

## DEVELOPING A LOCALIZED AND CONTEXT-DRIVEN APPROACH FOR IMPROVING THE INSTRUCTION OF STATISTICS AND PROBABILITY IN THE SECONDARY LEVEL IN THE PHILIPPINES

Dalmacio D. Dayta  
Division of City Schools, Caloocan  
Department of Education, Caloocan City, Philippines  
[dalmacio.dayta@deped.gov.ph](mailto:dalmacio.dayta@deped.gov.ph)

*This study aims to develop a contextualized and localized instructional material for improving the teaching of statistics and probability at the senior high school level in the Philippines. A contextualized and localized approach would help concretize otherwise abstract mathematical concepts and improve students' appreciation of their significance. A sample of students at a local high school were made to take lessons using an alternative, contextualized and localized material, while another used material representative of what is currently used by teachers (conventional). The contextualized and localized learning material improved students' understanding of the subject significantly, making the case for preferring such materials over the conventional ones currently in use in the Philippine educational system.*

### BACKGROUND

There has been a growing body of work from academics and educators around the world reconsidering how statistics curricula are designed at various levels of education. The data revolution has indeed made it urgent that a critical reevaluation be made regarding statistical literacy and how we impart it to our students (Prodromou, 2017). Ruz et al. (2018) traces some notable developments through official documentation, such as an initiative to introduce aspects of statistics and probability in Mathematics K–12 programs in the United States, and royal decrees in Spain that explicitly incorporate the subject in the first year of primary school through the last year of secondary school.

A critical step forward is given by Weiland (2019), in which it is highlighted that statistics be introduced in a contextualized manner. That is, rather than focusing entirely on abstract concepts and word problems involving “trivial” situations, students must be made to see how statistics can be useful in making sense of societal issues and real experiences. The following study investigates the positive gains of adopting such a contextualized and localized material for teaching statistics to senior high school students in the Philippines.

Guided by the Implementing Rules and Regulations of the Enhanced Basic Education Act of 2013, which encourages the development and use of locally produced learning materials, a team of teachers at a public high school led by the researcher undertook the development of a revised set of statistics modules for the senior high school level. The modules are based on the curriculum prescribed by the Department of Education (2013) for statistics and probability and contain problems and exercises curated for their relevance and familiarity to students in the locality.

The rest of my discussion is organized as follows: first I motivate my enterprise by giving a brief overview of the current state of mathematics education—specifically in the field of statistics—in the Philippines. I then justify the creation of an alternative, localized and contextualized set of materials for teaching statistics and, finally, discuss its impact as measured through a simple classroom application.

### STATISTICS EDUCATION IN THE PHILIPPINES

Mathematics education is an integral part of the reform sought by the Philippine Department of Education in its implementation of the K–12 program, with the twin goals of developing critical thinking and problem solving (Department of Education, 2013). Statistics and probability are closely integrated into this curriculum, particularly in the elementary level from grades 4–6, and in the junior high school level from grades 7–10. Statistics, focusing primarily on the scientific process of collecting, analyzing, and presenting data, provides the learners with the tools to critically assess available information and use them in producing rational, well-founded decisions (Batanero & Borovcnik, 2016).

This enterprise is challenged primarily by a lack of standardization in the teaching reference used across the country. In Caloocan City, Senior High School, implementing schools have no common

textbook being used in statistics and probability. Meanwhile, a comprehensive review by David and Maligalig (2006) of the various titles currently in use revealed several shortcomings: incorrect presentation of key statistical concepts, lack of discussions regarding the connection between probability and inference, and, most glaringly, the lack of relevant examples and exercises that pertain to real-life data or situations through which the students may grasp the relevance of the methods they were learning. Findings in the latter category match closely with some of the shortcomings Weiland (2019) identified with textbooks used in the United States.

Considering these issues, one finds a likely driver for the decline in mathematical performance of students at a nationwide scale. For the school year 2004–2005, performance in mathematics on the National Achievement Test (NAT) was at 50.70% Mean Percentage Score (MPS), followed by 47.82% MPS for the school year 2005–2006, and then at 46.37% MPS for 2011–2012 (de Dios, 2013). Administration of the NAT was halted the following school year, 2016–2017, for the first roll-out of the K–12 curriculum, but at the time, achieving 75% MPS for mathematics was an elusive goal. Action plans were necessary to address the situation.


### *Contextualizing and Localizing Statistics Education*

Following recommendations by Weiland (2019), the following study investigates the positive gains of standardizing and improving the teaching materials in use for statistics and probability in the country through a localized and contextualized approach. We use the operational definition by Garin et al. (2016) for *contextualized* learning, meaning to teach in connection with real life and within the culture of the learners. *Localization*, on the other hand, is a degree of contextualization (the other being indigenization) that refers to linking learning content listed in the curriculum to local facts, daily experiences, and authentic materials in the learners' community. Paragraph (h) of Section 10.2 of the Implementing Rules and Regulations for the Enhanced Basic Education Act of 2013 states, "The curriculum shall be flexible enough to enable and allow schools to localize, indigenize and enhance [the curriculum] based on their respective educational and social contexts."

The perceived value of contextualized teaching and learning is that this method can create a commonsense structure with which to focus instruction (Perin, 2011). If learning is not contextualized, it may be difficult for students to sustain focus and to connect because there is no meaning at all to what they are doing in the classroom. Meanwhile, the advantage of localization is demonstrated by Garin et al. (2017), in which students exposed to contextualized and localized learning instruction performed significantly better than those exposed to contextualized but not localized material. It is therefore imperative that the teaching of statistics and probability should relate the learning process to the local environment.

These two principles directed the production of our contextualized and localized modules for statistics and probability. For the pilot run to be conducted for this study, two chapters of this module were developed, namely: Random Variables and Normal Distribution. The contents of the first two chapters covers one grading period of statistics and probability. It is our intention that a full execution be conducted later, with the goal of developing a complete learning material that—with the proper approval—can be distributed to teachers in other schools and institutions.

Figure 1 shows a portion of the first chapter, introducing the concept of randomness and random variables. A main feature of the contextualized and localized material is that statistical concepts are presented using phenomena, situations, and issues that the learner will be familiar with. This introduction to random variables revolves around the motorcycle industry in Caloocan City (the location of the school at which this pilot study was conducted). Meanwhile, Figure 2 shows some items from the exercises portion of this chapter. Alongside items that have more to do with abstract mathematical formulations are items that concern current events (specifically a report on the president's approval ratings) and situations that—though hypothetical—nevertheless concern locales and structures of which students have immediate knowledge.



Ponder

on this...


---

Selling motorcycle is a growing business in Caloocan City. In fact, the city is tagged as the country's motorcycle capital and a motorcycle festival is being celebrated in the city every year. Last October 2018, the city celebrated its 3<sup>rd</sup> annual festival.

According to a news report, there were on average 23 vehicular accidents per day on EDSA in 2017. The fewer wheels a vehicle has, the higher the exposure to accidents and fatalities. Also, according to an analysis done by a data science consultancy, motorcycles are the most vulnerable form of transportation with 52% likelihood of fatalities.

There is no way to predict the specific motorcycle or automobile that will be involved in an accident, it is a **random occurrence**. Knowing the general pattern of accidents and fatalities, insurance companies may adjust their rates accordingly, that is knowing that on average 23 vehicular accidents happen on EDSA in 2017.

Source: <http://www.moneymax.ph/blog/the-cost-of-not-having-motorcycle-insurance-and-how-to-apply>



Source: <http://www.yamaha.com.ph>

Figure 1. A section of the contextualized and localized module on Random Variables

11. According to reports, during the school year 2014-2015 of the total school-age population (12-15 years old) in Caloocan City, the probability that a student is enrolled outside of Caloocan or an out of school youth is 0.453, the probability that a student is enrolled in a private school in Caloocan is 0.089 and the probability that a student is enrolled in a public school in Caloocan is 0.458. Let  $x = 0, 1, 2$  for enrolled outside of Caloocan, enrolled in a private school in Caloocan and enrolled in a public school in Caloocan respectively, construct a probability distribution and a probability histogram for the data.

Source: Caloocan City Comprehensive Development Plan 2017 – 2019, pg. 8.

12. Construct the probability distribution table for the answers in Example 2.4 and state whether it is in fact a probability distribution.

13. According the results of a survey done by the Social Weather Stations (SWS), 74% of adult Filipinos were satisfied with Pres. Duterte's performance, while only 15% were dissatisfied and some 11% were undecided. Let  $x = 0, 1, 2$  for satisfied, dissatisfied and undecided. Construct a discrete probability distribution for the data.

Source: [www.yahoo.com/Yahoo Poll: Are you satisfied with President Duterte's presidency in 2018? Ph.news.yahoo.com](http://www.yahoo.com/Yahoo%20Poll%3A%20Are%20you%20satisfied%20with%20President%20Duterte's%20presidency%20in%202018%3F)

14. Construct the distribution table for the following formula and state whether it is a discrete probability distribution

- $P(X) = \frac{x}{12}$ , for  $X = 1, 2, 3, 6$
- $P(X) = \frac{x-2}{x}$ , for  $X = 3, 5, 7, 11$

Figure 2. Some exercises from the contextualized and localized module on Random Variables

### EVALUATING THE IMPROVED TEACHING MATERIALS

With the assistance of teachers at the Tandang Sora Integrated School, a public high school in the Division of Caloocan City, two sections of grade 11, with 30 students each, participated in a controlled trial of the developed modules. One group was taught using the localized and contextualized materials (referred to as the experimental group) while the other group was taught using chapters and exercises derived from *Elementary Statistics* by Allan Bluman (2009) (referred to as the control group).

A pre-test and a post-test were administered to both groups to measure their competencies before and after the lessons.

In terms of their mean scores on the pre-test, students in the control group scored on average 13.57 (SD = 3.79), whereas those in the experimental group scored 14.77 (SD = 3.66), a difference found to be insignificant using a  $t$ -test of independent means. Meanwhile, on the post-test performance, the control group scored an average of 27.40 (SD = 3.70) whereas the experimental group scored 32.33 (SD = 5.49). Under a  $t$ -test for independent means, we are able to conclude significant different,  $t(58) = 4.014, p < 0.001$ .

## CONCLUSIONS

Although both conventional and contextual material resulted in an improvement of student performance, the contextualized learning material improved students' understanding of the subject significantly, making the case for preferring such materials over the traditional ones currently in use in the Philippine educational system. From these results, it may be recommended that educators and school administrators explore wider usage and development of contextualized and localized learning materials.

## ACKNOWLEDGMENTS

The present paper presents part of the work that I conducted for my thesis in completion of the degree of Master of Arts in Education, Major in Mathematics (Ma. Ed. Mathematics), at the National Teachers College. I would like to acknowledge the crucial support of my adviser, Dr. Maximo Y. Muldong. I would also like to acknowledge my son, Dominic Dayta, Assistant Professor for Statistics at the University of the Philippines, for his assistance during the preparation of my manuscript for ICOTS.

## REFERENCES

- Batanero, C., & Borovcnik, M. (2016). *Statistics and probability in high school*. Sense Publishers.
- Bluman, A. (2009). *Elementary statistics: A step by step approach* (7th ed.). McGraw-Hill Higher Education.
- David, I. P., & Maligalig, D. S. (2006). Are we teaching statistics correctly to our youth? *The Philippine Statistician*, 55(3-4), 1-28.
- de Dios, A. C. (2013, July 20). The National Achievement Test in the Philippines. *Phillipine Basic Education*. <https://www.philippinesbasiceducation.us/2013/07/the-national-achievement-test-in.html>
- Department of Education. (2013). *K to 12 basic education curriculum*. Republic of the Philippines. <https://www.deped.gov.ph/k-to-12/about/k-to-12-basic-education-curriculum/>
- Garin, R. M., Reyes, R., Domantay, G. F., & Rosals, J. (2017). Contextualized and localized teaching as a technique in teaching basic statistics. *Asia Pacific Journal of Education, Arts and Sciences*, 4(1), 62-67.
- Implementing Rules and Regulations of the Enhanced Basic Education Act of 2013, Republic Act No. 10533 (2013). <https://www.officialgazette.gov.ph/2013/09/04/irr-republic-act-no-10533/>
- Perin, D. (2011). *Facilitating student learning through contextualization*. Community College Research Center Teachers College, Columbia University.
- Prodromou, T. (2017). Statistical literacy in data revolution era: Building blocks and instructional dilemmas. *Statistics Education Research Journal*, 16(1), 38-43. <https://doi.org/10.52041/serj.v16i1.212>
- Ruz, F., Díaz-Levicoy, D., Molina-Portillo, E., & Ruiz-Reyes, K. (2018). Ways to strengthen the statistical literacy, reasoning, and thinking in the mathematics teachers training. In M. A. Sorto, A. White, & L. Guyot (Eds.), *Looking back, looking forward. Proceedings of the Tenth International Conference on Teaching Statistics (ICOTS10, July 2018), Kyoto, Japan*. ISI/IASE. [https://iase-web.org/icots/10/proceedings/pdfs/ICOTS10\\_7H1.pdf?1531364287](https://iase-web.org/icots/10/proceedings/pdfs/ICOTS10_7H1.pdf?1531364287)
- Weiland, T. (2019). The contextualized situations constructed for the use of statistics by school mathematics textbooks. *Statistics Education Research Journal*, 18(2), 18-38. <https://doi.org/10.52041/serj.v18i2.138>