Training in the Access, Evaluation and Exploration (AEE) of Satellite and Public Health Data Sets by using Giovanni System and Basic Statistical Packages

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Abstract

Space science and STEAM activities continue to offer many benefits that contribute to the sustainability and development of stations. We present experiences and solutions to the training of future National Technical Association (NTA) members from the USA, Ghana and Kenya. STEAM training of underrepresented minority students requires multiple strategies. First, it must start at the K-12 level and extend to college. Our department are “planting STEAM Seeds” by providing quality professional development training for teachers and parents that encourage students to pursue STEAM jobs careers. Secondly, the training should offer academic enrichment activities to students in form of in-school and after school STEAM activities or workshops such as our Science-Mathematics-Engineering Fair, STEAM Expos [or K-I2 Students, and Science Olympiad competition. Thirdly, STEAM training should promote across disciplinary institutions linkages and partnerships with public and private sectors. Finally making use of satellite and public health data sets through data management packages such as Microsoft Excel and Geospatial interactive online visualization and Analysis Infrastructure (Giovani: https://giovanni.gsfc.nasa.gov/giovanni/) will allow students to address a variety of research questions. Innovative and practical training of future scientists, especially those who are a part of the NTA community can improve decision-making in fields of STEAM and prepare the next NTA members.

Keywords: *education, science, technology, art, mathematics (STEAM).*

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Introduction

By the end of the 21st Century, half of the world population under eighteen will be in Africa [UNICEF Generation 2030: Africa study (2014)] and there is a need for individuals and institutions to work together as partners in STEAM [Drücker (1999)]. Universities continue to rely on industries, a thriving economy and good governance to educate students. Other institutions and nations rely on an educated workforce to remain competitive, progressive and profitable [Burlington (1993); The President's Council of Advisors on Science and Technology (2010); Members of the Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (2010); Members of the 2005 "Rising Above the Gathering Storm Committee" (2010); National Research Council (2012); National Science and Technology Council, Committee on STEM Education (2013); Committee on Equal Opportunities in Science and Engineering (2013); National Science Foundation, National Center for Science and Engineering Statistics (2015); Members of the Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (2010)]. There is a symbiotic relationship that is at the same time interdependent and beneficial between individuals and institutions interested in addressing the issue of underrepresentation of minorities into the STEM workforce.

In the USA, Historically Black Colleges and Universities (HBCUs) continue to award a large share of bachelor's degrees to African American students in STEAM. HBCUs are also the baccalaureate origins of one-quarter to one-third of black science and engineering (S&E) doctorate recipients [U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics (2012)]. However, as shown by the National Science Foundation data [National Science Foundation, National Center for Science and Engineering Statistics (2015)] for college aged population (18-24 years), black students only comprise 14.9% with B.Sc. degree recipients of 2% in the geosciences, 2.6% in physics and 3.9% in engineering. There is, therefore, a great need for HBCUs to play an increasing role in their nation-wide prevalence in these particular fields [Ken (2016)] as is estimated that the United States faces a shortage of almost 200,000 people with "deep analytical skills", as well as "1.5 million managers and analysts to analyze big data and make decisions based on their findings" [McKinsey Global Institute (2011)].

In sub-Saharan Africa the story is no different. A World Bank Report [Majgaard and Mingat (2012)] indicates that *educational resources are clearly necessary but not sufficient to produce higher levels of student learning*. Factors such pre-school education, school infrastructure, textbooks, multi-grade classes, community involvement and increased accountability, in-service teacher education and appropriate teacher salaries can contribute to appropriate student learning. These are factors we agree with and have observed over the years. These factors are captured in the Conceptual Framework Model (Figure 1) that we continue to expand [Kinyua 2016a].

There are four motivating factors for this report on our experiences. First, the State of Maryland graduation rate is less than 61% [The Chronicle for Higher Education (2016)], low college preparation and retention of some students is becoming rampant in all our countries. Second, the accelerating demands for STEAM talent in USA, Ghana and Kenya. Third, more rapid gains in STEAM for underrepresented minority populations are needed [National Science and Technology Council, Committee on STEM Education (2013); Members of the 2005 "Rising Above the Gathering Storm Committee" (2010)] for efforts to accelerate the quality and effectiveness of undergraduate education at our universities. Fourth, "University Laboratories are producing new algorithms for data mining applications for specific business or scientific research purposes" [Luan (2014)].

These motivating factors have led us to *"take the bull by the horns"* by way of utilizing the conceptual framework based on a computer microprocessor [Kinyua (1998a, b); Kinyua, A.M. (2000a, b)]. It involves continuous assessment and highlighting the scientific, social and technological partnerships between an individual, public and other institutions through "*Ngumzo*" (i.e. dialogue with peace, harmony, teamwork, and prompt decision) [Kinyua (1999)]. This is because if we are *"to improve education delivery, acquisition and the advancement of our people, it is our central role as individuals together with our institutions, in all our complexities, to pay more attention to our scheduling, planning, management and evaluation of priorities, leadership, support services and delivery of education among other inherent community and society activities."* Inputs for this partnership are captured through factors that characterize the support services for students, by staff as shown in Figure 1. This framework aims at improving the data acquisition, analysis and utility to enhance technical skills, co-operational activities and security. This design was adopted from the conceptual framework of the factors that determine school effectiveness [Kinyua (2000a), Heneveld (1994)]. This conceptual framework takes cognizance of the fact that contextual factors such as politics, culture, technological backwardness, globalization and economics play a key role in developing outcomes to this model [Majgaard and Mingat (2012)].

Methods

Our approaches to encourage and motivate students to pursue STEAM jobs and careers in our communities have encompassed the following: 1) providing early quality and professional development workshops for teachers and parents; 2) offering academic enrichment to students in the form of annual conferences or workshops such as the Science-Mathematics-Engineering Fair for K-12 Students, and Science Olympiad, Science Engineering Mathematics Aerospace Academy (SEMAA) Expo; 3) promoting cross disciplinary institutional linkages and partnerships through Memorandum of Understanding (MOU); and 4) training faculty, staff and students to make use of satellite and public health data sets through data management packages such as Microsoft Excel and Geospatial Interactive Online Visualization and Analysis Infrastructure (Giovanni) [https://giovanni.gsfc.nasa.gov/giovanni/] to tackle a variety of research questions. For example, comparison of MSU's weather station surface temperature data with Satellite observations; any possible link between particulate matter levels ($PM_{2.5}$) and asthma cases in Baltimore City; and ground precipitation analysis of satellite data.

Discussion and Results

The following eight major results have accrued from some of our concerted efforts over the years. First, the training in access, evaluation and exploration (AEE) of Satellite and Public Health Data Sets, using NASA Giovanni System and basic statistical packages by our students, faculty and staff have led to the outputs shown in Figures 2 to 6 [Kinyua 2016b]. The MSU Weather Station Surface Air Temperature measurements compares well with the Satellite data for 2014 (Fig. 2); $PM_{2.5}$ levels (Fig. 3) for Baltimore City (2000-2010) decreased from 17 to 13 ppm while the asthma hospital discharges for 2000-2009 (Fig. 4) continued to increase from 1912 to 2712 counts; and observed ground precipitation levels (Fig. 5) has continued to rise at MSU.

Second, from 2000 to 2018, the Science, Engineering, Mathematics and Aerospace Academy (SEMAA) has trained over 22,000 students since its inception. Along with the Center for Excellence in Mathematics and Science Education (CEMSE), both at Morgan State University, SEMAA is a nationally recognized leaders in K-12 and teacher training in STEAM education, respectively.

Group which promotes visibility and publicity for the University, as well as highlight its achievements; held a workshop on effective supervision, objective examination and mentorship of postgraduate students by academic staff and external supervisors, and on 28th June 2018, University of Embu became not only the first University but also the first Education Institutional in Kenya to attain ISO 27001:2013 Certification. ISO 27001:2013 is an internationally recognized standard for Information Security Management Systems (ISMS) [https://www.embuni.ac.ke/].

Conclusion

The issues discussed in this study have found their way into various education forums, industry, and government. In most countries, we have the national academy of sciences, national councils for science and technology, industrial research and development institutes, institution of engineers among other professional bodies, non-governmental organizations (NGOs) and many professional societies. It is hoped that our team activities will provide a useful resource to retired professionals, education institutions and governmental bodies to help train the next group of NTA members from our minority students locally and abroad. This is especially for those of us who aim to benefit and to improve the education delivery, digital information knowledge, effective institutional linkages that can enhance mutual research and development of human resources so as to promote security especially through economic success. Our concerted efforts are still being challenged by the contextual factors (Figure 1) that continue to remind us to be humble, patient, persistent and to have faith in the resilience of our communities.

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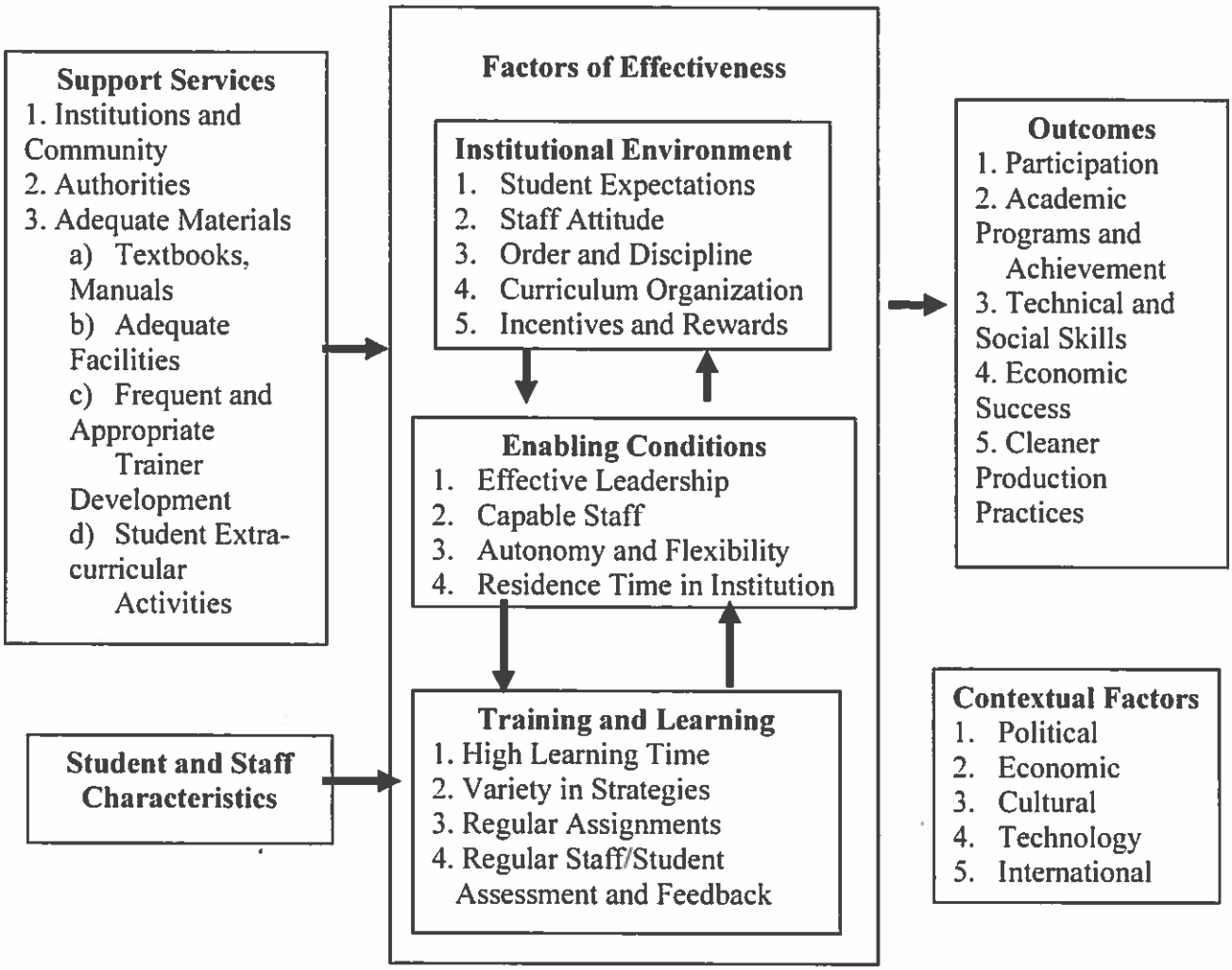
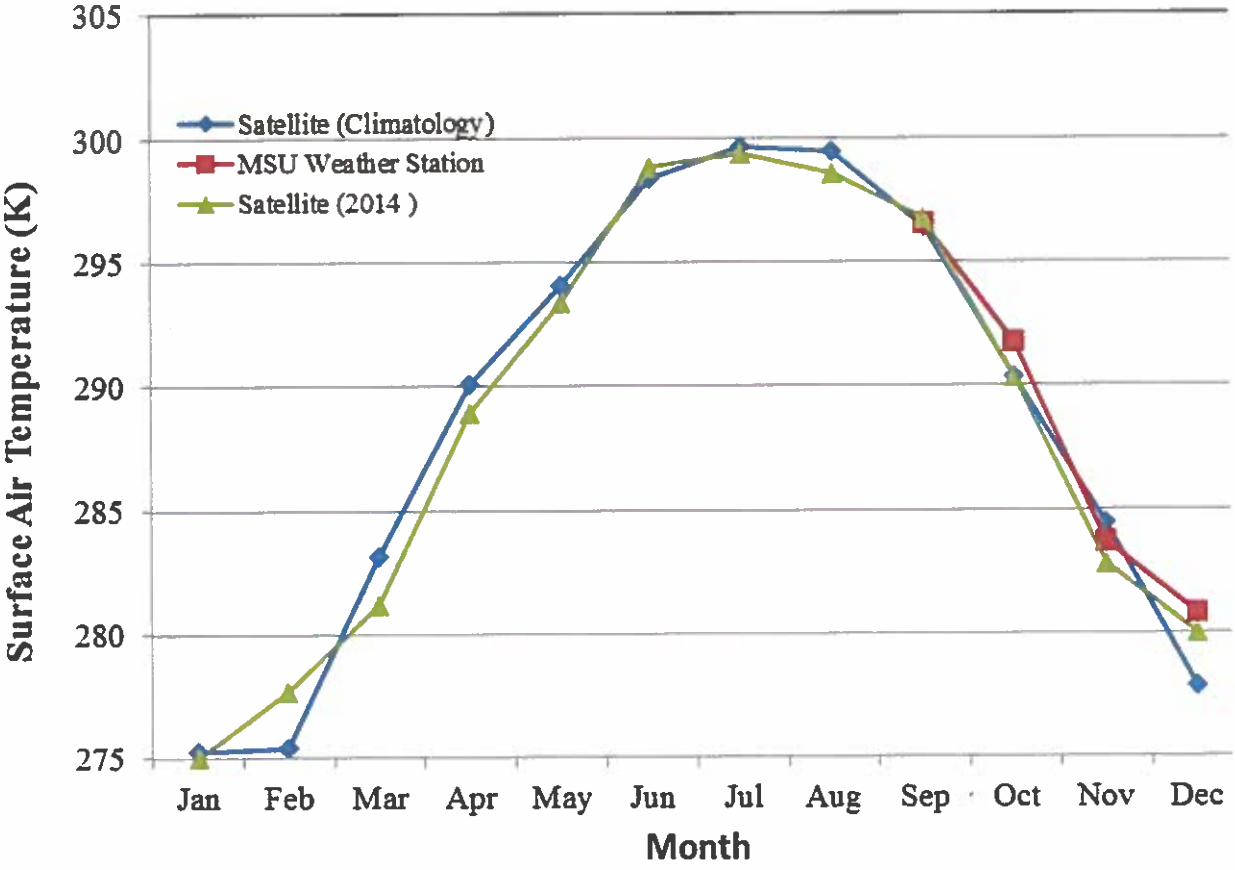


Figure 1. Education Program Partnerships: A Conceptual Framework for *Ngumzo* [Kinyua (2016a)]



. **Figure 2. Surface Air Temperature over Morgan State University**

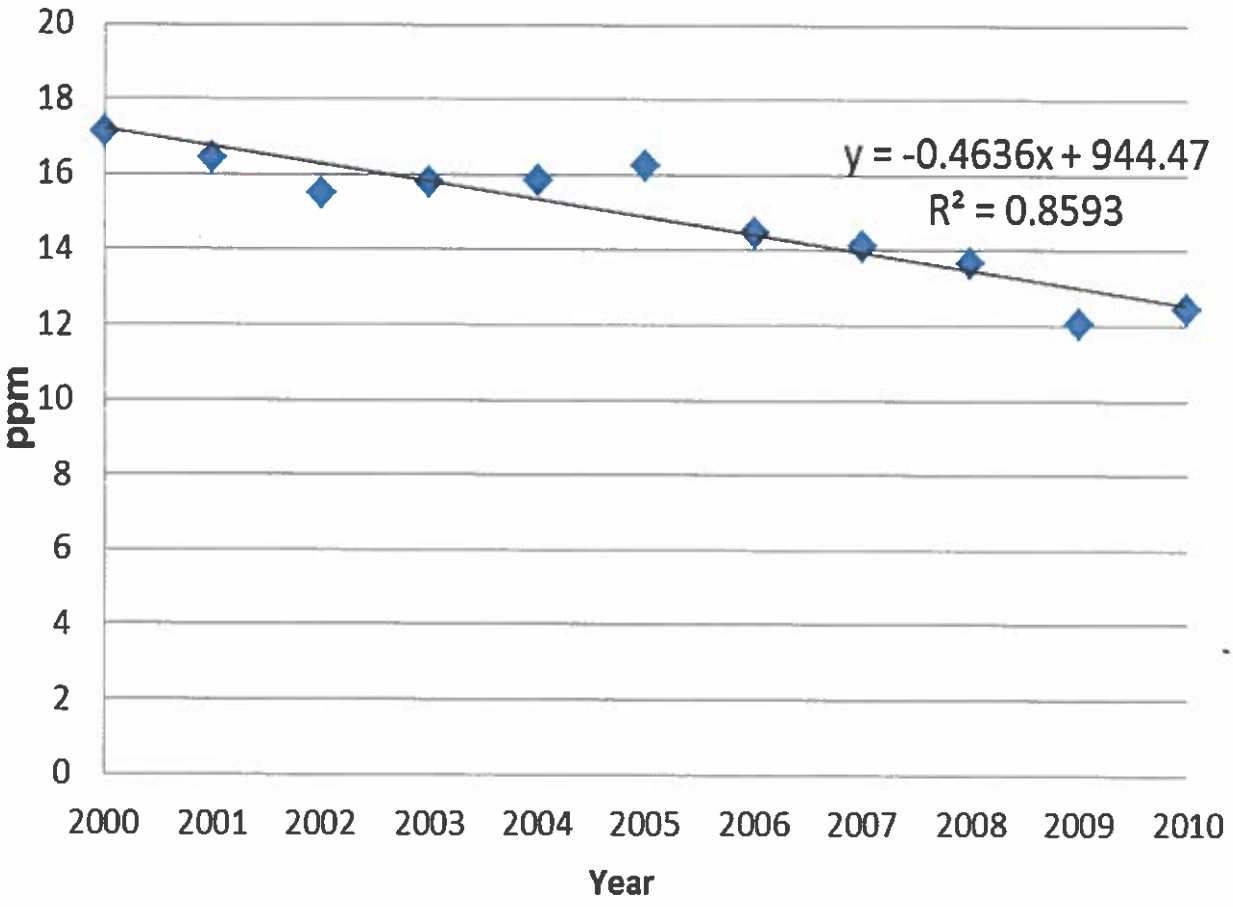


Figure 3. Baltimore City P.$M_{2.5}$ Levels