MATH STUDY SKILLS AND ATTITUDE TOWARDS MATHEMATICS AND STATISTICS AS ANTECEDENTS OF STATISTICS LEARNING

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ABSTRACT

The study presents the antecedents of academic performance in a Statistics using data gathered from 129 student respondents. Majority are female with most of both parents having a college degree and have Statistics in their high school. A four-part questionnaire which elicits information on the profile, the Math study skills, the Math attitude and the attitude toward Statistics was used. Respondents were found to use study strategies in class and in Math tests. There is a belief that they could succeed in Math with study partners. Much effort is exerted to get good grades which is their motivation. Higher grades are achieved when respondents ask questions when confused, specifically from the instructor and when they have study partner in class. Working hard is significantly related to getting higher grades. Significant predictors (F=6.35, p=.000) of academic performance as shown in the final grade are with high school Statistics (p=.007), cognitive competence (p=.000), hours of study (p=.001), math study skills for tests (p=.002), attitude towards stat –difficulty (p=.047) and attitude towards stat – cognitive (p=.091).

Keywords: Attitude, Learning, Math, Statistics, Study skills

INTRODUCTION

Statistics is a course required in most undergraduate programs. It involves the collection, presentation, analysis and interpretation of data gathered through direct or indirect methods. Statistics is a structural method to solve a problem (Ashaari, Judi, Mohamed, & Wook, 2011).

While many teachers of statistics are likely to focus on transmitting knowledge, many students are likely to have trouble with statistics due to a lot of factors. Commonly connoted as a Mathematics course, a lot of students have a feeling of fear or anxiety towards the course.

For many students, mathematics, traditionally thought to be difficult and dull, is often considered inaccessible, generating a negative attitude

towards it.(Mammana & Pennisi, 2009). Student's attitude towards a course is important because it affects the entire learning process.(Judi, Ashaari, Mohamed, & Wook, 2011)

Cognitive (Ashaari et al., 2011) and non-cognitive factors contribute to student learning. Negative attitude can impede learning of statistics, or hinder the extent to which students will develop useful statistical intuitions and apply what they have learned outside the classroom. (Gal & Ginsburg, 1994 in Judi et al, 2011). Cognitive and non-cognitive factors could interrupt the learning process involved and hinder the students from using statistics daily.(Ashaari et al., 2011). Many students are likely to have trouble with statistics due to non-cognitive factors, such as negative attitudes or beliefs towards statistics. (Awan & Ullah, 2011), perception, interest, expectation and motivation.(Ashaari et al., 2011). A three-dimensional model of attitude towards mathematics that includes students' emotional disposition, their vision of mathematics, and their perceived competence.(Di Martino & Zan, 2011).

Learning environment and teacher's factor are two factors that need the institutions' consideration in producing students with positive attitude towards mathematics and statistics (Binti Maat & Zakaria, 2010). Students likewise exhibit moderate to high anxiety towards statistics leading to low performance in the course. Hagen et al (2013) reported a drop by approximately 40% by the end of the course. Team-based learning however could yield to a favorable outcome.

A large proportion of students identify statistics courses as the most anxiety-inducing courses in their curriculum. Many students feel impaired by feelings of state anxiety in the examination and therefore probably show lower achievements (Macher et al., 2013). Students with higher academic achievement were intrinsically motivated and used a wider variety of learning strategies more frequently (Stover, Hoffmann, De la Iglesia, & Fernández Liporace, 2014).

With the foregoing character of students towards studying Statistics, this study was conceptualized. Classroom observations have revealed a low percentage of students has the willingness and capability to learn the course.

Objectives of the study

This study aims to present the antecedents of academic performance in a Statistics course by attaining the following objectives:

1. To evaluate the level of Mathematics skills and the attitude towards Mathematics.
2. To determine the level of anxiety and motivation towards Statistics.
3. To evaluate the level of attitude towards Statistics.
4. To present the Statistics course grade as measure of academic performance.

5. To identify the significant predictors of academic performance.
6. To propose a model of Statistics learning.

METHODOLOGY

Data were gathered from 129 students enrolled in the Statistics class using a combination of researcher-made and adapted questionnaires.

Profile of the Respondents

Majority of the respondents are female (79%). Most of the respondents have both parents who are college graduates (37% for father and 46% for mother). Some of them are college undergraduates (25% for father and 26% for mother. Majority of the respondents are not honor students during their high school (64%), neither are they student leaders (59%). About 77% have Statistics in their high school.

Data Collection and Analysis

The questionnaire is of four parts. Part 1 is composed of 12-item measure of the personal and study profile of the students on a checklist form. Part 2 is a 37-item Math Study Skills Self Survey with five sub-scales measured using a four-point Likert scale and adapted from Hopper. The sub-scales are time and place for studying (6 item), study strategies for the class (11 items), Math tests (8 items), anxiety (4 items), and motivation (8 items).

Part 3 is a 20-item Mathematics Attitude Inventory measured using five-point Likert scale. . Part 4 is the Survey of Attitudes towards Statistics adapted from Schau, 2003 and consists of 36 items measured in six sub-scales on a 7-point Likert scale. The sub-scales are affective (6 items, r=.80), cognitive competence (6 items r=.77), value (9 items r=.74), difficulty (7 items r=.64), interest (4 items, r=.77), and effort (4 items, r=.73).

Data were summarized and presented using frequency distribution and weighted mean. Analysis was done using regression and correlation.

RESULTS AND DISCUSSION

Level of Mathematics skills and the attitude towards Mathematics.

On the dimensions of study skills, the use of study strategies in class and in Math tests has equally the highest mean of 2.23 interpreted as sometimes. Time and place for studying is lowest at 1.71.

Table 1. Mean rating of Math study skills

Math Study Skills	Mean
Time and place for studying	1.71
Study strategies in class	2.23
Math tests	2.23

Time and place for studying

The median response for all measures of time and place for studying is 2 interpreted as sometimes. Majority of the respondents sometimes study Math every day during the semester (74%), try to do homework immediately after class (60%), and update themselves with their Math homework (54%). They also have specific time (57%) and place (56%) to study Math. About four out of ten respondents almost never study Math eight to ten hours a week and one-fourth has never thought of studying Math that long.

Students who used more time and study environment management have lower anxiety and have more positive attitudes toward Statistics .(Kesici, Baloglu, & Deniz, 2011b). Learning environment and teacher's factor are two factors that need the institutions' consideration in producing students with positive attitude towards mathematics(Binti Maat & Zakaria, 2010)

Table 2. Mean and frequency of measures of time and place for studying

		Frequency			
Measures	Mean	Always	Some times	Almost never	Never thought of it
I am careful to keep-up-to date with Math homework.	2.07	35	70	18	4
I study Math every day during the semester.	1.81	8	95	20	6
I have a specific place with few distractions to study Math.	1.79	18	72	33	6
I have a specific time to study Math.	1.74	15	74	31	9
I try to start my homework immediately after Math class.	1.72	10	77	36	5
I study Math eight to ten hours a week.	1.16	6	40	50	32
Composite Mean	1.71				

Study strategies for class

The strategies almost always done by the respondents is to take notes in class (76%) and copy all the steps in Math problems (64%). Good learning are developed using productive learning strategies (Liu et al., 2014).

Most of the respondents also asks questions when confused in the lesson (49%) and try to determine exactly what confused them (40%). They sometimes would also read handouts before coming to class (65%) and would

work on problems until they are fully understood (55%). The respondents sometimes seek the help of the instructor (53%) and develop memory techniques (46%). The use of help seeking strategies is association with less Math anxiety (Kesici, Baloglu, & Deniz, 2011b).

Learning environment plays a significant role in the enjoyment of mathematics (Machted et al, 2012). A positive attitude enables students to develop statistical thinking skills, to apply knowledge acquired in everyday life, and to have an enjoyable experience throughout the course(Judi et al., 2011). Self-determined motivation explained academic achievement through the use of learning strategies (Stover, Hoffmann, De la Iglesia, & Fernández Liporace, 2014).

Table 3. Mean and frequency of measures of study strategies for class

Measures	Mean	Always	Some times	Almost never	Never thought of it
I take notes in class.	2.71	98	26	3	2
I am careful to copy all the steps of Math problems in my notes.	2.55	83	35	8	2
I ask questions when I am confused.	2.36	63	51	13	2
I try to determine exactly when I go confused and exactly what confused me.	2.30	51	68	8	2
I work problems until I understand them, not just until I get the answers.	2.29	48	71	9	1
I ask the instructor when I am confused.	2.28	49	68	11	1
I review my notes and text beginning the homework.	2.26	50	65	12	2
I develop memory techniques to remember Math concepts.	2.08	42	59	24	4
I use alternate resources (other books, internet).	1.99	35	63	26	5
I read my handouts before I come to class.	1.88	16	84	27	2
I use index cards for formulas and vocabulary.	1.82	29	55	38	7
Composite Mean	2.23				

Math tests

When taking exams, majority of the respondents would always make notes on formulas that are needed (52%) and begin with the easy questions first (51%). Most of them always preview the test before answering (47%) and consumes the time allotted for the test (45%). Most of them would sometimes (50%).

About half of them would sometimes check and rework as many problems as possible during the time given and when they get their papers back, would take note of the mistakes they had made in the exam.

Table 4. Mean and frequency of measures of math tests

Measures	Mean	Always	Some times	Almost never	Never thought of it
Before I begin, I make notes on things such as formulas that I might need.	2.47	67	55	7	-
I begin with the easy questions first.	2.39	66	51	8	4
I preview the test before I begin.	2.36	61	58	6	4
I take the full amount of time allotted for the test.	2.31	58	54	16	1
I carefully check or rework as many problems as I have time to.	2.26	49	65	12	2
I finish my test on time.	2.19	46	63	18	2
I keep-up-to-date, so I don't have to 'cram' the night before the test.	1.98	30	70	22	6
When I get my tests back, I note the types of mistakes I made: concept errors, application errors or careless errors.	1.91	31	65	24	9
Composite Mean	2.23				

Level of anxiety towards Statistics

There is always anxiety in succeeding in Math class in 48% of the respondents. Majority of them sometimes have study partners in Math class and have relaxation techniques (both at 57%), take practice tests (53%). In a study, it was reported that self-confidence affects mathematics attitude (Tapia

& Marsh, 2005; Mellisa & Doornekamp, 2004). Belief about self and emotions affects Math attitude (Di Martino & Zan, 2010)

Table 5. Mean and Frequency of Level of Anxiety towards Statistics

Measures of anxiety	Mean	Always	Some times	Almost never	Never thought of it
I believe that I can succeed in Math class.	2.40	62	59	6	2
I have study partners in my Math class.	2.06	34	74	16	5
I take practice tests.	1.90	29	68	22	10
I know several good relaxation techniques.	1.84	21	74	26	8
Composite Mean	2.05				

Level of motivation towards Statistics

Good grades is always the highest motivator in Statistics among 81% of the respondents. About half of the respondents always enjoy learning. Majority sometimes keeps on practicing how to solve problems and makes sure that he knows what homework to do and how to do it (53%). They sometimes put so much effort to study the lesson and believes that they could get better grades. For some, they would rather get through fast than have a perfect paper (43%) and eventually will give up an assignment if difficult (50%).

Studies have shown that when Math is found enjoyable it affects the student's motivation to learn (Ismail, 2009). Motivation predicts achievement in Mathematics (Singh et al, 2002) and is related to Math attitude (Tapia & Marsh, 2005). When students find the value of Mathematics, they are motivated to learn (Mettas, Karmiotis & Christoforou, 2006). Students' engagement in motivational regulation is a function of their existing motivational beliefs and attitudes.(Wolters & Benzon, 2013)

In another study, Yusuf (2011) said that there was a considerable correlation between self-efficacy beliefs, achievement motivation, and self-regulated learning strategies. In another case, many students are likely to have trouble with statistics due to non-cognitive factors, such as negative attitudes or beliefs towards statistics. (Awan & Ullah, 2011), perception and motivation.(Ashaari et al., 2011)

Table 6. Mean and frequency of level of motivation towards statistics

Measures of motivation	Mean	Always	Some times	Almost never	Never thought of it
Good grades are important to me.	2.79	104	23	2	19
I put so much effort to study the lessons.	2.41	59	64	6	1
I enjoy learning.	2.40	65	51	12	2
I could get better grades.	2.32	48	76	3	13
I keep practicing how to solve problems.	2.27	49	68	10	1
Before I leave class, I make sure that I know what homework to do and how to do it.	2.19	43	69	16	0
I'd rather get through fast than have a perfect paper.	1.69	23	55	37	0
I give up if an assignment is difficult.	1.53	12	64	34	2
Composite Mean	2.20				

Level of attitude towards Statistics

Results show the highest mean attitude on effort (mean of 5.54). The respondents expends an amount of work to learn Statistics. The respondents would attend every class session (78%), tried to complete all assignments (75%) and studied hard for every test (71%).

On the other hand, the respondents agree that the course difficult (mean of 4.75) as it entails a lot of computations (71%) and is a complicated course (52%). They also agree that learning the course requires a great deal of discipline(73%) since it is highly technical (57%) and one should be able to learn a new way of thinking to perform in Statistics (70%).

However, the level of interest is still sustained (mean of 4.68). 73% of the respondents are interested in learning the course, in understanding statistical information (62%), in being able to communicate using statistical information (50%) and in making use of Statistics (42%).

The cognitive competence (mean of 4.47 is a little higher than the affective competence (mean of 4.20). Majority of the respondents agree on the belief that they can learn Statistics (79%) and that they can understand statistical equations (69%) even though they find it difficult to understand the concepts (52%). 54% of the respondents said they like Statistics and 40% said they enjoyed taking the course. However there are also those who gets

frustrated when going over tests in class (44%) and when they have to solve problems (39%). Some of the respondents are scared by Statistics (39%) and are under stress during the class (34%). Nearly half of the respondents (49%) said that Statistics should be required in their professional training, although 22% said that it is not applicable in their profession and that it is not applicable outside of his job. 31% said Statistics is used in everyday life but 22% said it is irrelevant. The result is similar to a study where students only indicated moderate agreement with the idea that statistics would be useful and relevant to their careers (Hagen, Awosoga, Kellett, & Dei, 2013). Cognitive and non-cognitive factors could interrupt the learning process involved and hinder the students from using statistics daily.(Ashaari et al., 2011)

Table 7. Perceived mean level of attitude toward statistics

Attitude	Composite Mean
Effort	5.54
Difficulty	4.75
Interest	4.68
Cognitive	4.47
Affective	4.20
Value	3.68

There are six components in the assessment of students' attitude, i.e. affect, cognitive ability, value, difficulty, interest and effort.(Judi et al., 2011)

Related to this, Kadijevich (2008) explains how three dimensions can be distinguished in the items on mathematics attitude: ‘‘(1) self-confidence denotes perceived ease, or difficulty, of learning mathematics; (2) liking mathematics stands for student’s affective, emotional and behavioral reactions concerning liking, or disliking, mathematics; (3) usefulness of mathematics denotes student’s beliefs concerning the contribution of mathematics to his/her educational and vocational performance’’ (p. 330).

Ashaari et al. (2011) said that students showed a highly positive attitude in making necessary efforts to understand the subject better. Similarly, students with higher cognitive abilities have a tendency to be more positive in attitude towards Math (Van Damme, Opdenakker & Van den Broeck, 2004). When students find the value of Mathematics, they are motivated to learn (Mettas, Karmiotis & Christoforou, 2006). Cognitive factors also play significant roles in contributing to the capability of the students excelling the subject. (Ashaari et al., 2011). Mathematics interest is a significant predictor of Mathematics achievement (Singh et al, 2002).

Statistics course grade as measure of academic performance

Most of the respondents (17%) have satisfactory grade of 2.25 (84-86%). One respondent has excellent performance while 11 or about 9% have failing marks. The mean grade is 83 with a standard deviation of 8. Final grades are skewed to the lower grades (84 and below).

.Table 8. Distribution of respondents according to final grade

Final grade	Classification	Frequency	Percent
1.00 (99-100%)	Excellent	1	0.78
1.25 (96-98%)	Superior	6	4.65
1.50 (93-95%)	Exemplary	9	6.98
1.75 (90-92%)	Very good	14	10.85
2.00 (87-89%)	Good	10	7.75
2.25 (84-86%)	Satisfactory	22	17.05
2.50 (81-83%)	Fairly satisfactory	18	13.95
2.75 (78-80%)	Fair	17	13.18
3.00 (75-77%)	Passed	19	14.73
5.00 (Below 75%)	Failed	11	8.53

Test of Relationships

Correlation analysis reveals a significant relationship between the final percent grade and two measures of the study strategies, one measure of anxiety, and one measure of the attitude towards Statistics at 5 % level of significance. Higher grades can be achieved when respondents ask questions when confused (r=.177, p=.048) and ask the instructor specifically (r=.189, p=.034). Having a study partner in class (r=.197, p=.028) can also help in getting higher grades. When a student works hard in a course (r=.188, p=.035), it will result to higher grade.

This conforms with the findings that a significant relationship exists between student's attitudes and academic achievement (.(Macher et al., 2013) and the learning process (Judi, Ashaari, Mohamed, & Wook, 2011; Singh, Granville & Dika, 2002). Likewise, the relation between attitudes on the one hand and the learning and retention of statistics skills on the other was reported by Slootmaeckers, Kerremans, & Adriaensen (2014). It was also revealed that there is a considerable and positive change in their attitudes towards learning in groups (Hagen, Awosoga, Kellett, & Dei, 2013). Thus, having a study partner is a lot of help.

Significant predictors of academic performance.

Significant predictors (F=6.35, p=.000) of academic performance as shown in the final grade are with high school Statistics (p=.007), cognitive competence (p=.000), hours of study (p=.001), math study skills for tests (p=.002), attitude towards stat –difficulty (p=.047) and attitude towards stat – cognitive (p=.091). It was earlier found that competence predicts Math attitude (Di Martino & Zan, 2010).

IMPLICATIONS

Statistics learning is an interplay of several factors. These factors include individual attitude, the environment and the personal conviction to learn the course. Statistics like any other Math subject is better learned by practice and by dealing with it at a longer time. Getting help from peers and the teachers contributes in the increased level of performance. Results have shown the significant role of the cognitive competence of the student. Their basic belief of how good they are in the subject could possibly dictate their learning and understanding the subject. Students who initially have the feeling of avoidance and non-openness to learning usually end up with not so good record of performance. It is a challenge for teachers of Statistics to reorient the students to open themselves to learning the course.

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