Challenges in Statistics in Developing Countries

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Abstract

There are many challenges facing statistics in developing countries. These challenges include unavailability of quality data, and statistics not actually being taught or taught well to all students. Mathematics teachers are often tasked with teaching statistics, but often they lack adequate training and experience required to be effective. Attempts to build capacity for statistics education in developing countries suffers from inadequate research quality, and failure to implement the research results available. Statistical offices do not attract the highest quality human resources, since in most countries official statistics is perceived as a government task of minor rank. Add to that brain-drain and these offices experience underemployment. Most existing literature on ways to improve statistics education focuses on classroom topics, such as teaching methods, student cognitions and attitudes. While all these factors are important, the goal of capacity building of statistics education is a complex undertaking when viewed in the context of a developing country and real world situations.

Ethiopia is one of the developing countries where data quality is a problem. Secondary data obtained from outside sources sometimes contradict the internal data. Researchers usually use existing statistical methods instead of developing new methods for specific situations. Graduate students from fields other than statistics usually lack statistical supervision from their advisors. Teaching methodology focuses more on theoretical concepts rather than on practical applications. In many organizations in Ethiopia, there are no positions designed to employ statisticians. Without trained personnel, organizations must use data collected by statistical offices or by international organizations rather than collect primary data for a particular research project. To improve the quality of education and to do high quality applied research, organizations and universities in developing countries should work with universities in developed countries. Staff members from universities in developing countries should share their experiences at universities in developed countries to improve their research and their teaching ability. We need to search for ways to allow access to research material, publications, and books online. We encourage individual volunteers and universities to collaborate with Hawassa University and other universities in Ethiopia to address the above challenges.

Keywords: Data Quality; Quality Human Resources; Quality Education; Research.

1. Introduction

Statistical topics have been introduced during K-12 school education in many countries over the last few decades. Statistics is seen as a vital topic since future citizens in all countries should be able to orient themselves in a data-driven world and possess the skills and understanding of issues in data collection, organization, analysis or interpretation (Zewotir & North, 2011). The need to acquire statistical knowledge has been recognized around the world and many countries have introduced statistics or data analysis (or related topics under labels such as data handling or stochastics or chance) as a topic in their national curricula for numerous grade levels. However, this does not mean that statistics is actually being taught, or taught well, to all students. In most countries, mathematics teachers are tasked with teaching statistics, but they do not necessarily have the knowledge required to do so (Stohl, 2005). Relatively little is known about attempts to build capacity for statistics education in developing countries, or about factors affecting the quality of statistics education in such countries.

"In almost all relevant issues of data collection, developing countries face different sets of problems as compared to industrialized countries" (Elahi, 2008, p. 297). As stated from a Pakistani perspective by Asad Elahi (2008, pp. 297-299) these difficulties in most developing countries are:

- Endogenous lying within official statistics itself on grounds of weaknesses of institutional and organizational set-up, of lack of resources and infrastructure or operational inadequacies;
- Exogenous lying outside of official statistics perceived as inability of the civil society, establishments or even of the administration to part reliable and timely data.

Weaknesses external to the Statistical Offices can be generally attributed to:

1) Level of literacy and lack of appreciation of importance of data collection as a national activity mixed with general cultural ethos of not sharing personal information.
2) Law and order situation in some areas rendering these areas inaccessible for data collection.
3) Cultural constraints in rural/tribal societies in not parting information about gender related issues or sharing information with outsiders.
4) Remote and thinly populated areas pose logistical as well as technical problems for example application of area sampling.
5) Infrastructural deficiencies i.e. insufficient postal services, inadequate transport, road networks, telephone and internet facilities.
6) Large informal economy in subsistence economies make statistical measurement complicated.
7) Even in formal economy especially in the Small and Medium Enterprises (SMEs), low standard of bookkeeping, inadequate administrative coverage and low standards of social performance. Thus, there are few formalized phenomena statistical that observation can refer to.
8) Lack of political will and administrative support discourages development of a vibrant and autonomous statistical structure which tends to support the perception that the production of statistics is a task of minor importance. Lack of credibility and transparency of data create the feeling that the governments tend to utilize statistics for window-dressing of its policy failures. Consequently, it leads to resistance to cooperate with the statistical offices
9) Socio-cultural inhibitions towards giving out personal information affect filling of questionnaire by the civil society. Business and industrial class in some economies avoid sharing data for fear of being sued for tax fraud. As a result, there is a low propensity to deliver data for statistics.
10) Developing countries are rapidly changing their structural and administrative setup. Consequently, scope, items and concepts of statistics and last but not the least their questionnaires have to be adjusted more frequently. This hampers to get civil society acquainted with carrying a certain statistical burden.
11) Quality of enumerators and quality control/vigilance of enumerators need improvement to ensure that the enumerators and interviewers are applying their instructions appropriately
12) For a lot of variables, the variance within a developing country is much larger than in an industrialized one. Prices pertaining to agricultural commodities differ a lot between the various provinces and districts due to lack of an organized marketing chain system and due to the fact that many of these commodities are neither graded nor branded. Their prices are volatile. The baskets of price indices in industrialized countries are much more determined by branded goods of industrial production, which makes collection of prices and compiling price indices much easier. The same might be true for the statistical observation of wages and salaries or of private households' consumption.

13) Statistics out of secondary data may replace costly surveys or may at least allow for additional benchmark estimates industrial countries. In developing countries, the option of using secondary sources is limited.

Weaknesses internal to the statistical offices can be identified as:

1. Statistical offices do not attract quality human resources as in most countries official statistics is perceived as a government task of minor rank. As a consequence, the salaries as well as the career planning and motivation of staff are low. Capacity building including technology up-gradation, modern training facilities and linking performance with reward is accorded a low priority. Training is hampered by a lot of fluctuation of staff.
2. Infrastructure for internal information and communication in many countries is poor. Decentralized data entry is not yet the norm. Access to the internet as well as internal networks often have still to be developed.
3. Allocations of financial resources for statistics organizations are inadequate.
4. Information on the institutional setup of the economy lack comprehensive and up to-date directories. This hampers drawing frames and applying elaborated techniques as, for example, stratified sampling.
5. Statistical organizations lack autonomy while the legal framework is outdated to meet requirements of a modern statistical structure.
6. There is absence of Strategic/Corporate and operational planning/management on modern lines.

As concluded by Delia North (2014) in the context of South Africa: “Most existing literature on ways to improve statistics learning focuses on in-class topics, such as teaching methods, students’ cognitions, or students’ attitudes. While all these factors are important and at the heart of the statistics education enterprise, this paper argues that the notion of capacity-building in the area of statistics education is a complex undertaking when viewed in the context of a developing country.”

For developing countries, additional challenges and barriers to teacher training include: “shortage of funds, lack of organizational and logistical infrastructure to disseminate information about the new school topic (i.e., statistics), logistical problems related to training large numbers of teachers who are distributed over a wide geographical area, varying levels of infrastructure at schools, varying levels of preparedness and awareness of statistics amongst teachers, varying conceptions among statistics instructors (who run the workshops) of what is required of teachers in schools, versus what teachers can actually implement in a classroom setting, and the extent to which textbooks exist written in such a way that they can help teachers design lessons and adapt them to the needs of students with different levels of skills.” (North et al., 2014).

Another statistical area of importance for developing countries is disability statistics. Literature reviews showed there is little data on disability in low-income countries in general. A few overview articles describe existing data as suffering from poor quality, lack of comparability and limited applicability. An exception is found in a series of international publications based on large prevalence studies having applied the Ten Question screening instrument. Three international initiatives to improve disability statistics in low-income countries are however reviewed: The United Nations Statistics Division has produced guidelines aimed at improving the collection, compilation and dissemination of disability data. The Washington Group (WG) was formed after the International Seminar on the Measurement of Disability held in New York in 2001. The objectives of the WG were to develop standard questions on disability for censuses and population surveys. A series of National, representative household surveys are carried out in Southern Africa by SINTEF Health research and partners. (Eide and Loeb, 2005).

To improve developing countries' statistical capabilities various consultation trips mainly worked on sampling frame development, probability sampling for surveys, weighting and nonresponse adjustment, and variance estimation was done. Administrative lists are generally too incomplete or outdated to be usable, except in a few cities, so area-sampling techniques are more commonly used in developing countries (Robison, 2010).

The importance of agriculture to the national economy of developing countries and its key role for overall economic growth, increased incomes, poverty reduction and fight against hunger is well recognized in many recent development studies. However, the lack of reliable data on the sector is a major challenge for developing adequate policies and programs, monitoring and evaluation of their outcomes and impacts and informing the international development debate in a fast-changing world (Keita et al., 2010).

For five years, a group of mathematics and statistics educators worked in collaboration to reflect on the teaching of statistics in school mathematics and on the training of those teachers who are responsible for this teaching, under the auspices of the International Commission on Mathematical Instruction and the International Association for Statistical Education. These documents have contributed to raising awareness of the need for increased statistical content at school levels to improve statistical literacy in young students around the world as well as awareness of the related challenges in training and supporting mathematics teachers who teach statistics (Batanero et al., 2011).

Inadequate funding, lack of equipment, facilities and materials, lack of awareness, lack of implementation of research results, low rating in human capital indices, brain-drain, underemployment, etc, as challenges of research and human capital development in Nigeria (Chikwe et al., 2015).

2. Challenges in Statistics in Ethiopia and Possible Solutions

2.1 Challenges in Statistics in Ethiopia

Data quality is a serious problem for research in Ethiopia. This problem is always encountered when researchers use secondary data. Sometimes data obtained from different sources are not compatible. For instance, data obtained from other organizations are less reliable than the data obtained from the Ethiopian Statistical Association and therefore, this secondary data is not reliable for research. In addition, time series and panel data is not available on a daily, or monthly basis and they are usually only available on an annual basis for a few years. For example, profit and liability data is not fully or accurately registered by many private organizations in Ethiopia to order to pay a relatively low tax. However, health related data obtained from patient registration cards and other medical records are relatively good. These findings are consistent with Elahi's (2008) findings.

Researchers in Ethiopia usually use existing statistical models instead of developing new models for a specific problem. For instance, among the research done in School of Mathematical Statistical Sciences about 90 percent of them were done with already developed models. Most practitioners (researchers other than statisticians) typically only use descriptive statistics rather than inferential statistics because they have limited knowledge of statistical methods. Graduate students from these fields usually lack statistical supervision from their advisors.

Research papers in Ethiopia are usually created for the purpose of academic promotion or for graduation. Research outputs are generally not presented for the concerned bodies like policy makers, societies and the organization for whom the data were obtained. Therefore the entity for which the research was conducted does not have the opportunity to benefit from the findings of the research

outcomes. Moreover, locally relevant research is limited because of inadequate funding, lack of equipment, facilities, materials, and lack of awareness. This situation is similar to the research challenges Chikwe et. al. (2015) found in Nigeria.

When teaching statistical methodology in Ethiopia, it is typically more focused on theory than on practical applications. This situation mirrors the findings of Batanero et al. (2011) who discuss the challenges in training and supporting mathematics teachers who teach statistics. One reason behind this is the shortage of materials and facilities for students to practice. For instance, the number undergraduate students in School Mathematical Statistical Sciences, Hawassa University is 500 but the number of desktop computers in the school is just 70, i.e. a seven to one ratio. Another challenge for statistics in Ethiopia is the limited number of references and papers available to compare new results with previous ones. Moreover, obtaining the new editions of textbooks and reference books is difficult. As a result, most textbooks and reference books in statistics are old. To buy books online requires open currency exchange whereas most money transferring mechanisms are restricted, since money-transferring organizations are established to transfer money from foreign countries to that specific country. For instance, Western Union, Money Gram, and so on in Ethiopia are established to transfer money from foreign countries to Ethiopia. This situation is similar to the findings of Stohl (2005) as relatively little is known about attempts to build capacity for statistics education in developing countries, or about factors affecting the quality of statistics education in such countries

In many organizations in Ethiopia, there are no positions to employ statisticians. Employees whose specialization is not statistics usually conduct the needed data analysis and many other organizations are simply not doing research, which could benefit their situations and status. This is similar to the findings of Chikwe et al. (2015) as underemployment is also a challenge in Nigeria.

2.2 Possible Solutions

Organizations should hire statisticians especially for the data collection and analysis. Universities in developing countries should create collaborations with researchers at universities in developed countries. In this regard, Hawassa University has been working with Norway Universities in Statistics starting from 2010/11. The Mathematical and Statistical Modeling (MASTMO) M.Sc. Program was a good model, and even after the project phases out, the program is still benefitting Hawassa University. There are Ph.D. projects continuing in applied statistics and applied mathematics. About 10 Ph.D. candidates with projects and eight without the projects are pursuing their Ph.D. degrees. This collaboration should be strengthened and other collaborations should be created in other specializations to improve the teaching of statistics and raise the quality of research. Other efforts to improve data quality and statistical analysis can be achieved by creating databases with reliable documented data.

The academic staff from universities in developing countries benefit by visiting universities in developed countries to share experiences. In this regard, about seven staff members each had 15 days training and four staff members had three-month training in the USA and Europe. The School Mathematical and Statistical Sciences at Hawassa University also established a statistical consultancy center with the supervision of Professor Eric Vance from University of Colorado Boulder. Currently, we give consultancy service for researchers, staff members, and graduate students that come to the collaboration center (Goshu, A. T., 2016). Also, primary author Degefu visited Rosenberger at The Pennsylvania State University in 2016 and while there worked in the Statistical Consulting Center collaborating with statistical graduate students who consult and collaborate with researchers and graduate students from other departments at Penn State.

Other non-governmental organizations like UNFPA, UNCF, and IMF sponsor projects and collect data on various issues in Ethiopia. Hopefully, they will continue their contributions and efforts for the collection of quality data and utilization of statistics for the developmental issues of the country.

3. Conclusions

Ethiopia is one of several developing countries that face many difficult challenges in building capacity in statistics. Quality data is often not obtained due to lack of qualified human resources in statistics, lack of appreciation for the importance of data collection, cultural based concerns about sharing personal information and other related problems. Research outcomes are too often not used for improving policy evaluation but instead were simply done for academic purposes. Graduate students from other disciplines than statistics usually lack adequate statistical supervision from their advisors. The teaching of methodology in statistics tends toward the theoretical due to lack of resources for doing applications and a lack of awareness of teachers. There is also a limitation of up-to-date textbooks, of teaching materials, and of research support. In many organizations, there are no positions for statisticians who could improve the quality of data collection and analysis.

Possible solutions to the above problems can be found by collaborating with statisticians especially for the collection and analysis within each organizational unit. Organizations in developing countries might work with universities in developed countries to increase the quality of their data and to do joint research. Moreover, universities in developing countries should work in collaboration with national and international universities to share their experiences and to produce qualified graduates. Nongovernmental organizations remain a huge untapped resource and should open their projects for academics and others to work collaboratively in the research areas of joint interest.

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