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A Survey of Mongolian Secondary School Student's Attitude Toward Statistical Topic

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The goal of this study was to analyze students' views about statistical themes in Mongolian secondary schools in Ulaanbaatar. To this end, 129 9th grade students were stratified random sampling at two secondary schools in Ulaanbaatar, Mongolia, and a survey was conducted on them. The attitude survey focused on six factors contributing to the attitude: affective, cognitive competency, value, difficulty, interest, and student effort. The results show that students believed their statistical knowledge and skills have increased compared to the beginning of the courses. Furthermore, the survey revealed that they perceived statistics as neither an easy nor a difficult subject. Students' interest in statistics was neutral in general. These results suggest a need to develop effective and innovative statistical teaching and learning methods that can attract attention to statistical topics.

Key words : Mongolia, Statistics education, Statistics topic, Student's attitude

Ⅰ. INTRODUCTION

Statistics is tool that help make rational decisions in living in the age of uncertainty. However, many students tend not to recognize the importance and necessity of statistics. For this reason, statistics is accepted as one of the most difficult fields of mathematics for student. Therefore, encouraging students to have a positive attitude toward statistics has become one of the core goals of statistical teaching. After all, learning attitudes towards statistics has frequently been reported to have a central role in students' mastery of statistics. It was hypothesized that students with positive attitude towards statistics would achieve well in the statistical performances (Awaludina, Ab Razak, Harris & Selamat, 2015; Chiesi & Primi, 2015). Commonly, attitude is defined as a settled way of thinking or feeling about something (Oxford Learner's Dictionaries, 2021), or it can also be referred to the belief or feelings towards an individual, idea, object, matter or event.

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As you can see, there are several studies on statistical attitudes, but little is known about statistics in Mongolia. Preschool, primary, secondary education, technical and vocational education and training, and higher education make up Mongolia's educational system. The new structural reform of the school system shifted from a 4-4-2 system to a 5-4-2 system and eventually to a 5-4-3 system, in accordance with worldwide trends. Schools began serving 7-year-olds in the 2004-2005 school year, and the school entry age was dropped to 6 in the 2008-2009 school year (Yembuu, 2010). Mongolia's school system, which was previously based on a ten-year school, has been trending towards eleven years of education (Wikipedia, 2021), although the present education system is 12 years. The content as well as the characteristics of mathematics program has drastically changed in last twenty years based on the change of philosophy of society. The mathematics program shifted to mathematics standards. Not only the contents but also the pedagogical part of mathematics program has changed. Statistic's topic except probability was not included in the Mongolian Mathematics curriculum until 2017. Under the Mongolian Secondary School Standard Mathematics Curriculum, basic understanding of statistics course is starting from fifth grade (Curriculum Development Division, 2019). In ninth grade mathematics curriculum statistics topics are followed by; data, collecting statistical data, types of statistical graphs, scatterplots and correlation, measure of central tendency and problem solving. From the core curriculum of basic education to the core curriculum of senior secondary education, ninth grade is a critical time.

However, as mentioned there is not much evidence to indicate research conducted to investigate students' attitude towards statistics in Mongolian schools. In a comparative study which evaluated seventh grade students' achievements in mathematics urban and rural schools in Ulaanbaatar Mongolia, it was discovered that students in urban schools outperformed better than in rural schools (Bolormaa & Tsetsegjargal, 2018). In an affiliated research conducted on 90 eleventh grade students in Darkhan-Uul, Mongolia, were discovered to having positive attitudes towards mathematics. As these studies measured just achievement in mathematics and attitudes toward mathematics, a crucial question was raised: How is the secondary school students' attitudes towards statistics' topic? The research questions guiding this research were:

What is the level of student's attitude towards statistics topic in secondary schools?

Are there any differences in students' attitude towards statistics based on gender?

Candace Schau Professor Emeritus at Arizona State University generated the Survey of Attitudes Toward Statistics (SATS) to measure students' attitudes and approaches towards their statistics' topic and how they affect teaching and learning. The SATS-28, first version of the survey used twenty-eight items to measure four important components which are: Affect, Cognitive Competence, Value, and Difficulty. The Affect component assesses students' positive and negative feelings towards statistics, whereas the Cognitive Competence scale assesses students' attitudes about intellectual knowledge and skills as they relate to statistics. The Difficulty scale assesses the difficulty of statistics as a subject, whereas the Value scale reflects its relevance, application, and worth. Later, SATS-36 a six factor model was created. This modernized version has thirty-six items to measure six components. The first four were from the original survey and Interest and Effort components were added. Each question is measured on a 7-point Likert scale,

with higher responses matching to more positive attitudes (Bond, 2007). The SATS-36 model was employed to get answers to our research questions. The SATS survey is planned to be delivered to students at the beginning and at the end of the statistics topic to measure how their attitudes changed over time. It is desirable to see positive differences to show that students' attitudes increased after taking a statistics topic. Instructors can use the outcomes to assess which kind of attitude is deficient and where to develop their teaching style. For instance, if students have a large decrease in the Value component, instructors can use new methods to show the importance of statistics in a student's life. Understanding the statistics subject is complicated not only by non-cognitive elements such as attitude, perception, interest, anticipation, and motivation, but also by cognitive factors such as a student's academic ability to perform well in the subject (Ashaari, et al., 2011). These two elements have the potential to hinder the learning process in statistics and prevent the abilities from being used in daily work (Ashaari et al., 2011). Therefore, in this study, students' attitude observation was performed using SATS as a method to investigate these problems.

Ⅱ. LITERATURE REVIEW

One of the foremost goals in statistical teaching is developing a positive attitude towards statistics among the students. In any case, learning attitudes towards statistics have frequently been stated to have an essential role in students' mastery of statistics. It was assumed that students with positive attitude towards statistics would perform better in the statistical performances (Awaludina, et al., 2015; Chiesi & Primi, 2015) In general, attitude is well-defined as a stable way of thinking or feeling about something, and it can also be raised to the belief or feelings towards an individual, idea, object, matter or event. Currently, attitude is defined by Fishbein and Ajzen (2010) as a tendency to respond on a mental object with some degree of favorableness or unfavorableness.

According to Garfield and Ben-Zvi (2008), statistics is considered as a challenging subject to learn for the reason of the difficulty of statistical concepts. Understanding of statistical concepts is unlike from understanding the procedure of statistics which involves plugging numbers into the correct formula. Students who can understand the statistical concepts have the ability to read and use tools such as measures of spread, central tendency and variability, percentage, ratio, as well as tables and graphs (Australian Bureau of Statistics, n.d.).

The major goal of statistics education is to encourage a positive attitude towards learning besides to advance students' ability of understanding of statistics (Liau, Kiat & Nie, 2015). A positive attitude towards learning is important to master the core content of the subject matters under study (Ghulami, Ab Hamid, & Zakaria, 2015). In tandem, statistics instructors believe that attitudes toward statistics are important in the process of learning (Mahmud, 2010). Ashaari, et al., (2011) emphasizes the importance of assessing students' attitudes towards statistics in order to stimulate the students to understand the statistics concept, improve their skills in statistics and to

enjoy the knowledge in their everyday lives. Students who have a negative attitude towards this subject will have difficulty in learning the topic effectively.

The first instrument to measure attitude toward statistics, the Statistics Attitude Survey (SAS) was developed by Roberts and Bilderback in 1980. This instrument was designed to be unidimensional, with 33 homogeneous items. Since that time, two other broadly used instruments measuring attitudes toward statistics and statistics anxiety have been developed, the Attitudes Toward Statistics Scale (ATS; Wise, 1985), and the Survey of Attitudes Toward Statistics Scale (SATS; Schau, Stevens, Dauphinee, & Del Vecchio, 1995). Students' attitudes about the use of statistics in their fields of study are measured in the first domain, which is tested on the Attitude Toward the Field of Statistics subscale. Measuring the students' attitudes toward the statistics courses in which they are enrolled was the second instrument, the Attitude Toward the Course subscale.

The majority of the few studies that have looked at attitude transformation have found that at least certain aspects of attitudes improve across statistical courses. (e.g., Roberts & Saxe, 1982; Waters, Martelli, Zakrajsek, & Popovich, 1988; Harlow, Burkholder, & Morrow, 2002). However, some of the studies found no change in attitude components (Green, 1993; Rhoads & Hubele, 2000). According to Schau (2000), one attitude component increased while two others decreased. Cashin & Elmore (1997) concluded that the ATS was the most frequently examined instrument, the SAS was the first instrument produced, the SATS, on the other hand, was the most recent and least researched in a review of measures used to evaluate attitude toward statistics.

In one study on the most recent version, SATS-36, the presupposed six-factor solution was supported by confirmatory factor analysis (Tempelaar, van Der Loeff, & Gijselaers, 2007). The Affect and Cognitive Competence factors, on the other hand, appeared to be extremely closely correlated, and the Difficulty variable was moderately to strongly correlated with above two variables. These findings overlap with the empirical studies on the SATS-28 (Chiesi & Primi, 2009; Cashin & Elmore, 2005). In the above studies, correlations for Affect and Cognitive Competence ranged between -0.85 and 0.96, for Affect and Difficulty components it ranged between 0.52 and 0.78 for, and for Cognitive competence and Difficulty components appeared to be between 0.49 and 0.63.

One of the purpose of this research include gender differences in attitudes toward statistics topic. There is a lot more research on gender differences. About one half of the studies that have inspected gender differences stated that boys expressed more positive attitudes toward statistics (e.g., Auzmendi, 1991; Roberts & Bilderback, 1980; Roberts & Saxe, 1982; Waters et al., 1988); these differences usually were minor. The others have found no attitude differences toward statistics between boys and girls (e.g., Cherian & Glencross, 1997; Sutarso, 1992; Tomazic & Katz, 1988; Wisenbaker & Scott, 1997; Schau, Dauphinee, & Del Vecchio, 1992). A few studies have informed more positive attitudes for girls on one scale but not on the others (Rhoads & Hubele, 2000; Zeidner, 1991) or at one time of administration but not at the other (Rhoads & Hubele, 2000).

Ⅲ. METHODOLOGY

Even though many students dislike mathematics, statistics and numbers in general, it is mandatory for most major fields of study, for instance, psychology, biology, and marketing. Students with negative attitudes are more likely to academically perform worse, resulting in unwillingness when solving statistical problems (Nolan, Beran, & Hecker, 2012). To evaluate students' attitudes towards their statistics' topic, we have used the Survey of Attitudes Toward Statistics (SATS) by Candace Schau (Schau et al., 1995).

The SATS-36 survey questionnaire covers 36 questions that examine six attitude components towards statistics lesson. SATS-36 survey questionnaire items and Scoring Guide are available at the following website (Schau, n.d.). Sub-defined components, definitions of each six components, sample pretest items and number of questions are presented in <Table Ⅲ-1>.

<Table Ⅲ-1> SUB-DEFINED COMPONENTS, DEFINITIONS, EXAMPLE QUESTIONS AND NUMBER OF QUESTIONS OF SATS

SATS-36 Components	Definition	Example question	Number of questions
Affect	Perspectives of students concerning statistics: Positives and negatives	I will be under stress during statistics class.	6
Cognitive competence	The attitudes of students about their academic abilities and knowledge when it comes to statistics	I will find it difficult to understand statistical concepts.	6
Value	Students' attitudes towards the importance, value, and use of statistics in private and professional lives	Statistical skills will make me more employable.	9
Difficulty	The students' perceptions of how difficult statistics lessons are	Statistics involves massive computations.	7
Interest	The degree of personal interest students have in statistics	I am interested in understanding statistical information.	4
Effort	How much time and work is spent learning statistics by the student	I intend to finish all of my statistics homework.	4

On a 7-point Likert scale, students answer "Strongly Disagree," "Neither Disagree nor Agree" (neutral or no attitude), and "Strongly Agree" to each of the 36 questions. A student who gives a higher numeric response to an item is more likely to respond positively than one who gives a lower response. In both cases, the student's score is based on the mean of the responses for all items assessing that aspect of their attitude. In order to receive a component score, students must answer all questions in a component. For all components of positive attitudes, except Difficulty, the meaning is clear. Difficulty scores indicate the extent to which students think that statistics is

easy or difficult, whereas higher scores indicate the degree to which they think it is difficult.

A pilot study of 129 ninth grade students of 84th secondary school and 53rd secondary schools of Ulaanbaatar were conducted in April 2019 (pretest) and again in May 2019 (posttest) in Ulaanbaatar Mongolia. 52% of them are female students and remainder of male students as shown in <Table Ⅲ-2>. Students were approached during the first week of April and asked to complete the SATS right before statistics topic begin. Then students were asked to complete the SATS again at the end of May right after they finish the statistics topic. Each instructor providde the final grades at the conclusion of the lesson.

<Table Ⅲ-2> THE FREQUENCY OF RESPONDENTS

Gender	Frequency	Percentage (%)
Male	62	48
Female	67	52
Total	129	100

It is essential to assess the internal consistency of any sample before interpreting its results, which is often measured by Cronbach's coefficient alpha. The pretest and posttest alpha values showed that all six components showed good to excellent internal consistencies <Table Ⅲ-3>.

<Table Ⅲ-3> CONSTRUCTION OF CRONBACH'S ALPHA VALUES VIA ATTITUDE FOR STATISTICAL PRETEST AND POSTTEST SCORE

Attitude Component	Pretest	Posttest
SATS Affect	0.74	0.82
SATS Cognitive	0.81	0.85
SATS Value	0.83	0.84
SATS Difficulty	0.84	0.88
SATS Interest	0.81	0.89
SATS Effort	0.78	0.84

SATS=Survey of Attitude Toward Statistics

Ⅳ. FINDINGS

To define where improvement was made, the researcher studied the six subscales within the survey. Affect, cognitive competence, value, difficulty, interest, and effort are the six subscales. On <Table Ⅳ-1> you will find the means and standard deviations of both pretest and posttest subscales, as well as the change scores. Improvement was seen in three out of six subscales, including affect, cognitive, and value. The means for the difficulty (3.57, 3.59), interest (3.51, 3.53) subscales are remained about the same, but the mean for effort subscale (4.64, 4,42) has decreased. In general, students' feelings concerning statistics have been improved and also now they believe that their knowledge in statistics have increased compared to the beginning of their

subject. At the end of the statistics; topic students are still neutral in their interest in statistics. They still believe that statistics topic wasn't easy or difficult. However, they stated they valued statistics and expended a great deal of effort, but not as much as they had intended at the outset. According to the paired-samples t test analysis, five of the six components had small p-values (<0.05), indicating that there were significant changes in students' attitudes. The only component with a non-significant change (p value = 0.107) was Effort. It is also worth noting that Effort is the only component with a 95% confidence interval that includes zero, which means this is an another indicator that no significant change has occurred. It can be interpreted that we are 95% confident that the mean change between the pre and posttest scores is between a 0.01 and a 0.13 increase in students' attitudes for the interest component.

<Table Ⅳ-1> MEAN AND STANDARD DEVIATIONS FOR PRETEST, POSTTEST, AND CHANGE SCORE WITH RELATION TO ATTITUDE

Attitude component	Pretest		Posttest		Change		95% Confidence Interval for the Difference	p-value
	M	SD	M	SD	M	SD		
SATS Affect	3.55	0.77	4.71	1.04	0.76	1.18	(0.15, 1.21)	0.027
SATS Cognitive	4.43	0.77	4.66	1.23	0.23	1.40	(0.11, 0.34)	0.032
SATS Value	4.89	0.72	4.99	1.60	0.10	1.35	(0.07, 0.39)	0.013
SATS Difficulty	3.57	1.14	3.59	0.95	0.02	0.92	(0.01, 0.17)	0.049
SATS Interest	3.51	0.87	3.53	1.82	0.02	1.03	(0.01, 0.13)	0.006
SATS Effort	4.64	1.32	4.42	1.79	-0.22	1.16	(-0.38, 0.31)	0.107

SATS=Survey of Attitude Toward Statistics

The following <Table Ⅳ-2> summarizes the posttest mean scores under affective attitude. Respondents indicated whether they agreed or disagreed with the component's items. Several of the statements such as items Q3(mean=4.55), Q4 (mean=5.01), Q15 (mean=4.88), Q18 (mean=5.12) and Q28 (mean=4.69) have shown a positive attitude. In question number eighteen which is "I don't feel stressed in my statistics class" students have answered with the highest mean score. A neutral attitude was displayed for statement Q19 with a mean of 4.01 which means students are neither agree nor disagree to the question "I enjoy taking statistics subjects".

<Table Ⅳ-2> MEAN SCORES FOR AFFECTIVE COMPONENT

Affective Attitude Component	Mean	Average result
Q3. I like statistics	4.55	Rather agree
Q4 When I'm asked to tackle a statistical problem, I'm not intimidated.	5.01	Rather agree
Q15. When I go through the answers to my statistics test in class, I'm not disappointed.	4.88	Rather agree
Q18 In my statistics class, I am not stressed	5.12	Rather agree
Q19. I enjoy taking statistics subjects	4.01	Neither agree, nor disagree
Q28. I am not afraid of statistics	4.69	Rather agree

The posttest mean score for each item in the cognitive competence attitude component is shown in <Table Ⅳ-3>. Students have shown a positive attitude for items Q31 (mean=5.58), Q32 (mean=5.62) and Q11 (mean=4.77) and neutral for item Q35 (mean=3.86). Students have shown highly positive attitude to the question number thirty-two, "I will understand statistics equations". A negative attitude was shown for items Q5 (mean=3.41) which means students do face problems in statistics because of their thinking style.

<Table Ⅳ-3> COGNITIVE CAPABILITY COMPONENT MEAN SCORE

Cognitive Capability Attitude Item	Mean	Average result
Q5. Because of my cognitive style, I have no difficulty with statistics.	3.41	Rather disagree
Q11. I know what is happening in statistics.	4.77	Rather agree
Q26. In statistics, I don't make many conceptual or numerical errors.	4.69	Rather agree
Q31. I can learn statistics.	5.58	Rather agree
Q32. I will understand statistics equations.	5.62	Rather agree
Q35. I don't find statistical concepts difficult to grasp	3.86	Neither agree, nor disagree

The posttest mean score for value component is shown in <Table Ⅳ-4>. The respondents gave a positive response towards item Q7 (mean=5.43), Q9 (mean5.=38), Q10 (mean=5.41) and Q16 (mean=5.36) and rest of the responses were all neutral. Students have given highly negative response to the question number seven, "Statistics is worthless." Though students have showed no negative responses towards value attitude items. To put it another way, students are having neutral knowledge of the use, relevance, and impact of statistics in their private and professional lives.

<Table Ⅳ-4> THE VALUE COMPONENT MEAN SCORE

Value Attitude Item	Mean	Average results
Q7. Statistics is worthless.	5.43	Rather agree
Q9. My studies should include statistics as a requirement.	5.38	Rather agree
Q10. Statistical skills will make me more employable.	5.41	Rather agree
Q13. Statistics is useful in my field of study.	5.35	Rather agree
Q16. Statistics is important in my daily life in addition to for academic purposes.	5.36	Rather agree
Q17. I use statistics in my daily life.	4.48	Neither agree, nor disagree
Q21. I often make decisions based on statistics.	4.41	Neither agree, nor disagree
Q25. I will use statistics in my future career.	4.49	Neither agree, nor disagree
Q33. Statistics is relevant for my life.	4.47	Neither agree, nor disagree

Regarding the posttest mean score for difficulty component, the students exhibited no positive response towards difficulty attitude items <Table Ⅳ-5>, neutral towards items Q6 (mean=3.86), Q8 (mean=3.51), Q22 (mean=3.57), Q24 (mean=4.01), and Q30 (mean=3.99). A negative response was given for item Q34 (mean=3.19) and Q36 (mean=3.12). Students are almost disagreeing to the opinion that statistics is not too technical and it needs new way of thinking to study statistics.

<Table Ⅳ-5> MEAN SCORES FOR DIFFICULTY COMPONENT

Difficulty Attitude Item	Mean	Average results
Q6. Statistics formulae are easy to understand.	3.86	Neither agree, nor disagree
Q8. Statistics is not a difficult topic.	3.51	Neither agree, nor disagree
Q22. Statistics can be quickly learned by most people.	3.57	Neither agree, nor disagree
Q24. Learning statistics does not require discipline.	4.01	Neither agree, nor disagree
Q30. Statistics does not involve too much calculation.	3.99	Neither agree, nor disagree
Q34. Statistics is not too technical.	3.19	Rather disagree
Q36. To study statistics, the least amount of new thinking is required.	3.12	Rather disagree

The students were found to show a neutral level of interest towards the statistics subject based on the posttest response given <Table Ⅳ-6>. Students have exhibited no positive responses toward interest attitude item, neutral for statements Q12 (mean=3.52), Q20 (mean=3.57) and Q23 (mean=3.61). Meanwhile negative attitude was shown for item Q29 (mean=3.43). From the mean score for interest component we can conclude that students are not likely interested in learning statistics topic in mathematics lesson.

<Table Ⅳ-6> INTEREST COMPONENT MEAN SCORE

Interest Attitude Item	Mean	Average results
Q12. I'm interested in communicating with others on statistical data.	3.52	Neither agree, nor disagree
Q20. I am interested in using statistics.	3.57	Neither agree, nor disagree
Q23. I am interested in understanding statistical information.	3.61	Neither agree, nor disagree
Q29. I am interested in learning statistics.	3.43	Rather disagree

The mean posttest scores for each component of the student's effort in the statistics lesson are shown in <Table Ⅳ-7>. They have given a positive response towards Q1 with a mean of 4.57, Q14 with a mean of 4.59 and Q27 with a mean of 4.53. A neutral attitude was displayed for statement Q2 with mean of 4.01. From the mean score for effort component we can conclude that students have good level of intentions to study hard for each statistics test.

<Table Ⅳ-7> EFFORT COMPONENT MEAN SCORE

Effort Attitude Item	Mean	Average results
Q1. I have intentions to finish all my statistics homework	4.57	Rather agree
Q2. I have intentions in striving for excellence in the topic of statistics	4.01	Neither agree, nor disagree
Q14. For each statistics test, I want to study diligently.	4.59	Rather agree
Q27. I intend to attend every lecture on the subject of statistics.	4.53	Rather agree

The Independent Sample t-Test analysis based on the results in <Table Ⅳ-8> discovered that there was no significant difference in students' attitudes about statistics depending on gender (t=1.399, df=127, p=0.172). Similarly, the results of the Independent Sample t-Test analysis <Table Ⅳ-9> also shows there were no significant difference in students' attitude towards statistics components between female and male students. Even though the mean score showed that the female students exhibited a more positive attitude in all the attitude components compared to

the male students, however, the differences were insignificant.

<Table Ⅳ-8> INDEPENDENT SAMPLE T-TEST ANALYSIS FOR THE DIFFERENCES IN STUDENTS' ATTITUDE TOWARDS STATISTICS BASED ON GENDER

Gender	n	M	SD	t	p
Female	67	3.589	0.471	1.399	0.172
Male	62	3.412	0.538		

<Table Ⅳ-9> INDEPENDENT SAMPLE T-TEST ANALYSIS FOR THE DIFFERENCES OF STUDENTS' ATTITUDE TOWARDS STATISTICS COMPONENT BASED ON GENDER

Component	Gender	n	M	SD	t	p
Affect	Female	67	4.812	0.638	0.925	0.723
	Male	62	4.627	1.109		
Cognitive Competence	Female	67	4.728	0.702	1.328	0.158
	Male	62	4.591	0.732		
Value	Female	67	4.997	0.911	0.322	0.103
	Male	62	4.978	1.047		
Difficulty	Female	67	3.643	0.822	0.398	0.682
	Male	62	3.532	1.073		
Interest	Female	67	3.549	1.099	1.109	0.256
	Male	62	3.508	1.091		
Effort	Female	67	4.501	1.009	1.726	0.136
	Male	62	4.342	1.276		

Ⅴ. CONCLUSION AND DISCUSSION

The results of this study confirmed the importance of students' pre and posttest attitudes toward statistics lesson (Table Ⅳ-1). From the data analysis we can conclude students nearly disliked statistics at the beginning of their statistics lesson. They believed statistics would be neither simple nor difficult on average, and they had some appreciation for statistics. They almost believed they could learn statistics. They were slightly more interested in statistics than they were not, with roughly half of the parts being indifferent. Finally, despite the fact that they find this subject is challenging, they have made a significant effort to comprehend the notion of statistics.

At the end of their statistics topic students' feelings concerning the importance of statistics is increased. On average, they believed their knowledge and skills have increased a little bit compared to the beginning of their courses. They continued to assume that statistics was not an easy or challenging subject. Unfortunately, they were now obviously moderate in their interest in statistics in general, even though some portions that had previously shown neutral opinions were

now disinterested. They still appreciated statistics and indicated that they put up a lot of effort, but not as much as they had expected at the start of their topic. At the pretest, difficulty attitudes were neutral on average and effort attitudes were high compared to the difficulty component. However, there was no change in Difficulty views after the posttest, but there was a drop in Effort attitudes. This may be acceptable. However, we wanted some improvement in other four components. Instead, on average, we found almost no changes in Cognitive Competence attitude and not enough increase in Interest attitudes. But there has been great increase in the Affect attitudes which means students' feelings concerning the importance of statistics is increased.

The majority of the questions in the interest, effort, and difficulty components showed a negative attitude toward statistics. As the interest component assesses the student's level of individual interest in statistics, the results have shown that the students are not much interested in learning and using statistics, and also students aren't as interested as they should be in being able to communicate statistical data to others. On the other hand, effort measures how much effort a student puts in to learn statistics, students were found to be not planning to work hard in statistics class but also not planning to attend every statistics class. The results show that the students have given not enough effort and are almost not prepared to learn statistics course even though they feel that this course is relevant to their subject of study as well as their future professional goals.

To make this course interesting and enjoyable for the students, rather than frustrating, the academic staff must pay close attention to their perspectives and attitudes toward the experience of learning statistics. Instructors must be aware of how students' behaviors change as a result of their learning experience and the impact of their success, as well as efforts to increase their knowledge and attempts to use statistical knowledge and abilities in their daily lives. The most vital thing is to get students like the lesson and make them interested in statistics. If students start to get interested in learning statistics topic, sooner or later they will start to provide some effort and probably will be thinking that statistics topics are not that difficult to understand.

Future research should be conducted to develop an appropriate approach for academic staff to balance the students' attitudes and perceptions of this lesson. To motivate students to understand and utilize statistics, instructors must make every effort to make teaching and learning more engaging, as well as to connect the concepts being taught to the students' daily lives and fields of study.

Moreover, if the students are more positive about their knowledge and skills applied to statistics, the better their understanding will be of statistical concepts. According to Millar and Schau (2010), even though students show high effort were still unable to influence their achievement in statistics. This is because the students who were hardworking could only affect the achievement if they had the suitable learning techniques in their studies. Besides that, students who struggled and had difficulty to learn statistics had a lower understanding of statistical concepts. Previous studies also revealed that the difficulty component could influence students' achievement in statistics (Cashin & Elmore, 2005).

Based on students' pre and post-attitude tests, the findings of this study will be a report on

current Mongolian students' attitudes toward statistics. In addition, this study found no evidence that male and female students vary in attitudes toward statistics topics. This finding has been reported in a variety of studies (Bradley & Wygant, 1998), with female students sharing similar attitudes and success with the men in these courses. The result of the research study was not consistent with Chiesi and Primi (2016), where the female students showed more a negative attitude and were less confident learning statistics. According to the researchers, female students have a tendency to undervalue their abilities and had more negative attitudes when compared to male students. Meanwhile, according to Araki (1995), the cultural treatment of men often encourages them to be more analytical thus statistics would seem less intimidating than for women. This worry must be considered when teaching statistics because it may constitute a barrier to learning. Future research will include gathering data from a wider sample of secondary school students, possibly from students in Mongolia's remote areas, because the topic of statistics in mathematics courses is new to both students and instructors.

Students will not apply statistics in their daily lives, at work, or in other classes unless they believe it is valuable, according to theories and research discoveries from other academic fields. They will only employ statistics if they believe they are capable of doing so. People will opt to take part in statistics assignments and courses that they find interesting and enjoyable. Furthermore, students must believe that the amount of time they devote to learning and performing statistics is reasonable. We want pupils to retain or enhance their views in these areas at the very least. Attitude is a big part of success, and statistics self-efficacy could be a big factor. If an instructor is aware of a student's self-efficacy and attitudes about their statistics course, the instructor may be able to help the students succeed in the topic and in their future professions.

REFERENCES

Ashaari, N. S., Judi, H. M., Mohamed, H., & Wook, M. T. (2011). Student's attitude towards statistics course. *Procedia Social and Behavioral Sciences 18*, 287-294.

Araki, L. (1995). *An exploratory study of student attitudes toward statistics and their retention of statistical concepts* (Master Thesis), Faculty of California State University, San Bernardino.

Attitude. (2021). *Oxford University Press*. Retrieved from Oxford Learner's Dictionaries Online database.

Australian Bureau of Statistics. (n.d.). *Statistical literacy*. Retrieved on July 13, 2018 from http://www.statlit.org/pdf/2007ABS-Statistical_Literacy_Paper.pdf

Auzmendi, E. (1991). Factors related to statistics: A study with a Spanish sample. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Awaludina, I. S., Ab Razak, R., Harris, H., & Selamat, Z. (2015). *Antecedents of students' achievement in statistics*. AIP.

Bolormaa, B., & Tsetsegjargal, A. (2018). Research about Mathematics achievements in urban and rural schools. *Research on Mathematics Teaching and Learning*, (pp. 25-30). Mongolian University of Education.

Bond, M. E. (2007). *Looking at the survey of attitudes toward statistics* (SATS). Retrieved from http://www.evaluationandstatistics.com/

Bradley, D. R., & Wygant, C. R. (1998). Male and female differences in anxiety about statistics are not reflected in performance. *Psychological Reports, 80*, 245-246.

Cashin, S. E. , & Elmore, P. B. (1997, March). *Instruments used to assess attitudes toward statistics: A psychometric evaluation*. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Cashin, S. E., & Elmore, P. B. (2005). The Survey of Attitudes Towards Statistics scale; A construct validity study. *Educational and Psychological Measurement, 65*(3), 1-16.

Cherian, V. I., & Glencross, M. J. (1997). Sex, socioeconomic status, and attitude toward applied statistics among postgraduate education students. *Journal of the Royal Anthropological Institute 3*, 1385 - 1386.

Chiesi, F., & Primi, C. (2009). Assessing statistics attitudes among college students: Psychometric properties of the Italian version of the Survey of Attitudes toward Statistics (SATS). *Learning and Individual Differences, 19*(2), 309 - 313.

Chiesi, F., & Primi, C. (2015). Gender differences in attitudes toward statistics: Is there a case for a confidence gap in K. Krainer & N. Vondrova (Eds.), *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education* (pp. 622-628). Prague, Czech Republic: Charles University.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. Psychology Press.

Garfield, J., & Ben-Zvi, D. (2008). *Developing students' statistical reasoning: Connecting research and teaching practice*. New York, NY: Springer Science+Business Media B. V.

Ghulami, H. R., Ab Hamid, M. R., & Zakaria, R. (2015). Students' Attitudes towards Learning Statistics. AIP Conference Proceedings, 1660, 050035; 10.1063/1.4915668. https://doi.org/10.1063/1.4915668

Green, K. E. (1993, April). Affective, evaluative, and behavioral components of attitudes toward statistics. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Harlow, L. L., Burkholder, G. J., & Morrow, J. A. (2002). Evaluating attitudes, skill, and performance in a learning-enhanced quantitative methods course: A structural modeling approach. *Structural Equation Modeling, 9*, 413 - 430.

Liau, A. K., Kiat, J. E., & Nie, Y. (2015). Undergraduate Students Investigating the Pedagogical Approaches Related to Changes in Attitudes Toward Statistics in a Quantitative Methods Course for Psychology Undergraduate Students. *The Asia-Pacific Education Researcher, 24*(2), 319-327. https://doi.org/10.1007/s40299-014-0182-5

Mahmud, Z. (2010). A discriminant analysis of perceived attitudes toward statistics and profile identification of statistics learners. Proceedings of the 2nd WSEAS International Conference on Multivariate Analysis and its Application in Science and Engineering, pp.41-47.

Millar, A. M., & Schau, C. (2010). Assessing Students' Attitudes: the Good, the Bad, and the Ugly. *Proceedings of the Joint Statistical Meetings*. www.statlit.org/pdf/2010MillarSchauASA.pdf

Nolan, M., Beran, T., & Hecker, K. (2012). Surveys assessing students' attitudes toward statistics: A systematic review of validity and reliability. *Statistics Education Research Journal, 11*(2), 103-123. Retrieved from http://www.stat.auckland.ac.nz/serj

Primi, C., & Chiesi, F. (2016). Statistics anxiety: A mediator in learning probability. In *13th International Congress on Mathematical Education* (pp. 1 - 7). Hamburg, July 24-31, 2016.

Rhoads, T. R., & Hubele, N. F. (2000). Student attitudes toward statistics before and after a computer-integrated introductory statistics course. *IEEE Transactions in Education, 43*, 182 - 187.

Roberts, D. M., & Bilderback, E. W. (1980). Reliability and validity of a statistics attitude survey. *Educational and Psychological Measurement, 40*, 235 - 238.

Roberts, D. M., & Saxe, J. E. (1982). Validity of a statistics attitude survey: A follow-up study. *Educational and Psychological Measurement, 42*, 907 - 912.

Schau, C. G., Dauphinee, T., & Del Vecchio, A. (1992, April). The development of the Survey of Attitudes Toward Statistics. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Schau, C., Stevens, J., Dauphinee, T., & Del Vecchio, A. (1995). The development and validation of the survey of attitudes toward statistics. *Educational and Psychological Measurement, 55*(5), 868-875. Retrieved from http://www.epm.sagepub.com

Schau, C. (2000, November). *Teaching and learning in statistics courses: Importance of students' attitudes and beliefs*. Paper presented to the faculty at Arizona State University.

Schau, C. (n.d.). *SATS-36 Scoring*. Retrieved from https://www.evaluationandstatistics.com/scoring

Sutarso, T. (1992). Students' Attitudes Toward Statistics (STATS). Paper presented at the Mid-South Educational Research Association, Knoxville, TN.

Tempelaar, D. T., van Der Loeff, S. S., & Gijselaers, W. H. (2007). A structural equation model analyzing the relationship of students' attitudes toward statistics, prior reasoning abilities and

course performance. *Statistics Education Journal, 6*(2), 78 - 102.

Tomazic, T. J., & Katz, B. M. (1988). Statistical anxiety in introductory applied statistics. *American Statistical Association Proceedings of the Section on Statistical Education*, 239 - 244.

Waters, L. K., Martelli, A., Zakrajsek, T., & Popovich, P. M. (1988). Attitudes toward statistics: An evaluation of multiple measures. *Educational and Psychological Measurement, 48*, 513 - 516.

Wikipedia. (2021). *Education in Mongolia*. Retrieved from https://en.wikipedia.org/wiki/Education_in_Mongolia

Wise, S. L. (1985). The development and validation of a scale measuring attitudes toward statistics. *Educational and Psychological Measurement, 45*, 401-405.

Wisenbaker, J. M., & Scott, J. S. (1997). Modeling aspects of students' attitudes and achievement in introductory statistics courses. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Yembuu, B. (2010). International encyclopedia of education. In P. Peterson, E. Baker, & B. McGaw (Eds.), *Mongolia* (pp. 681-686). Oxford: Elsevier.

Zeidner, M. (1991). Statistics and mathematics anxiety in social science students: Some interesting parallels. *British Journal of Educational Psychology, 61*, 319 - 332.

Боловсрол, соёл, шинжлэх ухаан, спортын яам (2019). БҮРЭН ДУНД БОЛОВСРОЛЫН СУР-ГАЛТЫН ХӨТӨЛБӨР-Сайжруулсан хоёр дахь хэвлэл (Curriculum Development Division, 2019). Retrieved from https://cdn.greensoft.mn/uploads/users/2649/files/Curriculum/EBS/Akhlakh.pdf

몽골 중등학생의 통계 주제에 대한 태도조사

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초록

본 연구는 몽골 울란바토르에 소재한 중등학교에서 통계 주제에 대한 학생들의 태도를 분석하기 위해 수행되었다. 이를 위해 몽골 울란바토르에 있는 두 개의 중등학교에서 9학년 학생 129명을 층화표집한 후 이들을 대상으로 설문조사를 실시하였다. 이 통계에 대한 태도 조사(SATS)는 태도에 기여하는 6가지 요인인 정서적 요인, 인지능력, 가치, 어려움, 흥미, 학생의 노력을 중심으로 이루어졌다. 그 결과 학생들은 자신의 통계 지식과 통계 기술이 학습 시작에 비해 다소 증가하였다고 믿는 것으로 나타났다. 또한 통계 주제에 대해서는 쉽지도 그렇다고 어렵지도 않다는 반응을 보였다. 그럼에도 통계에 대한 관심은 중립적이었다. 이러한 연구 결과는 통계 주제에 대해 관심을 끌 수 있는 효과적이고 혁신적인 통계 교수·학습 방법 개발이 요구된다는 것을 시사하고 있다.

주요용어 : 몽골, 통계 교육, 통계 주제, 학생태도

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