

Geomatics Education in Nigeria

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Key words: Geomatics, Education, Curricula, Employment, Funding.

ABSTRACT

Geomatics education in Nigeria is offered at three main levels namely, (i) University (ii) College of technology/Polytechnic and (iii) Technical College. Some low-level manpower is also produced through apprenticeship and on the job training.

Initially, the training offered in these Institutions was geared towards training in the field of Land Surveying. The advent of large memory personal computers and the need to store, manage and retrieve geo-referenced data led to the changing pattern of training. Production of maps can now be achieved almost in real time. By these developments, there is a change of emphasis from Surveying to Geomatics. Geomatics can be regarded as the integration of the traditional Surveying techniques and applications with the modern methods of Global Positioning System (GPS), Remote Sensing and Geographic Information System. Due to this change of emphasis, the training of surveyors in Nigeria is being modified to meet the training needs of geomatics education.

Apart from the traditional surveying training institutions which are adapting to the new situation, some other departments (such as Geography) also offer training relevant to Geomatics, particularly in Geographic Information Systems. Products from these training programmes can be employed in such organisations as the Federal and State Survey Departments, Federal and State Environmental Protection Agencies, Oil Companies, National Electric Power Authority, Nigeria Ports Authority, Federal Airports Authority and the Military, as well as private survey firms and companies.

In spite of the above, lack of facilities and dearth of the right calibre of staff is a major set back in Geomatics education in Nigeria. It is suggested that government should provide adequate funding for training and purchase of facilities. A clear policy on geomatics education in Nigeria is also important.

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1. INTRODUCTION

Geomatics education in Nigeria is offered at three levels in Nigeria. These are University, College of Technology/Polytechnic and Technical College. Some low-level manpower is also produced through apprenticeship training. In the past, these levels of training produced surveying manpower at professional, technological and technical levels. These level of education are discussed below:

1.1 Development of Surveying Education in Nigeria at Professional Level

It is often claimed that the Nigerian Surveyor was the first professional man to be exposed to formal training locally. Indeed, a school for the training of surveyors was first opened in 1908 in Lagos. That school was later moved to Ibadan in 1927 from where it finally moved to Oyo in 1935. When the Yaba College of Technology was established around 1932 as the highest institution in Nigeria, a provision was made for prospective surveyors to undergo basic educational studies in the institution for two years, followed by two years of surveying at the Survey School, Oyo. Successful candidates were subsequently awarded diploma of the College. The first exposure to University education came in 1947 when the first university in the country was established as the University College of Ibadan. There, provision was made for the training of professional surveyors for the country. The programme was later discontinued following a change in the policy of the colonial administration (Nwilo *et al*, 2000).

In 1962, the Nigerian College of Technology, Enugu became part of the then two year old University of Nigeria, Nsukka and the Nigerian Surveyor was again exposed to University education. The first set of 5 students of surveying from the University graduated in 1966, 58 years after the first Survey school was opened in Lagos (Fajemirokun, 1976).

The Department of Surveying and Geoinformatics of the University of Lagos started as a sub-department of Civil Engineering Department in 1970. The initial programme of the sub-department at the time was a two-year postgraduate course of studies and research leading to an M.Sc. (Surveying) degree. Graduates in fields cognate to surveying were admitted into the programme (Department of Surveying and Geoinformatics Unilag, 1999). Prior to all these, the Faculty of Engineering of the University of Lagos in 1967 arranged for a few students who were surveying undergraduates of the University of Nigeria, Enugu Campus and who were displaced by the Civil War, to complete their degree programmes in the Faculty, and earn a degree of the University. In 1974/75 session, the department started the B.Sc. degree programme.

The Department of Surveying, Ahmadu Bello University, Zaria was set up at about the same

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time that the University of Lagos started offering Surveying at postgraduate level, and had since been turning out graduates in surveying. University training in surveying is also offered at the Enugu State University, Enugu, Federal University of Technology Minna, Rivers State University of Science and Technology Port-Harcourt, Abubakar Tafawa Balewa University Bauchi, Imo State University Owerri, University of Uyo Uyo and the Federal University of Technology Yola. This makes it a total of ten universities offering professional training in the field of surveying in Nigeria at present.

1.2 Technical and Technology Education

There are currently sixteen Polytechnics and one Federal School of Survey running the National Diploma programme in Surveying at the technician levels; four of these institutions also run the Higher National Diploma programme at the technologist level (Bardi, 1996). In Nigeria, the National Board for Technical Education (NBTE) curriculum is used by all Polytechnics and similar institutions to train survey technicians and technologists. Thus, the main role of the Polytechnics in Nigeria is the training of technicians (National Diploma Certificate holders) and Technologists (Higher National Diploma Certificate holders) on production work and technical management for direct employment in industry and public service.

The structure of the National Diploma (ND) programme consists of four semesters of classroom, laboratory and workshop activities in the institutions, and a semester of three to four months duration of supervised industrial training. The structure of the Higher National Diploma (HND) programme is similar to that of the ND except that the supervised industrial training is not compulsory.

2. GEOMATICS EDUCATION IN NIGERIA

Initially, the type of training offered in the institutions discussed above was geared towards training in the field of surveying. Students may also be exposed to the basic rudiments of computer hard ware and software, and taught some of the programming languages. Courses on the various divisions of surveying were offered. Such divisions include Plane Surveying, Engineering Surveying, Geodetic Surveying, Photogrammetry, Remote Sensing and Hydrographic Surveying.

The advancement in computing technology which resulted in the development of high speed computers with large memory, coupled with the need by surveyors and other professionals to store, manage and retrieve geo-reference data quickly has led to the changing pattern in training. Furthermore, there is the tremendous impact that advances in technology, modern instrumentation and techniques have had on the Surveying profession. Though most of the traditional courses are still being offered in Nigerian Universities and polytechnics; new courses like Principles of Geoinformation systems, Digital Mapping, Coastal Mapping and Management, and GIS Tools and Applications are now being taken in the universities and polytechnics.

With the changing pattern of training, production of maps can now be almost achieved in real time. The above development has led to a change of emphasis from Surveying to Geomatics. A number of definitions for surveying have been given, for example by Clarke (1973), Fajemirokun (1988) and Bannister et al (1998). Surveying is defined by Bannister *et al* (1998) as “the art of making measurements of the relative positions of natural and man made features on the earth’s surface, and the presentation of this information either graphically or numerically”. With the advances in Information technology, however, the FIG defined a surveyor as “a professional person with the academic qualification and technical expertise to practice the science of measurement, to assemble and assess land and geographic related information, to use that information for the purpose of planning and implementing the efficient administration of the land, the sea and structures thereon, and to instigate the advancement and development of such practises” (NIS, 1997).

Grun (1998) called the enlarged tasks of Surveying Geomatics. He defined Geomatics as “the science of acquisition, management, modelling, analysis and representation of spatial data and processing with specific consideration of problems related to spatial planning, land use/land development and environmental issues”. Dale (1999) also defined Geomatics as the science of measuring and mapping the spatial distribution of data. According to ISO definition, Geomatics is the modern scientific term referring to the integrated approach of measurement, analysis, management and display of spatial data.

The activities of geomatics are included in, but not limited to, Surveying and Mapping, Cartography, Digital mapping, Geodesy, GIS, Land Information Management, Digital Photogrammetry and Remote Sensing. Geomatics can also be regarded as the integration of the traditional survey techniques and applications with the modern methods of Global Positioning System (GPS), Remote Sensing and Geographic Information System.

Due to the change of emphasis from Surveying to Geomatics, the training of surveyors in Nigeria is being modified to meet the training needs of geomatics education. Many institutions at the University and Polytechnic levels are now modifying their curricula so as meet the training needs for the geomatics education. It has indeed become very important for every higher institutions in the country to change or modify their curricula in order to produce the needed man power to meet the current needs in the private and public sectors. Many professionals in allied fields like engineering, sciences and social sciences and even in education and business administration are now embracing Geomatics. The higher institutions offering surveying are now saddled with the task of developing new curricula to train surveyors and professionals from other fields of study.

With the enlarged tasks of surveying, the need for new or modified curricula in the tertiary institutions in Nigeria has become paramount. In fashioning out new curricula for training the new generation surveyors, a critical look at employers’ need becomes very important. According to Brimicombe (1998), the result of a survey has identified that employers now look for three main attributes in survey recruits. These attributes are:

- They must be adaptive (get up to speed quickly).

- They must be adaptable (respond positively to change with ability to learn and apply new knowledge and skills).
- They must be transformative (should be able to anticipate and lead change; help their organisation transform).

The foregoing attributes can only be achieved through curricula that are adaptive to change. In other words, adequate training schemes must be put in place to meet up with the new demands in the geomatics industry. The National Board for Technical Education (NBTE) in collaboration with the Federal School of Surveying, Oyo in March 1998, held a workshop to review the curricula for survey for polytechnics in Nigeria and Federal School of Surveying, Oyo. The new curricula brought in courses like GIS, Environmental Management, Knowledge-based Systems, Digital Surveying and Internet Technology. Kufoniyi (1998) identified four broad specialised areas for geomatics education. These areas are:

- (i) Spatial data acquisition through computer-aided Surveying, analytical and digital photogrammetry, remote sensing, conversion of analogue map and other geospatial data into digital form using manual digitizing and scanning, and attribute data collection methods.
- (ii) Spatial data management which requires knowledge of database design and creation, database management systems, data transfer and exchange, spatial query development, spatial statistics, e.t.c.
- (iii) Cartography and geoinformation visualisation, dealing with data formats and information presentation: and
- (iv) Geospatial information infrastructure and management, dealing with aspects such as spatial standards, GIS policy, implementation issues.

Curricula are being developed to address the four broad-based areas stated above in tertiary institutions in Nigeria. In line with the development in colleges of Education and polytechnics, the National University Commission (NUC) had also directed all institutions offering surveying to modernise their curricula.

Department of Surveying and Geoinformatics, University of Lagos reviewed her curricula in line with the change of emphasis from surveying to geomatics. Some of the new courses introduced at the undergraduate level include Computer Application in Surveying, Principles of Geoinformation, Digital Mapping, Coastal Mapping and Management and GIS Tools and Applications. At the Graduate level, some of the new courses introduced are Data Acquisition Systems, Advanced Concepts in Geoinformatics, Spatial Data Structures, GIS Implementation Strategies, Spatial Statistics, Policy Issues in GIS Implementation, Digital Cartography, Knowledge-based Systems and Environmental Management. Internet Technology was also introduced at undergraduate and Postgraduate levels. Similar modifications have also been made to programmes at Masters and Doctorate levels.

The introduction of the new courses in the Department of Surveying and Geoinformatics, University of Lagos has led to an increase in the number of students seeking admission into our undergraduate and postgraduate programmes. In the last two years an average of seventy students were admitted into the undergraduate programme. This year the department has

increased its quota to 100 because of the high number of students seeking admission into the undergraduate programme.

Besides the normal postgraduate courses at M.Sc., M.Phil. and Ph.D. levels, the department in 1999 introduced a Professional Master of Geoinformatics programme which admits a wide range of candidates from different backgrounds. The programme is open to graduates in Surveying, Engineering, Physical Sciences, Social Sciences, Environmental Sciences, Business Management and Forestry. This programme runs for 12 months consisting of two semesters. The first semester is devoted to discussing the basic principles of the GIS and laying the foundation for understanding all aspects of spatial data acquisition. The second semester is used to cover advanced topics in Geospatial information production and data management. The students are also exposed to practical sessions.

3. EMPLOYMENT OPPORTUNITIES IN GEOMATICS EDUCATION

Apart from the traditional surveying training institutions in universities and polytechnics, which are adapting to the new geomatics education, some departments in Nigeria also offer training relevant to Geomatics. These departments are Geography Department, University of Ibadan and Geography Department, University of Lagos. Geography Department, University of Ibadan is the first institution to offer Master in GIS. Geography Department, University of Lagos is also running Postgraduate Diploma in GIS and Master of GIS programmes.

Several employment opportunities exist for products of geomatics education. Department of Surveying and Geoinformatics, University of Lagos Prospectus (1999) listed some of the places geomatics products could be employed. These include:

- i. Federal Ministry of Works and Housing.
- ii. Federal Housing Authority and State Housing Development Corporation
- iii. State Ministries of Works and Housing.
- iv. Federal Environmental Protection Agency.
- v. Banks and other Mortgage Finance Institutions.
- vi. National Electric Power Authority
- vii. Water Corporation and River Basin Development Authorities.
- viii. Nigerian Telecommunications Plc.
- ix. Nigerian Ports Authority.
- x. Oil Exploration and Marketing Companies.
- xi. Oil Service; Seismic and Oil exploration and Offshore Engineering Private Companies.
- xii. Universities, Polytechnics and Similar Institutions.
- xiii. Private Consulting Firms and Individuals.
- xiv. Agricultural Development Agencies.
- xv. Dredging and Marine Resource Agencies.
- xvi. Engineering Construction Companies.
- xvii. Armed Forces (Army, Airforce and Navy)
- xviii. Federal Capital Development Authority

Adeoye (1998) also provided information on the various geomatics user requirement needs in the country. From the employment list and the geomatics user requirement needs, the areas of employment for geomatics products is now very wide. Employment opportunities therefore abound for products of geomatics education.

4. PROBLEMS FACING GEOMATICS EDUCATION IN NIGERIA

Though the change of emphasis from surveying to geomatics by tertiary institutions and the industry has broadened the employment opportunities for geomatics products, there are some factors causing major setbacks in geomatics education in Nigeria. These factors are lack of facilities, unavailability of the right calibre of teaching staff and inadequate funding.

4.1 Inadequate Funding and Lack of Facilities

The problem of inadequate funding of tertiary education is critically affecting geomatics education in Nigeria. The universities and polytechnics are grossly under funded such that many are rendered virtually ineffective. The various governments do not seem to accord the surveying profession and the geomatics industry the importance place it should occupy and the priority it deserves in view of the indispensability of its products to sustainable development. Modern geomatics hardware and software are needed in the higher institutions to effectively pass geomatics education to the students. These hardware include A0 digitisers, scanners, high speed computers, GPS receivers, Total Station Equipment and Digital Levels, while some of the useful software are CAD and GIS software. These basic equipment and software are difficult to acquire due to the poor currency exchange rate and poor funding of the educational sector by the various governments. The poor economy of the country also has its toll on the nation's tertiary institutions. Apart from the Department of Surveying, University of Lagos and Federal School of Survey, Oyo and a few other institutions who may have just the minimum equipment, most other institutions lack the necessary equipment and software to pass geomatic education to the students effectively.

4.2 Unavailability of the Right Calibre of Teaching Staff

One of the greatest problems facing geomatics education in Nigeria is the unavailability of the right calibre of staff to teach or train the new students. Most of the personnel available for teaching are well grounded in the traditional survey techniques, but need to be re-trained in the new emerging geomatics techniques. Although through continuous Professional Development Programme and other in-house training programmes many seem to be grasping the new techniques in geomatics education, the number of staff needed for geomatics education is much more than what we have now. In addition, the few number of qualified staff are spread very thinly amongst the rather very large number of institutions offering programmes in geomatics education. There is therefore an urgent need to produce the right calibre of staff and in sufficient numbers for the universities and polytechnics, to impart the needed skills to the students.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Recommendations

The following recommendations if pursued and implemented, will go a long way to solve the numerous problems facing geomatics education in Nigeria, and also help to promote the geomatics industry.

1. All departments and institutions offering survey related programmes should constantly review their curricula to reflect the changing needs of the geomatics industry. Emphasis must not only be placed on traditional survey techniques; attention should also be given to modern techniques in data acquisition, data management and data presentation. New courses should also from time to time be introduced in the training programmes.
2. A clear policy by the relevant geomatics regulatory bodies should be made to unify all training programmes and also eliminate all impedance in the geomatics industry. In formulating such policy, the input from all the stakeholders in geomatics education and industry should be obtained and considered.
3. Government should give education the right priority and make funds available to universities, polytechnics and all other relevant organisations and firms so that the necessary equipment would be purchased to facilitate the training being offered by these institutions.
4. Tertiary institutions should also look beyond government subventions for funding of geomatics education. They should also seek for help from non-governmental agencies such as oil companies and some international organisations.
5. There should be a high degree of collaboration among the tertiary institutions. International research fellowships and scholarship awards to deserving young lecturers would also be of immense benefit to the geomatics industry.

5.2 Summary and Conclusions

Ten Universities presently run programmes in surveying and geomatics leading to bachelor degrees. A handful of these institutions also offer higher degree programmes. There are currently sixteen Polytechnics and a Federal School of Survey running the National Diploma programme in Surveying; three of these polytechnics and the Federal School of Surveying also run the Higher National Diploma programme. Some low-level manpower is also produced through apprenticeship training.

Initially, the type of training offered in these institutions was geared towards training in the field of computer with surveying. However advancement in computing technology, coupled with the need by surveyors and other professionals to store, manage and retrieve geo-reference data very fast led to the changing pattern in training. Universities and Polytechnics are now modifying their curricula to suit the needs of the geomatics industry. Though most of the traditional courses are still being offered in Nigerian Universities and polytechnics, new courses like Principles of Geoinformation, Digital Mapping, Coastal Mapping and

Management and GIS Tools and Applications are now being taken in the universities and polytechnics.

Products of Geomatics education can be employed in such organisations as the Federal and State Survey Departments, Federal and State Environmental Protection Agencies, Oil Companies, National Electric Power Authority, Nigeria Ports Authority, Federal Airports Authority and the Military.

Inadequate funding of tertiary institutions with lack of facilities for manpower development are affecting geomatics education in the country. Also the unavailability of the right calibre of teaching staff and in appropriate number are major setbacks in Geomatics Education in Nigeria.

Adequate funding with a clear policy on geomatics education will go a long way in promoting geomatics education in Nigeria.

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BIOGRAPHICAL NOTES

Prof. Francis A. Fajemirokun

Prof. Fajemirokun has a bachelor's degree in Surveying of the University of Nigeria, Enugu Campus and the Master of Science and Ph.D. degrees in Geodetic Science of the Ohio State University, Columbus Ohio.

Prof. Fajemirokun was one of the pioneer staff of the Department of Surveying at the University of Lagos where he has been since 1973. His higher degrees were in Geodesy (Celestial and Physical). He has been editor to the Map Maker, African Geodetic Journal and the Nigerian Journal of Engineering and Technology. He was national president of the Nigerian Institution of Surveyors 1992-1994. A Nigerian registered surveyor, he holds the fellowship of the Nigerian Institution of Surveyors and the International Association of Geodesy. He is also a member of the Nigerian Institution of Management, having held many administrative positions in the university, including the Deanship of both the Faculty of Engineering and the Scholl of Postgraduate Studies.

Professor Fajemirokun, a former visiting professor at the California State University in Fresno, USA, is a Professor of Surveying at the University of Lagos and has several publications in learned journals and conference proceedings.

Dr. Peter Chigozie Nwilo

Dr. Nwilo has a Ph.D. in Environmental Resources from the University of Salford, United Kingdom. He also has a Bachelor of Science and a Master of Science degrees in Surveying from the University of Lagos. His Ph.D. Thesis is on sea Level Variations and the Impacts along the Coastal Areas of Nigeria.

He is a registered surveyor, a member of the Nigeria Institution of Surveyors, an Editorial Board Member of the Journal of Environment Education and Information, University of Salford, U.K., an Honorary Advisory Board Member of the Encyclopedia of Life Support System and an Editorial Board Member of the African Geodetic Journal. Dr. Nwilo had a fellowship Award of the European Community for his Ph.D.; and was a Federal Government of Nigeria scholar for his M.Sc. and B.Sc. degrees.

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Dr. Nwilo has a total of 43 publications in journals and conferences in the areas of surveying, coastal management, oil spill, sea level variations, subsidence and environmental management.

Mr. Olusegun Temitope Badejo

Mr. O.T. Badejo graduated from the University of Lagos with a Bachelor of Science (B.Sc.) degree in Surveying in 1992. He also obtained a Master of Science (M.Sc.) degree in Surveying, in University of Lagos in 1996. His B.Sc. Project was on Sea Level Variation in a Coastal Seaport, while his M.Sc. research work was on Tidal Prediction Using Least Squares Approach. He is currently an M.Phil/Ph.D. candidate and also a Lecturer in Department of Surveying and Geoinformatics, University of Lagos. He is developing a Mathematical Model for Simulating Oil Spill Positions on Nigerian Coastal Waters.

Mr. O.T. Badejo is a Member of the Nigerian Hydrographic Society and an Associate Member of the Nigerian Institution of Surveyors. He has seven publications.