the subjects had to respond until they made the correct response. When the subjects made errors, they did not have to make another response. The subjects may have copied the correct answer, but they did not make another response in the absence of the correct answer. In such cases, the correct response was never emitted and therefore never reinforced. This lack of reinforcement could weaken the effectiveness of the "ideal" construction practice in which the subjects would have to make responses until they made the correct response.

Third, cheating by the subjects might have weakened the effects of the practice. Cheating would have consisted of looking at the correct answers on the next page before the subjects wrote their answers. Cheating has been one of the major problems in programmed instruction because it reduces the effects of programmed instruction by destroying the contingencies (Carr, 1959; Tobias, 1973). By cheating, the subjects just "copy" the correct answer; and as a result, the response does not come under the control of the question. Although the experimenter warned the subjects at the beginning of the session, he did not watch every subject all the time and there was no measurement of cheating. Thus, it is possible that cheating occurred and was not detected. It is also possible that the subjects with the construction workbook cheated more often than others because of the higher effort involved in the construction tasks. However, if they had done much cheating they could have completed their workbook much more rapidly and made fewer errors.

Finally and perhaps most importantly, the failure to use the check list may have damaged construction performance more severely than discrimination performance.
Neither the subjects with the discrimination nor the subjects with the construction workbook used the check list constantly. By including the check list, I was attempting to prompt accurate discrimination. However, the subjects used the check list only about half the time. Perhaps the infrequent use of the check list was more detrimental for those using the construction workbook than for those using the discrimination workbook. To put it simply, the construction performance consisted of two parts: outlining and checking the outline. The discrimination tasks explicitly trained checking the examples of the outline already made. The construction tasks were intended to train both parts. However, if the subjects did not use the check list and if they did not check their answers even "covertly" before they looked at the correct answer, their checking was never reinforced.

The failure to establish subtle discriminations for the subjects with the construction workbook is supported by the result of the discrimination test questions; discrimination performance (i.e., "checking") of the subjects who used the construction workbook was not as good as the subjects who used the other workbooks. This may be because the subjects with the construction workbook encountered fewer nonexamples lacking critical attributes. They did not make many mistakes in the workbook practice. The mean percentage of correct answers was 78%. In other words, the subjects did not have a chance to see nonexamples in 78% of the tasks; when they made mistakes, those mistakes were not necessarily minimally different nonexamples. Because the discrimination test questions consisted of minimally different nonexamples, perhaps the construction workbook's lesser effectiveness in conceptual training is due to the lack of a sufficient number of optimal nonexamples.

The performance of the construction workbook group would have been enhanced if the subjects' discrimination had been trained better. This might have been
achieved by providing stringent contingencies for using the check list in the workbook, and/or by adding discrimination practice in the construction workbook. Incidentally, I had an opportunity to use a revised workbook that had both discrimination and construction practice with more than 15 students. Although no quantitative evaluation of the students' final products (i.e., original outline of organizational goals) was made, informally they seemed better than the performance of the subjects in this study. However, research is needed to examine the effects of such a combination of different tasks.

In summary, the construction workbook may not have achieved its potential because (a) the subjects spent too much time and were tired, (b) correct responding was not reinforced enough, (c) cheating might have occurred, and (d) subtle discriminations were not established due to the lack of minimally different nonexamples and the lack of the use of the check list. These weaknesses may be overcome by using stricter contingencies that prevent cheating and ensure the subjects' compliance with the instruction and by adding discrimination practice in the construction workbook.

Even though the construction workbook may have had those weaknesses, the result of the comparison between the moderate quality discrimination workbook and the lower quality construction workbook may be still valid in practical reality. The programmed instruction that utilizes "ideal" construction practice may be too difficult to develop, especially without using personal computers. The quality of programmed instruction currently available using the construction practice may not be at its maximum level. Besides, the construction practice takes significantly more time on the learner's part. Given the same amount of time, the learner can work on more discrimination practice than construction practice. Therefore, it may not be justifiable to
select a program that utilizes construction tasks when the justification is only in terms of the terminal-response training rule.

Another reason that might be responsible for the failure to support the terminal-response training rule is that the rule may not apply under some circumstances. Terminal-response training may not be significantly important unless the objective of the instruction is to shape new response topographies. For example, it would seem almost impossible to teach playing tennis without the learner actually playing tennis. We can present good and bad forehand strokes and teach the learner to discriminate them. However, the learner will probably not be able to execute good forms without direct training of the forehand stroke. In other words, when the terminal response is a new response topography, the discrimination of the topography does not transfer to the execution of the topography. On the contrary, we can present examples and nonexamples of triangle and train the learner to discriminate them. If the learner has the repertoire of drawing lines, it seems likely that the discrimination of triangles would transfer to the construction of triangles.

Others have made similar analyses of the response mode. Tobias (1973) argued that whether the constructed-response mode is more effective than the multiple-choice mode depends on the subjects' "familiarity" with the content. Although he did not define "familiarity," the idea may be better understood with Holland's (1965) analysis: The constructed response mode should be used when the objective of the program is to shape a response topography (i.e., the subjects do not have the response topography in their repertoire), whereas multiple choice should be used when the objective is to develop fine stimulus discrimination. It seems reasonable that terminal-response training is necessary when the terminal response is not in the learner's repertoire in the beginning, but it is not so important when the objective is stimulus discrimination.
Therefore, to interpret these unexpected results, it is important to analyze what the discrimination and construction tasks consisted of in terms of the behaviors these tasks required. The responses needed to complete these tasks need to be described at a molecular level. Such analyses may help to identify why the terminal-response training was not effective in the construction workbook and the extent to which the results are generalizable. Also, it will help to identify how the workbook can be improved. So, in the following section, I will present molecular task analyses of these instructional tasks.

Theoretical Analyses of Instructional Tasks

Molecular analyses deal with smaller response units than molar analyses. Behavior analysts generally use small response units, avoiding such descriptions of behavior as "studying for an exam" and "working hard." Instead, they try to focus on more specific behaviors such as "reading the textbook" and "writing the final report at 10 pages per hour." Molecular analysts break down response units further. They use such response units as "opening the textbook," "reading a paragraph," and "underlining unfamiliar words." The purpose of the molecular analysis is to identify behavior and its controlling variables precisely.

The discrimination and construction tasks used in the workbooks actually required a chain of responses. For example, in order to respond to a discrimination task, the subjects had to read the outline of organizational goals, ask themselves questions while stating relevant rules (e.g., "Is the outcome defined as things?"), and answer those questions. In other words, before the subjects make the final response (e.g., "This is incorrect because the final output is defined in terms of activities."), they had to engage in a series of conceptual discriminations.
A unique aspect of such a response chain is that the responses in the chain are prompted by the subjects' own verbal behavior. Shimamune and Malott (1992) proposed a distinction between simple conceptual control and definition-based conceptual control. In simple conceptual control, an example of a concept (e.g., triangle) directly controls the terminal response (e.g., "It's a triangle"). In definition-based conceptual control, an example evokes a chain of responses based on the definition of the concept, consisting of simple conceptual control, and finally produces the terminal response. For instance, in the discrimination workbook, the subjects received the definition of "production system" as "processes in which inputs and outputs are different." Then, they were asked to label examples such as "cooking beef stew" as either "production," "distribution," or "research & development." Perhaps, the subjects asked themselves what the input and output of the process were and if they were different. In other words, "cooking beef stew" controls the selection of "production" using the response chain including the statement of the concept definition.

An Analysis of the Discrimination Task

Each unit of the stimulus-response chain consists of intraverbal responses and conceptual discriminations. Figure 15 illustrates a response chain involved in a discrimination task. Given the outline of organizational goals, the subjects ask themselves questions with regard to the attributes the correct outline must satisfy. In this example, the subjects ask questions about the definition of the final output first. The relation between the stimulus (i.e., the outline) and the response (i.e., a specific question) is intraverbal. A part of the question ("Final output") then must evoke reading the relevant part of the outline ("Taxi fair and tips"). This process may be more complex than it, at first, appears. In the workbook and job-aid, it read "The final
output of the organization must be placed on the top." Direct training of relevant behavior might be asking the subjects to point to final outputs given a variety of outlines. However, it was omitted in the workbook, because the subjects were assumed to have a verbal repertoire such that "placed on the top" can evoke the appropriate response. So, the most important thing at this step is the subjects asking the right questions.

At the next step, self-generated stimuli, "Things" and "Taxi fair and tips," constitute a conceptual intraverbal task: The subjects must be able to identify whether "Taxi fair and tips" are members of "Things." This concept was included in the earlier part of the workbook with the practice on "Input/Output versus Process." The confirming response ("Yes") must evoke the next question, which can be any relevant question but not the one already asked. The subjects need to keep asking the question with the detection of no fault or quit asking the question with the detection of a fault in the outline. This generic stimulus-response relation was not trained explicitly in the workbook. It was assumed to be a repertoire ordinary college students have acquired previously. The next question ("Is the final output defined in terms of profit?") requires another simple conceptual discrimination. This time the subjects must be able to identify whether "Taxi fair and tips" belong to "Profit." The concept is assumed to be in their repertoire and thus omitted from the workbook practice. Upon the detection of an error, the subjects circle "Incorrect" and write the missing critical attribute. Again, the important points here seem to be the subjects asking appropriate questions.

Discrimination tasks that require the response chains described above (i.e., definition-based conceptual control) should be distinguished from discrimination tasks that require simple intraverbal responses or conceptual control not involving definitions of the concepts. The former requires the subjects' appropriate intraverbal responses
Figure 15. Illustration of a Response Chain Involved in a Discrimination Task.

(i.e., rules and definitions) to adequately guide the response chain; the latter does not. Poor discrimination in the latter simply implies poor stimulus (class) control, whereas in the former it may mean the subjects (a) do not emit appropriate intraverbal responses (i.e., lack of appropriate rules) and/or (b) do not react to those intraverbal responses (i.e., lack of simple conceptual or intraverbal relations). In this study, there seemed few simple conceptual discriminations that were too difficult to cause a problem. For
example, few subjects should have had trouble with simple conceptual matching regarding "Taxi fair and tips" and "Profits." It was more important to ensure that the subject ask proper questions.

An Analysis of the Construction Task

The construction task used in this study should also be distinguished from more simple tasks that involve no verbally mediated stimulus-response chain. For example, drawing an original triangle probably need not require definition-based intraverbal responses; neither need giving an example of "fruit." These can be examples of "simple exemplification." On the other hand, some exemplification tasks require verbally mediated response-chain. For instance, giving an example of reinforcement may involve intraverbal responses based on the definition of reinforcement (e.g., "What would be a stimulus immediately following a behavior?"). We might call this "definition-based exemplification."

The construction task included both simple and definition-based exemplification with discriminative or conditional stimuli. The construction task did not ask for an original example of organizational goals. Instead, the organizational goals were specified, some cues for processes and resources were given, and the subjects were asked to recombine such information into an outline form.

Figure 16 illustrates a response chain for a construction task. Given a short description of an organization, the subjects are asked to outline its goals. First, they need to ask what is the final output of the organization. The definition of the final goal was given in the early part of the workbook and cues were given in the description of the organization. The answer ("Retarded people with vocational skills") may be evoked by the question directly (simple exemplification) or indirectly through intervening
verbal responses such as "What is the final product of this organization that is distributed to other organizations?" (definition-controlled exemplification). Practice of this sort was included in the construction workbook.

The subjects then write the answer within parentheses after stating the rule ("Outputs/inputs should be placed in parentheses"). In the construction workbook, there was practice on this response unit. The chain of responses continues until the outline is completed.

The subjects needed to engage in discrimination to produce complete outlines. In Figure 16, I analyzed the "self-editing" process at the very end. After the subjects finished outlining, they could check the outline according to the critical attributes and revise the outline if necessary. Such a "self-editing" process is essentially equivalent to the response chain required in the discrimination task. Only this time the subjects had not only to detect a fault but also to correct it.

The subjects seemed to have more trouble in emitting appropriate intraverbal responses than in simple or definition-based exemplification at each component of the stimulus-response chain as was the case in the discrimination task. For instance, the analysis of individual grading criteria revealed that the subjects had problems with the criterion of "Logical sequencing of goals." Often, the subjects outlined the goals placing inputs before outputs. This suggests that the subjects stated the rule in reverse: Instead of asking for output, process, and input in this order, they may have asked for input first, and then process and output.

From the above analyses, it becomes clear that the intraverbal responses required by the discrimination and construction workbooks were different. The discrimination practice may reinforce such intraverbal responses as "Is the final output defined as things?" whereas the construction practice may reinforce "What would be the
final output for this organization?" The construction workbook was less effective than the discrimination workbook on the discrimination tests maybe because the intraverbal responses taught in the construction workbook were not very useful for the discrimination task. For example, rules necessary for the construction task may not have included critical attributes of the correct outline.

Teaching a Strategy

Questioning oneself in a problem-solving situation can be analyzed as a "strategy" (Markle, 1990) involving "precurrent behavior" (Skinner, 1964). Precurrent behavior generates effective discriminative stimuli where no other discriminative stimulus is available. It consists of a stimulus-response chain leading to the terminal response that is not evoked by the initial stimulus setting. Markle (1990) described "strategy" as generic problem solving methods that can be acquired through the exposure to a number of problem situations such as thinking of a similar problem that you know how to solve and drawing pictures to figure out what the problem consists of. Such responses generate effective discriminative stimuli for appropriate behavior.

The objective of the workbook used in this study may be better understood as teaching a specific set of problem-solving behaviors--a strategy. The strategy was specified in terms of rules and definitions and could be applied to the outlining of a variety of organizational goals. In the problem-solving behavior in this study, whether in the discrimination or construction task, the most important thing was the occurrences of the appropriate intraverbal responses that guided the response chain. Simple discrimination and exemplification in each component of the chain were perhaps not completely novel to the subjects and thus caused little problem.
Stimulus | Response
--- | ---
Design the structure of organizational goals for a vocational school for mentally retarded people that teaches vocational skills for the population. | "What would be the final output?"

"Retarded people with vocational skills"

Write it with parentheses.

(Retarded people with vocational skills) | "What process will produce this output?"

"Training retarded people"

"What kind of process is this?"

"Production"

Write it with a colon and connect with a line.

(Retarded people with vocational skills) Production: Training retarded people. | "What is necessary for this process?"

"Retarded people and teachers"

Write them with parentheses and connect with lines.

(Retarded people with vocational skills) Production: Training retarded people. "Teachers are not the main resources."

Erase it.

Figure 16. Illustration of a Response Chain Involved in a Construction Task.
More explicit training of intraverbal responses might have produced better performance. By defining the terminal response in terms of an appropriate chain of questioning, and by following the rules of the terminal-response training and the active-response requirement, we can revise the workbook so that the subject's statement of the questions is directly reinforced in the workbook. If such a revision makes a significant improvement, then the active-response requirement and terminal-response training rules would still hold. Perhaps, this study did not support the rules because none of the workbooks explicitly trained the critical terminal behavior--interverbal responses.

For the workbooks used in this study, the check list was embedded in the workbook to facilitate the subjects' appropriate prompting responses. However, as I discussed previously, the subjects did not use it as often as I had hoped. In the future, perhaps we can use the check list not as a guide for editing outlines but as a guide for production. We can make the check list a part of the response requirement when the learners outline organizational goals. Also, we can increase the use of the check list by providing additional incentives, such as giving course points or money depending on the subjects' compliance with the instruction in the workbook.

Summary

The results of this study failed to support the necessity of the requirements of active-responding and terminal-response training, recommended by behavioral programmed instruction designers (Mager, 1988; Markle, 1990). Theoretical analyses suggest that the active-response requirement might not be effective when (a) the instructional material has well developed examples and nonexamples, (b) the learner has an extensive educational history, and (c) motivational variables for the learner are in effect.
The terminal-response training--training of outlining using the construction workbook--did not appear to be better than discrimination training or simple reading. The construction workbook might have been ineffective because (a) the subjects were tired, (b) correct responding was not reinforced enough, (c) cheating might have occurred, and (d) subtle discriminations were not established due to the lack of minimally different nonexamples and use of the check list. Also, the results seem to suggest that the terminal-response training may not be important when the topography of the terminal response is in the learner's repertoire and the objective of the instruction is stimulus discrimination.

Molecular analyses of instructional tasks seem to suggest that in teaching a strategy it is important to teach intraverbal responses with regard to concept definitions and rules explicitly in the instruction. This can be accomplished by explicitly requiring those intraverbal responses to be overt in the workbook practice and by providing consequences for the responses. It is possible that two rules--active-responding requirement and terminal-response training produced insignificant results because none of the workbooks explicitly trained the critical intraverbal responses.

Based on the results, this study suggests that there may be cases where some principles of programmed instruction do not apply. However, to identify the extent to which the results of the study can be generalized, or identify the limitations of the principles, we need further experimental investigations.
Appendix A

Human Subjects Institutional Review Board Approval
Date: March 3, 1992
To: Satoru Shimamune
From: Mary Anne Bunda, Chair
Re: HSIRB Project Number: 92-02-18

This letter will serve as confirmation that your research protocol, "Interactions between two kinds of interactions" has been approved under the exempt category of review by the HSIRB. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the approval application.

You must seek reapproval for any changes in this design. You must also seek reapproval if the project extends beyond the termination date.

The Board wishes you success in the pursuit of your research goals.

xc: Malott, Psychology

Approval Termination: March 3, 1993
Date: May 4, 1992

To: Satoru Shimamune

From: Mary Anne Bunda, Chair

Re: HSIRB Project Number: 92-02-18

This letter will serve as confirmation that your research protocol, "Interactions between two kinds of Instructions" has been reapproved by the HSIRB. The conditions and duration of this reapproval are specified in the Policies of Western Michigan University. You must seek reapproval for any change in this design.

The Board wishes you success in the continuation of your research goals.

xc: Malott, Psychology

Approval Termination: March 3, 1993
Appendix B

Reading Workbook
This is the first half of the Workbook for Goal-Directed Systems Design. Today, you will learn how to outline the structure of organizational goals. Follow the instruction and go through the workbook.

Time Start: ____________  Time Finished: ____________

• There are questions and answers in the workbook. You are asked to write your answer before you see the correct answers which appear on the next page. Do not look at the answers before you write your answers. If the instructor finds you doing so, you will be immediately dismissed from the study and receive no optional point.

• During this period, you are free to take a break anytime. Soft drink and snack are available. However, you are not allowed to talk to other participants about the material you are studying. Violation of this instruction will immediately lead to dismissal too.

• If you have any question, raise your hand. The instructor will help you.

This is the beginning of the workbook.

Now start.
Goal-Directed Systems Design is a technology of designing an ideal structure of organizational goals using a behavioral systems analytic approach. In this part of the workbook you will learn the concepts in the Goal-Directed Systems Design and do some practice in designing organizational goals.

What's behavioral systems analytic approach?

A system is an organized, integrated, unified set of components, accomplishing a particular set of goals. A system consists of inputs (resources), process, and outputs (goals). For example, an automobile is an example of system. It inputs gas, air, and directions from a driver and brings people from one place to another. It's a transportation system. A behavioral system is a system in which the principle components are human beings. For example, a university is an example of behavioral system, which inputs high-school graduates, educates them, and outputs college graduates.

In a behavioral systems approach, you define an organization as a set of systems by identifying output, process, and input for each component. In other words, you see an organization as a behavioral system or a collection of behavioral systems, each of which has an output, a process, and inputs.

Examples:

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Process</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A hospital:</td>
<td>Healthy people</td>
<td>Treatment</td>
</tr>
<tr>
<td>2</td>
<td>An amusement park:</td>
<td>Happier people</td>
<td>Amusement</td>
</tr>
<tr>
<td>3</td>
<td>A motel:</td>
<td>Rested people</td>
<td>Providing rooms</td>
</tr>
<tr>
<td>4</td>
<td>A bus company:</td>
<td>People at destination</td>
<td>Transportation</td>
</tr>
<tr>
<td>5</td>
<td>A book store:</td>
<td>People who have books</td>
<td>Selling books</td>
</tr>
</tbody>
</table>
In this workbook, you are asked to describe outputs, inputs, or goal as things or conditions. You are also asked to describe processes as activities or behaviors. We want you to learn this distinction because a process does not necessarily produce the expected output even when the process seems to be active. For example, even when a motel provides plenty of rooms, people may not get rested because of poor service, dirty bath room, etc. So, we do not want to say the goal of a motel is to provide rooms. That's what the motel does to accomplish the output—rested people. The goal should be described as "rested people" and one of its processes as "providing rooms". This distinction may seem odd and less important to you, but it becomes critical when you start designing the structure of organizational goals later.

**Rules**

Define **processes** of an organization as **activities** or **behaviors**.

*Use "verb + ing + noun" or to "to [verb] [noun]" to define a process.*

Example: Baking bread.

Define **outputs**, **inputs**, or **goals** of an organization as **things** or **conditions**.

*Avoid using "[verb] + ing + [noun]" or "to [verb] [noun]" to define an output/input.*

Example: Bread baked.

**Examples:** The following are examples of outputs and processes.

<table>
<thead>
<tr>
<th>Output</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread baked.</td>
<td>&lt;- To bake bread.</td>
</tr>
<tr>
<td>Watch manufactured.</td>
<td>&lt;- Manufacturing watch.</td>
</tr>
<tr>
<td>School bus drivers trained.</td>
<td>&lt;- Training school bus drivers.</td>
</tr>
<tr>
<td>An appointment made.</td>
<td>&lt;- To make an appointment.</td>
</tr>
<tr>
<td>The students who have learned.</td>
<td>&lt;- Teacher's teaching students.</td>
</tr>
</tbody>
</table>
In Goal-Directed Systems Design, ideally, the **ultimate goal** of an organization is selected first, then the various levels of intermediate goals needed to accomplish that ultimate goal are selected, and finally the initial goals needed to accomplish those intermediate goals are selected. In other words, you decide what to accomplish first and then design goals that will accomplish what you have decided to accomplish.

**Definition**

**Ultimate goal** is the highest level of organizational goal and ought to be the **well-being of living creatures**.

Why is the Goal-Directed systems Design important?

Philosophically, we believe the world would be better off if every organization sets the ultimate goal at the well-being of creatures on the earth and derives the intermediate and initial goals from the ultimate goal. We think that all of us should work toward this direction, and Goal-Directed Systems Design will help us to achieve this ultimate goal. However, we also think this might be too idealistic.

In this workbook, we are not selling our philosophical stand. Instead, we are providing a technology that helps you accomplish no matter what you want to accomplish. In fact, you are learning to analyze organizational goals not from the well-being of living creatures but from the final output of an organization. Regardless of the goal you start with, Goal-Directed Systems Design is useful and effective because of its goal-directed nature, or in other words, top-down approach.

**Definition**

**Top-down approach** is a technology of designing organizational goals by defining higher goals of an organization first, and then selecting subgoals that are necessary to accomplish those higher goals. Thus, the accomplishment of each subgoal contributes to the accomplishment of the higher goals.

Why is the Goal-Directed systems Design useful?

Top-down approach is valuable for the following reasons: First, it gives flexibility in designing organizations. As long as the desired output is accomplished, the process that produces the output could be anything. In systems engineering terms, this is called **equifinality**. There are a number of different processes that can produce the same final output. For example, working in a training department at a company, you may feel that you must train people whenever there is a performance problem. But, if you look at the desired outcome (i.e., job done), the best bet may not be training but rather a simple job-aid or even a replacement. Focusing on the output before selecting the process thus gives you flexibility in selecting processes.
Second, we take top-down approach in order to avoid two kinds of mistakes. One is an activity trap and the other is the means-ends trap. In both kinds of traps, we fail to accomplish what we want to accomplish even without knowing it.

An activity trap occurs when you are satisfied with an activity or process without producing a valuable accomplishment or output. For example, an instructor at a university may use a lot of advanced technologies in her psychology class, such as an interactive video and computer-assisted instruction. An activity trap occurs when she or the university is satisfied with the use of the technology and not concerned about how students are doing in the class. It may be the case that the students are failing to learn the material because they have few prerequisite skills to make use of the material the instructor has presented. To get around the trap, you have to focus on the output of a system. That is the students who learned the material.

Ends-means trap occurs when you are satisfied with the accomplishment of lower-level goals and not concerned with the accomplishment of higher-level goals to which the lower-level goals are supposed to contribute. In the former example, suppose the instructor finally succeeded in making the students learn in the class. An ends-means trap occurs, for example, when the students fail to succeed after they graduate from her class. The jobs they got do not require the skills she taught. To get around the trap, you need to derive your goals from what you are ultimately attempting to accomplish.

Examples and nonexamples: Read the following pairs of examples and nonexamples.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Nonexamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>In order to achieve the well-being of humanity we need to achieve the</td>
<td>In order to achieve the well-being of humanity, we need to, for instance,</td>
</tr>
<tr>
<td>physical well-being of humanity and the psychological well-being of</td>
<td>raise funds and send the money to the third world countries.</td>
</tr>
<tr>
<td>humanity, we need to, for instance, decrease mortality rate. To decrease</td>
<td></td>
</tr>
<tr>
<td>the mortality rate, for instance, we need to decrease Fetus Alcohol Syndrome. To decrease the FAS, we need to</td>
<td></td>
</tr>
<tr>
<td>provide behavioral management programs to pregnant women.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>In order to provide nutritious and delicious foods to customers with a</td>
<td>Because this restaurant is near a university, it would be better to serve</td>
</tr>
<tr>
<td>reasonable price, basically we need foods and customers. To get foods</td>
<td>fast foods.</td>
</tr>
<tr>
<td>we need to buy materials and cook them. To get customers we need</td>
<td></td>
</tr>
<tr>
<td>advertising.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To increase the happiness of employees, we can improve physical and</td>
<td>To decrease the time loss from injuries, we need to introduce safety</td>
</tr>
<tr>
<td>economical conditions of the employees. To improve their physical</td>
<td>programs such as encouraging seat belt use.</td>
</tr>
<tr>
<td>conditions, we can provide safety programs such as encouraging the seat</td>
<td></td>
</tr>
<tr>
<td>belt use, and diet or non-smoking program. To improve the economical</td>
<td></td>
</tr>
<tr>
<td>conditions we can introduce social welfare programs and life insurance.</td>
<td></td>
</tr>
</tbody>
</table>
Although it is ideal to analyze organizational goals from the ultimate goal, it is often difficult and time consuming. Therefore, in this program, you will only be asked to start analyzing organizational goals with a **final output** of organizations. A final output is the final product of an organization that is distributed outside the organization. It is defined in terms of **things or conditions** but not in terms of activities or behaviors. For example, the final output of this workbook is "students who can use Goal-Directed Systems Design" but not "teaching students how to use Goal-Directed Systems Design."

**Definition**

A **final output** of an organization is the final product that is distributed outside the organization.

**Examples:** Read the following pairs of examples and nonexamples carefully. Also, read the comments below.

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Examples</th>
<th>Nonexamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>An automobile company</td>
<td>Automobiles manufactured.</td>
<td>Net profits 30% increase.</td>
</tr>
<tr>
<td>A university.</td>
<td>Graduates, 1000 BAs, 60 MAs, and 10 Ph.Ds per year.</td>
<td>An increase in employees' commitment to the university.</td>
</tr>
<tr>
<td>A mental health hospital.</td>
<td>People who become functioning in society.</td>
<td>Reduction of labor costs.</td>
</tr>
<tr>
<td>A computer retail shop.</td>
<td>Personal computer systems sold.</td>
<td>Selling personal computer systems.</td>
</tr>
<tr>
<td>A city hotel.</td>
<td>Customers rested and satisfied with the service.</td>
<td>The reputation of the hotel.</td>
</tr>
</tbody>
</table>

**Comments:**

Profits are not a final output because it is not distributed to external organizations. This may seem contradict to the common sense notion--every profit organization's goal is $. We do not deny that characterization. But we are taking a different approach in viewing organizational goals in this workbook.

Commitments are not a final output because it is not distributed to external organizations. Nor are they the final product of the organization.

The reduction of the labor cost is not a final output because it is not distributed to external organizations. Many students are often confused by this, probably because there are so many materials that have "the reduction of costs" as a goal. In this workbook, we take a different approach. So, please set your primary experience aside for a while.

Selling computers is a process not an output.

Reputation is not the final product of the organization.
Now, you will learn how to design organizational goals. You will use **Output-Process-Input chain** to produce the structure of organizational goals. First, you define the final output of the organization. Then you define the process that produces that output. Then you define inputs that are necessary for the process. This output-process-input forms a subsystem. The inputs for one subsystem are the outputs from other subsystems. Once you have determined the inputs for a subsystem, you go on to define the processes that produce those inputs and the inputs needed for the processes—the next output-process-input chains. You will repeat this chaining until inputs are obtained from other organizations than the one you are analyzing. In other words, **you are linking subsystems in an organization by chaining the inputs of one subsystem to the output of another subsystem**. This chaining continues until the input to a subsystem is offered by other organizations than the one you are analyzing. As you can see in the following outline, it is easy to read the flow of resources in an organization when it is presented as the outline of organizational goals.

For example, let's analyze organizational goals for an automobile assembling factory. This factory simply gets every part needed for building an automobile and assembles the parts. The final output of this organization is "automobiles correctly assembled with no defect." So, first, you put this final output on the top of the outline.
Notice that the final output is put in parentheses. In Goal-Directed Systems Design, all outputs and inputs (goals and resources) are put in parentheses in order for us to easily distinguish them from processes. Now, the next thing you do is ask yourself how to accomplish this goal. In other words, what process do you need to produce correctly assembled automobiles? Assembling, right? So you put this process underneath the final output slightly (3-4 letters) indented to the right.

(Automobiles correctly assembled with no defect)
L Production: Assembling automobiles.

Notice that you do not have parentheses this time and, instead, have a label ("Production") and a colon before the description of the process. There are three kinds of labels for processes in Goal-Directed Systems Design. You will learn them shortly. Indenting is important here because we want to see the hierarchical structure of goals with ease. Indented items illustrate they are prerequisites for the item just above them. They must be fulfilled in order for the item just above them to be accomplished. In other words, a process must be active to produce its output, and inputs must be obtained in order for a process to be active. By connecting two levels by lines, you can see more easily the relationship between outputs, process and inputs.

The next question is: what resources do you need for the process? Well, you can come up with many things that you think necessary for assembling automobiles. Front line workers, tools for the workers, electricity, the parts of the automobile, etc. In the output-process-input chains, however, you only focus on the flow of main resources, which is the parts of the automobile in this case.

(Automobiles correctly assembled with no defect)
L Production: Assembling automobiles.
L (The parts of the automobile)

The analysis does not stop here. As you might guess, the next question is: what process do you need to get the parts? Before analyzing this, let's review the definition of the "output-process-input chain", and learn about main resources and labels for processes.

**Definition**

Output-Process-Input chain is a way of sequencing goals first by asking what you want to accomplish (output), second how you accomplish it (process), and third what you need to accomplish it (inputs).

Then, each input is analyzed in the same way until the organization that you are analyzing has made contact with some other organizations.
To make an Output-Process-Input chain you must follow Rules in outlining the structure of organizational goals.

Rules in outlining the structure of organizational goals

1. The final output of the organization must be placed on the top.
2. Outputs and inputs consist only of main resources.
3. Output and input are put in parentheses.
4. Processes must be labeled.
5. Lower level must be indented to the right and connected with a line.
6. Multiple resources or multiple processes must be located at the same level and connected with a line.

What are the main resources?

We like to make a distinction between the primary resources that are directly processed in a process and the resources that are used in order to process those primary resources. For example, every behavioral system has workers as human resources (such as builders in a factory). However, they are not the main resources for the manufacturing process in the sense that the builders themselves are not being processed. Instead, what the builders use in the manufacturing process (such as wood and nails) is considered the main resources. Builders are considered main resources when their training or recruiting is analyzed. In such a case, you draw a different outline which starts with "skilled builders" as the final output.

Definition

Main resources consist of raw materials for production processes, resources that are distributed by distribution processes, or customers.

Examples: Read the following examples and nonexamples carefully. Also read the comments below.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Examples</th>
<th>Nonexamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger shop.</td>
<td>Vegetables, bread, cheese, etc.</td>
<td>Cutting board, ovens, microwave, etc.</td>
</tr>
<tr>
<td>Publisher of a magazine.</td>
<td>Articles and photographs.</td>
<td>Writers and photographers.</td>
</tr>
<tr>
<td>Bar.</td>
<td>Beers, popcorn, etc.</td>
<td>Tables, chairs, glasses, etc.</td>
</tr>
<tr>
<td>University.</td>
<td>Students.</td>
<td>Professors.</td>
</tr>
</tbody>
</table>

Comments:

Raw materials such as vegetables, bread, cheese, etc. Labors (e.g., cooks) and equipment (e.g., cutting board, ovens) are not the main resources.

Articles and photographs. Writers and photographers are not the main resources.

The waitstaff, tables, chairs, glasses, etc. are not the main resources.

Professors and instructors are not the main resources.
We provide a classification system to help you to define a variety of processes when you design organizational goals. There are three kinds of processes: Production, distribution, and research and development (R&D).

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong> is a process in which inputs and outputs are different.</td>
</tr>
<tr>
<td><strong>Distribution</strong> is a process in which inputs and outputs are the same.</td>
</tr>
<tr>
<td><strong>Research &amp; Development</strong> (R &amp; D) is a production process specifically conducted in order to develop procedures, instructions, equipment, and standards used in another production or distribution process.</td>
</tr>
</tbody>
</table>

**Examples:** Carefully read the following examples and nonexamples of production, distribution, and R & D processes.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Production</th>
<th>Distribution</th>
<th>R &amp; D</th>
<th>Nonexamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A farm</td>
<td>Planting crops.</td>
<td>Shipping out crops to foreign countries.</td>
<td></td>
<td>Cows and chickens.</td>
</tr>
<tr>
<td>A pharmaceutical company.</td>
<td>Manufacturing a cold medicine</td>
<td></td>
<td>Experimenting effects of new drugs on human perception.</td>
<td>The chemical equation of a new drug.</td>
</tr>
</tbody>
</table>

**Comments:**
- Training and educating are classified as production because the output (i.e., trained people) is different from the input (i.e., untrained people).
- Cows and chickens are resources.
- Workers are resources.
- The chemical equation presents a procedure of how to make the new drug. The production of a procedure is R&D, whereas manufacturing of the drug by following that chemical equation is production.
Examples: Carefully look at the following examples of organizational goals. Learn how the labels for processes are used. Also learn the main resources necessary for each process.


(Televisions repaired)
  - Production: Repairing televisions.
    - (Broken televisions)


(Customers at the destination)
  - Distribution: Transporting.
    - (Customers at the departure place)

3. Organization: A fire fighting department.

(Fire extinguished)
  - Production: Fire fighting.
    - (Fire)
      - (Water)

Comments: Actually it is deproduction of fire. However, in this workbook, production includes extinction of something, for example, cleaning pollution from a lake.

You have more examples on the next page.

(Customer with pizza)
  Distribution: Selling pizza.
    (Pizza)
    (Customers)

Comments: Customers are always one of the main resources in the selling process.


(Wine)
  Production: Making wine.
    (Grape)


(Electricity at customers' house)
  Distribution: Transfer electricity.
    (Electricity)
    (Customers)
Let's go back to our example of the automobile assembling factory. How do you get the parts of the automobile? Well, in this factory, all parts are bought from another company. So, the outline looks like this:

(Automobiles correctly assembled with no defect)
- Production: Assembling automobiles.
  - (The parts of the automobile)
- Distribution: Buying the parts.

What do you need to buy the parts? The parts must be for sale, right? So, you put it in underneath the outline, and you are all set. Because selling or manufacturing the parts is not your business, you can stop the analysis here. Remember that your outline always ends up with resources that are provided by some other organizations.

(Automobiles correctly assembled with no defect)
- Production: Assembling automobiles.
  - (The parts of the automobile)
  - Distribution: Buying the parts.
    - (The parts for sale)

Let us show you some examples and nonexamples of the outline of organizational goals. We use the following questions when we make the outlines.

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) What do you want to accomplish?</td>
<td>Identify the final output in terms of things or conditions. Do not identify the final output in terms of process or activity.</td>
</tr>
<tr>
<td>(2) How do you accomplish it?</td>
<td>Identify process(es) that accomplish the goal.</td>
</tr>
<tr>
<td>(3) What do you need for the process?</td>
<td>Identify the main resources for the process. Don't put other resources, such as line workers and tools used in the process. These other kinds of resources are analyzed later. Don't forget customers as one of the main resources for any selling process.</td>
</tr>
</tbody>
</table>

Once you identify resources, repeat the questions (2) and (3) for each resource you have identified: How do you get the resource? What do you need to do to accomplish that?
This is a simple example of the design of organizational goals for a factory that manufactures furniture. The final output is "furniture manufactured", and in the simplest design, there are only two subsystem involved.

**Example:** Look at the following example and nonexample of outlines designed for a toy manufacturing factory. Read the comment to know what is wrong with the nonexample.

**Example:**

(Toys manufactured)
- Production: Manufacturing toys.
  - (Raw materials)
    - Distribution: Buying raw materials
      - (Raw materials for sale)

**Nonexample:**

(Toys manufactured)
- Production: Manufacturing toys.
  - (Raw materials)
  - Distribution: Buying raw materials.
    - (Raw materials for sale)

**Comment:** The distribution process must be indented to the right under "(Raw materials)."

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? **Yes** **No**
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes** **No**
3. Are lower goals right indented from higher goals and connected with line? **Yes** **No**
4. Does the outline end up with resources? **Yes** **No**
5. Are all processes defined as activities and labeled correctly? **Yes** **No**
6. Are all inputs the main resources for the process? **Yes** **No**
7. Are all the main resources necessary for the process defined? **Yes** **No**
8. Are all inputs and outputs main resources? **Yes** **No**
The next example is the design of organizational goals for a computer shop that buys computers from manufacturing companies and sells them to customers. The final output is "computers sold". Notice that there are two main resources for the process of selling computers. One is goods to be sold (i.e., computers) and the other is customers. For any selling process, the customer is always one of the main resources. Notice how two resources (i.e., computers and customers) are placed in the outline and how they are connected by a line. The line shows that both of them are the main resources for the process, (i.e., selling computers) and they are, in this sense, located at the same level.

**Example:** Look at the following example and nonexample. They are organizational goals designed for a university book store. The book store buys books from a merchant and sells them to the student. Read the comment to see what is wrong with the nonexample.

**Example:**

(Books sold)
- Distribution: Selling books.
  - (Books)
    - Distribution: Buying books from a merchant.
      - (Books for sale)
    - (Customers)

**Nonexample:**

(Books sold)
- Distribution: Selling books.
  - (Books)
    - Distribution: Buying books from a merchant.
      - (Books for sale)

**Comment:** Every selling process must have "customers" as one of the main resources.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? **Yes** No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes** No
3. Are lower goals right indented from higher goals and connected with line? **Yes** No
4. Does the outline end up with resources? **Yes** No
5. Are all processes defined as activities and labeled correctly? **Yes** No
6. Are all inputs the main resources for the process? **Yes** No
7. Are all the main resources necessary for the process defined? **Yes** No
8. Are all inputs and outputs main resources? **Yes** No
Some organizations manufacture goods and sell those goods. For example—the design of organizational goals for a hamburger shop. The final output is "hamburgers sold."

Example: Look at the example and nonexample of the outlines designed for a small apparel shop that sews clothing and sells them. Read the comment and know what is wrong with the nonexample.

Example:

(Clothing sold)
- Distribution: Selling clothing.
  - (Sewed clothing)
    - Production: Sewing clothing
      - (Raw materials)
        - Distribution: Buying raw materials.
          - (Raw materials for sale)
    - (Customers)

Nonexample:

(Clothing sold)
- Distribution: Selling clothing.
  - (Sewed clothing)
    - Production: Sewing clothing
      - (Raw materials)
        - Distribution: Buying raw materials.
          - (Raw materials for sale)
    - (Customers)

Comment: "(Customers)" must be placed at the same level as "(Sewed clothing)."

You can check your outline regarding the following points.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."

1. Is the final output located at the top and defined as things or conditions? **Yes No**
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes No**
3. Are lower goals right indented from higher goals and connected with line? **Yes No**
4. Does the outline end up with resources? **Yes No**
5. Are all processes defined as activities and labeled correctly? **Yes No**
6. Are all inputs the main resources for the process? **Yes No**
7. Are all the main resources necessary for the process defined? **Yes No**
8. Are all inputs and outputs main resources? **Yes No**
Example: Look at the following example and nonexample designed for a mental hospital, and read the comment for what is wrong with the nonexample.

Example:
(Mentally retarded people who have vocational skills)
L Production: Teaching vocational skills.
L (Mentally retarded people who do not have vocational skills)

Nonexample:
(Mentally retarded people who have vocational skills)
L Production: Learning vocational skills.
L (Teachers)

Comment: Teachers are not the main resources for the teaching process; students are.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No
Example: Look at the following example and nonexample of organizational goals designed for Greyhound bus company, which is one of the biggest transportation companies in the US. Read the comment and know what is wrong with the nonexample.

Example:
(Customers at the destination)
- Distribution: Transporting customers.
  - (Customers at departure place)

Nonexample:
(Customers at the destination)
- Distribution: Transporting customers.
  - (Customers at departure place)
  - (Drivers)
  - (Busses)

Comment: Drivers and busses are not the main resources, and you do not put them in the outline.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No
Example: Look at the following example and nonexample of organizational goals designed for the U.S. Mail. Read the comment and know what is wrong with the nonexample.

Example:

(Mail delivered)
  ▼ Distribution: Distributing mail.
    ▼ (Mail collected)
      ▼ Distribution: Collecting mail.
        ▼ (Mail posted)

Nonexample:

(Distributing mail)
  ▼ Distribution: Collecting mail.
    ▼ (Mail posted)

Comment: The final output must not be process.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No
Often you need more than one resource for a process. For example, in order to cook hamburgers, you may want to bake bread yourself rather than buying bread from some other organizations. Then, you have to treat bread differently from other materials that you buy from other organizations as you can see in the following example.

(Hamburgers sold)
  - Distribution: Selling hamburgers.
    - (Cooked hamburgers)
      - Production: Cooking hamburgers.
        - (Bread)
          - Production: Baking bread.
            - (Raw material for baking bread)
              - Distribution: Buying raw materials.
                - (Materials for sale)
              - (Other raw materials)
                - Distribution: Buying raw materials.
                  - (Materials for sale)
        - (Customers)

You may want to have more than one process for an output. For example, in the example above, you may still buy some bread from another company. If so, you place that process at the same level as the other process.

(Hamburgers sold)
  - Distribution: Selling hamburgers.
    - (Cooked hamburgers)
      - Production: Cooking hamburgers.
        - (Bread)
          - Production: Baking bread.
            - (Raw material for baking bread)
              - Distribution: Buying raw materials.
                - (Materials for sale)
            - Distribution: Buying bread.
              - (Bread for sale)
        - (Other raw materials)
          - Distribution: Buying raw materials.
            - (Materials for sale)
      - (Customers)
Example: Let's work on one that is a little more complex. The psychology department at WMU receives applications for its graduate programs and selects new students from the applicants. Look at the example and nonexample of organizational goals for the department, and read the comment to know what is wrong with the nonexample.

Example:
( Accepted students )
  - Distribution: Selecting qualified students.
    - ( Applicants )
      - Distribution: Recruiting applicants.
    - ( Prospects )

Nonexample:
( Accepted students )
  - Distribution: Selecting qualified students.
    - ( Applicants )
      - Distribution: Sending applications.
    - ( GRE score )

Comment: Sending applications is what the applicants do and not the department's process.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No
Example: How about the entertaining business? Kalamazoo State Theater provides, for example, rock and roll concerts to make some people happy. Look at the following example and nonexample of the organizational goals, and read the comment to know what is wrong with the nonexample.

Example:
(Happy people)
  — Production: Providing rock'n roll concerts.
  — (Less happy people)

Nonexample:
(Earnings from the concerts)
  — Production: Providing rock'n roll concerts.
  — (No money)

Comment: Earnings are not the final outcome of the organization. They are not distributed outside the organization. Happy people, on the other hand, will go back to where they belong to. They are distributed to the society.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No
Example: The following organizational goals are outlined for a company teaching sky diving. Read the comment and know what is wrong with the nonexample.

Example:
(People who have sky diving skills)
  - Production: Teaching sky diving skills.
    - (People who do not have sky diving skills)

Nonexample:
(People who have sky diving skills)
  - Production: Teaching sky diving skills.
    - (People who do not have sky diving skills)
    - (Instructors)

Comment: Instructors are not the main resource. The instructors are directly responsible for the teaching process but not processed through the process.

You can check your outline regarding the following points.
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

This is the end of the workbook.
Turn the workbook in and receive the test now.
Appendix C

Discrimination Workbook
Instruction

This is the first half of the Workbook for Goal-Directed Systems Design. Today, you will learn how to outline the structure of organizational goals. Follow the instruction and go through the workbook.

Time Start: ____________    Time Finished: ____________

• There are questions and answers in the workbook. You are asked to write your answer before you see the correct answers which appear on the next page. **Do not** look at the answers before you write your answers. If the instructor finds you doing so, you will be immediately dismissed from the study and receive no optional point.

• During this period, you are free to take a break anytime. Soft drink and snack are available. However, you are not allowed to talk to other participants about the material you are studying. Violation of this instruction will immediately lead to dismissal too.

• If you have any question, raise your hand. The instructor will help you.

This is the beginning of the workbook.

Now start.
Goal-Directed Systems Design is a technology of designing an ideal structure of organizational goals using a **behavioral systems analytic approach**. In this part of the workbook you will learn the concepts in the Goal-Directed Systems Design and do some practice in designing organizational goals.

**What's behavioral systems analytic approach?**

A system is an organized, integrated, unified set of components, accomplishing a particular set of goals. A system consists of inputs (resources), process, and outputs (goals). For example, an automobile is an example of system. It inputs gas, air, and directions from a driver and brings people from one place to another. It's a transportation system. A behavioral system is a system in which the principle components are human beings. For example, a university is an example of behavioral system, which inputs high-school graduates, educates them, and outputs college graduates.

In a behavioral systems approach, you define an organization as a set of systems by identifying output, process, and input for each component. In other words, you see an organization as a behavioral system or a collection of behavioral systems, each of which has an output, a process, and inputs.

**Practice:** For the following behavioral systems, identify each component of the system as either output, process, or input. Put O for output, P for process, or L for input.

1. A hospital:
   - Sick people. __O__
   - Treatment. __P__
   - Healthy people. __O__

2. An amusement park:
   - Happier people. __O__
   - Amusement. __P__
   - People. __O__

3. A motel:
   - Providing rooms. __O__
   - Tired people. __P__
   - Rested people. __O__

4. A bus company:
   - People at place of departure. __O__
   - People at destination. __P__
   - Transportation. __O__

5. A book store:
   - Selling books. __O__
   - People who don't have books and books to be sold. __O__
   - People who have books. __O__

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>Comments</td>
<td>Carefully read the definition, questions, answers and feedback again.</td>
<td>Good</td>
<td>Excellent</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In this workbook, you are asked to describe outputs, inputs, or goal as things or conditions. You are also asked to describe processes as activities or behaviors. We want you to learn this distinction because a process does not necessarily produce the expected output even when the process seems to be active. For example, even when a motel provides plenty of rooms, people may not get rested because of poor service, dirty bathroom, etc. So, we do not want to say the goal of a motel is to provide rooms. That's what the motel does to accomplish the output—rested people. The goal should be described as "rested people" and one of its processes as "providing rooms". This distinction may seem odd and less important to you, but it becomes critical when you start designing the structure of organizational goals later.

**Rules**

Define processes of an organization as activities or behaviors. Use "verb + ing + noun" or to "to [verb] [noun]" to define a process.

Example: Baking bread.

Define outputs, inputs, or goals of an organization as things or conditions. Avoid using "[verb] + ing + [noun]" or "to [verb] [noun]" to define an output/input.

Example: Bread baked.

**Practice:** Identify the following items by checking either output or process.

Example: To bake bread. _Output or _Process (Check one).

1. Manufacturing watch. _Output or _Process (Check one).

2. School bus drivers trained. _Output or _Process (Check one).

3. Writing a book. _Output or _Process (Check one).

4. To make an appointment. _Output or _Process (Check one).

5. Teacher's teaching students. _Output or _Process (Check one).

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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<tr>
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</tbody>
</table>
In Goal-Directed Systems Design, ideally, the ultimate goal of an organization is selected first, then the various levels of intermediate goals needed to accomplish that ultimate goal are selected, and finally the initial goals needed to accomplish those intermediate goals are selected. In other words, you decide what to accomplish first and then design goals that will accomplish what you have decided to accomplish.

**Definition**

**Ultimate goal** is the highest level of organizational goal and ought to be the well-being of living creatures.

Why is the Goal-Directed systems Design important?

Philosophically, we believe the world would be better off if every organization sets the ultimate goal at the well-being of creatures on the earth and derives the intermediate and initial goals from the ultimate goal. We think that all of us should work toward this direction, and Goal-Directed Systems Design will help us to achieve this ultimate goal. However, we also think this might be too idealistic.

In this workbook, we are not selling our philosophical stand. Instead, we are providing a technology that helps you accomplish no matter what you want to accomplish. In fact, you are learning to analyze organizational goals not from the well-being of living creatures but from the final output of an organization. Regardless of the goal you start with, Goal-Directed Systems Design is useful and effective because of its goal-directed nature, or in other words, top-down approach.

**Definition**

**Top-down approach** is a technology of designing organizational goals by defining higher goals of an organization first, and then selecting subgoals that are necessary to accomplish those higher goals. Thus, the accomplishment of each subgoal contributes to the accomplishment of the higher goals.

Why is the Goal-Directed systems Design useful?

Top-down approach is valuable for the following reasons: First, it gives flexibility in designing organizations. As long as the desired output is accomplished, the process that produces the output could be anything. In systems engineering terms, this is called equifinality. There are a number of different processes that can produce the same final output. For example, working in a training department at a company, you may feel that you must train people whenever there is a performance problem. But, if you look at the desired outcome (i.e., job done), the best bet may not be training but rather a simple job-aid or even a replacement. Focusing on the output before selecting the process thus gives you flexibility in selecting processes.
Second, we take top-down approach in order to avoid two kinds of mistakes. One is an activity trap and the other is the means-ends trap. In both kinds of traps, we fail to accomplish what we want to accomplish even without knowing it.

An activity trap occurs when you are satisfied with an activity or process without producing a valuable accomplishment or output. For example, an instructor at a university may use a lot of advanced technologies in her psychology class, such as an interactive video and computer-assisted instruction. An activity trap occurs when she or the university is satisfied with the use of the technology and not concerned about how students are doing in the class. It may be the case that the students are failing to learn the material because they have few prerequisite skills to make use of the material the instructor has presented. To get around the trap, you have to focus on the output of a system. That is the students who learned the material.

Ends-means trap occurs when you are satisfied with the accomplishment of lower-level goals and not concerned with the accomplishment of higher-level goals to which the lower-level goals are supposed to contribute. In the former example, suppose the instructor finally succeeded in making the students learn in the class. An ends-means trap occurs, for example, when the students fail to succeed after they graduate from her class. The jobs they got do not require the skills she taught. To get around the trap, you need to derive your goals from what you are ultimately attempting to accomplish.

Practice: Read the definition of top-down approach again and, for the following pairs of descriptions, indicate which is an example of top-down approach.

1. A. In order to achieve the well-being of humanity, we need to, for instance, raise funds and send the money to the third world countries.  
   B. In order to achieve the well-being of humanity, we need to achieve the physical well-being of humanity and the psychological well-being of humanity. In order to achieve the physical well-being of humanity, we need to, for instance, decrease mortality rate. To decrease the mortality rate, for instance, we need to decrease Fetus Alcohol Syndrome. To decrease the FAS, we need to provide behavioral management programs to pregnant women.

2. A. In order to provide nutritious and delicious foods to customers with a reasonable price, basically we need foods and customers. To get foods we need to buy materials and cook them. To get customers we need advertising.  
   B. Because this restaurant is near a university, it would be better to serve fast foods.

3. A. To increase the happiness of employees, we can improve physical and economical conditions of the employees. To improve their physical conditions, we can provide safety programs such as encouraging the seat belt use, and diet or non-smoking program. To improve the economical conditions we can introduce social welfare programs and life insurance.  
   B. To decrease the time loss from injuries, we need to introduce safety programs such as encouraging seat belt use.

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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<td>Excellent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Answers for Practice:
1. B. 2. A. 3. A.

Although it is ideal to analyze organizational goals from the ultimate goal, it is often difficult and time consuming. Therefore, in this program, you will only be asked to start analyzing organizational goals with a final output of organizations. A final output is the final product of an organization that is distributed outside the organization. It is defined in terms of things or conditions but not in terms of activities or behaviors. For example, the final output of this workbook is "students who can use Goal-Directed Systems Design" but not "teaching students how to use Goal-Directed Systems Design."

A final output of an organization is the final product that is distributed outside the organization.

Practice: The following are descriptions of final outputs for some organizations. Identify which is an example of final output in each pair.
1. A B is an example of final output (circle one) of an automobile company.
   A. Net profits 30% increase.
   B. Automobiles manufactured.

2. A B is an example of final output (circle one) of a university.
   A. Graduates, 1000 BAs, 60 MAs, and 10 Ph.Ds per year.
   B. An increase in employees' commitment to the university.

3. A B is an example of final output (circle one) of a mental health hospital.
   A. People who become functioning in society.
   B. Reduction of labor costs.

4. A B is an example of final output (circle one) of a computer retail shop.
   A. Personal computer systems sold.
   B. Selling personal computer systems.

5. A B is an example of final output (circle one) of a city hotel.
   A. The reputation of the hotel.
   B. Customers rested and satisfied with the service.

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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<td>Good</td>
<td>Excellent</td>
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Answers and Feedback for Practice:
1. B: Profits are not a final output because it is not distributed to external organizations. This may seem contradict to the common sense notion--every profit organization's goal is $. We do not deny that characterization. But we are taking a different approach in viewing organizational goals in this workbook.
2. A: Commitments are not a final output because it is not distributed to external organizations. Nor are they the final product of the organization.
3. A: The reduction of the labor cost is not a final output because it is not distributed to external organizations. Many students are often confused by this, probably because there are so many materials that have "the reduction of costs" as a goal. In this workbook, we take a different approach. So, please set your primary experience aside for a while.
4. A: Selling computers is a process not an output.
5. B: Reputation is not the final product of the organization.

Now, you will learn how to design organizational goals. You will use Output-Process-Input chain to produce the structure of organizational goals. First, you define the final output of the organization. Then you define the process that produces that output. Then you define inputs that are necessary for the process. This output-process-input forms a subsystem. The inputs for one subsystem are the outputs from other subsystems. Once you have determined the inputs for a subsystem, you go on to define the processes that produce those inputs and the inputs needed for the processes--the next output-process-input chains. You will repeat this chaining until inputs are obtained from other organizations than the one you are analyzing. In other words, you are linking subsystems in an organization by chaining the inputs of one subsystem to the output of another subsystem. This chaining continues until the input to a subsystem is offered by other organizations than the one you are analyzing. As you can see in the following outline, it is easy to read the flow of resources in an organization when it is presented as the outline of organizational goals.

[Diagram of Output-Process-Input chain]

For example, let's analyze organizational goals for an automobile assembling factory. This factory simply gets every part needed for building an automobile and assembles the parts. The final output of this organization is "automobiles correctly assembled with no defect." So, first, you put this final output on the top of the outline.
Notice that the final output is put in parentheses. In Goal-Directed Systems Design, all outputs and inputs (goals and resources) are put in parentheses in order for us to easily distinguish them from processes. Now, the next thing you do is ask yourself how to accomplish this goal. In other words, what process do you need to produce correctly assembled automobiles? Assembling, right? So you put this process underneath the final output slightly (3-4 letters) indented to the right.

(L) Production: Assembling automobiles.

Notice that you do not have parentheses this time and, instead, have a label ("Production") and a colon before the description of the process. There are three kinds of labels for processes in Goal-Directed Systems Design. You will learn them shortly. Indenting is important here because we want to see the hierarchical structure of goals with ease. Indented items illustrate they are prerequisites for the item just above them. They must be fulfilled in order for the item just above them to be accomplished. In other words, a process must be active to produce its output, and inputs must be obtained in order for a process to be active. By connecting two levels by lines, you can see more easily the relationship between outputs, process and inputs.

The the next question is: what resources do you need for the process? Well, you can come up with many things that you think necessary for assembling automobiles. Front line workers, tools for the workers, electricity, the parts of the automobile, etc. In the output-process-input chains, however, you only focus on the flow of main resources, which is the parts of the automobile in this case.

(L) Production: Assembling automobiles.

(L) (The parts of the automobile)

The analysis does not stop here. As you might guess, the next question is: what process do you need to get the parts? Before analyzing this, let's review the definition of the "output-process-input chain", and learn about main resources and labels for processes.

**Definition**

Output-Process-Input chain is a way of sequencing goals first by asking what you want to accomplish (output), second how you accomplish it (process), and third what you need to accomplish it (inputs).

Then, each input is analyzed in the same way until the organization that you are analyzing has made contact with some other organizations.
To make an Output-Process-Input chain you must follow Rules in outlining the structure of organizational goals.

**Rules in outlining the structure of organizational goals**

1. The final output of the organization must be placed on the top.
2. Outputs and inputs consist only of main resources.
3. Output and input are put in parentheses.
4. Processes must be labeled.
5. Lower level must be indented to the right and connected with a line.
6. Multiple resources or multiple processes must be located at the same level and connected with a line.

What are the main resources?

We like to make a distinction between the primary resources that are directly processed in a process and the resources that are used in order to process those primary resources. For example, every behavioral system has workers as human resources (such as builders in a factory). However, they are not the main resources for the manufacturing process in the sense that the builders themselves are not being processed. Instead, what the builders use in the manufacturing process (such as wood and nails) is considered the main resources. Builders are considered main resources when their training or recruiting is analyzed. In such a case, you draw a different outline which starts with "skilled builders" as the final output.

**Definition**

Main resources consist of raw materials for production processes, resources that are distributed by distribution processes, or customers.

**Practice:** For the following pairs of resources, circle the one that consists of examples of main resources for a specified organization.

1. Hamburger shop:  
   A. Vegetables, bread, cheese, etc.  
   B. Cutting board, ovens, microwave, etc.

2. Publisher of a magazine:  
   A. Writers and photographers.  
   B. Articles and photographs.

3. Book shop:  
   A. Books.  
   B. Employees.

4. Bar:  
   A. Tables, chairs, glasses, etc.  
   B. Beers, popcorn, etc.

5. University:  
   A. Professors.  
   B. Students.

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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We provide a classification system to help you to define a variety of processes when you design organizational goals. There are three kinds of processes: **Production**, **distribution**, and **research and development** (R & D).

### Definition

**Production** is a process in which inputs and outputs are different.

**Distribution** is a process in which inputs and outputs are the same.

**Research & Development** (R & D) is a production process specifically conducted in order to develop procedures, instructions, equipment, and standards used in another production or distribution process.

### Practice: Carefully read the definitions and label the following components with production, distribution, R & D, or none of them. Put P for production, D for distribution, R for R & D, or N for none.

1. In a restaurant.
   A. Cooking a beef stew.  
   B. Serving a beef stew to a customer.  
   C. Revising beef stew recipe.  
   D. Tips.

2. In a human resource department in a company.
   A. Training new employees.  
   B. Developing a training program.  
   C. Selecting new employees from job applicants.

3. In a farm.
   A. Cows and chickens.  
   B. Shipping out crops to foreign countries.  
   C. Planting crops.

4. In an automobile company.
   A. Manufacturing automobiles.  
   B. Devising a new safety mechanism.  
   C. Selling automobiles.  
   D. Line workers at the assembling line.

5. In a pharmaceutical company.
   A. Manufacturing a cold medicine.  
   B. Experimenting effects of new drugs on human perception.  
   C. The chemical equation of a new drug.

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers and Feedback for Practice:
1. P, D, R, N
2. P, R, D; Training and educating are classified as production because the output (i.e., trained people) is different from the input (i.e., untrained people).
3. N, D, P; Cows and chickens are resources.
4. P, R, D, N; Workers are resources. If you did not put N for cows and chickens and line workers, you need to review the distinction between output/input and process (page 2-3).
5. P, R, N; The chemical equation presents a procedure of how to make the new drug. The production of a procedure is R&D, whereas manufacturing of the drug by following that chemical equation is production.

Practice: The following are uncompleted descriptions of some organizational subsystems. Complete the analysis by checking (1) the process and (2) the main resource(s).

Example: Organization: A television repair company.

(Televisions repaired)
L ______ : Repairing televisions.
L ( ________ )
1) √ Production _ Distribution _ R&D
(2) __ Customers √ Broken televisions _ Televisions for sale


(Customers at the destination)
L ______ : Transporting customers.
L ( ________ )
1) ___ Production _ Distribution _ R&D
(2) __ Customers at the departure place _ Taxes _ Drivers

2. Organization: A fire fighting department.

(Fire extinguished)
L ______ : Fire fighting.
L ( ________ )
1) ___ Production _ Distribution _ R&D
(2) _ Residents __ Fire fighters _ Water

You have more questions on the next page.

(Customers with pizza)

L : Selling pizza.

( )

(1) ___Production ___Distribution ___R&D

(2) ___Raw materials ___Customers ___Waitstaff


(Wine)

L : Making wine.

( )

(1) ___Production ___Distribution ___R&D

(2) ___Bottles ___Grapes ___Customers


(Electricity at customers' house)

L : Transfer electricity.

(Customers)

( )

(1) ___Production ___Distribution ___R&D

(2) ___Electricity ___Generator ___Oil

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers and Feedback for Practice:
1. Distribution, customers at departure place.
2. Production, water.; Actually it is deproduction of fire. However, in this workbook, production includes extinction of something, for example, cleaning pollution from a lake.
3. Distribution, customers; Customers are always one of the main resources in the selling process.
4. Production, grape.
5. Distribution, electricity.

Let's go back to our example of the automobile assembling factory. How do you get the parts of the automobile? Well, in this factory, all parts are bought from another company. So, the outline looks like this:

(Automobiles correctly assembled with no defect)
  – Production: Assembling automobiles.
    – (The parts of the automobile)
      – Distribution: Buying the parts.

What do you need to buy the parts? The parts must be for sale, right? So, you put it in underneath the outline, and you are all set. Because selling or manufacturing the parts is not your business, you can stop the analysis here. Remember that your outline always ends up with resources that are provided by some other organizations.

(Automobiles correctly assembled with no defect)
  – Production: Assembling automobiles.
    – (The parts of the automobile)
      – Distribution: Buying the parts.
        – (The parts for sale)

Let's practice making the outline of organizational goals. In doing so, ask yourself the following questions.

<table>
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<tr>
<th>(1) What do you want to accomplish?</th>
<th>Identify the final output in terms of things or conditions. Do not identify the final output in terms of process or activity.</th>
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<td>(2) How do you accomplish it?</td>
<td>Identify process(es) that accomplish the goal.</td>
</tr>
<tr>
<td>(3) What do you need for the process?</td>
<td>Identify the main resources for the process. Don't put other resources, such as line workers and tools used in the process. These other kinds of resources are analyzed later. Don't forget customers as one of the main resources for any selling process.</td>
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Once you identify resources, repeat the questions (2) and (3) for each resource you have identified. How do you get the resource? What do you need to do to accomplish that?
This is a simple example of the design of organizational goals for a factory that manufactures furniture. The final output is "furniture manufactured", and in the simplest design, there are only two subsystem involved.

(Furniture manufactured)
  □ Production: Manufacturing furniture.
    □ (Raw materials)
      □ Distribution: Buying raw materials
        □ (Raw materials for sale)

Practice: Look at the example and the following two outlines carefully. Which is the correct outline of the organizational goals for a toy manufacturing factory, which buys materials to make toys? State the reason as well. We are not concerned with shipping the toys yet. You can use the check list presented below. Also you may go back to previous pages for definitions.

A.  
(Toys manufactured)
  □ Production: Manufacturing toys.
    □ (Raw materials)
      □ Distribution: Buying raw materials
        □ (Raw materials for sale)

B.  
(Toys manufactured)
  □ Production: Manufacturing toys.
    □ (Raw materials)
      □ Distribution: Buying raw materials.
        □ (Raw materials for sale)

A B  is the correct outline (circle one).

Because ________________________________________________________________

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Yes Excellent!

Did you get it right? No Correct your answer in red.
The next example is the design of organizational goals for a computer shop that buys computers from manufacturing companies and sells them to customers. The final output is "computers sold". Notice that there are two main resources for the process of selling computers. One is goods to be sold (i.e., computers) and the other is customers. For any selling process, the customer is always one of the main resources. Notice how two resources (i.e., computers and customers) are placed in the outline and how they are connected by a line. The line shows that both of them are the main resources for the process, (i.e., selling computers) and they are, in this sense, located at the same level.

Practice: Look at the example and the following two outlines carefully. Which is the correct outline of the organizational goals for a university book store? Explain your answer. The book store buys books from a merchant and sells them to the student. You may go back to previous pages for definitions.

A.

Books sold

Distribution: Selling books.

Books

Distribution: Buying books from a merchant.

Books for sale

B.

Books sold

Distribution: Selling books.

Books

Distribution: Buying books from a merchant.

Books for sale

Customers

A B is the correct outline (circle one).

Because__________________________

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right?
Answers for Practice:

B is the correct answer. Every selling process must have "customers" as one of the main resources.

Some organizations manufacture goods and sell those goods. For example—the design of organizational goals for a hamburger shop. The final output is "hamburgers sold."

Practice: Look at the example and the following two outlines carefully. Which is the correct outline of the organizational goals for a small apparel shop that sews clothing and sells them. Explain your answer.

A. (Clothing sold)
   L Distribution: Selling clothing.
   L (Sewed clothing)
   L Production: Sewing clothing
   L (Raw materials)
   L Distribution: Buying raw materials.
   L (Raw materials for sale)
   L (Customers)

B. (Clothing sold)
   L Distribution: Selling clothing.
   L (Sewed clothing)
   L Production: Sewing clothing
   L (Raw materials)
   L Distribution: Buying raw materials.
   L (Raw materials for sale)
   L (Customers)

A B is the correct outline (circle one).
Because

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Yes Excellent!
Idid you get it right? No Correct your answer in red.
Answers for Practice:
A is correct. "(Customers)" must be placed at the same level as "(Sewed clothing)."

Practice: Look at the following two outlines carefully. Which is the correct outline of the organizational goals designed for a vocational school for mentally retarded people? Explain your answer.
A. (Mentally retarded people who have vocational skills)
   - Production: Teaching vocational skills.
   - (Mentally retarded people who do not have vocational skills)

B. (Mentally retarded people who have vocational skills)
   - Production: Learning vocational skills.
   - (Teachers)

A B is the correct outline (circle one).
Because

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Yes Excellent!
Did you get it right? No Correct your answer in red.
Answer for Practice:
A is correct. Teachers are not the main resources for the teaching process; students are.

Practice: Let's analyze some other types of organizations. Greyhound bus is one of the biggest transportation companies in the US. Which of the following outlines is the correct design of organizational goals for this company? Explain your answer.

A.
- (Customers at the destination)
  - Distribution: Transporting customers.
    - (Customers at departure place)
    - (Drivers)
    - (Busses)

B.
- (Customers at the destination)
  - Distribution: Transporting customers.
    - (Customers at departure place)

A B is the correct outline (circle one).

Because

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer.

Did you get it right?

Yes Excellent!
No Correct your answer in red.
Workbook for Goal-Directed Systems Design [D]

**Answer for Practice:**
B is the correct outline. Drivers and busses are not the main resources, and you do not put them in the outline.

**Practice:** How about the U.S. Mail? Focus on their function in mail delivery. Which of the following is the correct design of organizational goals? Explain your answer.

A.  
(Mail delivered)  
- Distribution: Distributing mail.  
- (Mail collected)  
- Distribution: Collecting mail.  
- (Mail posted)

B.  
(Distributing mail)  
- Distribution: Collecting mail.  
- (Mail posted)

A  B is the correct outline (circle one).

Because

Check List:
1. Is the final output located at the top and defined as things or conditions? **Yes No**
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes No**
3. Are lower goals right indented from higher goals and connected with line? **Yes No**
4. Does the outline end up with resources? **Yes No**
5. Are all processes defined as activities and labeled correctly? **Yes No**
6. Are all inputs the main resources for the process? **Yes No**
7. Are all the main resources necessary for the process defined? **Yes No**
8. Are all inputs and outputs main resources? **Yes No**

Now, turn the page and check your answer.  
**Yes** Excellent!  
**No** Correct your answer in red.
Answer for Practice:
A is the correct design. The final output must not be process.

Often you need more than one resource for a process. For example, in order to cook hamburgers, you may want to bake bread yourself rather than buying bread from some other organizations. Then, you have to treat bread differently from other materials that you buy from other organizations as you can see in the following example.

(Hamburgers sold)
  L Distribution: Selling hamburgers.
    L (Cooked hamburgers)
      L Production: Cooking hamburgers.
        L (Bread)
          L Production: Baking bread.
            L (Raw material for baking bread)
              L Distribution: Buying raw materials.
                L (Materials for sale)
          L (Other raw materials)
            L Distribution: Buying raw materials.
              L (Materials for sale)
    L (Customers)

You may want to have more than one process for an output. For example, in the example above, you may still buy some bread from another company. If so, you place that process at the same level as the other process.
Practice: Let's work on one that is a little more complex. The psychology department at WMU receives applications for its graduate programs and selects new students from the applicants. Which of the following two presents the correct design of organizational goals for this specific process? Explain your answer.

A.
(Accepted students)
- Distribution: Selecting qualified students.
  - (Applicants)
    - Distribution: Recruiting applicants.
  - (Prospects)

B.
(Accepted students)
- Distribution: Selecting qualified students.
  - (Applicants)
    - Distribution: Sending applications.
  - (GRE score)

A B is the correct outline (circle one).

Because

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Yes Excellent!

Did you get it right? No Correct your answer in red.
Answers for Practice:
A is the correct design. Sending applications is what the applicants do and not the department's process. Explain your answer.

Practice: How about the entertaining business? Kalamazoo State Theater provides, for example, rock and roll concerts to make some people happy. Which of the following two presents the correct design of organizational goals for this organization?

A. 
(Happy people)
  Production: Providing rock'n roll concerts.
  (Less happy people)

B. 
(Earnings from the concerts)
  Production: Providing rock'n roll concerts.
  (No money)

A B is the correct outline (circle one).

Because _____________________________

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. [Yes] Excellent!

Did you get it right? [No] Correct your answer in red.
Answers for Practice:
A is the correct design. Earnings are not the final outcome of the organization. They are not distributed outside the organization. Happy people, on the other hand, will go back to where they belong to. They are distributed to the society.

Practice: The following organizational goals are outlined for a company teaching sky diving. Which is the correct design for this organization? Explain your answer.

A.
(People who have sky diving skills)
  \hspace{1cm} \text{Production: Teaching sky diving skills.}
  \hspace{1cm} (People who do not have sky diving skills )
  \hspace{1cm} (Instructors)

B.
(People who have sky diving skills)
  \hspace{1cm} \text{Production: Teaching sky diving skills.}
  \hspace{1cm} (People who do not have sky diving skills )

A, B is the correct outline (circle one).

Because

Check List:
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right?
Answers for Practice:
B is the correct design. Instructors are not the main resource. The instructors are directly responsible for the teaching process but not processed through the process.

This is the end of the workbook.
Turn the workbook in and receive the test now.
Appendix D

Construction Workbook
This is the first half of the Workbook for Goal-Directed Systems Design. Today, you will learn how to outline the structure of organizational goals. Follow the instruction and go through the workbook.

Time Start: ____________  Time Finished: ____________

• There are questions and answers in the workbook. You are asked to write your answer before you see the correct answers which appear on the next page. Do not look at the answers before you write your answers. If the instructor finds you doing so, you will be immediately dismissed from the study and receive no optional point.

• During this period, you are free to take a break anytime. Soft drink and snack are available. However, you are not allowed to talk to other participants about the material you are studying. Violation of this instruction will immediately lead to dismissal too.

• If you have any question, raise your hand. The instructor will help you.

This is the beginning of the workbook.

Now start.
Goal-Directed Systems Design is a technology of designing an ideal structure of organizational goals using a behavioral systems analytic approach. In this part of the workbook you will learn the concepts in the Goal-Directed Systems Design and do some practice in designing organizational goals.

What's behavioral systems analytic approach?
A system is an organized, integrated, unified set of components, accomplishing a particular set of goals. A system consists of inputs (resources), process, and outputs (goals). For example, an automobile is an example of system. It inputs gas, air, and directions from a driver and brings people from one place to another. It's a transportation system. A behavioral system is a system in which the principle components are human beings. For example, a university is an example of behavioral system, which inputs high-school graduates, educates them, and outputs college graduates.

In a behavioral systems approach, you define an organization as a set of systems by identifying output, process, and input for each component. In other words, you see an organization as a behavioral system or a collection of behavioral systems, each of which has an output, a process, and inputs.

Practice: For the following behavioral systems, identify each component of the system.

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Process</th>
<th>Input</th>
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<tbody>
<tr>
<td>1. A hospital:</td>
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<tr>
<td>2. An amusement park:</td>
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<td>3. A motel:</td>
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<tr>
<td>4. A bus company:</td>
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<td></td>
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<tr>
<td>5. A book store:</td>
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Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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</table>
Answers for Practice: In the order of output -- process -- input.
1. A hospital: Healthy people -- Treatment -- Sick people.
3. A motel: Rested people -- Providing rooms -- Tired people.
4. A bus company: People at destination -- Transportation -- People at place.of departure.
5. A book store: People who have books -- Selling books -- People who don’t have books and books to be sold.

In this workbook, you are asked to describe outputs, inputs, or goal as things or conditions. You are also asked to describe processes as activities or behaviors. We want you to learn this distinction because a process does not necessarily produce the expected output even when the process seems to be active. For example, even when a motel provides plenty of rooms, people may not get rested because of poor service, dirty bath room, etc. So, we do not want to say the goal of a motel is to provide rooms. That's what the motel does to accomplish the output--rested people. The goal should be described as "rested people" and one of its processes as "providing rooms". This distinction may seem odd and less important to you, but it becomes critical when you start designing the structure of organizational goals later.

Rules

Define processes of an organization as activities or behaviors.
Use "verb + ing + noun" or "to [verb] [noun]" to define a process.
Example: Baking bread.

Define outputs, inputs, or goals of an organization as things or conditions.
Avoid using "[verb] + ing + [noun]" or "to [verb] [noun]" to define an output/input.
Example: Bread baked.

Practice: For the following processes, identify an output that is produced by the processes. For the following outputs, identify a process that might produce the outputs.

Example:
Process: To bake bread. Output: Bread baked.

4. Process: To make an appointment. Output: __________________

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

Score | 0 | 1 | 2 | 3 | 4 | 5
Comments | Carefully read the definition, questions, answers and feedback again. | Good | Excellent
Answers for Practice:
1. Watch manufactured.
2. Training school bus drivers.
4. An appointment made.
5. The students who have learned. An example of incorrect answer: students learning.

In Goal-Directed Systems Design, ideally, the ultimate goal of an organization is selected first, then the various levels of intermediate goals needed to accomplish that ultimate goal are selected, and finally the initial goals needed to accomplish those intermediate goals are selected. In other words, you decide what to accomplish first and then design goals that will accomplish what you have decided to accomplish.

**Definition**

**Ultimate goal** is the highest level of organizational goal and ought to be the well-being of living creatures.

Why is the Goal-Directed systems Design important?
Philosophically, we believe the world would be better off if every organization sets the ultimate goal at the well-being of creatures on the earth and derives the intermediate and initial goals from the ultimate goal. We think that all of us should work toward this direction, and Goal-Directed Systems Design will help us to achieve this ultimate goal. However, we also think this might be too idealistic.

In this workbook, we are not selling our philosophical stand. Instead, we are providing a technology that helps you accomplish no matter what you want to accomplish. In fact, you are learning to analyze organizational goals not from the well-being of living creatures but from the final output of an organization. Regardless of the goal you start with, Goal-Directed Systems Design is useful and effective because of its goal-directed nature, or in other words, top-down approach.

**Definition**

**Top-down approach** is a technology of designing organizational goals by defining higher goals of an organization first, and then selecting subgoals that are necessary to accomplish those higher goals. Thus, the accomplishment of each subgoal contributes to the accomplishment of the higher goals.

Why is the Goal-Directed systems Design useful?
Top-down approach is valuable for the following reasons: First, it gives flexibility in designing organizations. As long as the desired output is accomplished, the process that produces the output could be anything. In systems engineering terms, this is called equifinality. There are a number of different processes that can produce the same final output. For example, working in a training department at a company, you may feel that you must train people whenever there is a performance problem. But, if you look at the desired outcome (i.e., job done), the best bet may not be training but rather a simple job-aid or even a replacement. Focusing on the output before selecting the process thus gives you flexibility in selecting processes.
Second, we take top-down approach in order to avoid two kinds of mistakes. One is an activity trap and the other is the means-ends trap. In both kinds of traps, we fail to accomplish what we want to accomplish even without knowing it.

An activity trap occurs when you are satisfied with an activity or process without producing a valuable accomplishment or output. For example, an instructor at a university may use a lot of advanced technologies in her psychology class, such as an interactive video and computer-assisted instruction. An activity trap occurs when she or the university is satisfied with the use of the technology and not concerned about how students are doing in the class. It may be the case that the students are failing to learn the material because they have few prerequisite skills to make use of the material the instructor has presented. To get around the trap, you have to focus on the output of a system. That is the students who learned the material.

Ends-means trap occurs when you are satisfied with the accomplishment of lower-level goals and not concerned with the accomplishment of higher-level goals to which the lower-level goals are supposed to contribute. In the former example, suppose the instructor finally succeeded in making the students learn in the class. An ends-means trap occurs, for example, when the students fail to succeed after they graduate from her class. The jobs they got do not require the skills she taught. To get around the trap, you need to derive your goals from what you are ultimately attempting to accomplish.

Practice: Read the definition of top-down approach again and, for the following pairs of descriptions, indicate which is an example of top-down approach.

1. A_ B is an example of top-down approach (circle one).
   A. In order to achieve the well-being of humanity, we need to, for instance, raise funds and send the money to the third world countries.
   B. In order to achieve the well-being of humanity we need to achieve the physical well-being of humanity and the psychological well-being of humanity. In order to achieve the physical well-being of humanity, we need to, for instance, decrease mortality rate. To decrease the mortality rate, for instance, we need to decrease Fetus Alcohol Syndrome. To decrease the FAS, we need to provide behavioral management programs to pregnant women.

2. A_ B is an example of top-down approach (circle one).
   A. In order to provide nutritious and delicious foods to customers with a reasonable price, basically we need foods and customers. To get foods we need to buy materials and cook them. To get customers we need advertising.
   B. Because this restaurant is near a university, it would be better to serve fast foods.

3. A_ B is an example of top-down approach (circle one).
   A. To increase the happiness of employees, we can improve physical and economical conditions of the employees. To improve their physical conditions, we can provide safety programs such as encouraging the seat belt use, and diet or non-smoking program. To improve the economical conditions we can introduce social welfare programs and life insurance.
   B. To decrease the time loss from injuries, we need to introduce safety programs such as encouraging seat belt use.

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers for Practice:
1. B. 2. A. 3. A.

Although it is ideal to analyze organizational goals from the ultimate goal, it is often difficult and time consuming. Therefore, in this program, you will only be asked to start analyzing organizational goals with a **final output** of organizations. A final output is the final product of an organization that is distributed outside the organization. It is defined in terms of **things or conditions** but not in terms of activities or behaviors. For example, the final output of this workbook is "students who can use Goal-Directed Systems Design" but not "teaching students how to use Goal-Directed Systems Design."

**Definition**

A **final output** of an organization is the final product that is distributed outside the organization.

**Practice:** The following are descriptions of final outputs for some organizations. Identify which is an example of final output in each pair.

1. A B is an example of final output (circle one) of an automobile company.
   A. Net profits 30% increase.
   B. Automobiles manufactured.

2. A B is an example of final output (circle one) of a university.
   A. Graduates, 1000 BAs, 60 MAs, and 10 Ph.Ds per year.
   B. An increase in employees' commitment to the university.

3. A B is an example of final output (circle one) of a mental health hospital.
   A. People who become functioning in society.
   B. Reduction of labor costs.

4. A B is an example of final output (circle one) of a computer retail shop.
   A. Personal computer systems sold.
   B. Selling personal computer systems.

5. A B is an example of final output (circle one) of a city hotel.
   A. The reputation of the hotel.
   B. Customers rested and satisfied with the service.

Now, turn the page to see our answer and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Now, you will learn how to design organizational goals. You will use **Output-Process-Input chain** to produce the structure of organizational goals. First, you define the final output of the organization. Then you define the process that produces that output. Then you define inputs that are necessary for the process. This output-process-input forms a subsystem. The inputs for one subsystem are the outputs from other subsystems. Once you have determined the inputs for a subsystem, you go on to define the processes that produce those inputs and the inputs needed for the processes—the next output-process-input chains. You will repeat this chaining until inputs are obtained from other organizations than the one you are analyzing. In other words, **you are linking subsystems in an organization by chaining the inputs of one subsystem to the output of another subsystem.** This chaining continues until the input to a subsystem is offered by other organizations than the one you are analyzing. As you can see in the following outline, it is easy to read the flow of resources in an organization when it is presented as the outline of organizational goals.

For example, let's analyze organizational goals for an automobile assembling factory. This factory simply gets every part needed for building an automobile and assembles the parts. The final output of this organization is "automobiles correctly assembled with no defect." So, first, you put this final output on the top of the outline.
Notice that the final output is put in parentheses. In Goal-Directed Systems Design, all outputs and inputs (goals and resources) are put in parentheses in order for us to easily distinguish them from processes. Now, the next thing you do is ask yourself how to accomplish this goal. In other words, what process do you need to produce correctly assembled automobiles? Assembling, right? So you put this process underneath the final output slightly (3-4 letters) indented to the right.

Notice that you do not have parentheses this time and, instead, have a label ("Production") and a colon before the description of the process. There are three kinds of labels for processes in Goal-Directed Systems Design. You will learn them shortly. Indenting is important here because we want to see the hierarchical structure of goals with ease. Indented items illustrate they are prerequisites for the item just above them. They must be fulfilled in order for the item just above them to be accomplished. In other words, a process must be active to produce its output, and inputs must be obtained in order for a process to be active. By connecting two levels by lines, you can see more easily the relationship between outputs, process and inputs.

The the next question is: what resources do you need for the process? Well, you can come up with many things that you think necessary for assembling automobiles. Front line workers, tools for the workers, electricity, the parts of the automobile, etc. In the output-process-input chains, however, you only focus on the flow of main resources, which is the parts of the automobile in this case.

The analysis does not stop here. As you might guess, the next question is: what process do you need to get the parts? Before analyzing this, let's review the definition of the "output-process-input chain", and learn about main resources and labels for processes.

<table>
<thead>
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<tr>
<td><strong>Output-Process-Input chain</strong> is a way of sequencing goals first by asking what you want to accomplish (output), second how you accomplish it (process), and third what you need to accomplish it (inputs).</td>
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Then, each input is analyzed in the same way until the organization that you are analyzing has made contact with some other organizations.
To make an **Output-Process-Input chain** you must follow **Rules in outlining the structure of organizational goals**.

<table>
<thead>
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<th>Rules in outlining the structure of organizational goals</th>
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<tr>
<td>1. The <strong>final output</strong> of the organization must be placed on the top.</td>
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<tr>
<td>2. Outputs and inputs consist only of <strong>main resources</strong>.</td>
</tr>
<tr>
<td>3. Output and input are put in <strong>parentheses</strong>.</td>
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<tr>
<td>4. Processes must be <strong>labeled</strong>.</td>
</tr>
<tr>
<td>5. Lower level must be <strong>indented to the right</strong> and connected with a <strong>line</strong>.</td>
</tr>
<tr>
<td>6. <strong>Multiple resources or multiple processes</strong> must be located at the <strong>same level</strong> and connected with a <strong>line</strong>.</td>
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What are the **main resources**?

We like to make a distinction between the primary resources that are directly processed in a process and the resources that are used in order to process those primary resources. For example, every behavioral system has workers as human resources (such as builders in a factory). However, they are not the main resources for the manufacturing process in the sense that the builders themselves are not being processed. Instead, what the builders use in the manufacturing process (such as wood and nails) is considered the main resources. Builders are considered main resources when their training or recruiting is analyzed. In such a case, you draw a different outline which starts with "skilled builders" as the final output.

**Definition**

**Main resources** consist of raw materials for production processes, resources that are distributed by distribution processes, or customers.

**Practice:** For the following organizations and their processes, identify the main resources.

1. A hamburger shop's cooking:

2. A publisher's editing a magazine:

3. A book shop's selling:

4. A beer bar's service:

5. A university's teaching:

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers and Feedback for Practice:
1. Raw materials such as vegetables, bread, cheese, etc. Labors (e.g., cooks) and equipment (e.g., cutting board, ovens) are not the main resources.
2. Articles and photographs. Writers and photographers are not the main resources.
4. Beers, popcorn, etc. The waitstaff, tables, chairs, glasses, etc. are not the main resources.
5. Students. Professors and instructors are not the main resources.

We provide a classification system to help you to define a variety of processes when you design organizational goals. There are three kinds of processes: Production, distribution, and research and development (R&D).

<table>
<thead>
<tr>
<th>Production is a process in which inputs and outputs are different.</th>
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<tbody>
<tr>
<td>Distribution is a process in which inputs and outputs are the same.</td>
</tr>
<tr>
<td>Research &amp; Development (R &amp; D) is a production process specifically conducted in order to develop procedures, instructions, equipment, and standards used in another production or distribution process.</td>
</tr>
</tbody>
</table>

Practice: Carefully read the definitions and label the following components with production, distribution, R & D, or none of them. Put P for production, D for distribution, R for R & D, or N for none.

1. In a restaurant.
   A. Cooking a beef stew. C. Revising beef stew recipe.
   B. Serving a beef stew to a customer. D. Tips.

2. In a human resource department in a company.
   A. Training new employees. C. Selecting new employees from job applicants.
   B. Developing a training program. D. Line workers at the assembling line.

3. In a farm.
   A. Cows and chickens. C. Planting crops.
   B. Shipping out crops to foreign countries.

4. In an automobile company.
   A. Manufacturing automobiles. C. Selling automobiles.
   B. Devising a new safety mechanism. D. Line workers at the assembling line.

5. In a pharmaceutical company.
   A. Manufacturing a cold medicine. C. The chemical equation of a new drug.
   B. Experimenting effects of new drugs on human perception.

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers and Feedback for Practice:
1. P, D, R, N
2. P, R, D; Training and educating are classified as production because the output (i.e., trained people) is different from the input (i.e., untrained people).
3. N, D, P; Cows and chickens are resources.
4. P, R, D, N; Workers are resources. If you did not put N for cows and chickens and line workers, you need to review the distinction between output/input and process (page 1-2).
5. P, R, N; The chemical equation presents a procedure of how to make the new drug. The production of a procedure is R&D, whereas manufacturing of the drug by following that chemical equation is production.

Practice: The following are uncompleted descriptions of some organizational subsystems. Complete the analysis (1) by checking the process and (2) by describing the main resource(s).

Example: Organization: A television repair company.

(Television repaired)
L ________ : Repairing televisions.
   L ( ________________ )

(1) _ Production _ Distribution _ R&D

(2) Main resources: _______________________________________________________


(Customers at the destination)
L ________ : Transporting customers.
   L ( ________________ )

(1) _ Production _ Distribution _ R&D

(2) Main resources: _______________________________________________________

2. Organization: A fire fighting department.

(Fire extinguished)
L ________ : Fire fighting.
   L ( ________ )

(1) _ Production _ Distribution _ R&D

(2) Main resources: _______________________________________________________

You have more questions on the next page.

(Customers with pizza)
\[ \text{L } (\text{Customers}) \]
\[ \text{L } (\text{Pizza}) \]
\[ \text{L } (\text{Selling pizza}) \]

(1) __Production  __Distribution  __R&D

(2) Main resources: ________________________________


(Wine)
\[ \text{L } (\text{Wine}) \]
\[ \text{L } (\text{Making wine}) \]

(1) __Production  __Distribution  __R&D

(2) Main resources: ________________________________


(Electricity at customers' house)
\[ \text{L } (\text{Customers}) \]
\[ \text{L } (\text{Transfer electricity}) \]

(1) __Production  __Distribution  __R&D

(2) Main resources: ________________________________

Now, turn the page and check your answers. How many items did you get right? Mark the number of correct choices you made.

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Answers and Feedback for Practice:
1. Distribution, customers at departure place.
2. Production, water; Actually it is deproduction of fire. However, in this workbook, production includes extinction of something, for example, cleaning pollution from a lake.
3. Distribution, customers; Customers are always one of the main resources in the selling process.
4. Production, grape.
5. Distribution, electricity.

Let's go back to our example of the automobile assembling factory. How do you get the parts of the automobile? Well, in this factory, all parts are bought from another company. So, the outline looks like this:

(Automobiles correctly assembled with no defect)
  - Production: Assembling automobiles.
    - (The parts of the automobile)
    - Distribution: Buying the parts.

What do you need to buy the parts? The parts must be for sale, right? So, you put it in underneath the outline, and you are all set. Because selling or manufacturing the parts is not your business, you can stop the analysis here. Remember that your outline always ends up with resources that are provided by some other organizations.

(Automobiles correctly assembled with no defect)
  - Production: Assembling automobiles.
    - (The parts of the automobile)
    - Distribution: Buying the parts.
    - (The parts for sale)

Let's practice making the outline of organizational goals. In doing so, ask yourself the following questions.

<table>
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<tr>
<th>(1) What do you want to accomplish?</th>
<th>Identify the final output in terms of things or conditions. Do not identify the final output in terms of process or activity.</th>
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<tbody>
<tr>
<td>(2) How do you accomplish it?</td>
<td>Identify process(es) that accomplish the goal.</td>
</tr>
<tr>
<td>(3) What do you need for the process?</td>
<td>Identify the main resources for the process. Don't put other resources, such as line workers and tools used in the process. These other kinds of resources are analyzed later. Don't forget customers as one of the main resources for any selling process.</td>
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</table>

Once you identify resources, repeat the questions (2) and (3) for each resource you have identified: How do you get the resource? What do you need to do to accomplish that?
This is a simple example of the design of organizational goals for a factory that manufactures furniture. The final output is "furniture manufactured", and in the simplest design, there are only two subsystem involved.

Practice: Look at the example carefully and make an outline of organizational goals for a toy manufacturing factory that buys materials to make toys. What's the final output of the factory? Don't be concerned with shipping the toys yet. You may go back to previous pages for definitions.

(Furniture manufactured) <- Put the final output here.

___ : ________ <- How do you accomplish the goal?

(Raw materials needed to manufacture the toys)

___ : ________ <- How do you get the materials?

(Raw materials for sale) <- What is the main resource for the process?

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer.
Did you get it right?
Yes | Excellent!
No | Correct your answer in red.
Answers and Feedback for Practice:
(Toys manufactured)
  - Production: Manufacturing toys.
    - Raw materials
      - Distribution: Buying raw materials
      - Raw materials for sale

The next example is the design of organizational goals for a computer shop that buys computers from manufacturing companies and sells them to customers. The final output is "computers sold". Notice that there are two main resources for the process of selling computers. One is goods to be sold (i.e., computers) and the other is customers. For any selling process, the customer is always one of the main resources. Notice how two resources (i.e., computers and customers) are placed in the outline and how they are connected by a line. The line shows that both of them are the main resources for the process, (i.e., selling computers) and they are, in this sense, located at the same level.

Practice: Look at the example carefully and make an outline of organizational goals for a university book store. The book store buys books from a merchant and sells them to the student. You may go back to previous pages for definitions. You may not be able to draw an outline at once. I usually make one first and check it according to the check list shown below, revise it, and finally get the final outline. So, take your time and feel free to revise your outline several times until you are confident about it.

Now connect each level with lines.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right?
Answers for Practice:

(Books sold)
- Distribution: Selling books.
  - (Books)
    - Distribution: Buying books from a merchant.
      - (Books for sale)
    - (Customers) <-Didn't forget customers, did you?

Make sure that (Books) and (Customers) are at the same level. The lines must come from "Distribution: Selling books."

Some organizations manufacture goods and sell those goods. For example--the design of organizational goals for a hamburger shop. The final output is "hamburgers sold."

Practice: Look at the example carefully and make an outline of organizational goals for a small apparel shop that sews clothing and sells them. You may need three subsystems. You may go back to previous pages for definitions.

Now connect each level with lines.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer.

Did you get it right?
Answers for Practice:

(Clothing sold)
- Distribution: Selling clothing.
  - (Sewed clothing)
    - Production: Sewing clothing
      - (Raw materials)
    - Distribution: Buying raw materials.
      - (Raw materials for sale)
  - (Customers)

You did not forget "(Customers)", did you?

Practice: Design the structure of organizational goals for a vocational school for mentally retarded people that teaches vocational skills for the population.

Now connect each level with lines.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
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7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right?

<table>
<thead>
<tr>
<th>Yes</th>
<th>Excellent!</th>
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<tr>
<td>No</td>
<td>Correct your answer in red.</td>
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Goal-Directed Systems Design [E]

Answer for Practice:
(Mentally retarded people who have vocational skills)
- Production: Teaching vocational skills.
- (Mentally retarded people who do not have vocational skills)

Note: You did not have teachers as the main resource, did you?

Practice: Let's analyze some other types of organizations. Greyhound bus is one of the biggest transportation companies in the US. Define the final output and then make an outline of organizational goals for this company. You may go back to the previous page to see the definitions. Hint: You need only one subsystem for this.

Now connect each level with lines.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right? Yes Excellent!
No Correct your answer in red.
Goal-Directed Systems Design [E]

Answer for Practice:

(Customers at the destination)
  L Distribution: Transporting customers.
  L (Customers at departure place)
Note: Buses are not main resources. They are equipment with which the customers are transported.

Practice: How about the U.S. Mail? Focus on their function in mail delivery. First, define the final output, and then make an outline of organizational goals for this organization. You may go back to the previous page to refer to the definitions. Hint: You need only two subsystem for this: They collect mail from mail boxes and deliver the mail to individuals.

Now connect each level with lines.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right?

Yes Excellent
No Correct your answer in red.
Often you need more than one resource for a process. For example, in order to cook hamburgers, you may want to bake bread yourself rather than buying bread from some other organizations. Then, you have to treat bread differently from other materials that you buy from other organizations as you can see in the following example.

You may want to have more than one process for an output. For example, in the example above, you may still buy some bread from another company. If so, you place that process at the same level as the other process.
**Practice:** Let's work on one that is a little more complex. Make an outline of organizational goals for the psychology department at WMU that receives applications for its graduate programs and selects new students from the applicants.

Now connect each level with **lines**.

Before turning the page, **check** your outline regarding the following points. You **must revise** your answer when any of them is "**No**."

1. Is the final output located at the top and defined as things or conditions? **Yes No**
2. Are all outputs/inputs defined as things or conditions and put in parentheses? **Yes No**
3. Are lower goals right indented from higher goals and connected with line? **Yes No**
4. Does the outline end up with resources? **Yes No**
5. Are all processes defined as activities and labeled correctly? **Yes No**
6. Are all inputs the main resources for the process? **Yes No**
7. Are all the main resources necessary for the process defined? **Yes No**
8. Are all inputs and outputs main resources? **Yes No**

Now, turn the page and check your answer. Did you get it right?

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<td></td>
</tr>
<tr>
<td><strong>No</strong></td>
<td><strong>Correct your answer in red.</strong></td>
<td></td>
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</tbody>
</table>
Answers for Practice:
(Accepted students)
- Distribution: Selecting qualified students.
  - (Applicants)
    - Distribution: Recruiting applicants.
    - (Prospects)

Recruiting process is optional. In fact, few universities spent any effort in recruiting good students.

Practice: How about the entertaining business? Make an outline of organizational goals for Kalamazoo State Theater that provides, for example, rock and roll concerts to make some people happy.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
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7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right? Yes Excellent! No Correct your answer in red.
Answers for Practice:
(Happy people)
L Production: Providing rock’n’roll concerts.
L (Less happy people)

Make sure you got the correct final output—happy people or something like that. Do did not put profits as the final output, did you?

Practice: Your final practice is on a company teaching sky diving. Make an outline for this organization.

Before turning the page, check your outline regarding the following points. You must revise your answer when any of them is "No."
1. Is the final output located at the top and defined as things or conditions? Yes No
2. Are all outputs/inputs defined as things or conditions and put in parentheses? Yes No
3. Are lower goals right indented from higher goals and connected with line? Yes No
4. Does the outline end up with resources? Yes No
5. Are all processes defined as activities and labeled correctly? Yes No
6. Are all inputs the main resources for the process? Yes No
7. Are all the main resources necessary for the process defined? Yes No
8. Are all inputs and outputs main resources? Yes No

Now, turn the page and check your answer. Did you get it right? Yes | Excellent!
No | Correct your answer in red.
Answers for Practice:
(People who have sky diving skills)
- Production: Teaching sky diving skills.
- (People who do not have sky diving skills)

The main resource for an educational process is always the student. Don't put the teacher. The teacher is personnel directly responsible for the teaching process but not processed through the process.

This is the end of the workbook.
Turn the workbook in and receive the test now.
Appendix E

Pretest/Posttest and Job-Aid
The following questions will assess your competency in Goal-Directed Systems Design. When answering the questions, you can use the check list, definitions, rules, and worked-out example provided in the other booklet.

• Each correct answer is worth **ONE** optional point.

• If you have any question, please raise your hand, and the instructor will help you.

• If the instructor finds any signs of cheating, you will be dismissed from the study and receive no optional point.

Now, turn the page and start.
1. The following outlines present the structures of organizational goals designed for the organizations described below. Judge whether each outline is correct or incorrect. If you think an outline is incorrect, explain why the outline is incorrect.

A. Organization: The kitchen in Davis Hall buys raw material from distribution companies and cooks meals for the students residing in the dorm

(Meal cooked)

- Production: Cooking meals.
  - (Raw material for cooking meals)
- Distribution: Buying raw materials.
  - (Materials for sale)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.

B. Organization: A stress management workshop that offers a variety of relaxation training for those who have stress related problems.

(Relaxed people)

- Production: Offering relaxation training.
  - (Stressed people)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.

C. Organization: A remedial school in downtown Chicago teaches basic academic skills such as math and reading to children living nearby.

(Skilled children in math and reading)

- Production: Teaching children math and reading.
  - (Unskilled children in math and reading)
  - (Teachers)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.
D. Organization: Panopoulos Salons, a beauty salon in Kalamazoo, changes people’s appearance by providing services for hair, nail, skin care, etc.

(Providing services)
  - Production: Good looking people.
    - (People who need the services to be good looking)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.

---

E. Organization: A health food shop in Kalamazoo is selling health foods that they purchase from dealers and also make fresh vegetable drinks.

(Health foods sold)
  - Distribution: Selling health foods.
    - (Health foods)
      - Distribution: Buying health foods.
        - (Health foods for sale)
      - (Customers)
    - Production: Making original health drinks.
      - (Raw materials)
      - Distribution: Buying raw materials.
        - (Raw materials for sale)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.

---

F. Organization: A taxi in downtown Chicago.

(Taxi fare and tips)
  - Distribution: Transporting customers.
    - (Customers)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.
G. Organization: A flower shop in Portage buys flowers from farmers in the county and sells them in the shop.

(Flowers sold)
- Distribution: Selling flowers.
  - (Flowers)
    - Distribution: Buying flowers from farms.
      - (Flowers for sale)
  (Customers)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.


H. Organization: Howard-Johnson, a lumber company in Battle Creek, manufactures building materials such as plywood, doors, and cabinets from raw materials and sells them in the store.

(Building materials sold)
- Distribution: Selling building materials.
  - (Building materials)
    - Distribution: Buying raw materials.
      - (Raw materials for sale)
    (Customers)
  - Production: Making building materials.
    - (Building materials)
      - Distribution: Buying building materials.
        - (Building materials for sale)

This is correct / incorrect (circle one). If you circle incorrect, explain your answer.
2. For the following organizations, outline the structure of the organizational goals.

A. Organization: A SONY's factory in Detroit gets parts from other factories and assembles them to produce televisions.

Outline the organizational goals here.
B. Organization: The human resource department at General Motor selects new employees from job applicants and train them to provide work force to other departments.

Outline the organizational goals here.
C. Organization: Kalamazoo City Recreation Center recruits the participants for its summer golf lessons and teaches basic golf skills.

Outline the organizational goals here.
D. Organization: The emergency room at Bronson Hospital provides emergency services for patients.

Outline the organizational goals here.

This is the end of the test.
Please turn this in to the experimenter.
Job-Aid
for
Goal-Directed Systems Design

Check List for the Outline of Organizational Goals
Definitions and Rules
Worked-Out Example

Satoru Shimamune
Western Michigan University
Check List for the Outline of Organizational Goals

Check your outline of organizational goals using this list. If you answer No to any of the following questions, something is wrong with your outline.

1. Is the final output located at the top and defined as things or conditions?
2. Are all outputs/inputs defined as things or conditions and put in parentheses?
3. Are lower goals right indented from higher goals and connected with line?
4. Does the outline end up with resources?
5. Are all processes defined as activities and labeled correctly?
6. Are all inputs the main resources for the process?
7. Are all the main resources necessary for the process defined?
8. Are all inputs and outputs main resources?
## Definitions and Rules

### Definition
**Top-down approach** is a technology of designing organizational goals by defining higher goals of an organization first, and then selecting subgoals that are necessary to accomplish those higher goals. Thus, the accomplishment of each subgoal contributes to the accomplishment of the higher goals.

### Definition
**A final output** of an organization is the final product that is distributed outside the organization.

### Definition
**Output-Process-Input chain** is a way of sequencing goals first by asking what you want to accomplish (output), second how you accomplish it (process), and third what you need to accomplish it (inputs).

Then, each input is analyzed in the same way until the organization that you are analyzing has made contact with some other organizations.

### Rules in outlining the structure of organizational goals
1. The **final output** of the organization must be placed on the top.
2. Outputs and inputs consist only of **main resources**.
3. Output and input are put in **parentheses**.
4. Processes must be **labeled**.
5. Lower level must be **indented to the right** and connected with a **line**.
6. Multiple **resources** or multiple **processes** must be located at the same level and connected with a **line**.
Main resources consist of raw materials for production processes, resources that are distributed by distribution processes, or customers.

Production is a process in which inputs and outputs are different.

Distribution is a process in which inputs and outputs are the same.

Research & Development (R & D) is a production process specifically conducted in order to develop procedures, instructions, equipment, and standards used in another production or distribution process.
Worked-Out Example

Organization: A Timex factory in Flint receives parts from factories in Mexico and assembles them to produce type C2 wrist watches.

The outline of the organization:

(Wrist watches assembled)
- Production: Assembling parts.
  - (Parts)
    - Distribution: Distributing parts from factories in Mexico.
    - (Parts produced in the factories in Mexico)
Appendix F

Subjects' Evaluation Form
Workbook on Goal-Directed Systems Design
Exit Questionnaire

Please evaluate each of the following items and comment according to your personal view.

1. Were the instructions and explanations in the workbook easy or difficult to follow?
   Easy. 1 2 3 4 5 Difficult. (Please circle one.)
   Comment:

2. Were you already familiar with the concepts of behavioral systems analysis?
   Very much. 1 2 3 4 5 Very little. (Please circle one.)
   Comment:

3. Did any of the material seem unnecessary? Do you feel that you could have learned the same amount even if some of the material were cut off? If so, what parts?
   There are lots of unnecessary parts. 1 2 3 4 5 Don't think so. (Please circle one.)
   Comment:

4. Did any of the material seem to need more explanation or practice? If so, which parts?
   Need more practice and explanation. 1 2 3 4 5 Don't think so. (Please circle one.)
   Comment:

5. Was the presentation of the material interesting or dull?
   Interesting. 1 2 3 4 5 Dull. (Please circle one.)
   Comment:

6. Do you feel that you can use Goal-Directed Systems Design if asked?
   Yes, I can. 1 2 3 4 5 No way. (Please circle one.)
   Comment:

7. Do you ever expect to use Goal-Directed Systems Design in future?
   Yes, I will. 1 2 3 4 5 No way. (Please circle one.)
   Comment:
8. What is the best feature in the workbook?  
Comment:

9. What is the worst feature in the workbook?  
Comment:

10. How can I improve the workbook?  
Comment:

11. What is your overall evaluation of the workbook?  
Good. 1 2 3 4 5  Bad. (Please circle one.)  
Comment:

Thank you very much.
BIBLIOGRAPHY


