

**EDUR 7130**  
**Presentation 2b**

**4. Variables and Measurement Scales**

**4a. Variables and Constants**

What is the difference between a variable and a constant?

- Variable has more than one category present (e.g., sex = male/female – note variable and categories)
- Constant has only one category (e.g., sex = female only)

Variable and Constant Examples

Students in a classroom (variable or constant?):

- Age = all 21 years of age
- GPA = ranges between 1.65 and 3.86
- Race/Ethnicity = Asian, Black, Hispanic
- Transportation to class = Walk

Age = constant

GPA = variable

Race = variable

Transportation to class = constant

Measurement – process of assigning labels to categories of a variable.

A variable does not to be quantitative, no numbers are required (e.g, sex, race, etc.)

**4b. Scales of Measurement**

Nominal – just categories, no inherent rank (e.g., sex = male/female)

Ordinal – categories, but also with inherent rank (e.g. SES as labeled low, middle, high)

Interval – categories, ranked, with equal interval – sticking point is lack of true zero point, few variables with equal interval have no zero point

Ratio – categories, ranked, equal interval, and true zero point, examples:

- time to complete a task
- counting objects in a box
- number of points scored during a game

This is the only type of variable for which one can compute ratios (e.g., if it takes me 10 seconds to complete a task, but takes you only 5 seconds, then it took me,  $10/5 = 2$ , twice as long)

Equal interval characteristics – this is a function of the measuring scale used, not of the categories themselves

Examples of measurement scales that produce equal intervals:

- Ruler in millimeters or inches,
- stop watch to record in seconds,
- counts of number of items scored correctly on tests,

- percentage of items scored correctly on tests

Test 1:

Bryan = 45%

Miriam = 85%

Melinda = 100%

Ratio =  $45/100 = .45 \times 100 = 45\%$

#### 4c. Qualitative vs Quantitative Variables

Nominal, Categorical = Qual,

Ordinal = Quan (sometimes treated as qual if categories are few)

Interval = Quan

Ratio = Quan

If categories of a variable can be ranked, it is quan, if not ranked then qual.

A few situations in which categories can be ranked, but we treat variable as qualitative (e.g. SES with three categories – easier for data analysis via statistics to treat as quan than qual).

Below is a scale that could be used to measure one's current level of happiness with life.



Source: <http://www.backtosafety.com/posts/emotional-check-in-chart/>

Responses to this scale:

- Are they qualitative or quantitative?
- Are they nominal, ordinal, interval, or ratio?

#### Things to notice

- no numbers are used in the happiness scale above
- despite lack of numbers, this scale demonstrates a quantitative response
- categories can be sorted, or ranked, from most to least happiness
- yet, due to lack of precision of measurement, this scale is at best ordinal

#### 4d. Independent and Dependent Variables

IV = variable that comes first in time sequence

DV = variable that follows IV in time sequence

Example 1:

There will be a difference in math scores between males and females.

What are the variables, and which are IV and DV, and are they Qual or Quan variables?

Answer

IV = sex (female/male), Qual

DV = math scores, Quan

Reason = one's sex precedes math performance in time

Example 2:

Class size and student final test scores are not related.

What are the IVs and DVs, and is the IV qual or quan?

Answer

IV = class size, Quan

DV = student final test scores, Quan

Example 3:

Students whose parents are educators will earn higher scores on a test than students whose parents are not educators.

What are the IVs and DVs, and is the IV qual or quan?

Answer

IV = occupation of parents, Qual

DV = test scores, Quan

Example 4:

For females in public schools, researchers found that one's mathematics attitude predicts well one's mathematics achievement.

Which are the IV and DV, and are they Qual or Quan variables?

Answer

Variables -

IV = mathematics attitude (not enough information to judge Qual or Quan, but most likely Quan)

DV = mathematics achievement

Constants –

Sex: because there is only one category, female

School Setting: only public schools included, nonpublic schools not included in hypothesis

#### 4e. Identifying Variables in Studies (with focus on Reading Tables or Graphs)

Example 1

*Europe's Journal of Psychology*, 8(1), pp. 159-181, doi:10.5964/ejop.v8i1.301  
www.ejop.org

Exploring the Relationship among Loneliness, Self-esteem, Self-efficacy and Gender in United Arab Emirates College Students

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Table 1. Descriptive statistics and Cronbach's alpha values ( $n = 495$ ).

Variables	Males ( $n = 203$ )		Females ( $n = 292$ )		Total ( $n = 495$ )		$\alpha$
	M	SD	M	SD	M	SD	
Loneliness	40.96	11.08	45.06	9.93	43.38	10.60	.91
Self-esteem	29.43	5.50	26.97	4.44	28.60	5.14	.76
Self-efficacy	28.37	5.03	27.54	4.72	27.88	4.68	.87

Based upon this table, what are the IV and DV for this study?

Variables are: sex (male and female), loneliness, self-esteem, and self-efficacy

IV = sex

DV = loneliness, self-esteem, and self-efficacy

Example 2

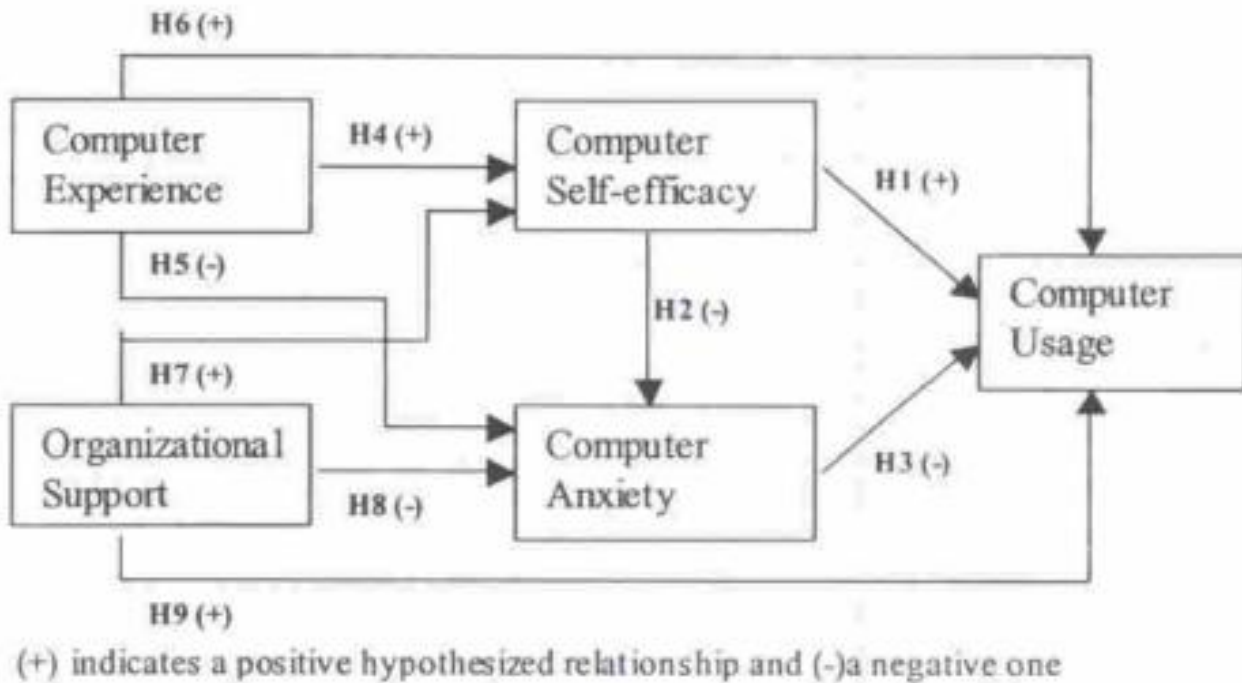
**AN EMPIRICAL INVESTIGATION INTO THE  
RELATIONSHIP BETWEEN COMPUTER SELF-EFFICACY,  
ANXIETY, EXPERIENCE, SUPPORT AND USAGE**

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**FIGURE 3**  
**Research Conceptual Model**



What do the arrows tell us in this theoretical model?

Which are IV and DV in this model?

Overall DV = Computer usage

Two clear IV = computer experience, organizational support

Mixed IV and DV = Computer self-efficacy, computer anxiety

Example 3

# Study Habits, Skills, and Attitudes

## The Third Pillar Supporting Collegiate Academic Performance

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**TABLE 2**

***Reliability Artifact Distributions for SHSA Constructs and GPA Criterion***

Categories	$M r_{xx}$	$SD r_{xx}$	$k_{rel}$
<b>Predictors</b>			
Aggregate measures	0.82	0.10	15
Study habits	0.83	0.07	30
Study skills	0.71	0.07	23
Study attitudes	0.83	0.09	12
Study motivation	0.71	0.09	18
Study anxiety	0.75	0.05	11
Deep processing	0.68	0.09	24
Surface processing	0.64	0.09	16
Strategic processing	0.73	0.09	12
Metacognitive skills	0.79	0.06	7
<b>Criterion</b>			
First-semester freshman GPA	0.83	0.02	3
Freshman GPA	0.83	0.02	3
GPA	0.83	0.02	3

**Note.** SHSA = Survey of Study Habits and Attitudes;  $M r_{xx}$  = mean of reliability distribution;  $SD r_{xx}$  = standard deviation of reliability distribution;  $k_{rel}$  = number of independent reliability coefficients on which distributions are based.

All predictor variables are IV (10 variables), an all criterion variables are DV (3 variables)

Example 4

## Motivational and Self-Regulated Learning Components of Classroom Academic Performance

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A correlational study examined relationships between motivational orientation, self-regulated learning, and classroom academic performance for 173 seventh graders from eight science and seven English classes. A self-report measure of student self-efficacy, intrinsic value, test anxiety, self-regulation, and use of learning strategies was administered, and performance data were obtained from work on classroom assignments. Self-efficacy and intrinsic value were positively related to cognitive engagement and performance. Regression analyses revealed that, depending on the outcome measure, self-regulation, self-efficacy, and test anxiety emerged as the best predictors of performance. Intrinsic value did not have a direct influence on performance but was strongly related to self-regulation and cognitive strategy use, regardless of prior achievement level. The implications of individual differences in motivational orientation for cognitive engagement and self-regulation in the classroom are discussed.

Purpose of study: determine whether motivation components and self-regulated learning predict academic performance for 7<sup>th</sup> grade students.

**Table 2**  
*Zero-Order Correlations Between Motivation and Self-Regulated Learning Variables and Performance*

Variable	Grade 1	Seat-work	Exams/Quizzes	Essays/Reports	Grade 2
Motivation components					
Intrinsic value	.25**	.21**	.20**	.27**	.30***
Self-efficacy	.34***	.19*	.24**	.25**	.36***
Test anxiety	-.24**	-.14	-.21**	-.14	-.23**
Self-regulated learning components					
Strategy use	.18*	.07	.20**	.19*	.20**
Self-regulation	.32***	.22**	.28**	.36***	.36***

Note.  $N = 173$ .

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

How many variables are identified in this table?

10 variables

1. intrinsic value
2. self-efficacy
3. test anxiety
4. strategy use
5. self-regulation
6. grade scores 1
7. grade scores 2
8. seat-work
9. exams
10. essays

Which do you think are predictors and criterions?

Predictors: Intrinsic value, self-efficacy, test anxiety, strategy use, self-regulation

Criteria: self-work, exams, essays grade 1, grade 2

Example 5

## Comparison of Hypermedia Learning and Traditional Instruction on Knowledge Acquisition and Retention

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Purpose is to learn whether hypermedia enhanced instruction (experimental) produces better knowledge scores than traditional instruction not enhanced with hypermedia (control).

**Table2.—Declarative, Conditional, and Procedural Knowledge Posttest Results**

Group	Declarative knowledge ( <i>k</i> = 36)	Conditional knowledge ( <i>k</i> = 23)	Procedural knowledge ( <i>k</i> = 22)
Control			
<i>M</i>	18.42	12.17	7.92
<i>SD</i>	5.99	3.81	2.937
Experimental			
<i>M</i>	19.60	14.33	8.80
<i>SD</i>	5.40	4.37	3.299
<i>p</i>	.594	.188	.475
<i>t</i>	0.54	1.35	0.73

Which are IV and DV in this table? Be precise in naming the IV and DVs. Name all presented in this table.

IV = type of instruction (experimental group = hypermedia, control = tradition)

DV = three DVs: declarative knowledge scores, conditional knowledge scores, and procedural knowledge scores.



