# SUSTAINING STUDENT ENGAGEMENT IN A COLLEGE STATISTICS COURSE THROUGH A REFLECTIVE TEACHING MODEL USING YOUTH STATISTICS

Liza Lorena Jala[1] and Enriqueta Reston[2]
[1]University of Cebu, Philippines
[2]University of San Carlos, Philippines
azilanerol@yahoo.com

*This paper described how micro data on youth statistics generated by official statistical agencies in the Philippines and from various international surveys are used in teaching college students to sustain their engagement in learning statistics through contextualized data-based activities. Through a reflective teaching model, statistical concepts and methods are introduced using a creative integration of multiple data sets on youth statistics from various interdisciplinary perspectives of the social sciences. Teaching-learning activities are modular, which incorporate features of constructivist teaching and learning using inductive and active learning approaches. Student motivation and ownership of learning is also sustained as students make sense of youth statistics which reflect their own sector of the population. Portfolio assessment is used to provide students the opportunity to reflect on their learning with data and for the teacher to assess their understanding of statistical concepts and development of statistical literacy skills.*

## INTRODUCTION

Statistics is one of the core courses in the undergraduate curriculum. It is even the most widely taught topics in the university level and studied mainly as a tool to solve problems on the fields of education, geography or medicine which requires greater emphasis on the teaching of formulas for computation (Batanero, 2004). Students have mastered the algorithm yet they lack of understanding on the connection of concepts to the discipline (Schau & Mattern, 1997; cited in Batanero, 2004). Moreover, these students fail to recognize statistical procedures in solving real problems on data analysis (Quilici & Mayer, 1996; cited in Batanero, 2004). Even the graduate students are still having misconceptions on the concepts of sampling, sample representativeness, and the logic of inferential reasoning which stemmed from poor background knowledge on inferential statistics in their undergraduate statistics courses (Jala & Reston, 2010). This shows that teaching and learning statistics at university seem to be activities directed primarily to students' passing assessments and gaining paper credentials, which tends to be the case especially in service courses, where, indeed, the vast majority of statistics students are found (Sowey, 1995).

For the past decades, statistics education focused on improving the teaching and learning processes in the undergraduate introductory statistics courses and in the integration of statistics as an important component of the pre-college mathematics and science curriculum (Gal & Garfield, 1997; Batanero, Godino & Roa, 2004). Recently, the goals of statistics education placed increasing emphasis on empowering citizens from all walks of life to function effectively in an information-laden society (European Commission, 1996; cited in Murray & Gal, 2002) using statistical information produced by an increasing number of public agencies and private organizations so that awareness and capability to react intelligently to various social, political, economic, phenomena is developed (Reston & Jala, 2013). According to Murray and Gal (2002), different target audiences has different information need which should be considered in order for data producers, statistical reporters and educators to be effective in transmitting informative messages (cited in Reston & Jala, 2013). These recent development on the teaching of statistics calls for a more relevant and responsive statistics education that must offer meaningful learning opportunities for students so they can connect what they learn inside the classroom to what is happening around them, more so, sustaining their learning of it. Thus, this paper focused on making students connects concepts with real world phenomena and to sustain their understanding of statistics concepts through exposure and engagement to youth statistics and the use of reflective teaching model.

The Reflective Teaching Model (RTM) is grounded on the constructivist theory that advocates learning as a process of change (Taggart & Wilson, 2005). Using this model, student's activities are intended to assimilate and accommodate knowledge in which Taggart & Wilson (2005) contends that through simultaneous processes of assimilation and accommodation, new

In K. Makar, B. de Sousa, & R. Gould (Eds.), *Sustainability in statistics education. Proceedings of the Ninth International Conference on Teaching Statistics (ICOTS9, July, 2014), Flagstaff, Arizona, USA.* Voorburg, The Netherlands: International Statistical Institute. iase-web.org 

information is added to an existing repertoire of knowledge. Students are engaged in active experimentation wherein they try out what they have learned from the classroom giving them the concrete experiences. After exposure to concrete experiences, they reflect on their experience and conceptualize what they have learned.

## METHOD

This is a qualitative study, which analyzes the students' reflections from the portfolio that they started to build-up containing the activities and the critical reflections, to check the extent of their understanding of basic statistics concepts. Participants of this study are 14 students in a Basic Statistics course who are enrolled summer of 2014 in a non-sectarian university located in Mandaue City, Cebu, Philippines. Of these participants, three (3) are males and eleven (11) are females. One (1) student is in the 2nd year level, eight (8) are in their third year level and five (5) are in their fourth year level or are graduating students. Thirteen (13) of them are from the College of Business and Accountancy and one (1) from the College of Customs Administration. Five (5) of them are working or are engaged in their own small business in a nearby market and the rest are full-time students.

On the first meeting of the summer class, the Survey of Attitudes toward Statistics – 28 (SATS-28 ©) by Schau (2003) was administered to the study participants to assess their attitudes towards statistics. The SATS-28 © comprises 28 items which assess four components of students' attitudes toward statistics; namely affect, cognitive competence, value and difficulty. The instrument used a 7-point Likert type response scale with higher scores corresponding to more positive attitudes.

The reflection activities, which they compile in their portfolio, are given after exposure on actual activities and on actual data sets mainly geared on summarizing and presenting data. In their reflection activities, they are made to write the extent of their understanding of the concepts they learned which are assessed using a scoring rubric.

## FINDINGS

### *Students' Attitudes and Beliefs towards Statistics*

The Affective subscale of SATS© 28 assessed the students' feelings towards statistics. It was found that two items had a modal score of 6, indicating a high level of agreement to the statements *"I am frustrated going over statistics tests in class (Item 11)" and "I am scared by statistics. (Item 21)"*

These responses were validated during informal conversation after discussion or after class hours, where some students mentioned that numbers really scare them. In a layman's term, one student mentioned, *"Hadlok jod ko, ambot lang, bisan unsaon pa nimo pasabot Madam"* (I am really scared, and I cannot explain why, although you have made it easier Madam).

The Cognitive Competence subscale of SATS© 28 assessed the students' attitudes about their intellectual knowledge and skills when applied to statistics. It was found that students' responses indicated that most of them agreed on their extent of knowledge and skill when statistics is applied to real life problems. Most of them have high level of agreement, having two items on *"I can learn statistics. (Item 23)" and "I understand statistics equations (Item 24)"* (modal score 6.00). Moreover, they showed high level of disagreement, with modal score of 2.00, on the following two items *"I can make a lot of Math errors in statistics (Item 20)"* and *"Statistics concepts are difficult to understand (Item 27)"* reflecting a positive attitude towards their ability to do problems when applied to statistics.

The Value subscale of SATS© 28 assessed students' attitudes about the usefulness, relevance, and worth of statistics in personal and professional life. It was found, based on their responses that most of them were in total agreement (mode = 6.00) about the usefulness, relevance and worth of statistics in personal and professional life indicating a positive valuing of statistics in their lives. They agreed (mode = 6.00) that statistics is worthy and relevant in their lives and day to day living. Moreover, they agreed (mode = 6.00) that their skill on statistics would give them the edge over other job applicants, when they would apply for work after graduation.

The Difficulty subscale of SATS© 28 assessed students' attitudes about the difficulty of statistics as a subject. The students' strongly agreed (mode = 7.00) that statistics is highly technical and complicated subject which requires them a great deal of discipline in doing massive computation. And that most people must learn a new way of thinking in order to do statistics.

Summing up, most of the students said that statistics would help them in their day to day living and in their future endeavors, giving them the edge over others who are not skillful enough to do statistics. Although they viewed statistics in a more positive manner, yet they still have the fear of it. Many students are not ready to embrace and function within a problem-solving-oriented learning environment in statistics education due to the attitudes they carry from their experiences with mathematics and mathematics teachers (Gal, Ginsburg and Schau, 1997).

*Reflective Activities*

Results of the reflective activities given after every major concept presented in the class revealed their understanding and ability of reasoning in summarizing and presenting raw data from surveys. In addition, there are misconceptions of basic concepts found. It is shown in the succeeding pages the activities and their reflections and conceptualizations.

Activity No. 1. Blood Typing

Knowing ones blood type is important in a medical emergency that might require a blood transfusion or an organ transplant. With this, I would like you to ask 30 students in this campus and ask their blood type. Then present what you have found in the mini survey.

What have you learned?

Majority of the students (86%) were able to present their data properly, showing a simple frequency distribution table with blood types on the first column and the frequency counts on the second column. Of these students, fifty percent (50%) of them included the proportion of blood types of their respondents by showing the percentage after the frequency count. They said that it is good to know their blood types and felt better that they are able to do the summary on their own. One student added that he has already the idea on how to summarize the sales of his small store of "ready to wear" clothing in the market by summarizing it on a "weekly" and per "size" basis, more so, he can project ahead what items he needed to buy in large quantity. This response showed connection of concept learned on summarizing data to his livelihood and day to day living. But it is a sad thing to note that two (2) students showed an interval (A – AB and B – O) of blood types in summarizing the results of their mini survey. They explained that they thought blood types have intervals because of the blood type AB.

The next reflection activity is on interpreting a result of a survey done by the National Statistics Office (NSO) which was released in the year 2011. This is a survey result showing the distribution of working children by sex and type of work.

Activity No. 2. Writing an Interpretation of the Survey Results on Children (NSO, 2011)

Write a one-page interpretation of the results on the survey about children who are exposed to work at an early age. What have you learned? How do you feel knowing that there are children having these experiences?

The same student who was able to connect the summary of blood types to his daily business activities has been able to provide a better understanding and a better grasp of information presented on the scenario of child labor. He was able to properly relate the percentage of the "working boys", the percentage of the "working girls" and the "type of work" to the total number of working children surveyed. He even provided his own understanding why these children are working at an early age, exposing themselves to hazardous types of works by citing his own experience in the neighborhood fireworks industry. But all the rest of the students failed to see the connections of the survey results providing explanation such as *"this calculation simply illustrate that the boys has a large number of population in the society"*, *"the female minors got 40% out of 100"*and *"it is not easy to have a job because some of them are unemployed"*. These responses showed that they could not read tables more so could not understand information found on it.

## CONCLUSIONS AND RECOMMENDATIONS

It is evident from the findings of this study that students have a mixed of positive and negative attitudes and beliefs about statistics. In as much as they are scared to do statistics but they believe that it would give them the edge over the other job applicants if they can show the skill that they can do it. They actively participated in the modular contextualized data-based learning activities with data sets on youth statistics from various interdisciplinary perspectives of the social sciences. More so, they showed motivation to learn more and sustain what has been learned as they reflect their own sector of the population.

In view of these findings, it is but important to assess students' beliefs and attitudes towards statistics before and after the course. This will provide feedback whether there is a change in attitude after exposure to contextualized data-based learning activities. Moreover, a more extensive portfolio assessment will be used to provide students the opportunity to reflect on their learning with data and for the teacher to assess their understanding of statistical concepts and to develop statistical literacy skills.

## REFERENCES

Batanero, C. (2010). *Statistics education as a field of research and practice*. Paper presented at the 10th International Congress of Mathematics Education (ICME 10), Kailow Graphic, Denmark. *www.icme10.dk*

Batanero, C., Godino, J., & Roa, R. (2004). Training teachers to teach probability. *Journal of Statistics Education*, *12*(1).

Gal, I., & Garfield, J. B. (1997). Curricular goals and assessment challenge in statistics education. In Gal, I. & Garfield, J. B. (Eds.), *The assessment challenge in statistics education.* Amsterdam: IOS Press and International Statistical Institute.

Gal, I., Ginsburg, L., & Schau, C. (1997). Monitoring attitudes and beliefs in statistics education. In Gal, I. & Garfield, J. B. (Eds.), *The assessment challenge in statistics education*. Amsterdam: IOS Press and International Statistical Institute.

Jala, L. L., & Reston, E. (2010). Graduate students' conceptions of statistical inference In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php

Murray, S., & Gal, I. (2002). Preparing for diversity in statistical literacy: Institutional and educational implications. In B. Phillips (Ed.), *Proceedings of the Sixth International Conference on Teaching Statistics (ICOTS6).* Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php

Reston, E., & Jala, L. L. (2013). *Educational uses of youth statistics for the revised tertiary general education curriculum in the Philippines.* Paper presented at the 2013 Joint IASE/IAOS Satellite Conference, Macau, China.

Schau, C. (2003). *Students' attitudes: The "other" important outcome in statistics education*. Paper presented at the Joint Statistical Meetings, San Francisco, CA.

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

Sowey, E. (1995). Teaching statistics: Making it memorable. *Journal of Statistics Education, 3*(2).

Taggart, G., & Wilson, A. (2005). *Promoting reflective thinking in teachers: 50 action strategies.* Thousand Oaks, CA: Corwin Press.