Identifying Variables

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Abstract: *Variables are qualities, properties, or characteristics of person, things, or situations that change or vary. Chin and kramer stated that 'variables are concepts at different level of abstraction that are concisely defined to promote their measurement or manipulation within study'. Variables are classified based on their nature, action, and effects on the variables. All research projects are based around variables. A variable is the characteristic or attribute of an individual, group, educational system, or the environment that is of interest in a research study. Variables can be straightforward and easy to measure, such as gender, age, or course of study. Other variables are more complex, such as socioeconomic status, academic achievement, or attitude toward school. Variables may also include an aspect of the educational system, such as a specific teaching method or counseling program. Characteristics of the environment may also be variables, such as the amount of school funding or availability of computers. Therefore, once the general research topic has been identified, the researcher should identify the key variables of interest.*

Keywords: Variables, dependent variable, independent variable

1. Introduction

Variables are qualities, properties, or characteristics of person, things, or situations that change or vary. Chin and kramer stated that 'variables are concepts at different level of abstraction that are concisely defined to promote their measurement or manipulation within study'. Variables are classified based on their nature, action, and effects on the variables.

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For example, a researcher is interested in low levels of literacy. Literacy itself is still a broad topic. In most instances, the broad topic and general variables need to be specifically identified. For example, the researcher needs to identify specific variables that define literacy: reading fluency (the ability to read a text out loud), reading comprehension (understanding what is read), vocabulary, interest in reading, etc. If a researcher is interested in motivation, what specific motivation variables are of interest: external motivation, goals, need for achievement, etc? Reading other research studies about your chosen topic will help you better identify the specific variables of interest.

The main types of the variables are as follows:
1) Independent and dependent variables
2) Research variable
3) Demographic variables
4) Extraneous variables

Independent Variables

In experimental research, an investigator manipulates one variable and measures the effect of that manipulation on another variable. The variable that the researcher manipulates is called the **independent, or grouping variable**. The independent variable is the variable that is different between the groups compared: all the members of one group will have the same **level** of the independent variable, a second group will have a different level of that same variable, and the same for a 3rd or 4th group, if present.

For example, let's take a study in which the investigators want to determine how often an exercise must be done to increase strength. Stop for a minute and think about how they might organize a study so they could figure this out. There are usually several possible studies that could be done to address a question.

These investigators decided to compare 3 groups, one group participate in a set of specific exercises 4 times per week; a second group would do the same exercises, but only twice per week, and a control group would participate in stretching exercises that would have no impact on strength. The variable that differs between these 3 groups that are compared is an **Independent Variable**. This particular independent variable has 3 LEVELS of the SINGLE independent variable - in this example: type of exercise.

Some non-experimental studies also have independent variables, but they may not be determined or manipulated by the investigators. For example, a study may compare test performance between men and women; so gender would be the independent variable. However, since investigators didn't determine or specify which individuals would be men and which would be women, it is not considered to be an active independent variable. Because gender does define the variable used for comparison, it is still an independent variable, even though it has lost some of its power.

Dependent Variables

The **outcome variable** measured in each subject, which may be influenced by manipulation of the independent variable is termed the **dependent variable**. In experimental studies, where the independent variables are imposed and

manipulated, the dependent variable is the variable thought to be changed or influenced by the independent variable.

Example: Effects of a new tooth paste on incidence of caries in 1st grade children. The intervention group was given toothpaste, while the control group was given an identical toothpaste that did not contain the secret ingredient. Subjects were observed brushing their teeth 3 times per day with the assigned toothpaste (by teacher or parent). 6 months later, dental appointments were scheduled, and the number of dental caries present in each child was reported.

In this study, the toothpaste was the **independent variable;** it was different between the two **groups**: one level was the toothpaste itself, and the second level (a control group) was the identical toothpaste (a placebo). The **outcome measure (dependent variable)** - that "depended" upon the type of toothpaste, was the number of dental caries.

Identifying the key variables is important for the following reasons:
- The key variables provide focus when writing the Introduction section.
- The key variables are the major terms to use when searching for research articles for the Literature Review.
- The key variables are the terms to be operationally defined if an *Operational Definition of Terms* section is necessary.
- The key variables provide focus to the Methods section.
- The Instrument will measure the key variables. These key variables must be **directly** measured or manipulated for the research study to be valid.

Identifying Independent & Dependent Variables

- Let's say that a study reports "The effects of kicking on the position of the ball." Just from this title of the study, we can tell that the outcome measure (the dependent variable) will be the position of the ball (or the distance traveled). The variable thought to influence the distance, the independent variable, would be the kicking. We would assume that in the study, some balls were kicked (intervention or experimental group), and others were not kicked; or had something else done to them; so there were at least 2 levels of the independent variable.
- You can use this typical form to determine the independent and dependent variables from the title of the study. If the study title is in the form "The effects of X on Y in Z". X is the independent variable and Y is the dependent variable - the outcome, and Z is the type of subjects represented.
- A simple example would be: The effects of tomatoes on risk of prostate cancer in Scandinavian men. The "tomatoes" is in the X position, so it is the independent variable - it is the variable being compared between groups (and the variable possibly manipulated - it also implies that there's another level - a comparison group of some sort). The Y position is "risk of prostate cancer" - that's the dependent variable, which is measured as the outcome. The target population: Scandinavian men is the sample in which the study was done - however, the results may be more generalizable. (back to top)
  2.example:

A randomized trial of breast cancer risk counseling: the impact on self-reported mammography use
From this title, you can tell that the **independent variable** is type of counseling (with 2 or more levels, risk counseling and no counseling or standard care). The **dependent variable** is self-reported mammography use.

Variable Summary:

	Independent Variable	Dependent Variable
manipulated/ measured	"manipulated" or "imposed" by researchers in an experiment	measured as outcome variable
groups different/ groups the same	grouping variable: different levels for different groups in observational studies	all subjects in all groups are measured the same way
	each study may have several independent variables	each study likely has several to many dependent variables

Demographic variables

The term *demographics* refers to particular characteristics of a population. The word is derived from the Greek words for *people* (*demos*) and *picture* (*graphy*). Examples of demographic characteristics include age, race, gender, ethnicity, religion, income, education, home ownership, sexual orientation, marital status, family size, health. Demographic information provides data regarding research participants and is necessary for the determination of whether the individuals in a particular study are a representative sample of the target population for generalization purposes. Usually demographics or research participant characteristics are reported in the methods section of the research report and serve as independent variables in the research design. Demographic variables are independent variables by definition because they cannot be manipulated. Demographic variables may also be entered into multivariate models for controlling and confounding effects. For example, the marketing department of a business might use demographic variables as an important input when formulating target customer profiles.
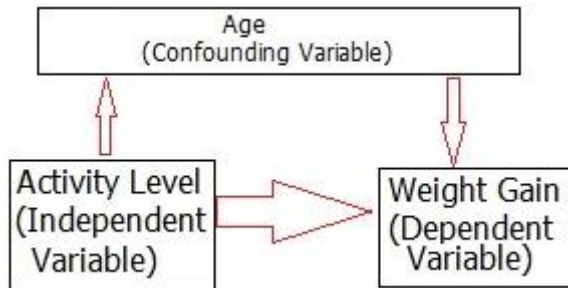
Extraneous Variables

Extraneous variables are any variables that you are not intentionally studying in your experiment or test. When you run an experiment, you're looking to see if one variable (the independent variable) has an effect on another variable (the dependent variable). In an ideal world you'd run the experiment, check the results, and voila! Unfortunately…like many things in life…it's a little more complicated that than. Other variables, perhaps ones that never crossed your mind, might influence the outcome of an experiment. These undesirable variables are called extraneous variables. For example: you want to know if online learning increases student understanding of statistics. One group uses an online knowledge base to study, the other group uses a traditional text. Extraneous variables could include prior knowledge of statistics; you would have to make sure that group A roughly matched group B with prior knowledge before starting the study. Other extraneous variables could include amount of support in the home, socio-economic income, or temperature of the testing room.

Types of Extraneous Variables
1) **Demand characteristics**: environmental clues which tell the participant how to behave, like features in the surrounding or researcher's non-verbal behavior.
2) **Experimenter / Investigator Effects**: where the researcher unintentionally affects the outcome by giving clues to the participants about how they should behave.
3) **Participant variables**, like prior knowledge, health status or any other individual characteristic that could affect the outcome.
4) **Situational variables**, like noise, lighting or temperature in the environment.

Confounding Extraneous Variable

One type of extraneous variable is called a confounding variable. Confounding variables directly affect how the independent variable acts on the dependent variable. It can muddle your results, leading you to think that there is cause and effect when in fact there is not. In the above example, a confounding variable could be introduced if the researcher gave the text book to students in a low income school, and assigned online learning to students in a higher income school. As students in higher income schools typically take more challenging coursework than students in lower income schools, pre-knowledge becomes a confounding extraneous variable.

Extraneous variables should be controlled if possible. One way to control extraneous variables is with random sampling. Random sampling does not eliminate any extraneous variable, it only ensures it is equal between all groups. If random sampling *isn't* used, the effect that an extraneous variable can have on the study results become a lot more of a concern.

Identifying variables in Research Design
After the key variables have been identified, the researcher needs to identify how those variables will be studied, which is the heart of the research design. There are four primary research designs:

- **Descriptive:** Describes the current state of variables. For example, a descriptive study might examine teachers' knowledge of literacy development. This is a descriptive study because it simply describes the current state of teachers' knowledge of literacy development.
- **Causal Comparative:** Examines the effect of one variable that cannot be manipulated on other variables. An example would be the effect of gender on examination malpractice. A researcher cannot manipulate a person's gender, so instead males and females are compared on their examination malpractice behavior. Because the variable of interest cannot be manipulated, causal comparative studies (sometimes also called *ex post facto)*ccompare two groups that differ on the independent variable (e.g., gender) on the dependent variable (e.g., examination malpractice). Thus, the key identifying factor of a causal comparative study is that it compares two or more groups on a different variable.
- **Correlational:** Describes the relationship between variables. Correlational studies must examine two variables that have continuous values. For example, academic achievement is a continuous variable because students' scores have a wide range of values - oftentimes from 0 to 100. However, gender is not a continuous variable because there are only two categories that gender can have: male and female. A correlational study might examine the relationship between motivation and academic achievement - both continuous variables. Note that in a correlational design, both variables must be studied within the same group of individuals. In other words, it is acceptable to study the relationship between academic achievement and motivation in students because the two variables (academic achievement and motivation) are in the same group of individuals (students). However, it is extremely difficult to study two variables in two groups of people, such as the relationship between teacher motivation and student achievement. Here, the two variables are compared between two groups: teachers and students. I strongly advise against this latter type of study.
- **Experimental and Quasi-Experimental:** Examines the effect of a variable that the researcher manipulates on other variables. An experimental or quasi-experimental study might examine the effect of telling stories on children's literacy skills. In this case, the researcher will "manipulate" the variable of telling stories by placing half of the children in a treatment group that listens to stories and the other half of children in a control group that gets the ordinary literacy instruction.

Descriptive studies are the most simple research design and provide the least amount of information about improving education. Therefore, descriptive studies should only be conducted for first degree and diploma projects. Only in special cases should a Masters thesis be descriptive. Doctoral dissertations should aim for experimental or quasi-experimental studies.

Once the key variables and the research design have been identified, the rest of the study falls into place.
- The *purpose, research questions, and hypotheses* will be written about the variables based on the research design.
- The *Instruments* will be developed to measure the key variables and the *Instruments* section in Chapter 3 is written to describe the instruments.
- The *Procedures* section describes the treatment for experimental studies and/or how the instrument will be administered.
- The *Method of Data Analysis* describes how the data is summarized and tested based on the research questions and hypotheses.

Thus, the most difficult part of planning the research study is identifying the research variables and research design. Considerable time and thought needs to be given. Once the

key variables have been identified, then the research study can be developed. It is important to develop the research study before writing the paper. If thought is not given to how the research study should be conducted, then a researcher might spend considerable time and energy for developing a project that is completely un researchable.

References

[1] http://www.pt.armstrong.edu/wright/hlpr/text/3.1.variables.htm
[2] http://korbedpsych.com/R02Variables.htmlmadaboutscience.weebly.com
[3] https://madaboutscience.weebly.com/identifying-variables.html
[4] https://examples.yourdictionary.com/independent-and-dependent-variable
[5] https://www.sciencebuddies.org
[6] https://www.teacherspayteachers.com
[7] https://www.statisticshowto.datasciencecentral.com/extraneous-variable/
[8] https://www.researchgate.net
[9] http://methods.sagepub.com/reference/encyc-of-research-design