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Summary: *The purpose of this paper is to discuss how task analysis (TA) can be utilized to help pre-service and practicing teachers to generate lesson plans that can positively impact the achievement of students. The connection between state standards, ordering of learning objectives, task analyses, and assessments are described. Different approaches to constructing and implementing TAs are presented. While TAs for the psychomotor domain are briefly described the emphasis is on developing such analyses for outcomes associated with the cognitive domain. Examples are provided that demonstrate the process of developing TAs for a Georgia Performance Standard, and classic guidelines for creating task analyses are reviewed.*

Key words: *Task analysis, cognitive task analysis, creative task analysis, teaching skills, lessons, achievement.*

Introduction

One of the most challenging topics our students and we face each semester in our educational psychology classes involves converting Georgia Performance Standards (GPS) into more meaningful learning outcomes that prospective teachers with limited experience can use to build their lesson plans. GPS outcomes, like their predecessors in the Quality Core Curriculum, can use ambiguous language (words and phrases such as *understand* and *demonstrate* that mean different things to different people when it is time to assess students' achievement), and sometimes cover large amounts of content. Once teachers have acquired some proficiency in converting GPS outcomes into objectives that are clear to other professionals, parents/caregivers, and students, educators must still grapple with designing both assessments and instructional activities that effectively enable students to master the concepts and skills specified in the objectives.

Assessment in effective instruction

According to Gronlund (1998) effective and valid assessments are closely aligned with effective instruction: "Effective instruction requires that we ex-

pand our concern to a teaching-learning-assessment process, with assessment as a basic part of the instructional program" (p. 3). Hickman and Anderson (1979) present a model using Robert Mager's approach to effective instruction that educators can use to evaluate the degree that curricular materials are appropriate for use with learning disabled students. Mager's approach (as cited in Hickman & Anderson, 1979) to instruction is one already familiar to those who have experience with effective instruction. First, one develops and sequences clear objectives. Each objective is then broken down into its sequenced subcomponents. Finally, instructional materials and assessments are compared to the objectives and task analyses to determine how well they are aligned.

Gronlund (2000) identified six principles of effective achievement testing. When phrases such as "effective achievement testing" are mentioned, many assume the focus is on exams, tests, and quizzes. While the phrase does include traditional testing, the word *test* is a broader term and should be viewed as a synonym for assessment (Gage & Berliner, 1992, p. 569). Thus, these rules apply to informal assessments designed to help students learn content, to formative assessments which are used to identify specific students' strengths and weaknesses, formal assessments which are taken for a grade, and summative assessments which attempt to answer the question, "How did the students do?" with respect to a particular unit or lesson.

The first principle (Gronlund, 2000) concerns the relationship that must exist between the lesson's outcomes/objectives and the items on the assessment: Assessment items must directly relate to objectives that were taught to students and be proportionate with the amount of time spent on each objective in class. Most states, today, have mandated standards for each subject and grade level, and educators are supposed to teach the content and skills associated with the state's standards to their students. As pointed out earlier, most state standards are invariably vague so teachers (hopefully in consultation with one another) must transform each standard into a set of sequenced objectives that clearly inform students what they are to say and do (and how well) after instruction. Once these objectives are developed, they must be taught to students. Each item on every assessment should clearly and directly relate to these objectives and the weight of a specific item on the assessment should approximate the time spent on the objective in class. Gronlund's second principle is related to his first: Any single assessment, including summative exams, should only have items that cover a representative set of the lesson's objectives. In other words, no single assessment is likely to have items that cover all of the objectives taught

in a lesson, but across all assessments in the lesson, all the objectives should be represented.

Gronlund's (2000) third and fourth principles are related to the type of items one uses on the assessments and the purpose of the assessment. The items on the assessment should be the type that is most appropriate for the objective it taps. If an assessment is designed to help students learn material or to acquire a higher level of fluency (i.e., worksheets done individually or in small groups, or homework), one should probably use supply-type items that require students to write rather than select items such as multiple-choice (which should mainly be used as summative assessments). Most importantly, items on assessments should reflect the same level of the Bloom et al. (1956) taxonomy as the objective it measures. The final principles postulated are that the assessment should be reliable and promote and improve student learning.

Ordering of objectives

Once one has good objectives and has identified appropriate assessments that are aligned with the objectives one must also ensure that the objectives are ordered appropriately (Resnick, Wang, & Kaplan, 1973). Content and skills covered in one objective that are pre-requisites to later objectives should precede the latter. Likewise, objectives requiring students to perform at the higher levels of the Bloom et al. (1956) taxonomy will generally come after those related to the same content but requiring students to perform at the lower levels. For example, list and describe objectives requiring knowledge and/or comprehension and should be earlier in a sequence than objectives requiring the student to apply, analyze, etc.

The ordering of objectives within each unit is based on detailed analyses of each task. These analyses are designed to reveal component and prerequisite behaviors for each terminal objective, both as a basis for sequencing the objectives and to provide suggestions for teaching a given objective to children who are experiencing difficulty. The detailed analyses identify many behaviors that are not part of the formal curriculum, but which underlie the stated objectives and may need to be taught explicitly to some children. (Resnick et al., 1973, p. 682)

Creating task analyses

After one has sequenced the objectives for the lesson appropriately, the next step in developing an effective lesson plan involves identifying the step-by-step

progression for successfully completing the skills denoted in each objective. This is formally called a task analysis (Gagne, 1962). Conceptually, a complex activity specified in an objective is reduced to its subcomponent behaviors that are placed in a sequential order.

Both Resnick et al. (1979), and Williams and Cuvo (1986) describe two approaches, general and specific, for developing task analyses (TA). Specific task analyses "...provide a detailed description of the responses and response sequences that constitute a behavioral chain" (Williams & Cuvo, 1986, p. 39), while the general approach uses only "...mandatory steps that constitute essential task outcomes" (p. 39). Their study used each approach to teach disabled clients apartment upkeep skills. They found that specific TAs were most effective to teach the clients the necessary skills, while the general TAs were best for assessing client's proficiency levels.

Hughes (1982) emphasizes that there is not just one way to construct a good task analysis (TA) for the behavior specified in an objective. One of her most important points is that objectives written at the higher levels of any taxonomy of objectives (e.g., Bloom et al., 1956) requires that the students already possess the content and skills at the lower levels, which should effect how a lesson's objectives are sequenced. For example, objectives requiring that students compare and contrast begin with students describing the features or characteristics of the elements that will be compared. Hughes states that Gagne originally described TAs as working backwards from the final response in the chain that collectively represent the complex behavior specified in the objective. She points out that this (i.e., backward chaining) is one approach to constructing TAs.

Other approaches she describes are the stimulus response table (basically an example of forward-chaining), observing a proficient student who verbalizes what she is doing as she does an objective (this is the approach most teachers probably use though the teacher does the complex activity rather than observing a student do it), flow-charting which she suggests for objectives requiring performance at the higher levels of the Bloom et al. (1956) taxonomy, and the critical incident approach in which more proficient students (those who can do the complex behavior specified in the objective) identify the sub-component responses that are most important to successfully completing the objective (what Williams & Cuvo [1986] term the general approach to TAs). The identified sub-components are then emphasized in the lesson. Ideally, teachers will use the approaches in combination to produce effective lessons that efficiently enable learners to acquire new skills in all three domains (affective, psychomo-

tor, and cognitive). The key is to insure that each subcomponent identifies an overt action that the students must perform.

Congnitive task analyses

Many of the objectives teachers use tap the higher levels of the Bloom et al. (1956) taxonomy. Task analyses for such objectives may require cognitive-based steps as well as behavioral ones. Yates (2007) has identified over 100 different types of cognitive task analyses (CTA). Yates developed a taxonomy for CTAs requiring cognitive-process steps that identifies the most frequently used CTAs and whether they refer to processes or outcomes. According to Yates, most CTAs are aligned with content stored as declarative rather than as procedural memory, which is understandable because procedural memory deals mainly with behavioral chains.

Cameron, Shapiro, and Ansleigh (2005) presented what they called a *rational task analysis* to a developmentally delayed child that was to train him how to ride a bicycle. After reviewing the task analysis program the child rejected the program. The first mistake made in this skills-based psychomotor program (since the TA was for bike riding) involved the assumption that the TA program, by itself, could be used to modify the child's behavior. While academic TAs can often be the basis for stand-alone instructional lessons that do not require teacher-implementation (e.g., a tutorial software program or an explanatory handout) most TAs, including those for academics, are developed by the teacher to be used as the basis for the teacher to develop a lesson plan to teach the students the skills/content identified in an objective. In other words, the TA identifies the sequenced sub-component responses associated with the performance in the objective, and the teacher then teaches these components to the students.

While there are several different types of TAs, the most commonly used in educational settings are whole task, backward-chaining, and forward-chaining. In a whole-task TA, the teacher would model/demonstrate the action the learner is to imitate. In backward-chaining the trainer teaches the last action in the chain, then the next-to-last, etc. In forward-chaining, the sub-component behaviors are taught in the sequence that they actually occur in the complex behavior specified in the objective.

Batra and Batra (2005–2006) used matched participants to determine which chaining procedure, whole task, forward, or backward, was most effective in teaching disabled children simple psychomotor skills such as tying shoes. In

their review of literature they found that with respect to psychomotor skills backward chaining was superior or equivalent to forward chaining (one study they cited found that all three approaches, whole task, forward, and backward were about the same). With academic responses, though, the results were mixed. In their study, forward and backward chaining were found to be equally effective as the basis for teaching simple psychomotor tasks. Whole task presentation was not studied.

Teaching skills based on the task analyses

In our experiences forward-chaining is the easiest to teach others how to do because it represents doing the behavior. In a forward-chained TA one will simply list, in order, the first thing to do, the second, etc. until the complex action stated in the objective is completed. It is a straightforward process, but novices often make predictable mistakes. The most common mistakes include (a) skipping steps, (b) not specifying an overt action at each step, and (c) not having enough steps.

Teachers generally are masters of their content and they do the tasks associated with their objectives almost rotely because they have practiced them countless times. Since it is so easy for teachers to do complex activities it is a good idea to double check the sequence of one's academic content to ensure that certain steps have not been skipped. Specifying an overt action at each step is critical because it provides the teacher and learner with an objective reference point to monitor progress. No one can objectively "know" if a person has actually acquired a skill until the person demonstrates it.

Obviously, TAs developed through different approaches are tools that teachers can use to as the basis for teaching the sub-component skills (cognitive or behavioral) to students, but TAs are usually not, by themselves, adequate to help students develop new skills. The sub-components must be taught. Most educators will teach the sub-component skills in the order that they appear in the TA by explaining and modeling. Once separate component skills are mastered, the teacher models how the sub-components occur in a smooth sequence.

Gilbert and Gilbert (1992) state that when teaching complex inter-related skills such as mathematics' times tables, performance science principles demonstrate that students learn to do a complex behavior more efficiently when first taught the more difficult components in the complex activity. This suggests an instructional approach to teach the skills and content of an objective that is different from the approaches most commonly cited in the literature (i.e.,

whole task, forward-and-backward chaining, specific [all behaviors in the chain included] and general [only critical behaviors included]).

Examples of task analyses

The following represents a sequenced set of six objectives and their TAs on the four basic types of sentences which are based on a Georgia Performance Standard and aligned to the appropriate levels of cognitive processes according to the Bloom et al. (1956) taxonomy:

Georgia Performance Standard (Source: www.georgiastandards.org)
ELA4C1

ELA4C1 The student demonstrates understanding and control of the rules of the English language, realizing that usage involves the appropriate application of conventions and grammar in both written and spoken formats. The student

a. Recognizes the subject-predicate relationship in sentences.
b. Uses and identifies four basic parts of speech (adjective, noun, verb, adverb).
c. Uses and identifies correct mechanics (end marks, commas for series, capitalization), correct usage (subject and verb agreement in a simple sentence), and correct sentence structure (elimination of sentence fragments).
d. Uses and identifies words or word parts from other languages that have been adopted into the English language.
e. Writes legibly in cursive, leaving space between letters in a word and between words in a sentence.
f. Uses knowledge of letter sounds, word parts, word segmentation, and syllabication to monitor and correct spelling.
g. Spells most commonly used homophones correctly (there, they're, their; two, too, to).
h. *Varies the sentence structure by kind (declarative, interrogative, imperative, and exclamatory sentences and functional fragments), order, and complexity (simple, compound).*

1. **List and define in their own words using complete sentences the 4 categories of sentences with 100% accuracy. (Comprehension)**
   Task Analysis:
   a. Write the name of one of the 4 types of sentences.

b. Using the text or notes, copy the definition of the sentence.
c. Using a thesaurus, re-write the definition using paraphrasing.
d. Punctuate each sentence according to its type (period, exclamation point, or question mark.)
e. Repeat a-d for the remaining 3 types of sentences.

2. State the correct end punctuation associated with each of the 4 types of sentences with 100% accuracy. (Knowledge)

Task Analysis:

a. Write the names of the 3 types of end punctuation
b. Write the symbol for each end punctuation.
c. Write period for Declarative
d. Write Period for Imperative
e. Write question mark for Interrogatory
f. Write exclamation point for Exclamatory.

3. When given 12 sentences without end punctuation, correctly punctuate at least 10 of the sentences. (Application)

Task Analysis:

a. Write the name and symbol for the 3 types of end punctuation.
b. Write the name of each of the 4 types of sentences
c. Write next to the name of each sentence type the end punctuation it requires.
d. Read the first sentence, if it makes a command or states a fact, used the period; if it asks a question, use a question mark; if it demonstrates a high level of emotion, end it with an exclamation point.

OR

Task Analysis:

a. Make 4 columns and write the name of the 4 sentence type, one in each column
b. Under the declarative column write, ends with a period; for imperative write, ends with a period; for interrogatory write, ends with a question mark; and for exclamatory write, ends with an exclamation point.
c. Read first sentence. If the sentence makes a command, label it imperative and end it with a dot; if the sentence simply states a fact, label it declarative and end it with a dot; if the sentence asks a question, label it interrogatory and end it with a question mark; if the sentence conveys

a high level of affect, label it exclamatory and end it with an exclamation point.

d. Repeat step c for remaining sentences.

4. **When given 20 sentences, label at least 17 correctly as to the type of sentence each is in no longer than 15 minutes. (Application)**

   Task Analysis:

   a. read first sentence; if there is an !, write exclamatory next to it
   b. if the sentence ends in a ?, write interrogatory next to it.
   c. If the sentence ends in a ., write I or D. Re-read sentence; if sentence merely states a fact, label it declarative; if the sentence is a "power statement," label it imperative.

5. **When given a topic, Ss will write an example of each of the 4 types of sentences for the topic with 75% accuracy. (Evaluation)**

   Task Analysis:

   a. Re-write the topic/idea in your own words.
   b. Write the definition of a declarative sentence–(stating a fact)
   c. Underline in the topic (a above) a fact that is explicit or implicit
   d. Write the definition of an imperative sentence.
   e. Write a command or request related to the topic.
   f. Write the definition of an interrogatory sentence.
   g. Write a question related to the topic.
   h. Write the definition of an exclamatory sentence
   i. Write a sentence with high excitement/emotion related to the topic.

6. **On a homework or in-class assignment, Ss will, when given a topic, write at least one 5-7 sentence paragraph on the topic that employs each of the 4 types of sentences with 75% accuracy (correct grammar and spelling). (Evaluation)**

   Task Analysis:

   a. Write the topic that has been assigned.
   b. Name and define the 4 sentence types.
   c. Write 3 examples of each type of sentence that are related to the topic.
   d. Arrange the sentences in step c into a paragraph using at least one from each of the 4 types of sentences.
   e. Proof and summarize the paragraph ensuring at least 5 sentences.
   f. After each sentence in parentheses, write the name of the sentence type.

Guidelines for task analyses

Siegel and Siegel (1975) had education students develop task analyses (TA) on a group of topics over a ten-year period. They then derived 10 guidelines based on the numerous sample TAs provided by the education majors. Their first guideline is *Avoid extraneous material* (p. 16). This means that one should not add non-essential steps or behaviors; the TA should deal only with the skill the students are to learn. The second is, *Don't spend too much time in re-teaching the prerequisite* (p. 16). If the student already possesses these skills the teacher should only demonstrate/review them once or twice to activate the students' prior knowledge then begin teaching the TA's sub-component behaviors starting at the students' entry skill level (i.e., at the sub-component the students can already do). (Of course, if the students do not yet possess the prerequisite skills/knowledge, teach those before teaching the behavioral steps of the TA.)

The third guideline, *Use what the child knows-and this includes prerequisites-to help him learn the new* (Siegel & Siegel, 1975, p. 16). For example, if one's objective is to teach students how to compare the powers of the legislative branch to that of the judiciary's, one should begin by having students list the powers (already taught) of each branch as the first step to then begin the comparison. The fourth, *Assume motivation* (p. 16) simply means that one should not expend too much time and energy to either determine what the students' motivational level is, or to increase it. As the students acquire and master each behavioral step, acquisition/improvement, and mastery should be contingently reinforced following the generic rules used in shaping any new response.

The fifth guideline, *Identify the sequential components* (Siegel & Siegel, 1975, p. 17), simply specifies that the component skills one must do to accomplish the complex behavior indicated in an objective must be ordered (though not necessarily taught) in the sequence that they occur. The sixth guideline is to *Avoid the "recipe" approach* (p. 17). As the teacher you are an expert with respect to the skill being learned and can easily follow a listing (i.e., recipe) of sequenced/chained responses. The students you are teaching, however, will likely benefit from explanations and demonstrations related to many of the sub-component behaviors until the students also become familiar with them (at which point, these types of prompts should be faded as extraneous).

The seventh guideline identified by Siegel and Siegel (1975) involves, *Avoid substituting a variety of activities in lieu of an instructional sequence* (p. 18). These types of activities may give students practice on one or more of the sub-component skills, but they are not the focus of the instructional sequence that enables

the students to learn the behavior in the objective. Once the students learn the separate component responses, in sequence, then provide them with practice opportunities on the entire task so the sub-components are practiced as a whole. Guideline eight, *Become proficient in technical aspects of the instructional task* (p. 18) means that the teacher should practice the objective's behavior, and each of the sub-component responses, in order to anticipate problems and/or possible prompts to provide the learners.

The remaining two guidelines are to *Avoid scientific jargon* (Siegel & Siegel, 1975, p. 18), and *Don't just present, teach* (p. 19). Teachers often write TAs using terminology that may or may not make sense to students. Guidelines 6, 9, and 10 all suggest that the TAs one develops are primarily for the teacher (i.e., a mini-lesson for a specific objective) rather than a listing provided to the students. One uses the sequenced responses in the TA to identify the skills and content to teach rather than as the teaching vehicle. "All of these guidelines can be encapsulated into two prepotent principles: (1) Stipulate that the given child is absolutely ready for your sequence, but that (2) he is utterly incapable of learning it without specific instruction" (Siegel & Siegel, 1975, p. 21).

Discussion

This paper summarizes the role of task analysis in the creation of quality lesson plans. Once a pre-service or practicing educator has finished a TA for a specific objective, the TA is like a blueprint that can followed to teach (by explaining and modeling) students the series of discrete behaviors identified in the complex action specified by an objective, and to smoothly (via practice) acquire proficiency over the complex behavior specified in each objective. By selecting appropriate Georgia Performance Standards and creating sequenced objectives and task analyses, educators can more effectively teach the academic skills necessary to help increase the achievement of Georgia's P-12 grade students.

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