7

Task and Content Analysis

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Editor's Note

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Task and/or content analysis is a set of activities that help instructional designers understand the domain (knowledge, skills, etc.) to be taught. It is a critical part of the instructional design process, solving at least three problems for the designer:

1. It defines the knowledge and skills required to solve the performance problem or alleviate a performance need. This step is crucial because most designers are working with an unfamiliar domain.
2. Because the process forces subject-matter experts to work through each individual step of what is required to solve a problem, subtle details of the knowledge and skills to be taught can be more easily identified.
3. During the process, the designer has the opportunity to view material from the learner's perspective. Using this perspective, the designer can often gain insight into appropriate instructional strategies for the materials they will ultimately create.

Task/content analysis does not begin in a vacuum. It begins with the needs or goals derived from the definition of the instructional problem. Designers should also consider what they uncovered during their learner analysis. An understanding of the learner's knowledge and background related to the instructional domain helps designers determine the beginning point for the analysis as well as the depth and breadth of analysis. The output of a task/content analysis is documentation of the content that could possibly be included in the instructional materials. This output then serves as input for developing detailed instructional objectives.

Preparing to Conduct a Task or Content Analysis

A task/content analysis can take many different forms. Designers most often work with one or more subject-matter experts (SMEs), individuals who are experts in the content area. The SME is our link to the instructional domain; we rely on this individual (or individuals) to provide accurate, detailed information for use in developing the instructional unit. Our task as designers is to help the SME elaborate on the content and tasks in a meaningful, logical manner.

In this chapter, we describe the different kinds of content structures designers might encounter in their work, and how each can require different types of strategies to analyze (and later teach) effectively. We then describe three specific techniques for analyzing these knowledge and skill structures: (a) a topic analysis well suited for defining cognitive knowledge; (b) a procedural analysis for use with psychomotor tasks, job tasks, or cognitive sequences involving a series of steps; and (c) a critical incident method, which is useful for analyzing interpersonal skills.

Content Structures

Six structures are often associated with a task/content analysis: facts, concepts, principles and rules, procedures, and interpersonal skills.

Facts

A fact is a statement that offers detail, makes an observation, describes a relationship, or describes a characteristic of a concept. For example, ‘‘The chemical symbol for potassium is K’’ is a fact that describes a relationship between potassium and K. Most topics include many facts because they are the building blocks or tools of any subject—the ‘‘vocabulary’’ the learner must master for understanding. But unless facts are arranged in structured patterns, they will be of limited use to a learner and are often quickly forgotten.

Concepts

Concepts are categories used for grouping similar or related ideas, events, or objects. For example, we might use the concept of soft drinks to categorize the aisle in the grocery store that contains colas, orange drink, root beer, and so forth. The concept of fruit would include apples, oranges, bananas, and dates, but not potatoes. We use concepts to simplify information by grouping similar ideas or objects together and assigning the grouping a name (e.g., fruit, islands, or democracies). Some concepts, such as fruit, are considered concrete concepts because we can easily show an example. Concepts such as safety, liberty, peace, and justice are abstract concepts because they are difficult to represent or illustrate.

Principles and Rules

Principles and rules describe a relationship between two concepts. In microeconomics, we can derive several principles from a supply-and-demand curve. For example, ‘‘as price increases, the supply increases’’ is a principle that describes a direct relationship between two concepts (i.e., price and supply) that increase and decrease together. ‘‘As price decreases, demand increases’’ describes a different relationship between price and demand that causes one to increase as the other decreases.

Procedures

A procedure is an ordered sequence of steps a learner must execute to complete a task. A recipe for making a cake or casserole is a procedure. Similarly, a procedure could be a series of steps needed to plant a rosebush, or it could be a complex series of cognitive processes required to debug a computer program or diagnose the flu.

Interpersonal Skills

This broad category includes behaviors and objectives related to interpersonal communication, for example the development of interviewing skills, solving group conflict, leading a group, or how to sit (e.g., appropriate body language) when being interviewed on television.

Topic Analysis

A topic analysis is used to define connections and relationships between the facts, concepts, principles, and rules that make up a knowledge domain. Such an analysis is typically done in layers, much like what an archaeologist finds when excavating a site. First, the top layer of soil is scraped away. Then layers of earth are removed, and each artifact's identity and location are recorded. Similarly, a designer working with the SME carefully reveals the first layer of information while looking for indicators of knowledge structures (i.e., facts, concept, and principles). Once the structure is revealed, additional detail is gathered for each structure, and new information appears as the designer digs deeper into the content.

A topic analysis thus provides two types of information. First, it identifies the content that will be the focus of the intended instruction. Second, it identifies the structure of the components. We should note that during a topic analysis, the designer might also identify one or more procedures that require analysis. While the topic analysis is not suited for analyzing procedures, our next methodology, procedural analysis, would be appropriate. As you conduct a topic analysis, then, you should remain focused on identifying the facts, concepts, and principles that make up the domain.

Analyzing a Topic

Let's examine a topic analysis example. Imagine we are designing a beginning carpentry course. The course includes an introductory module on different types of wood fasteners. To begin, we can ask an SME to describe the different fasteners. Our question prompts the following outline:

I. Nails
II. Screws
III. Bolts

The SME considered these three major categories adequate to describe the various types of fasteners. So we might next ask the SME to further define each category. He expanded our outline as we asked additional questions. To get started, we might ask from what material fasteners are made, how they are sized, and how they are used.

I. Nails
    A. Generally made from wire
    B. Range in size from 2-penny to 60-penny
        1. Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch
            a. Example: 7-penny nail is 2.25 inches long
    C. Typically driven into one or more pieces of wood with a hammer or nail gun
II. Screws
    A. Made from steel

B. Size determined by the gauge (thickness) and length
    1. Length varies from 0.25 to 6 inches
C. Usually twisted into a hole with screwdriver
D. Provide a more secure joint than nails

III. Bolts
A. Made from steel
B. Measured by length and diameter
    1. Available in fine or coarse threads
C. Placed through a hole and then a nut is tightened from opposite side

Let's examine the content structure identified in the outline. Some of the facts identified in the outline are as follows:

a. Nails are generally made from wire
b. Bolts are made of steel
c. Bolts are measured by length and diameter
d. Screw length varies from .25 to 6 inches

The concepts identified in the topic analysis are:

a. Nail
b. Screw
c. Bolt

One procedure was identified in the task analysis:

Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch.

Our SME helped us identify one principle in the content:

Screws provide a more secure joint than nails.

Next, we can ask the SME to provide detailed information on each fastener category, starting with nails. Once he finishes, we can organize the content using the following steps:

1. Identify the different content structures (facts, concepts, and principles; we might have also identified procedures, and interpersonal skills that we will also need to analyze using other procedures).
2. Group related facts, concepts, principles, and interpersonal skills. For example, in our full outline of wood fasteners, we would group all the information about nails, then the information about screws, and so forth.
3. Arrange the various components into a logical, sequential order.
4. Prepare the final outline to represent your task analysis.

A completed topic analysis on nails, then, could look like this:

I. Nails
A. Generally made from wire

B. Range in size from 2-penny to 60-penny
    1. Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch
    2. Example: 7-penny nail is 2.25 inches long
C. Size is written as 2d for ‘‘2-penny’’
D. Typically driven into one or more pieces of wood with a hammer
E. Types of nails
    1. Common nails
        a. Most commonly used nail
        b. Available in sizes from 2d to 60d
            i. 8d size is most common
        c. Identified by flat head
        d. Used for general purposes
    2. Box nails
        a. Smaller in diameter than common nails
        b. Available in sizes ranging from 2d to 40d
        c. Also identified by its flat head
        d. Used in lumber that may split easily
        e. Often used for nailing siding
    3. Finishing nails
        a. Have a very small head that will not show
            i. Head can be sunk into wood and hole filled
        b. Available in sizes 2d to 20d
        c. Used primarily for finishing work and cabinetry
    4. Common brads
        a. Similar to finishing nails but much smaller
        b. Available in various lengths
            i. Length expressed in inches or parts of an inch
        c. Used for finishing work
    5. Roofing nails
        a. Similar to common nails but with a larger head
        b. Available in lengths from 0.75 inch to 2 inches
            i. Available in various diameters
        c. Used for roofing

How detailed should a topic analysis be? There is no strict guideline, but as a rule of thumb you can use your learner analysis as a guide, since this should describe the learners’ prior knowledge of the content area. A course on home repair for apprentice carpenters, for example, will require a different amount of detail than a course for homeowners.

Procedural Analysis

A procedural analysis is used to analyze tasks by identifying the steps required to complete them. This technique can be used for both observable and unobservable procedures. You conduct a procedural analysis by asking an SME to walk through the steps of a process, preferably with the same equipment and in the same environment in which the task is performed. For example, if you are conducting a procedural analysis for repairing an electric meter, the SME should have an electric meter and the necessary tools to refer to during your interview.

Each step of a procedure analysis includes three questions:

1. What does the learner do?
    a. Identify the action in each step that the learner must perform.
    b. These actions are either physical (e.g., loosening a bolt) or mental (e.g., adding two numbers).
2. What does the learner need to know to do this step?
    a. What knowledge (e.g., temperature, pressure, orientation) is necessary?
    b. What does the learner need to know about the location or orientation of the components that are a part of this step (e.g., how to position a wrench to remove a hidden nut)?
3. What cues (tactile, smell, visual, etc.) inform the learner that there is a problem, the step is done correctly, or a different step is needed (e.g., a blinking light indicates you can release the starter switch)?

In the following procedural analysis, a designer visited a cabinetmaker and asked him how to prepare a piece of woodwork for the final finish. During the analysis, the designer asked him variations of the three questions described in the previous paragraphs to identify the steps, knowledge, and cues. As part of the analysis, the cabinetmaker informed him that someone who finishes furniture would already know the basics of sanding and using a paint sprayer. The designer's analysis produced the following steps:

1. Inspect all surfaces for defects.
    a. Tactile cue: Feel for dents, scratches, and other surface defects.
    b. Visual cue: Splits or cracks are normally visible.
2. Repair defects in surface.
    a. Use sand and glue to fill minor defects.
    b. Reject pieces that you cannot repair for rework.
3. Spray two coats of lacquer sanding sealer on all surfaces.
    a. Visual cue: Dry, misty appearance indicates too-light application.
    b. Visual cue: Runs or sags indicate too-heavy application.
4. Prepare for final finish.
    a. Allow a 20-minute minimum drying time for sealer coat.
    b. After drying, rub out all parts with #400 grit silicon carbide abrasive paper.
    c. Remove dust from all surfaces with air gun, then wipe with clean, lint-free cloth.
5. Complete the final finish.
    a. Spray two coats of finishing lacquer on all parts.
    b. Visual cue: Dry, misty finish indicates too-light application.
    c. Visual cue: Runs or sags indicate too-heavy application.
    d. Allow a minimum of four hours for second coat to dry.
6. Inspect final finish.
    a. Tactile cue: Feel for grit or runs that may not be visible.
    b. Rub out all surfaces with #000 steel wool.
    c. Remove dust from all finished surfaces with air gun and lint-free cloth.
    d. Apply a thin coat of wax to all finished surfaces.
    e. Buff all surfaces to high gloss.
    f. Visual cue: Wax becomes dull prior to buffing.

The Critical Incident Method

The two methods we have described—topic and procedural analyses—work well with concrete content and highly structured tasks. Analyzing other processes, however, such as how to conduct an interview, resolve an interpersonal conflict, or close a sales opportunity, are more difficult because they vary from instance to instance. Although the instances share certain elements, typically a breadth of skills and techniques actually accounts for one's success. A procedural analysis works quite well for analyzing how to apply the final finish to a wooden table, for instance, because the basic process is repeated time after time, with variations due to size and type of wood. But closing a sale, however, depends on several conditions (e.g., personality of the buyer, financial status of the buyer) that change with each sale. There are also complex tasks that an SME might consider an ''art,'' for example, determining where to drill an oil well, predicting successful stocks or mutual funds to purchase, or determining which type of psychotherapy to use with a patient.

To define content for these types of instruction we need an analysis method that provides different points of view on the skills/processes involved. For example, we might interview a salesperson who uses a very calm approach and another who uses high-pressure tactics. This is what we call a *critical incident analysis*, or an interview technique where the designer interviews several individuals to provide a rich source of data about possibilities.

There are two, key questions to ask as part of a critical incident analysis: First, ask an SME to identify three instances when he or she was successful in achieving a goal. Second, ask the SME to identify three instances when he or she was not successful in achieving the same goal.

Next, ask additional questions to gather three types of information:

1. What were the conditions before, during, and after the incident?
    a. Where did the incident occur?
    b. When did it occur?
    c. Who was involved?
    d. What equipment was used, and what was its condition?
2. What did you do?
    a. What did you do physically?
    b. What did you say and to whom?
    c. What were you thinking?
3. How did this incident help you reach or prevent you from reaching your goal?

(Ideally, this process should then be repeated with other SMEs.)

An analysis of critical incident interviews will identify knowledge and techniques the SMEs use to accomplish their goals. But note that although the critical incident analysis provides a list of topics and procedures that experts used, it does not include a list of the steps or details for topics. But using the information from this analysis you can perform a topic and/or procedural analysis to further define the content for the instruction.

Critical Incident Analysis Template

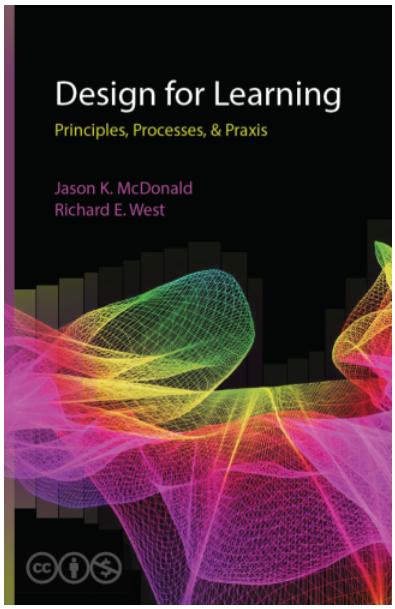
Conclusion

Task/content analysis is a critical step of the instructional design process. It can be easy to neglect, or to carry out superficially, especially given the time it takes to capture the detail required to do it right. But skipping this analysis will likely cause problems in future phases of the design process, particularly when it is time to design instructional activities. If designers only have superficial understanding of the content, or only rely on their subject matter experts' tacit understanding of the content, they are unlikely to design instructional materials that support learners in actually mastering the desired learning outcomes. Instructional designers should ensure they reserve enough time in their design process to carry out their task/content analysis in an adequate manner.

Application Exercises

Like any other skill, becoming proficient at task/content analysis requires practice. If you don't have a current instructional design project you can practice on your own by:

1. Identifying a topic area you personally wish you knew more about and interviewing an expert to create a diagram of the knowledge structure.
    a. You may consider interviewing more than one expert to see what kind of unique structures emerge from their different point of views.
2. Identifying a simple skill and interviewing/observing an expert to create a diagram of how the skill is completed.
    a. If you interview another expert about the same skill, is there more or less variability in the results than you found with your topic analysis?
3. Identifying a complex interpersonal skill and conducting a critical incident analysis with an expert.
    a. If you interview another expert about the same skill, is there more or less variability in the results than you found with your topic or procedure analysis?



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