Quantitative Research Dissertation
Chapters 3, 4, and 5 (Suggested Content)

Information below is suggested content; seek guidance from committee chair about content of all chapters in the dissertation.

Brief Review – Chapter 3: Method (not Methodology)

There is a tendency to report results of sample and measurement information in Chapter 4. However, this information should be reported in Chapter 3.

Participants

This section contains information on:

- study setting,
- how participants were sampled,
- sample size sought,
- sample size obtained,
- response rate,
- participant demographics, etc.

There is no such thing as a "sample population" so don't use this word combination.

Table 1 below is an example showing participant demographics.

Table 1: Undergraduate Sample Demographics

Variable	n	%
Sex		
Female	162	82.7
Male	34	17.3
Race		
African American or Black	35	17.9
Asian	3	1.5
Multi-racial	6	3.0
White	152	77.6
Age		
18	1	0.5
19	46	23.5
20	76	38.8
21	46	23.5
22	10	5.1
23	7	3.6
24	3	1.5
25+	7	3.6

Materials, Measurement, Variables

Explain how variables were measured including

- questionnaire/instrument/scale selection or development,
- item creation or selection,
- item analysis procedures,
- item scaling (e.g., 1 = “not true of me” to 7 = “very true of me”),
- Items to be reverse scored, etc.

Discuss evidence for reliability of scores such as

- Cronbach’s α, split-half, KR-20, KR-21
- test-retest
- parallel forms
- rater/score agreement (Cohen’s kappa, Krippendorff’s alpha, etc.),

and evidence for validity of scores, for example,

- logical validity: content validity rationale – theory, research, item & sampling validity, expert review
- empirical validity: construct, predictive, concurrent, structural analysis (factor).

Unless your dissertation focuses on the psychometrics of an instrument, or scale, one should discuss validity and reliability in this sub-section of Method, not in Chapter 4.

Procedure

In this section provide a detailed, step-by-step description of the method/procedures used to collect your data. Enough detail should be offered here, and in other sections of Chapter 3, to enable one to replicate your study without having to guess or contact you for clarification.

Analysis

The dissertation should not contain an analysis section. The proposal for the dissertation study should contain an analysis section because you are proposing how to analyze the data to be collected. However, the dissertation should not contain an analysis section because once the data are collected, you will perform the analysis, so the dissertation instead contains a results section, which is the purpose of Chapter 4.

Chapter 4: Results

1. Opening of Chapter

Briefly restate, in a few sentences or a paragraph, the

- purpose of study, and
- research questions and hypotheses.

2. Data Examination, Variable Scoring, and Descriptive Statistics

Before presenting results that address your research questions or hypotheses, first discuss

- your process of data examination,
- variable scoring and creation, and then
- present descriptive statistics.

Some of this information is secondary to your study and, if reported, may be better suited for placement in an appendix rather than Chapter 4.

Data Examination. Explain to readers the

- process of reviewing your data for errors or outliers (extreme cases),
- identifying missing information, and
- and any corrective steps taken to address errors and missing information.

Frequencies. Calculating tables of frequencies can be an excellent first step to identifying problematic data.

Example 1: Frequencies. Questionnaire Item: In general, my parents ignore what I have to say:

1 = Not at all
2 = Somewhat
3 = A Moderate Amount
4 = Quite a Bit
5 = Very Much

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		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.0	12	4.8	5.0	5.0
	2.0	28	11.2	11.7	16.7
	3.0	36	14.5	15.1	31.8
	4.0	73	29.3	30.5	62.3
	5.0	89	35.7	37.2	99.6
	6.0	1	.4	.4	100.0
	Total	239	96.0	100.0	
Missing	System	10	4.0		
Total		249	100.0		

The problem identified by the frequency table above is the presence of a score “6” which should not be possible since the variable score range is only 1 to 5. This appears to be a data entry error.

Example 2: Frequencies. Questionnaire Item: What is your race/ethnicity?

1 = American Indian, Alaska Native
2 = Asian
3 = Black or African American
4 = Hawaiian/Pacific Islander
5 = Hispanic/Latino
6 = White
7 = Mixed/Multi-racial

Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		8	3.2	3.2	3.2
	"Dark Skin"	1	.4	.4	3.6
	1	1	.4	.4	4.0
	2	3	1.2	1.2	5.2
	2,3,4	1	.4	.4	5.6
	3	60	24.1	24.1	29.7
	4	1	.4	.4	30.1
	6	169	67.9	67.9	98.0
	7	3	1.2	1.2	99.2
	7 (6+2)	1	.4	.4	99.6
	blank	1	.4	.4	100.0
	Total	249	100.0	100.0	

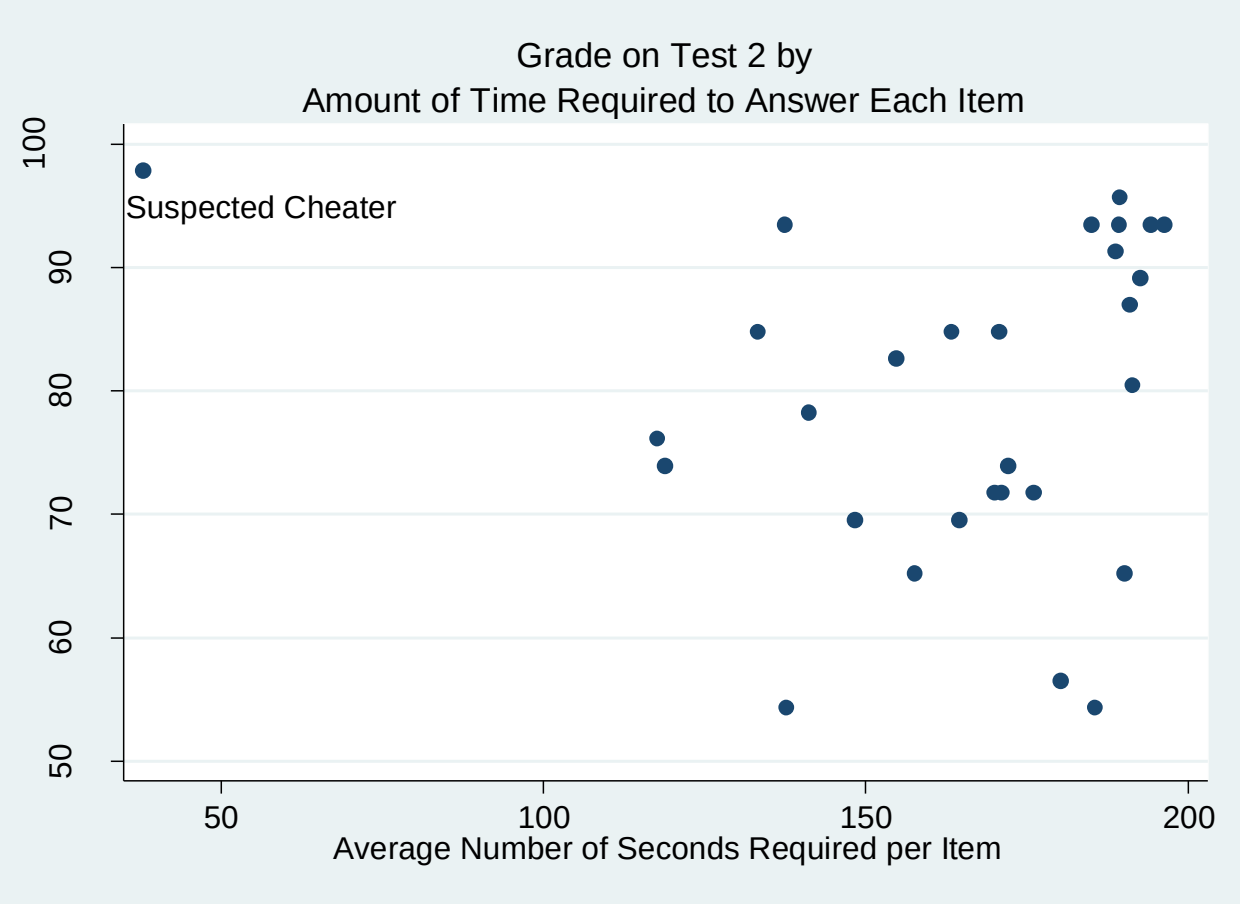
Scatterplots. These can be excellent ways to determine problematic data or outliers.

Example Scatterplot. What is the relation between Test 2 scores and the average time required to answer each item on Test 2?

Pearson r = -0.025

Very weak, slightly negative relation; the more time one takes to answer each question, the lower will be test scores.

How does this relation appear if plotted via a scatterplot?

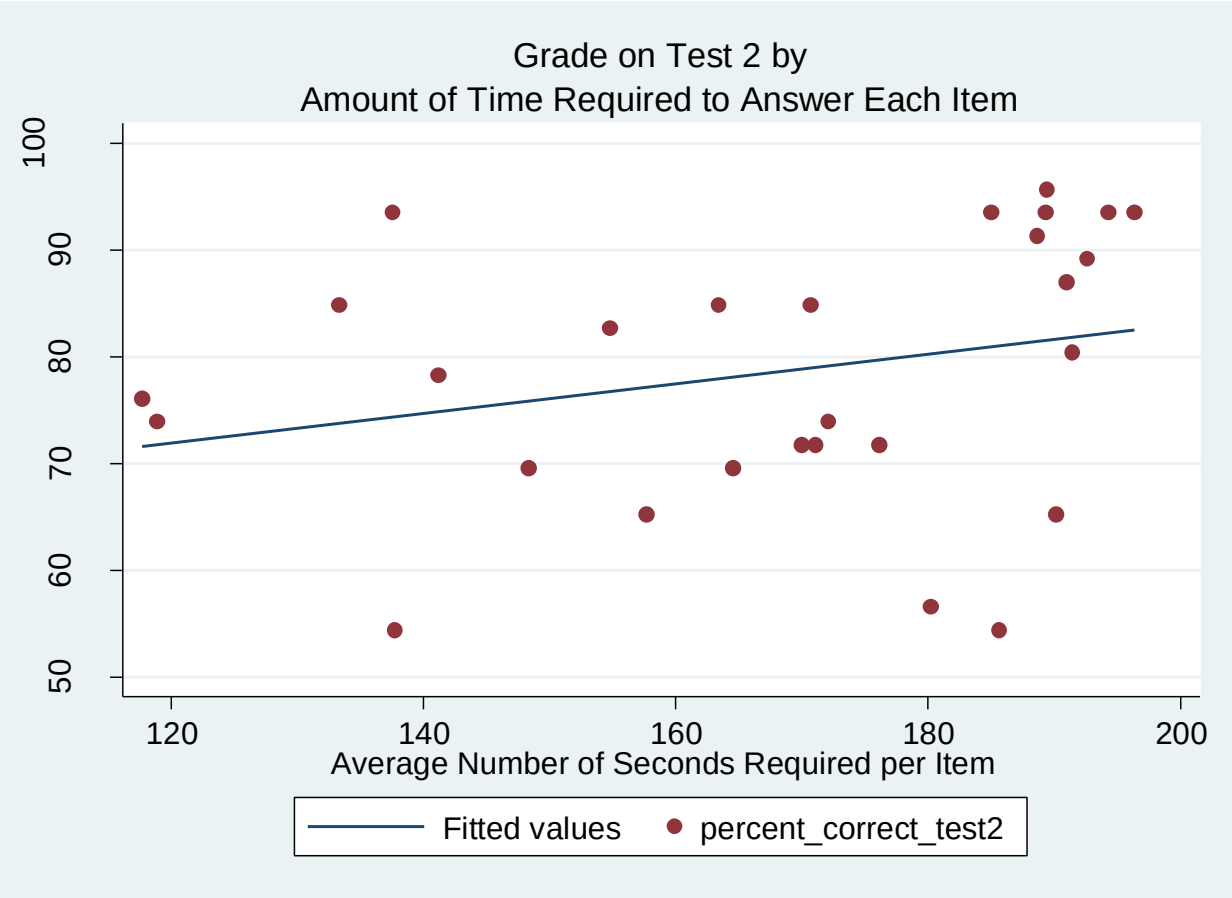


This scatterplot does not show much of a relationship, but it does show a clear outlier – an observation that differs greatly from all other observations.

What happens if the suspected cheater, the outlier, is removed from the analysis?

Pearson r = 0.26

Positive weak to moderate relation: the more time on test items, the higher are test scores.



Variable Scoring and Creation. Explain in chapter 4 the following:

- the process of scoring variables (e.g. use of raw data from responses or convert to scale scores),
- identification of special scoring procedures (e.g., items that must be reverse scored),
    - Formula: Reversed Score = (minimum score) + (maximum score) – actual score
- how missing data or problematic data were addressed,
- calculation of composite variables (e.g., summation of raw scores after reverse scoring, mean of items after reverse scoring, etc.),
- coding of categorical variables (e.g., dummy or contrast coding for regression), and
- any special coding needed beyond that described above (e.g., normalized gain scores).

Example 1. This example explains how a scaled variable (ranging from 1 to 5) with a non-scaled response (option 6) was recoded for statistical analysis.

"To assess instructor reputation, students answered this question: "Before taking this course, what did you hear about this instructor?" Reponses ranged from (1 "very bad" to 5 "very good", and 6 "didn't know about the instructor"). For statistical modeling purposes, responses were recoded into one of three categories: negative reputation (score of 1, 2, or 3; about 18.5% of respondents), positive reputation (score of 4 or 5; about 24.8% of respondents), and no reputation (score of 6; about 56.7% of respondents)."

Example 2. This example shows how one explains reverse scoring and formation of a composite variable.

"Perceived autonomy support was measured by student responses to three statements, "The instructor was willing to negotiate course requirements with students," "Students had very few choices in course requirements or activities that would affect their grade," and "The instructor made changes to course requirements or activities as a result of student comments or concerns." The response scale for each item ranged from 1 ("strongly disagree") to 5 ("Strongly agree"). The second item has reverse polarity from the other two items and was therefore reverse scored. The composite measure of perceived autonomy support was then formed by taking the mean response of the three items."

Descriptive Statistics. Present basic descriptive statistics for each variable included in analyses presented in Chapter 4. These may include the following.

- Categorical, Nominal, Qualitative Variables:
  - category counts/frequencies
  - category percentages
  - contingency (cross-classification) tables (e.g., 2x2 table of sex by test outcome [pass vs fail])
- Quantitative, Ordinal, Interval, Ratio Variables:
  - Central Tendency (mean, median, mode)
  - Variability (standard deviation, range, variance)
  - Maximum and minimum scores, maximum and minimum possible scores
  - Correlations among IV and DVs
  - Means on DVs across categories of IVs

Often such descriptive information is presented with analyses performed to answer research questions, so a separate presentation of descriptive statistics is not needed in this section.

Example 1. Table showing descriptive information for two categorical variables.

Questionnaire Item				
	Yes		No	
Do you have daily contact with parents?	n	%	n	%
	107	54.6	89	45.4
Is staying in contact with parents the reason for you having the following accounts?	n	%	n	%
Facebook	58	29.6	138	70.4
Email	47	25.3	139	74.7
Instagram	27	13. 8	169	86.2
Snapchat	18	9.2	177	90.8
Google+	3	1.6	186	98.4
Pinterest	3	1.5	192	98.5
Twitter	2	1.0	192	99
YouTube	1	0.5	191	99.5
My Space	1	0.5	185	99.5
LinkedIn	0	0.0	189	100
Tumblr	0	0.0	193	100
Yik Yak	0	0.0	191	100

Example 2. Table showing descriptive information for both qualitative and quantitative variables.

Participate Demographic Information	
Sex	
Female	N = 1324 (44.3%)
Male	N = 1669 (55.6%)
Age	
Female	Mean = 70.14 years (range = 3.0 to 105.0 years)
Male	Mean = 66.80 years (range = 2.2 to 105.0 years)

Source: Suiter, D., & Leder, S. (2007). Clinical Utility of the 3-ounce Water Swallow Test. Dysphagia, 23, 244-250.

3. Statistical Findings

Order of presentation:

(a) List the research question/hypothesis of interest (take then in order),
(b) explain which analysis was conducted to address that question/hypothesis,
(c) present results of the analysis, then
(d) move to next research question/hypothesis.

In short, organize results by research questions and hypotheses.

Presentation of Common Statistical Analyses.

Below are the following:

- Statistical analyses results should include both tabular and written presentations
- Example tables for commonly employed statistical procedures are provided below
- Inferential statements: tells reader whether you rejected or failed to reject the null hypothesis
    - Significant: means only that the null hypothesis, Ho, was rejected
    - Significant: does NOT mean something important was found
        - The correlation between X and Y was statistically significant; this means a relation between X and Y was found
        - The correlation was not statistically significant; this means a relation between X and Y was not found
- Interpretational statements: tell readers, in simple language, what the statistics mean
    - Statistic: Pearson r = -.45 between academic self-efficacy and test anxiety in mathematics
    - Interpretation: Students who were more confident in their mathematical skills tended to have lower levels of anxiety when taking a mathematics test

Correlations. Correlations, specifically Pearson's r, may be used to assess whether a linear relationship exists between two quantitative variables. A categorical variable with only two categories may also be included as part of a correlational study, although care must be exercised for interpretations. Pearson's r may range from -1.00 to 1.00, with these two extremes representing perfect and very strong relationships, and a value of 0.00 representing no linear relationship.

Table of Correlations. Table 1 below provides an example correlation matrix of results. The data represent Ed.D. students reported levels of anxiety and efficacy toward doctoral study, their graduate GPA, and sex.

Table 1. Correlations and Descriptive Statistics for Anxiety and Efficacy Toward Doctoral Study, Graduate GPA, and Sex of Student

	1	2	3	4
1. Doctoral Anxiety	---			
2. Doctoral Efficacy	-.43*	---		
3. Graduate GPA	-.24*	.31*	---	
4. Sex	-.11	.19*	-.02	---
M	3.20	4.12	3.92	0.40
SD	1.12	1.31	0.24	0.51
Scale Min/Max Values	1 to 5	1 to 5	0 to 4	0, 1

Note. Sex coded Male = 1, Female = 0; n = 235.

* $p < .05$.

Written Results. For inferential statistical tests, one should provide discussion of inferential findings (was null hypothesis rejected; are results statistically significant), and follow this with interpretation of results. The focus of this study was to determine whether anxiety and efficacy toward doctoral study are related, and whether any sex differences for doctoral students are present for anxiety and efficacy.

Pearson's correlations were calculated and results revealed that efficacy toward doctoral study was negatively and statistically related, at the .05 level of significance, to students' reported level of anxiety toward doctoral study, and positively related with students' sex. There was not a statistically significant relationship between student sex and doctoral study anxiety. These results indicated that students' who held higher levels of anxiety about doctoral study also tended to demonstrate lower levels of efficacy toward doctoral work. The positive correlation between sex and efficacy must be interpreted within the context of the coding scheme adopted for the variable sex where 1 = males and 0 = females. Since the correlation was positive, this means that males hold higher average efficacy scores than do females. Lastly, there was no evidence in this sample that anxiety toward doctoral study differs between males and females; both sexes appeared to display similar levels of anxiety when thinking about doctoral work.

Independent Samples t-test. Researchers use t-tests to determine whether sample groups appear to differ on some continuous (quantitative) outcome.

Table of t-test Results. Table 2 below shows mean differences on SAT verbal and mathematics subscales, and for GPA, by sex.

Table 2: Results of t-tests and Descriptive Statistics for SAT Verbal, SAT Math, and GPA by Sex

Outcome	Group						95% CI for Mean Difference		
	Male			Female					
	M	SD	n	M	SD	n		t	df
SAT-Verbal	463.81	98.89	45	532.21	101.23	44	-110.56, -26.24	-3.22*	87
SAT-Math	515.43	99.56	44	483.31	98.97	44	-9.95, 74.20	1.52	86
College GPA	2.71	1.32	45	3.16	1.16	44	-0.97, 0.07	-1.71	87

* $p < .05$.

***Written Results*.** As before, both inferential and interpretational components are needed to discuss results.

Results of the two-group t-test show a statistically significant difference, at the .05 level, in SAT verbal scores between females and males. There were no statistical differences, however, in SAT mathematics scores or grade point averages between the sexes. Descriptive statistics in Table 2 show that females scored higher on the SAT verbal subscale than did males. While this sample of students did demonstrate some mean differences between the sexes on the SAT mathematics subscale and college GPA, these differences can be attributed to sampling error and probably do not reflect true population differences between the sexes.

Chi-square (χ^2) Tests. Chi-square tests are used with qualitative (categorical) variables, and may be interpreted as a test of association (relationship) or difference.

Table of χ^2 Results. Table 3 below shows dropout status (in counts and percentages) by sex.

Table 3: Results of Chi-square Test and Descriptive Statistics for Dropout Status by Sex

Dropout Status	Sex	
	Female	Male
In School	70 (70%)	40 (40%)
Out of School	30 (30%)	60 (60%)

Note. Numbers in parentheses indicate column percentages.
$\chi^2 = 18.18$*, df = 1,
* $p < .01$

***Written Results*.** Again, include both inferential and interpretation information.

There was a statistical difference, at the .05 level of significance, in dropout status between females and males. Males were more likely to drop out (60%) than females (30%).

Analysis of Variance (ANOVA). ANOVA is used to compare a quantitative (continuous) outcome across two or more groups.

Table of ANOVA Results. Table 4 and 5 below show differences in teacher job satisfaction (scaled from 1 = low to 5 = high) across three levels of schools within a district.

Table 4: ANOVA Results and Descriptive Statistics for Teacher Satisfaction by School Type

School Type	Mean	SD	n
Elementary	4.33	0.72	15
Middle	3.11	1.23	18
High	2.53	1.45	15

Source	SS	df	MS	F
Group	25.47	2	12.73	9.12*
Error	62.84	45		

Note. R^2 = .28, adj. R^2 = .26.

* p < .05

Table 5: Multiple Comparisons and Mean Differences in Teacher Satisfaction by School Type

Comparison	Mean Difference	s.e.	95% CI
Elementary vs. Middle	1.22*	0.41	0.19, 2.25
Elementary vs. High	1.80*	0.43	0.73, 2.87
Middle vs. High	-0.58	0.41	-1.61, 0.45

* p < .05, where p-values are adjusted using the Bonferroni method.

***Written Results*.** Inferential and interpretation results.

All statistical tests were conducted at the .05 level of significance. Results of the analysis of variance, presented in Table 4, show that there were statistically significant mean differences in levels of reported satisfaction among teachers sampled from elementary, middle, and high schools. Table 5 displays all pairwise comparisons of teacher satisfaction among the three schools. These comparisons indicate that mean levels of satisfaction for elementary teachers were different from those reported by either middle or high school teachers, and there is no statistical evidence in this sample to suggest satisfaction levels differ between middle and high school teachers. Elementary school teachers sampled reported higher levels of satisfaction with their jobs than did either middle or high school teachers. There does not appear to be a difference in mean job satisfaction between middle and high school teachers.

Analysis of Covariance (ANCOVA). ANCOVA is used to compare a quantitative (continuous) outcome across two or more groups while also attempting to equate groups on possible confounding variables.

***Table of ANCOVA Results*.** Tables 6, 7, and 8 show differences in reading achievement among three types of instruction after taking into account students' level of reading performance, via a pretest, prior to instruction.

Table 6: Descriptive Statistics for Pre-treatment Measures by Instruction Type

Pre-measure	Type of Instruction								
	Cooperative Learning			Lecture			Self-guided		
	M	SD	n	M	SD	n	M	SD	n
Reading Pretest	45.75	11.13	5	41.83	15.43	4	46.67	13.33	5
Course Grade	86.88	8.89	5	89.25	9.56	4	88.17	10.12	5

Table 7: ANCOVA Results and Descriptive Statistics for Reading Achievement by Instruction Type

Type of Instruction	Reading Achievement			
	Observed Mean	Adjusted Mean	SD	n
Cooperative Learning	82.20	80.77	6.98	5
Lecture	87.25	88.21	8.96	4
Self-guided	76.00	76.67	9.77	5

Source	SS	df	MS	F
Pretest	492.29	1	492.29	15.14*
Instruction	298.73	2	149.37	4.59*
Error	325.26	10	32.53	

Note. R^2 = .705, Adj. R^2 = .617, adjustments based on prior achievement mean = 78.50

* p < .05

Table 8: Multiple Comparisons and Mean Differences in Reading Achievement by Instruction Type

Comparison	Mean Difference	s.e.	95% CI
CL vs. Lec	-7.44	3.88	-18.56, 3.68
CL vs. SG	4.10	3.65	-6.37, 14.57
Lec vs. SG	11.54*	3.83	0.55, 22.52

Note. Comparisons based upon ANCOVA adjusted means controlling for prior reading achievement mean of 78.50. CL = cooperative learning, Lec = lecture, SG = self-guided.

* p < .05, where p-values are adjusted using the Bonferroni method.

***Written Results*.** Both inferential and interpretational.

ANCOVA results show that student reading achievement varied by both type of instruction and prior reading performance. Both findings were statistically significant at the .05 level. After taking into account prior reading performance, students in the lecture group scored about 11 points higher in reading achievement than students in the self-paced group. Mean differences in reading achievement between cooperative learning and self-paced, and between cooperative learning and lecture, were not statistically significant. Findings from this study suggest that students read best after lecture instruction, although the difference observed in performance between students in the lecture group and students in the cooperative learning group were not large enough in this sample to show clear differences in favor of the lecture method. Students in the self-paced method of instruction tended to score

lowest, but differences in performance between cooperative learning students and self-paced students were small and could be explained as sampling error.

Regression. Regression is used to assess how one or more IVs relate to one quantitative (continuous) outcome. The IVs may be either qualitative or quantitative; regression and ANOVA/ANCOVA are mathematically linked and produce the same results although the presentation and interpretation may appear to be different.

***Table of Regression Results*.** Tables 9 and 10 show results assessing the relationship between achievement, the DV, and two predictors (two IVs), time spent studying and academic ability.

Table 9: Descriptive Statistics and Correlations among Achievement, Time, and Ability

Variable	Correlations		
	Achievement	Time	Ability
Achievement	---		
Time	.720*	---	
Ability	.866*	.472	---
Mean	84.500	4.833	5.667
SD	9.709	2.980	2.605

Note. n = 12

* p < .05

Table 10: Regression of Achievement on Time Spent Studying and Academic Ability

Variable	b	se	95%CI	t
Time	1.30*	0.437	0.31, 2.29	2.98*
Ability	2.52*	0.500	1.39, 3.65	5.05*
Intercept	63.90*	2.836	57.49, 70.32	22.54*

Note. R^2 = .874, adj. R^2 = .846, F = 31.27*, df = 1,9; n = 12.

*p < .05.

(or, the F ratio and df can be reported like this: $F_{1,9}$ = 31.27*)

***Written Results*.** Both inferential and interpretational.

> Both the correlation and regression results showed that achievement was positively, strongly, and significantly related at the .05 level to time spent studying and academic ability. In summary, the more time spent studying and the higher one's academic ability, the greater one's achievement.

4. Chapter 4 Summary

Provide a briefly summary of findings. Address the study's overall question, if one is present. If a specific analysis does not address the overall question, then explain how totality of findings address that question.

Chapter 5: Discussion

Many options exist for this chapter, so best to follow guidance of committee chair. Below are a few ideas to consider.

Restate study purpose and research questions/hypotheses or an abbreviated version of these.

Explain how findings in Chapter 4 address study purpose and research questions.

Use simple language so most readers can understand your findings. No need to repeat technical information presented in Chapter 4, instead, explain with general interpretations (e.g., the findings show that the more confidence one has, the less anxiety one experiences) unless there are particular findings/statistics that are important to restate (e.g. highly unusual or unexpected results).

Discuss findings

- Are findings consistent or inconsistent with your hypotheses? Explain how.
- For research questions, what was learned – what was answered?
- Are findings consistent or inconsistent with theory? Explain how; compare and contrast.
- Are findings consistent or inconsistent with prior research? Explain how; compare and contrast.
- Anything new learned?
- Anything unusual with your study?

When discussing findings, consider threats to validity of result interpretations

- Example: In a study comparing motivation and achievement of female and male students when offering words of encouragement, male students may have viewed these words as phony and without merit and therefore lost some interest in the instructional module that was part of a study.
- Example: Learned after the study the instructional treatment was not implemented fully by teachers in all classes.
- Example: Found that respondents consistently failed to answer a few key items on a questionnaire and therefore compromised measurement of some of the key constructs.

If you do find serious threats to the validity of your study, explain how these may have impacted study results and cautiously offer interpretation of results with these limitations in mind.

- Example: In a study comparing motivation and achievement of female and male students when offering words of encouragement, male students may have viewed these words as phony and without merit and therefore lost some interest in the instructional module that was part of a study. Therefore, the differences observed in motivation means between males and females may have resulted from the treatment, or may have resulted from male student reactions to perceptions of insincerity by the instructor.

Evaluate and interpret the results, but be objective – look carefully at results to determine if they are consistent or inconsistent with your expectations. This is one of the more common mistakes I see in studies.

If results are counter to what you expected, attempt to explain why this may be the case (i.e., anything unusual about your study, unusual about the sample of participants or settings, etc.).

Discuss theoretical and practical significance of your findings.

Any recommendations for practice in the field of your study?

Building on your study, make recommendations how the study could be improved for future research (e.g., address threats to internal or external validity, improve upon design or measures, include relevant confounding variables, consider other settings or groups to target for study).