



Research Methodology

Chapter 8: Measurement of Variables: Operational Definition and Scales

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Measurement of Variables

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- Objects that can be physically measured by some calibrated instruments pose no measurement problems. For example:
 - ▣ The length and width of a rectangular office table and the office floor area.
 - ▣ Physiological phenomena pertaining to human beings such as blood pressure, pulse rates, and body temperature, as well as certain physical attributes such as height and weight.

Measurement of Variables cont.

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- But when we get into people's subjective feelings, attitudes, and perceptions, the measurement of these factors or variables becomes difficult.
- There are at least two types of variables: one lends itself to **objective** and precise measurement; the other is more abstract and does not lend itself to accurate measurement because of its **subjective** nature.

Measurement of Variables cont.

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- However, despite the lack of physical measuring devices to measure the subjective type of variables, there are ways of tapping the subjective feelings and perceptions of individuals.
- One technique is to break down the abstract notions, or concepts such as motivation, involvement, satisfaction, buyer behavior, and the like, into observable characteristic behavior.

Operational Definition: Dimensions and Elements

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- Operationalizing, or operationally defining a concept to make it measurable, is done by looking at the behavioral **dimensions**, facets, or properties denoted by the concept.
- These dimensions are then translated into observable and measurable **elements** so as to develop an index of measurement of the concept.
- Operationally defining a concept involves a series of steps.

Operational Definition: Dimensions and Elements cont.

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- **Example:** Operationalizing the Concept of Learning
- We need to define the concept operationally and break it down to observable and measurable behaviors.
- In other words, we should delineate the dimensions and elements of the concept of learning. The dimensions of learning may include:
 1. Understanding
 2. Retention
 3. Application

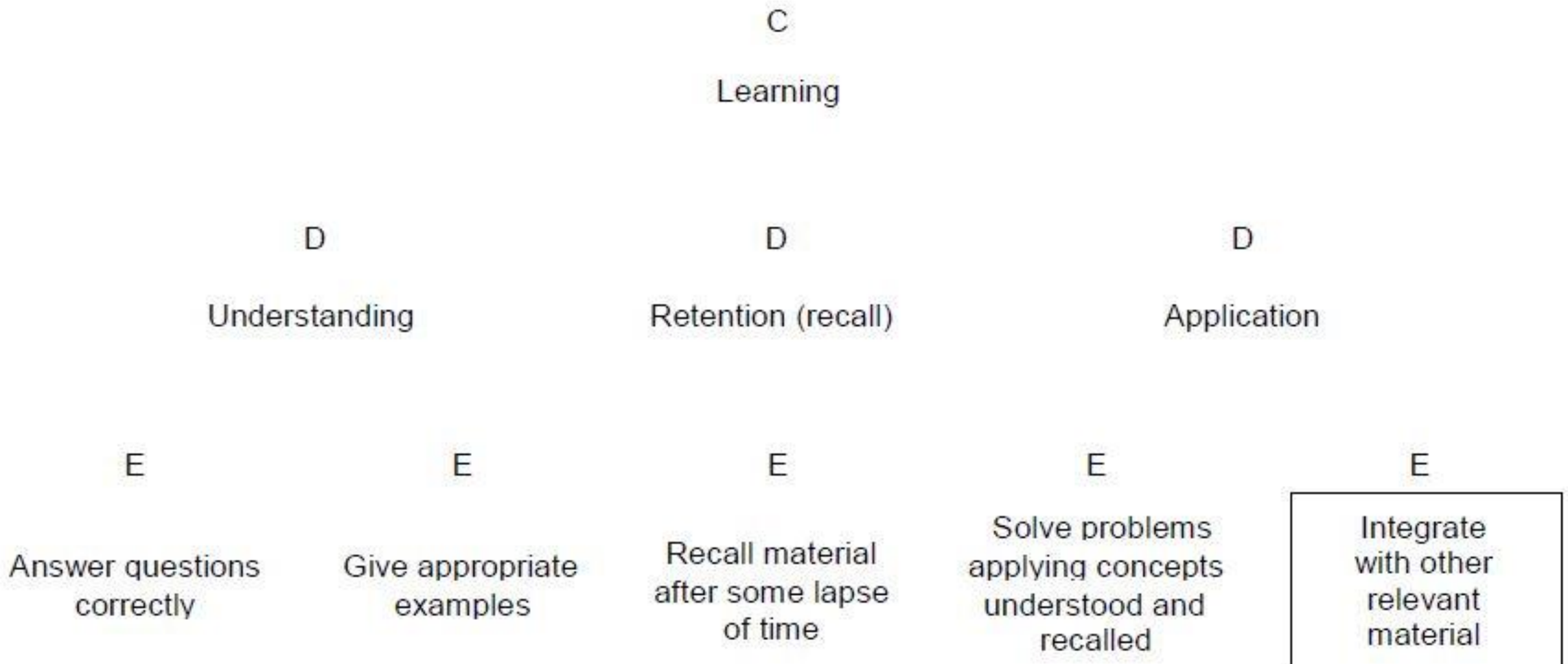
Operational Definition: Dimensions and Elements cont.

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- We can be reasonably certain that a student in the class is “learning” when the individual (1) understands what is taught in the classroom, (2) retains (i.e., remembers) what is understood, and (3) applies whatever has been understood and remembered.
- Terms such as understanding, remembering, and applying are still abstract even though they have helped us to get a better grasp of what learning is all about.
- It is necessary to break these three dimensions into elements so that we can measure the concept of learning.

Operational Definition: Dimensions and Elements cont.

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Scales

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- A scale is a tool or mechanism by which individuals are distinguished as to how they differ from one another on the variables of interest to our study.
- There are four basic types of scales:
 - ▣ Nominal
 - ▣ Ordinal
 - ▣ Interval
 - ▣ Ratio

Nominal Scale

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- A nominal scale is one that allows the researcher to assign subjects to certain categories or groups.
- For example, with respect to the variable of gender, respondents can be grouped into two categories – male and female.
- These two groups can be assigned code numbers 1 and 2.
- Nominal scales categorize individuals or objects into ***mutually exclusive*** and ***collectively exhaustive*** groups.

Nominal Scale cont.

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- The information that can be generated from nominal scaling is to calculate the percentage (or frequency) of males and females in our sample of respondents.
- For example, if we had interviewed 200 people, and assigned code number 1 to all male respondents and number 2 to all female respondents, then computer analysis of the data at the end of the survey may show that 98 of the respondents are men and 102 are women.

Nominal Scale cont.

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- This frequency distribution tells us that 49% of the survey's respondents are men and 51% women.
- Other than this marginal information, such scaling tells us nothing more about the two groups. Thus the nominal scale gives some basic, categorical, gross information.

Ordinal Scale

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- An ordinal scale not only categorizes the variables in such a way as to denote differences among the various categories, it also rank-orders the categories in some meaningful way.
- The preference would be ranked (e.g., from best to worst; first to last) and numbered 1, 2, and so on.

Ordinal Scale cont.

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- **Example:** Rank the following five characteristics in a job in terms of how important they are for you. You should rank the most important item as 1, the next in importance as 2, and so on, until you have ranked each of them 1, 2, 3, 4, or 5.

Job Characteristic

Ranking of Importance

The opportunity provided by the job to:

- | | |
|---|---|
| 1. Interact with others. | — |
| 2. Use a number of different skills. | — |
| 3. Complete a whole task from beginning to end. | — |
| 4. Serve others. | — |
| 5. Work independently. | — |

Ordinal Scale cont.

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- We can now see that the ordinal scale provides more information than the nominal scale.
- Note, however, that the ordinal scale does not give any indication of the magnitude of the differences among the ranks.
- This deficiency is overcome by interval scaling.

Interval Scale

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- The interval scale lets us measure the distance between any two points on the scale.
- The interval scale not only groups individuals according to certain categories and taps the order of these groups, it also measures the magnitude of the differences in the preferences among the individuals.

Interval Scale cont.

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- **Example:** Indicate the extent to which you agree with the following statements as they relate to your job.

Strongly Disagree 1	Disagree 2	Neither Agree Nor Disagree 3	Agree 4	Strongly Agree 5	
The following opportunities offered by the job are very important to me:					
a. Interacting with others	1	2	3	4	5
b. Using a number of different skills	1	2	3	4	5
c. Completing a task from beginning to end	1	2	3	4	5
d. Serving others	1	2	3	4	5
e. Working independently	1	2	3	4	5

Ratio Scale

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- The ratio scale overcomes the disadvantage of the arbitrary origin point of the interval scale, in that it has an **absolute** zero point, which is a meaningful measurement point.
- Thus the ratio scale not only measures the magnitude of the differences between points on the scale but also taps the proportions in the differences.
- It is the most powerful of the four scales because it has a unique zero origin (not an arbitrary origin) and subsumes all the properties of the other three scales.

Ratio Scale cont.

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- The weighing balance is a good example of a ratio scale.
- It has an absolute zero origin calibrated on it, which allows us to calculate the ratio of the weights of two individuals.
- For instance, a person weighing 250 pounds is **twice** as heavy as one who weighs 125 pounds.
- Note that multiplying or dividing both of these numbers (250 and 125) by any given number will preserve the ratio of 2:1.

Summary of Scales

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Scale	Highlights			Unique Origin	Measures of Central Tendency	Measures of Dispersion	Some Tests of Significance
	Difference	Order	Distance				
Nominal	Yes	No	No	No	Mode	—	χ^2
Ordinal	Yes	Yes	No	No	Median	Semi-interquartile range	Rank-order correlations
Interval	Yes	Yes	Yes	No	Arithmetic mean	Standard deviation, variance, coefficient of variation	t , F
Ratio	Yes	Yes	Yes	Yes	Arithmetic or geometric mean	Standard deviation or variance or coefficient of variation	t , F

Note: The interval scale has 1 as an arbitrary starting point. The ratio scale has the natural origin 0, which is meaningful.

Summary of Scales cont.

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- The nominal scale highlights the differences by classifying objects or persons into groups, and provides the least amount of information on the variable.
- The ordinal scale provides some additional information by rank-ordering the categories of the nominal scale.
- The interval scale not only ranks, but also provides us with information on the magnitude of the differences in the variable.
- The ratio scale indicates not only the magnitude of the differences but also their proportion.