

## SPECIALIST AND NON-SPECIALIST STUDENTS' ATTITUDES TOWARDS STATISTICS

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*This study is about students' attitudes towards statistics courses in higher education institutions in Indonesia. The participants were students from a Mathematics Education department (MED) as specialist students, and students of English language teaching (ELT) as non-specialist students. Both groups of students experienced a teaching intervention design to encourage active learning. Data were collected through observations during the teaching sessions, and interviews with a sample of students at the end of the teaching intervention. Phenomenographic analysis of the data showed that the specialist students express their interest in statistics in a long term (career) while for the non-specialist students had interest in short-term (study completion).*

### INTRODUCTION

Higher education institutions in Indonesia are required to include Statistics as a mandatory subject in their curriculum. Statistics courses are intended to give a foundation on quantitative methods, in which the implementation can be customized according to the requirements of each department (Ministry of Education and Culture of Indonesia, 2005). The regulation makes all departments have at least one course about quantitative analysis as a mandatory course, and the rationale is that the students will need it in their research as the completion for their degree. However, for some departments, such as English Language Teaching, Literature, or Philosophy, most of their students will not use quantitative method in their research and for the students it may become a burden to enroll in a course that they think will not be beneficial for them. Statistics course(s) for all departments are often assigned to the math or statistics department lecturers, and most of them just use the same topics and methodology that they would for math and statistics students. This might work for students in engineering, medicine, agriculture who will use quantitative analysis throughout their study and research (specialist students), but might not be suitable for students from arts department (non-specialist students), despite the intention that topics and methodology should be customized to meet the needs of each department. This is why we are interested to have a look into the specialist and non-specialist students' attitudes towards statistics after a teaching intervention that was designed to encourage active learning.

### ATTITUDES TOWARDS STATISTICS

McLeod (1992) defines attitude as an affective response that involves positive or negative feelings of moderate intensity and reasonable stability. Attitudes towards statistics represent a summation of emotions and feelings experienced over time in the context of learning mathematics or statistics (Gal, Ginsburg, & Schau, 1997). Attitudes towards statistics in this study focus on students' negative or positive responses to statistics in and out of the statistics classroom. The attitudes towards statistics in the classroom should show the students' responses on the topics, the teaching methodology, their ability in the course. The attitudes towards statistics outside the classroom is the students' responses about their possible usage of statistics in the future, the effort they are willing to spend to learn statistics.

Self-efficacy to learn statistics is an individual's confidence in his or her ability to successfully learn statistical skills necessary in a statistics course (Perepiczka et al, 2011). Ramirez et al (2012) believe that students' positive attitudes toward statistics are the most important and influential outcome from an introductory statistics course. These research results emphasize the importance of attitudes toward statistics to support students' achievement in statistics and also offer reasons as to why some students bring negative attitudes in their statistics class.

### METHOD

The participants were 43 specialist students and 6 non-specialist students from two different universities. The use of two different universities was due to the unavailability of

specialist students at the non-specialist students' university. The specialist students were undergraduate students from Mathematics Education department enrolled in a Basic Statistics course and the non-specialist students are undergraduate students from English Language Teaching department that enrolled in the Research Methods 2. Research Methods 2 covers three main topics in research in education: quantitative analysis, qualitative analysis, and classroom action research. The intervention was implemented during the quantitative analysis sessions. The intervention was for 6 sessions (150 mins each) for specialist students, and 10 sessions (75 mins each) for non-specialist students. One of the researcher did the teaching intervention and the interviews, these roles may have bias issue, but on the positive side it gave us direct access to the data and control on how the intervention and interviews should be done. The instructor (the first named author) was not the regular instructor and the regular instructor has cleared the instructor credentials and capabilities prior the intervention to the students. It is important that the students knew that the instructor had the capabilities to teach them the subject.

### *Teaching Intervention*

The teaching intervention in this study was designed to promote active learning, since active learning has been widely considered as a way to improve students' attitudes toward statistics for example in Gal and Garfield (1997) and Carlson and Winquist (2011). Cooperative learning as a form of teaching designed to promote active learning was used in this study, and accompanied with constant feedback and the use of worksheets. The constant feedback mean that students had opportunities to ask questions throughout the session, and feedback was given in the form of clues or hints or some corrections to the mistakes rather than providing the answers. The worksheet was designed to consist of a series of tasks and instructions for use during the session; the tasks were questions about concepts and/or computational problems. In the cooperative learning settings, the specialist students were grouped into small groups of three (one group has four member) and groups of two for the non-specialist. In groups, the students had to discuss the topic they have learned, solve the problems, and do the data analysis. Each group must ensure that all members understand, and are able to solve each problem. The students completed the tasks in the worksheet as a group during each session, and also did some independent work before each session. The independent work was in the form of homework exercises or reading materials on a chapter about the topic that will be discussed on the next session. The researcher was always available to assist each group, providing the constant feedback. The constant feedbacks allowed us to understand how the students learn the topic and their individual difficulties.

### *Data Collection*

The data collection process consisted of two activities: observation data, in the form of an observational journal, and interviews. Observational data were collected through observation journal written at the end of each session about the situation during the session. The instructor collected the data about students' interaction and activities from his point of view. Observational data are meant as supporting information about the situation during the session, therefore we are not only reliant on the interview data. Interviews were held at the end of all sessions, after the students have their mid-term exam results, 8 specialists and 3 non-specialist students participated in the interviews. The interview questions are: (1) How was your experience with your Basic Statistics/Research Method 2 course? (2) Do you think you will be able to work with the next session in this class? (3) Is there any negative impact for you from the teaching method? (4) What would you suggest to improve your learning experience? The interviews were about collecting information about the sessions from the students' point of view.

### *Data Analysis*

Most of the research on attitudes towards statistics has used quantitative analysis. This research uses qualitative analysis since we believed that it was better way to understand the attitudes. A phenomenographic approach used to analyze the qualitative data, to explore the students' experience, understanding, and interpretations of statistics. We used the phenomenographic approach since it has a strength that the categories of description are developed from data and are not preconceived and this allows the researcher to see the phenomenon, in this

instance the experience of learning statistics, through the eyes of the students (Gordon, 2004). There are seven steps to implement phenomenography analysis according to Sjöström & Dahlgren (cited in Khan, 2014) that includes: familiarization, compilation condensation, preliminary grouping, preliminary comparison of categories, naming the categories, and final outcome space. This study did not exclusively use the seven steps, but simplified it by only uses some of the steps in an iterative process that moves in the same direction toward developing the categories to understand the phenomena. These steps are: (1) Familiarization: familiarization with the contents of the transcripts and journals by reading it for several times; (2) Condensation: extracting meaningful and relevant components from the transcribes; (3) Preliminary grouping: similar answers were identified and classified into preliminary groups. This is an iterative process, to develop a list of categories of descriptions; (4) Naming the categories: the categories were named after that were confirmed to differentiate between categories; (5) Final outcome space: I developed the final outcome space is developed based on the internal relationships and different ways of understanding the phenomena.

## RESULTS

Iterative process of the 5 steps in phenomenography analysis helped us to develop the categories of description about the students' attitudes toward statistics phenomena for both specialist and non-specialist students. Categories of descriptions that emerged from the non-specialist students are:

- *Learning through applying knowledge.* In this category, the students expressed their experience that it was really helpful if worksheet was completed side-by-side with the lecturer explanation:
  - “We did the exercises...that was...so we understand, and we can understand better rather than it was just being explained”
- *Importance of feedback.* Students felt feedbacks helped them to identify the mistakes, and understand better:
  - “If there are any mistakes you corrected it right away, so we can directly fix the mistakes and we can understand better”
- *Use of quantitative methods.* Most were more interested in using a qualitative method for their graduation project, but some were interested to use the quantitative methods if applicable:
  - “I will use quantitative, but if I need a deeper analysis I will use qualitative”
- *Confidence level on learning statistics.* The students level of confidence to enroll to further statistics course offered by the department:
  - “I will just give it a try, not optimistic but I will give it a try”
- *Effects of group work on learning.* Experience in the group work had both positive and negative effect:
  - “It depends to if we get a partner that can contribute, then it helps”
  - “I enjoyed the group work”

For the specialist students, the categories of descriptions that emerged from the interviews are:

- *Importance of statistics for their career.* Students expressed how statistics will play an important role in their career as a teacher:
  - “To help me, since it's an education (department), we have to have enough skills and knowledge for teaching later”
- *Confidence level on learning statistics.* As for non-specialist students, this category explores confidence to enroll to further statistics course:
  - “I am sure that I will succeed”
- *Effects of group work on learning.* Specialist student shared their experience in the group work:
  - “I enjoyed the group work better, since if there is something that I do not understand, I can ask (my friend)”
- *Access to the instructor.* Students appreciate that the instructor going around the class:
  - “Since some of the students are afraid to ask (question) in front of the class, so if the instructor come to us makes us more comfortable to ask questions”
- *Expectations for a statistics class.* This category emerged from the students that re-taking the course:

- “I feel a bit of having a low self-esteem since I have to share the class with the freshmen”

## DISCUSSION

The group work did not always work out for the non-specialist students, while for the specialist students, they found it really helpful. The reason is because there are only six non-specialist students which only have two members for each group, and it get worse when there are students did not attend the session. The situation was much different with the specialist students, where each group has 3 or 4 members, with the large size they can easily interact between groups not just within group. Specialist students considered they will need skills and knowledge in statistics for their future career, that is slightly different for the non-specialist students. Non-specialist students start to consider using quantitative analysis for their graduation project as an alternative to the qualitative analysis. Both specialist and non-specialist agreed to the importance of the feedback, non-specialist students said that the immediate feedbacks helped them to identify their mistake(s) and specialist students felt that if easy access to the instructor made them more comfortable to ask questions for feedbacks.

Category *Learning through applying knowledge* is specific for non-specialist students, they found that to learn quantitative analysis it was easier to learn through applying knowledge, in each session each section of that day session followed by worksheet, the reason was because it was a short session of 75 minutes and the instructor wanted to maximize the group work in learning.

Category *Expectations for a statistics class* is specific for specialist students. There were 3 students who were re-taking the course who felt it was a little bit intimidating to share the class with the freshmen. Also as seniors that had experience with the regular instructor, it was a low expectation about the session prior the intervention.

Specialist and non-specialist students both have a positive response to the teaching designed to promote active learning, they have positive attitudes about their ability in a statistics course. Specialist students expressed their interest in statistics in a long term (career) while non-specialist student had interest in short-term (study completion).

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