REFORM EFFORTS IN TRAINING STATISTICS TEACHERS IN THE PHILIPPINES: CHALLENGES AND PROSPECTS

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In the Philippines, the growing concern in the teaching of statistics at the secondary and tertiary levels is evident in various reform efforts initiated by individuals and professional groups of statisticians. This paper examines the past and on-going individual and institutional activities geared towards teacher training and preparation of statistics teachers in all levels of the Philippine educational system. It presents the Philippine experience as a good example of how the different individuals and groups work together to achieve reforms. Institutional efforts towards statistical capacity building are primarily done through the Philippine Statistical System and the Philippine Statistical Association . The challenges encountered in these reform efforts are examined as basis for recommended courses of action towards more effective institutionalization of reforms in statistics education.

INTRODUCTION

At the international level, the growing concern about improving the quality of statistics education is evident in the current reform efforts geared towards statistics teaching in the following domains: the curriculum, the teacher, and the external resources supporting the teaching-learning processes such as books and technology resources. The teacher is basically regarded as the forerunner of the curriculum, and thus, efforts geared towards improvement of the quality of statistics education rely heavily upon efforts to improve the quality of teacher training and preparation.

From a global perspective, two reform movements have been affecting the teaching and learning of statistics in all educational levels; namely: (1) reforms focused on content and pedagogy that advocate the shift of focus from computation and procedures to statistical thinking and reasoning; and (2) reforms in the area of assessment as a tool to improve student learning, focusing on better alignment of instruction with important learning goals and assessment (Garfield & Gal, 1999). Further, statistics education research over the last decade has pointed out the development of statistical literacy and interpretive skills as a universally recognized goal of instruction (Rumsey, 2002; Del Mas, 2002). Consequently, reform movements in teaching statistics have given increasing attention to the development of statistical thinking and reasoning as important skills encompassing statistical literacy. These reform movements have implications for both the statistics curriculum and the professional development and preparation of teachers. Chance (1997) argues that as the emphasis of instructional goals in statistics courses change favouring statistical literacy skills over procedural calculations, there is a need for instructors to accompany these new goals with more authentic assessment techniques to evaluate progress towards these goals.

Moreover, for most countries, although the teaching of statistics in the primary and secondary school levels is part of the mathematics curriculum, several studies have established that mathematics teachers frequently lack specific training and preparation in statistics education (for example, Batanero, Godino & Roa, 2004). At the tertiary level, Cobb (1993) provides considerable evidence that only a comparatively small fraction of introductory college statistics sections are taught by statisticians or teachers with substantial and recent training in the subject. Most college statistics courses are taught in mathematics departments by teachers of mathematics with minimal statistics background. Cobb further claims that of all subjects taught as often as statistics, surely no other subject is so often taught by faculty with so little formal training in the subject.

In the Philippines, the teaching of statistics has become a growing area of concern among professional groups of statistics educators and statisticians. Although it is widely

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accepted that statistics is an important tool in research and the production and communication of information, there is still a lack of recognition of statistics as an independent science since it is taught within school mathematics. In the Basic Education Curriculum (BEC) comprising six years of elementary and four years of secondary education, mathematics is among one of four major subject areas in which the teaching of basic statistical concepts such as averages, data presentation techniques and probability are integrated. Only government science high schools offer statistics as an elective subject in the 3rd or 4th year of secondary schooling. Thus, unless a student majors in statistics, mathematics and related disciplines, the three-unit introductory college statistics course is the first and only encounter with statistics as a formal subject for most students in the Philippines. The course is generally regarded as part of the mathematics requirement of baccalaureate degree programs. Within the limitations of a three-unit one-semester introductory statistics course in the midst of a continuously expanding statistical knowledge-base, students may be entering classes that have lagged behind the technological advances of this information age. Consequently, there is an urgent need to provide in-service professional training in statistics to these teachers.

This paper aims to examine and analyze the on-going individual and institutional reform efforts made in the Philippines to address the need to equip statistics teachers with the pedagogical content knowledge and skills in teaching statistics, to explore best practices, to identify the challenges encountered, and to suggest future directions. In the light of the curricular contexts and available external resources supporting statistics education in the country, we seek to answer the following questions:

1. What is the level of training and preparation of mathematics teachers teaching statistics in the Philippines?
2. What activities have been done by institutions and individuals in the Philippines to address the needs of mathematics teachers teaching statistics?
3. What are the challenges encountered in these reform efforts in statistics education?
4. What prospects and future directions may be taken toward more effective institutionalization of these reform efforts to make statistics education relevant and meaningful?

METHODS

A survey on institutional and individual reform efforts geared towards improving statistics education over the past decade was made using a researcher-developed questionnaire. Statistical associations and leading academic institutions in the country were asked to provide a listing of the activities from 1997 to 2007 that they have conducted to help address the needs of teachers of statistics in all educational levels over the past decade. Documents of associations and institutions supporting education and training of statistics teachers were also examined. Further, a case study was done in 2005 involving 44 teachers of introductory college statistics courses in one region of the country to provide in-depth qualitative information on the status of statistics teaching at the tertiary level. Focus group discussions were conducted in groups of 6-8 teachers to gain insights on their instructional goals and classroom practices in the light of the global reform movements that focus on statistical literacy as the main goal of statistics education.

Respondents include individual statistics educators and practitioners as well as private and government institutions and professional associations involved in statistics education and training across the 17 regions of the country. Twelve higher educational institutions offering statistics programs, one government statistical agency and a national professional association of statisticians were the primary informants of this study.

RESULTS AND DISCUSSION

Training and Preparation of Teachers of Statistics in the Philippines

As of 2006, nineteen academic institutions in the country offer Bachelors (BS) and Masters (MS) programs in statistics. Only two of these 19 higher education institutions offer a

PhD in Statistics; namely: University of the Philippines (UP), School of Statistics in Diliman, Quezon City and UP Institute of Statistics in Los Baños, Laguna. They produce the majority of statistics graduates in the country, totaling 107 BS graduates, 10 MS graduates, and 1 PhD graduate in 2006. These numbers of graduates are of the same levels as those in 2005 (Bersales, 2006). These graduates, however, usually get employed in the private companies and, thus, there is a dearth of statistics majors who teach especially in the provinces. Consequently, the teaching of introductory statistics courses is primarily handled by the mathematics departments and assigned to mathematics majors. It must be noted, though, that the faculty profile of the leading academic institutions offering statistics programs shows that the majority of faculty have either PhD or MS degrees in statistics or mathematics (Bersales, 2006). This indicates that, although few institutions offer statistics as a major, the schools offering them provide courses taught by qualified instructors.

As reported by Tabunda (2006) from a survey done by the Commission on Higher Education (CHED) in 2001, only a little over 5% of the survey respondents consisting of 1,073 faculty teaching statistics in 484 higher education institutions in the country have a degree in statistics. This dearth of statistics majors in the teaching force is echoed in a case study conducted among 44 statistics teachers who participated in a regional statistical literacy seminar for college statistics teachers in Region VII (Central Visayas) held in 2005. Information provided through a questionnaire revealed that of these 44 participants, the majority (62%) of teachers' undergraduate background was in mathematics, the remaining 38% had their majors in the natural sciences, engineering and psychology, and none had a bachelor's degree in statistics. The findings from a series of focus group discussions with these teachers revealed that the majority focused on the development of computational and problem-solving skills, and none of them mentioned the development of statistical literacy and reasoning skills as the main goal of instruction (Reston, Jala & Edullantes, 2006). Probing further on the classroom experiences of the focus group participants reveals an acute need for curricular resources, technological and administrative support, and the need for development of statistical thinking and reasoning among teachers, as evident in the following findings:

- Teaching approaches are basically computational, using routine formula-based calculations.
- Some teachers have misconceptions on many basic statistical concepts and processes, such as in sampling and inferential procedures.
- Aside from computation of statistical measures, teachers lack the skill to design activities geared towards developing statistical literacy among students.
- The advances of computer technology in the organization and analysis of data are rarely explored in statistics classes.
- Teaching strategies and assessments are primarily the traditional lecture and drill, and written tests.
- Some college statistics teachers expressed a concern that they are constrained by departmental restrictions on the course content as they are asked to focus on preparing students for licensure examinations.

Reform Efforts to Address the Needs of Mathematics Teachers Teaching Statistics

As with any area in education, the quality of teaching offered to students depends heavily on the continuing professional development of teachers, that is, their in-service training and preparation in order to cope with the demands and challenges of this information age. In this context, we examined and analyzed the reform efforts made by institutions and the local statistics education community as to how these efforts have responded to the needs of mathematics teachers teaching statistics in the light of the international reform movement on pedagogy and assessment systems.

In the Philippines, institutional efforts focused on building statistical capacity are primarily done through the Philippine Statistical System (PSS) and the Philippine Statistical Association (PSA). The PSS, a decentralized system of government agencies that provide statistical information and services to the public, has always included the academe in its

advocacies for proper generation and use of government statistics and of appropriate statistical methodologies. In the PSS, the main agency that is involved in statistical capacity building is the Statistical Research and Training Center (SRTC), its training and research arm. In recognition of the fact that knowledge and appreciation of statistics start in the schools, SRTC included advocacies involving statistics education. It sponsored the writing of reference materials that elementary teachers in various subjects can use to illustrate the use of statistics (Bersales & Patungan, 1999), a high school textbook that can be used by third year and fourth year high school students of the mathematics subject required by the Department of Education (Bersales, 2003), and a tertiary level introductory statistics book (Albert, 2007).

SRTC further included the training of college statistics teachers in its advocacies for proper teaching of statistics. It forged partnerships with selected higher academic institutions all over the country and provided the training of the faculty of these institutions as affiliates of SRTC. On the other hand, the PSA is the nationwide professional association of statisticians in the Philippines and is a staunch advocate of proper instruction of statistics in the educational system as well as appropriate methodologies of data collection, generation of statistics, analysis and interpretation of data by the government as well as by private sector. The PSA has included statistical literacy in its advocacies. Two major activities of the association focused on statistics education, particularly on teachers teaching statistics and the provision of locally available textbooks as references. In its 2005 annual conference with the theme *"Are We Teaching Statistics Correctly to our Youth*?", the PSA released the results of an evaluation study on locally available textbooks on introductory statistics. As a result of the evaluation, it recommended the following: (1) improve the availability and the selection process for better textbooks, and (2) improve the competency of statistics teachers (David & Maligalig, 2006).

In line with teacher training, the PSA piloted the training of statistics teachers, who are mostly mathematics majors, in collaboration with the SRTC. Training was done for two batches of teachers in April to May, 2007, with a total of 43 participants, who came from different regions of the country. In addition to deepening understanding of statistical concepts and the development of statistical thinking and reasoning, these trainings also introduced to the teachers the integration of technology resources in teaching statistics as a way to minimize formula-based calculations. On a scale of 1(least favorable) to 5(most favorable), the participants' evaluation on each item/criterion averaged much better than 4. All participants said that they will recommend the course to their schools so the benefit that they reaped would extend to their fellow statistics teachers. They also recommended institutionalizing/regionalizing the teaching of the course so more teachers can avail themselves of it at the shortest possible time (PSA Report, 2007).

Data provided by academic institutions on statistics teacher training have shown that these colleges and universities have tapped each other's faculty members as resource persons in trainings conducted for statistics teachers. Aside from teacher training, other activities done to improve statistics instruction include the writing of training modules, textbooks and other reference materials, and the conduct of colloquia, symposia and Statistics Congresses. For more than five years now, annual joint student-faculty research conferences have been conducted by the University of the Philippines School of Statistics in Diliman and the Institute of Statistics in Los Baños in which faculty and students present their research papers.

Challenges in Statistics Teacher Training and Preparation

The training of statistics teachers, who are mostly majors of mathematics and other fields, has posed several challenges as expressed by the academic institutions who responded to the survey. These challenges include: (1) limited or no access to statistical software; (2) lack of skills in using computer technology; (3) low level of statistics background; (4) lack of actual application of statistics to appreciate the subject matter; and (5) need for developing statistical reasoning and deeper understanding of concepts. Furthermore, there is a need for resource persons with actual experience in using statistics. There are also very few takers for statistics programs and thus, there is a need for more intensive information campaigns regarding statistics to make it attractive to potential enrollees among high school students. The need for the creation of statistical consulting and computing offices in academic institutions that will

make such services more accessible to teachers teaching statistics was likewise mentioned.

An analysis of the activities done by SRTC, PSA and the leading academic institutions and individual statistics educators to address the needs of mathematics teachers teaching statistics reveals that these efforts have been primarily in the form of short-term training programs like seminars and workshops on special topics in statistics, various fora addressing teacher's needs in the regions, review of locally published statistics books, and the writing of modules and reference materials including books in statistics. The themes for most of the training programs were focused on enriching teachers' knowledge of course content in statistics and training on statistical methods. However, very few programs focused on enhancing teachers' pedagogical skills in teaching statistics and developing teachers' statistical literacy and reasoning skills. It is also noted that most of these activities were intended for teachers of college introductory statistics, and very few of the activities were aimed at meeting the needs of primary and secondary education teachers who are teaching statistics within the school mathematics curriculum.

Within the constraints of limited manpower expertise in statistics in the country, the challenge then for these various government and private institutions and individuals who have initiated these reform efforts is to pool both human and institutional resources in coming up with more unified and long term programs to address the needs of mathematics and other teachers teaching statistics. Aside from the pre-service programs preparing future teachers, there is a need for sustained collaboration between government and private academic institutions to continue professional development of statistics teachers. The initiatives started by SRTC and PSA need the support of the higher education institutions whose pool of statistics faculty are tapped for further teacher training to reach the grassroots level of the teaching force.

CONCLUSIONS AND FUTURE DIRECTIONS

The examination of reform efforts in statistics education in the Philippines revealed the need for sustainable collaboration of government institutions supporting education, professional statistics and mathematics associations, academic institutions offering statistics program and teacher education institutions in the teacher training and preparation of future statistics teachers and in the ongoing professional development of in-service teachers. In the Philippines, the supply of graduates of academic institutions offering statistics programs is inadequate to meet the needs of academic institutions for statistics teachers. With the dearth of teachers teaching statistics who have in-depth training on statistics–its theory, methods, and applications–there is a need for more long-term and enriched training and preparation not only on statistical content and methods but in pedagogy and assessment as well.

The current collaborative efforts of the Philippine Statistical Association, the Statistical Research and Training Center, the academic institutions that offer statistics programs, and individual statisticians and statistics educators should be sustained with one institution providing coordination. There is a need for the training activities to be expanded. This would need logistics support from different institutions as well as from the Commission on Higher Education (CHED), the government institution tasked to provide policy decisions on tertiary education as well as the evaluation and monitoring of tertiary education institutions. We recommend that logistics support include equipment, statistics software, books and reference materials needed in support of statistics instruction.

Furthermore, there is also a need to expand collaborations to include mathematics societies in the Philippines as well as academic institutions that offer teacher education programs. There should be advocacy for academic programs on mathematics education to provide more statistics courses or minors in statistics. Collaborations with mathematics societies in the conduct of teacher training should support the expansion of teacher training activities suggested earlier.

We also recommend that impact evaluation studies of the reform initiatives discussed in this paper be conducted. In most cases, training programs have become part of the routine activities of the institutions, and little has been done to investigate how these training programs have improved the teachers' instructional practices when they go back to their classrooms. We suggest more research-based information to guide educational decision-makers and policy

leaders, particularly the CHED, to take more concrete actions to improve the status of teacher preparation and competencies in teaching statistics. In light of the technological advances that have impacted the teaching and learning of statistics, there is the need for alignment of these local reform efforts with the global reform movements that call for enhancing statistics content and pedagogy, shifting the focus from computation and procedures to an emphasis on statistical thinking and reasoning, and the alignment of instruction with important learning goals and assessment.

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