Model Factors that Affect Mastery of Statistics on Psychology Students at University of Padjadjaran

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Abstract. This research is a causal study used to obtain a model of the influence of cognitive and non-cognitive factors which affect the mastery of statistics in psychology students from University of Padjadjaran. The cognitive factor studied is the mathematical thinking skill. The non-cognitive factors studied are the attitude and anxiety towards statistics. To obtain Mastery of Statistics, students must take a final exam in Statistics 2. The sample group of this research are college students from 2013 in the Faculty of Psychology at University of Padjadjaran. The data processing is done through path analysis. The result of this research shows that having mathematical thinking skills positively influences the mastery of statistics. The aspect of affect, cognitive competence, value and difficulty can negatively influence anxiety factors and other non-cognitive factors such as fearful behavior, hopes, demands, history, and self-concept. The aspect of effort positively influenced the student’s attitudes towards statistics while negatively influencing hopes and demands. Fearful behavior factors within anxiety factors towards statistics that will influence scores used to represent the mastery of statistics.

1. Introduction
College students have realized that statistics is an important tool for analyzing data, drawing conclusions, and is a basis for other subjects such as psychometrics, construction test, experimental psychology, research methodology, and thesis. However, that understanding and awareness is not enough to encourage students to master statistics. Many students have struggled applying statistics into other fields such as advanced experimental psychology. It is clear from the reluctant use and appraisal of statistics that students, specifically within advanced experimental psychology, see it as a difficult subject.

Previous studies conducted have focused on the attitude of students taking statistics which stated that “attitude” plays an important role in social psychology. Ajzen (1985) defines attitude as, “the disposition of the individual to respond positively or negatively to various aspects that can be separated from the world of the individual” where the world being mentioned is statistics. Various lectures and students within the field of statistics are convinced that one’s attitude towards statistics is very important. Students who feel and express a negative attitude can create an uncomfortable classroom atmosphere (Gal & Ginsburg, 1994). Attitudes on statistics will affect the achievement and use of applying statistics outside of the classroom.
However, the research conducted for this essay concludes that there is no relationship between the attitude students have about statistics and their success when studying for a mastery of statistics. Effort in changing the statistics curriculum into a more practical use method, also, has no effect on students’ attitudes towards the subject of statistics (Jatnika & Abidin, 2013). Since it is important to increase students within the mastery of statistics, other factors need to be explored besides the attitudes have towards statistics.

According Chiesi & Primi (2009), there are two major factors, cognitive and non-cognitive, that will influence the students participating in the mastery of statistics which are more psychological. This essay will explore those factors as the basis to help preparing programs, academic and non-academic, to improve students within the mastery of statistics.

Problem Identification:
Statistics is important to be mastered by students and graduates within the Faculty of Psychology however, the mastery of statistics still does not meet the learning objectives that have been set. Because this gap exists, it is important to do research about:

- What are the factors that influence the master of statistics oh psychology students at University of Padjadjaran?
- How do each factors influence psychology students trying to master statistics at University of Padjadjaran?

2. Method
This research is a causal study to obtain a model of influence of cognitive and non-cognitive factors on the mastery of statistics on psychology students at University of Padjadjaran.

The variables and measurements are:

- Cognitive Factor is the learning skill of students related to the way of receiving and processing information in learning process (Lee, et al, 2002). The cognitive factor studied is mathematical thinking skills. Mathematical thinking skill is measured by RA (Rechenaufgaben), one of subtest in IST (Intelligence Structure Test) (Liepmann et al, 2007).
- Non-cognitive Factor is the skills outside of a student’s learning skill which are related to psychology and environmental factors (Lee, et al, 2002). The non-cognitive studied is attitude and anxiety toward statistics. Attitude towards statistics measured by Student Attitude towards Statistics (SATS) which was developed by Schau (2003) and consists aspects:
  - Affect
  - Cognitive competence
  - Value
  - Difficulty
  - Interest
  - Effort
- Anxiety towards statistics measured by Statistics Anxiety Measure (SAM) which was developed by Earp (2007) and consists aspects:
  - Anxiety
  - Fearful Behavior
  - Attitude
  - Expectation
  - History and Self-Concept
  - Performance
- Mastery of Statistics is measured by students’ final scores in the course statistics 2. The mastery of statistics quantified by taking the final scores from Statistics 2 which is a combination of the midterm, final exam, quizzes, and assignments score.
The sample group of this research are 125 college students from 2013 in the Faculty of Psychology at University of Padjadjaran with the following courses finished:
- Statistics 1
- Statistics 2

The data is analyzed using:
- A trial phase was performed to determine the Psychometric Properties of the instrument. This was done by calculating the reliability and validity of the instruments.
- The hypothesis was tested by using path analysis to obtain a model of influence on cognitive and non-cognitive factors on psychology students participating in mastery of statistics at University of Padjadjaran.

3. Result and Discussion

Below are result of trial phase to determine the Psychometric Properties of the instrument:

### Table 1. Results from measuring SATS Instrument’s Reliability

| Aspect     | Alpha Cronbach |
|------------|----------------|
| Affect     | 0.844          |
| Cognitive  | 0.766          |
| Value      | 0.716          |
| Difficulty | 0.400          |
| Interest   | 0.828          |
| Effort     | 0.783          |

### Table 2: Results from measuring SATS Instrument’s Confirmatory Factors Analysis

| Goodness of Fit Methods                        | Coefficients | P   |
|------------------------------------------------|--------------|-----|
| Goodness of Fit Index                         | 0.89         |     |
| Root Mean Square Error of Approximation (RMSEA)| 0.017        |     |
| Chi-Square                                   | 9.26         | 0.32|

### Figure 1. SATS Instrument’s Confirmatory Factors Analysis

Based on the results from Table 1, Table 2 and Figure 1, it can be seen that the SATS measuring instrument is reliable and valid.

### Table 3. Result of SAM Measuring Instrument’s Reliability

| Aspect                             | Alpha Cronbach |
|------------------------------------|----------------|
| Anxiety                            | 0.882          |
| Fearfull Behavior                  | 0.825          |
| Attitude                           | 0.784          |
| Expectation                        | 0.723          |
| History & Self-Concept Factor      | 0.862          |
Table 4. Result of SAM Measuring Instrument’s Confirmatory Factor Analysis

| Goodness of Fit Methods                      | Coefficients | P       |
|----------------------------------------------|--------------|---------|
| Goodness of Fit Index                        | 0.931        |         |
| Root Mean Square Error of Approximation (RMSEA) | 0.196        |         |
| Chi-Square                                   | 27.50        | 0.0005  |

Based on the results from Table 3, Table 4 and Figure 2, it can be seen that the SAM measuring instrument is reliable and valid without performance aspect.

Below are the result of data processing:

Table 5. Result Track for SATS Influences on SAM (Fearful Behavior) with Backward Method

| Aspects   | Beta (Standardized Coefficients) | t     | p   |
|-----------|----------------------------------|-------|-----|
| Affect    | -0.177                           | -1.716| 0.090|
| Cognitive | -0.397                           | -3.849| 0.000|

Table 6. Result Track for SATS Influences on SAM (attitude) with Backward Method

| Aspects   | Beta (Standardized Coefficients) | t     | p   |
|-----------|----------------------------------|-------|-----|
| Affect    | -0.225                           | -2.496| 0.015|
| Cognitive | -0.257                           | -2.514| 0.014|
| Value     | -0.170                           | -1.766| 0.081|
| Difficulty| -0.368                           | -4.012| 0.000|

Table 7. Result Track for SATS Influences on SAM (Expectation) with Backward Method

| Aspects   | Beta (Standardized Coefficients) | t     | p   |
|-----------|----------------------------------|-------|-----|
| Affect    | -0.279                           | -2.845| 0.006|
| Cognitive | -0.483                           | -5.374| 0.000|
| Effort    | 0.449                            | 4.694 | 0.000|

Table 8. Result for SATS Influences on SAM (History and Self Concept) with Backward Method

| Aspects   | Beta (Standardized Coefficients) | t     | p   |
|-----------|----------------------------------|-------|-----|
| Affect    | -0.233                           | -2.700| 0.009|
| Cognitive | -0.480                           | -5.300| 0.000|
| Difficulty| -0.222                           | -2.536| 0.013|

Table 9. Result Track for SAM Influences on Mastering Statistics Subject with Backward Method

| Aspects   | Beta (Standardized Coefficients) | t     | p   |
|-----------|----------------------------------|-------|-----|
| Fearful Behavior | -0.277                         | -2.567| 0.012|

Figure 2. SAM Instrument’s Confirmatory Factors Analysis
Table 10: Result Track for Mathematical Thinking Skill on Academic Achievement with Backward Method

| Aspects | Beta (Standardized Coefficients) | t   | p    |
|---------|----------------------------------|-----|------|
| RA      | 0.352                            | 3.340 | 0.001 |

Table 5 through Table 10 are briefly displayed in Figure 1 below:

![Figure 3: Model Factors that Affect Mastery of Statistics on Psychology Students at University of Padjadjaran](image)

From this research, it can be inferred that mathematical thinking skill positively influences the mastery of statistics. This concludes that the higher the students’ skill to think practically by counting, reasoning and thinking consecutively in making inferences, the higher the statistics score they get. This idea is comprehensible because the materials and the problems in the statistics course under the Faculty of Psychology are related to thinking, counting practical-mathematically, and thinking consecutively skills in making inferences.

This research also proves the accuracy of the hypothesis because that the aspects of attitude toward statistics does influence the aspects of anxiety about statistics. The influence varies, but almost all of them are negative. The only positive influences is the influence of effort aspect of attitude toward statistics, on expectation aspect of anxiety about statistics.

Affect aspect on students regarding statistics, negatively influences anxiety factor, fearful behavior, hopes/demands, history, and self-concept. Which means, the more positive students feel about statistics, the lower students feel anxiety, fear, worry and have hopes/demands concerning statistics. It also means the more positive students feel about statistics, the more positive students’ self-esteem concerning statistics.

Cognitive competence aspect on students, negatively influence all anxiety about statistics factors. Which means, the more students judge themselves as knowing and skilled when applying statistics, the lower students feel anxiety, fear, and worry about statistics. This also means the more students judge themselves as knowing and skilled when applying statistics, the more positive attitude they have toward statistics, and the more positive their self-esteem concerning statistics. Value aspect on students toward statistics; negatively influence fearful behavior factor and students’ attitude toward statistics. This means, the more students judge statistics as useful, relevant, and beneficial for their personal and professional life matters, the lower they feel fear and worry about statistics and the more
positive attitude they have toward statistics. Difficulty aspect on students toward statistics, negatively influences fearful behavior factor, attitude toward statistics, and self-concept concerning statistics. Which means, the more students judge statistics are easy, the lower they feel fear and anxiety concerning statistics, the more positive attitude they have toward statistics, and the more positive self-esteem they have concerning statistics.

Interest aspect on students does not influence anxiety about statistics factors. Which means, the interest level students have on statistics does not influence their anxiety, fear, and worry about statistics, hopes/demands on statistics, and self-esteem they have concerning statistics. Effort aspect positively influences students’ attitude toward statistics and negatively influences hopes/demands. This means, the more effort the students put to learn statistics, the more positive their attitude toward statistics and the lower their comprehension on demands to mastery statistics.

Anxiety about statistics factor that influences scores that represent the mastery of statistics subject, is only fearful behavior factor. The relation is negative, which means the more the students are scared of statistics teachers, asking for help, and the more worried and tense they are, the lower their scores that represent the mastery of statistics subject.

4. Conclusions

- Mathematical thinking skill positively influence the mastery of statistics
- Affect aspect on students regarding statistics, negatively influences anxiety factor, fearful behavior, hopes/demands, history, and self-concept.
- Cognitive competence aspect on students, negatively influence all anxiety about statistics factors.
- Value aspect on students toward statistics; negatively influence fearful behavior factor and students’ attitude toward statistics.
- Difficulty aspect on students toward statistics, negatively influences fearful behavior factor, attitude toward statistics, and self-concept concerning statistics.
- Interest aspect on students does not influence anxiety about statistics factors.
- Effort aspect positively influences students’ attitude toward statistics and negatively influences hopes/demands
- Anxiety about statistics factor that influences scores that represent the mastery of statistics subject, is only fearful behavior factor.

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