Higher Education in Geographical Information Technology: University Educational Programme and its Application to State Level Planning in India

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Keywords: Geo-Information Technology, ESRI FIG Grant, Higher Education, Annamalai University, India.

SUMMARY

This paper documents about the development of Geographical Information Technology at Annamalai University, India which is one of the Universities being honored by the International ESRI FIG Software Grant and one among the 25 institutions in the world introducing Higher Education in Geographical Information Technology. The education is introduced with the aim of teaching of Geographical Information Technology to the student and staff of University in developing country through online training and softwares, the solution to the application scientists or end users. The multidisciplinary subjects namely Earth Sciences, Civil and Structural Engineering, Agricultural and Marine sciences, Statistics, Sociology and Rural Development departments are strengthen the field. This paper also deals the importance and need of knowledge and practical utility of Geographical Information Technology in Tamil Nadu State, India in accounts to the analyse of earth resources, developing the communications and creation of data base and to monitor the changes in utilization of resources and environment. This introduction of Geoinformatics knowledge is being a next goal in learning of advanced prime information technology within the University Campus.

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1. INTRODUCTION

Introducing of Geographical Information Technology as Higher Education in the University program in developing country like in India is unquestionable in learning of importance of the cartographic formation, as part of the whole educational process to youths and scientists taking into account the needs of human relations with the geographical space of the modern map technologies. Here, a revised scheme of education in Remote Sensing and Geographical Information Technology is required in view of understanding of principles and recent methods with its applications ranking through better resource and data management. The said highly complementary tool provides integrated and total solutions and has to be taught in the University as a subject of Higher Education.

In India, understanding to recent advances in computer, satellite, digital technologies and geographical information system have had a tremendous input in the field of surveying and mapping and professionals lead to include the new surveying and mapping techniques as a new curricula in data acquisition and management system in several fields namely, Global Positioning System, Remote Sensing, Digital Photogrammetry, Digital Cartography, Geographical Information System, Cadastral Survey, Mapping of Mineral and Earth Resources, Coastal and Environmental Management. Though, there are several issues, which need to be talked at policy level to improve the operationalisation of Geographical Information Technology exercising in the School and University education, the co-ordination at Government and Science Institution level is increased and several space applications become of commercial nature. In the rapidly changing world, land administration must be offer to all employees with greater opportunities for access to knowledge, irrespective of their age or social circumstances. The massive investments in Cadastral Surveys thematic mapping information and agriculture sectors due expected to generate over 21,000 million Indian rupees, the certain development has to be meet by the Higher Education.

2. NEED OF HIGHER EDUCATION

Continuous training and education has become an important issue in the rapidly evolving information society. A fundamental transformation continues to occur in higher education. Information and Communication Technologies (ICT) are having a deep effect on teaching and learning and are eroding traditional geographical boundaries resulting in greater competition and opportunity. Students or trainees are also changing. Part-time, adult learners know that learning is no longer confined to university campuses, and are seeking flexible ways to meet their personal, academic or employment objectives.

In order to take an active part in the current processes of change, the employees should be able to develop their fund of knowledge on a continuous basis, thus continually expanding and renewing it. This means, that it is necessary to promote on life long basis creativity, flexibility, adaptability, and the ability to learn-to-know and to solve problems. These are the conditions we must meet in order to avoid the rapid obsolescence of skills. Therefore new structures must be developed to help the anticipating needs and the evolution of job profiles.

This problem can be overcome by a joint effort on the part of specialized training and higher education establishments. Cooperation between universities, training centres and the business world is the basic way of collecting and transmitting knowledge in association with public and private partners at national and regional level, they can promote life long education.
So, the task is to reorganize educational resources in association with the employment services. In an extension of existing education programme, the first objective has to be develop still further the corporate dimension of education is improve the quality of education by increasing exchanges of experience and information on good practices.

In the 21st century or advanced information society, the educational goal and curriculum of Geoinformation technology course should be more focused. To establish an area of higher education by recognition of qualifications, it is required to establish and to promote physical mobility and the virtual mobility made possible by the new technologies of communication; to develop common databases and knowledge on skill needs; to conduct comparative research on methodologies used and policies implemented; to improve the interoperability of systems of distance learning and to increase the level of standardization of the new decentralized multi-media training tools etc.

The goal of education of Geoinformation in Annamalai University Campus is to equip a lab with practical ability where the educational program and the curriculum are differed compare to other Universities. On the other hand, the Department of Earth Sciences in the University is able to produce professionals and experts equipped with the theory and the practical ability to analyze and solve the various problems related to earth resources in the field of Geo-information technology. The department of Earth Sciences provides the curriculums that are focused on obtaining knowledge in Geoinformation technology to the various departments of University teaching principles of survey, agriculture, botany, computer applications, statistics, earth and mineral resources, land and urban management and to environmental assessment. The goal and growth of higher education in Geoinformation technology have been closely related to the development plans and demands of the public. Further, we have to pay more attention on how to keep the advantages in Surveying & Mapping in Geodesy, Engineering Surveying, Photogrammetry & Remote Sensing, Cartography & GIS etc. among students and experts.

3. GEO-INFORMATION

Geo-information is a technology used in a number of different disciplines for a broad range of applications. Any discipline, or interdisciplinary concerned with spatially related data benefits from this technology. The provision of utility of service and infrastructure in

sustaining development in India is hindered by lack of Geo-Information, especially in the rapid growing areas. To the need of available and accurate information, it is a basic tool for economics, planers in providing cost effective and sustainable land use and resource plans in the country.

The role of the professional land surveyor in sustaining development in India encompasses a wide spectrum of activities. It also looks at the role of surveyor play in the management and developmental plans or schemes for chiefs and other individual land and other natural resources. By incorporating geo-information into this management system, it will facilitate the quick update of land and other resource records. Having identified the magnitude of problem of property taxation in India, we believe that the inadequate assessment system being used and presently it can be improved through the development of a Natural Resource Assessment System for an accurate and up to date preparation of resource maps.

4. GEOINFORMATION UNDER ESRI FIG GRANT

The Annamalai University of India has received Geo-information technology as a major grant in the form of software and training from the Environmental Systems Research Institute (ESRI) and the International Federation of Surveyors (FIG) under ESRI FIG Grant program. The goal of the program is to foster and support the integration of Geographic Information System (GIS) technology in the Colleges and Universities of developing countries worldwide to teaching their students with the latest Geo-information technology. Under which, the grant has been implemented in this University with the primary objective of promoting the Geo-information technology and the uses and applications of GIS among the student and staff of the University as part of learning of higher education in GIS technology. The offered software's and ESRI virtual campus training are available to the students, staff and end users of the University. The progress of objective is yet to be monitored, as the program is implemented recently.

5. DISTANCE LEARNING: VIRTUAL CAMPUS OF ESRI

Now a day, "distance learning " is often used to describe education via Internet. The classic approach has been dramatically changed in the times of the Internet and multi-media. Internet is dramatically changing the situation of education. Nowadays, various kinds of educational materials are on Internet, and anyone can access for suitable information from a well-prepared web site for education. The WWW technology allows educators as well as students to access to educational materials spread all over the world. Virtual Academy is represents the key challenge of distance learning and implementing of new IT paradigm. The ESRI, USA developed Virtual Campus for learning of Geo-information Technology is a good entrance for accessing educational materials and resources related to remote sensing, GIS, and GPS. It is a kind of online textbook for remote sensing and photogrammetry, GIS and GPS. Even though, you don 't have any educational materials, you can teach or learn more remote sensing, photogrammetry as well as GIS using these educational materials available on Internet. The sophisticated educational materials can also be provided with CD-ROMs. However, there are several advantages of Internet against other media. One is the actuality of

the contents and latest knowledge. Since the contents or the methodology or interpretation can be revised at any time, students can see latest information / news of the subject. Another advantage is accessibility. After studying the course material and taking practical exercises using internet and computer, the students answer the delivered questions and respond via internet for evaluation of solutions and returns answers or corrections in time bounded manner. The course is also enlightened the livelong seminar and education.

The Virtual Campus of ESRI is aiming equilibrium between basic concepts and the approach of any application possibilities. Besides, it also presents the future trends in the remote sensing technology and Geographical Information technology. Existing lecture courses always made available on the web. Existing knowledge and research results also made available, and packed in way tailored for use in different areas of professional practice. All graduates and users have access to the newest knowledge throughout their training period. These, online campus training and distant learning courses is integrated even if the delivery may be shaped in different ways for sharing knowledge of geo-information on the web site, a data standardization scheme is also existed. A part of above said grant, the introduction of the geo-processing technology through online training in the Annamalai University is materialized which is being a profitable and deserves for the development of technical skills and a general understanding of the new system of organization in the field of GIS technology.

6. STRUCTURING OF CURRICULUM IN GEOINFORMATION TECHNOLOGY

Digital Revolution coupled with the new Information and Communication Technology has made and will continue to make a great impact on education and training curriculums in photogrammetry, Remote sensing and GIS. This impact can be observed in the integration of these three disciplines and other aspects of surveying and mapping sciences such as Geodesy, Surveying and Cartography, with Information / Communication Technology. The adoption of an integrated approach to teaching to students and staff of University and mapping has in turn necessitated changes in the curriculum of rather old knowledge in this field. This impact is also observable world wide in recent times, by the changing of the names of such institutions to new names such as Geomatics, Geomatics Engineering or Geoinformatics to reflect restructuring of their curriculums. Similarly, for the said curriculums, the following five stages has been recognized (Ayeni, 1992,1999).

- Defining the aims and objectives of the proposed curriculum program based on technological innovation and the needs of India.
- Identification of contents of proposed educational program
- Implementation of methods and strategies for the proposed contents
- Evaluation and assessment
- Getting a feed back from the current students

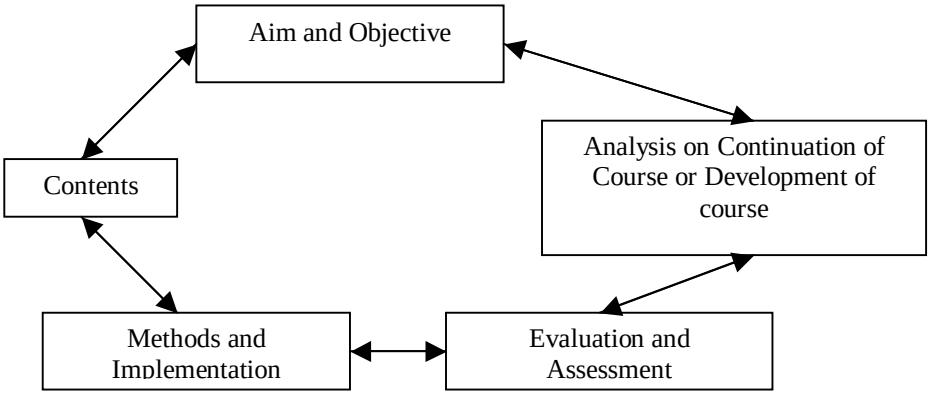

Fig.1: Stages in Curriculum Development:

The factors considered during the implementation of the said curriculum contents are,

- the state of the art of the technology at national and international level.
- the professional requirements
- the employer requirements
- the facilities available to the training
- the experts available to fulfill the contents to the trainees and
- the current curriculum, if any, existing in the institution

The participants of the given curriculum included are,

- To the Teaching, non-teaching and Technical staff of University.
- To the programs at different levels, such as 4 year B.E, 5 & 2 year M.Sc, M.A, MBA, 3 year Ph.D and Part time Diploma.
- The extra curricular activity which is intended to start to share the knowledge of Geo-information technology in the school level.

6.1 Recommendation of Modules

After highlighting and introducing the distance learning online training course to different faculties of department relevant to this subject of Geo-information technology through sending circular and lecturing to the students and staff of the University, the following modules are planned to give to the participants with reference to courses and softwares available and interest among the different level of participants in the form of Modules.

Module I:	General Introductory Courses
Module II:	Learning Courses
Module III:	Application Courses
Module IV:	Research Courses
Module V:	Research Project Based Work

6.2 Evaluation and Analysis

To maintain the dynamic nature of this curriculum, evaluation and assessment are proposed. Based on the result of evaluation and a vital input, future curriculum revision or restructuring is being proposed. The student performance and course evaluation is being monitored guidance with parent institutions.

7. THE NEED OF GEO-INFORMATION TECHNOLOGY IN INDIA

The understanding of spatial data integration into the Geographic Information System along with their modeling strategies is to promote more effective digital mapping in the present fast changing field of information technology environment. GIS along with Remote Sensing technology provides an excellent spatial information and framework for understanding the fundamental principles of spatial analysis. Due to the rapid development in the Geographical Information System and Remote Sensing technologies, it has become possible to analyze resources and to monitor the environmental degradation and their restoration through the computer simulation and modeling at the global and the micro-regional levels (Blackburn and Milton, 1997). So, the technologies have been used to form a basis for cost-effective technologies for broad scale evaluation of many environmental monitoring problems including land use and earth resources assessment (Kontees et al., 1993 and Wharton, 1987) and ecological restoration, including forestry management (Skidmore, 1989).

India is the largest developing country with most population in the world. Increasing pressure, brought by rapid economic development and population growth, on resources and environment has caused serious problems on informal land occupation, threatened diversity of biology and worsen environmental pollution. Consequently, sustainable development as a national strategy is enjoying high priority in the new century. The GIS techniques and geo-information technology are to be developed in order to manage the resources namely population and health, resources and environment, education and security, and economic and social development under sustainable development. These define the scope of related data collection and organization. It is also in line with the sustainable development of different resources. The data of different resources must be obtained for the process of determining, recording and dissemination of information and value for the use of land and other resources when implementing resource management policies.

Therefore, we can use these geo-information techniques to document the geographical information on the behavior and pattern of the population, migration, and growth, up to date maps of residential areas and for their developmental plans. Such kind of accurate information namely knowing the exact amount of electricity load, volume of water, number of telephone lines, types of drainage systems, etc. can be distributed or provided to a particular area. Therefore, to explore more with the applications of said techniques, the following objectives are framed.

7.1 Objectives

The major objectives for implementing the Geo-information technology includes,

- to examine ecological and social systems
- to assess geospatial environmental degradation; and
- to explore suitable strategies for population-environment nexus of India

By ascertaining the above objectives, this study discusses the environmental degradation risks arisen due to the wide spread human interference with nature. Besides this, suitable control measures are to be suggested to minimise the adverse developmental impact on the environment.

Consequently, the ultimate goal is achieved with an understanding of spatial and descriptive data integration into the GIS environment, which has provided practical examples and strategies for more effective sustainable environment development. It can definitely be pointed out that this particular field of technology is expected to expand manifold in future leading to more efficient, comprehensive and effective for geospatial environmental solutions for different regional problems.

7.2 Collection and Processing of Data

There has been much improvement from the traditional methods of land surveying as a result of the introduction of modern survey equipment. Thus all the surveying activities in the land administration in India are influenced by the technological know how and the handling of the survey equipment.

The modern technology of Geo-information data acquisition has revolutionized the land surveying profession in sustaining development in the land and mineral resource delivery sector. However, the old methods are not completely defaced as some of the methods are complimented with the modern methods. This has brought about a complete review of labor, time and cost involved in the processing and the transfer of information in resource administration issues.

In India today, the main objectives to use the Geo-information technology includes,

- to provide and collect information on the environment to check its degradation so that the next decade of human settlement are not at risk
- to minimize the issue of land litigation.
- to maximize revenue resource data collection on land use
- to provide information on the trend and pattern of land use which can be used in the preparation of 5 or 10 year strategic plans for the District capitals with respect to revenue collection.

Thus the services of the Geo-information is urgent need to provide rapid and accurate survey data for processing and presentation for a sustainable development.

7.3 Relevance of Remote Sensing

Now a days, the increase in spectral resolution (IRS-1C, PAN) by moving from hyperspectral to multispectral detectors likely means a corresponding ability to detect smaller objects. The technique is tailored for use in conjunction with one metre resolution of IKONOS imagery in a 'simplified' environment, perhaps small recreational objects can be detected. Further, the introduction of Quick Bird 0.61 metre resolution imagery provides an optional data source having a higher resolution. The high-resolution imagery contains a wealth of inter-object detail and as a result, classification schemes can be developed and handled aim with the collection of spatial and contextual information to the Geo-information technology (Guidon, 2000).

8. ASSESSMENT OF NATURAL RESOURCES AND ENVIRONMENT MANAGEMENT

Since the past 100 years, the scientists from different disciplines: geographers, ecologists, environmentalists, and climatologists deliberated the theme of environmental degradation, and anthropogenic ecological imbalance due, for instance, to deforestation and afforestation. But in the recent past, due to the rapid development in the Geographical Information System and Remote Sensing Technology has become possible to monitor environmental degradation and their restoration through the computer simulation and modeling.

Technological developments in the acquisition and processing of Geo-Information data have changed the field of assessment of Natural Resources and Environment Management drastically. These developments have led to time and cost effective data acquisition processes, subsequently leading to increasing volume of data being collected. India as a country however, has suffered a setback in the proper acquisition, management and processing of Geo-information data to support the rapid pace of development. The rate of growth of localities has been rapid as compared to the rather slow rate of the provision of utility services and infrastructure, the monitoring and collection of revenue is very important. Therefore, the implementation and application of Geo-information technology programme to monitor the said resources in India is inevitable.

9. STATE LEVEL PLANNING

Governments of developing countries, local authorities, resource custodians and non-governmental organizations are "real environmental managers" playing key roles in sustainable development and the people who actively use a natural resource must be responsible for its sustainability. The objectives of the Indian remote sensing programme towards sustainable management of natural resources include "the developmental planning and decision making at micro-level", in consonance with the accepted concept to "think globally and act locally" (Government of India, 1999).

In India, the increasing pressure, brought by rapid economic development and population growth, on resources and environment has caused serious problems on informal land occupation, threatened diversity of biology and worsen environmental pollution. Consequently, sustainable development as a national strategy enjoying high priority in the new century. Population and health, resources and environment, education and security, and economic and social development are among the themes for sustainable development. These define the scope of related data collection and organization. So, that the next decade of human settlement are not at risk provide information on the trend and the assessment of Natural Resources and Environment Management. Thus, the study of said technology to the state level planning in India are required for thematic mapping, agriculture, forestry, environmental monitoring, earth and mineral resources prospecting, ocean development, land management and exploration, planning and construction.

10. CONCLUSIONS

Among the five stages in the development of Geo information Technology curriculum in the Annamalai University has been demonstrated as the curriculum development in a dynamic as well as a continuous process. Since, the curriculum is a continuous process, the evaluation and analysis will be monitored and explored so as to make curriculum as a rational and acceptable balance between technological pressure and users requirements.

Further, the ESRI FIG Grant and its feasibility and usefulness of a Geo-information Technology has been discussed in view of developing countries to conduct a good environmental earth resources managements and remote sensing applications. The proposed programme in the level of University education will have significant higher education operational and informational capacity in comparison with its analogues. Further, it presents an ideal opportunity for training students, engineers and scientists in different disciplines, including engineering, software development for on-board and ground computers and management of sophisticated technical programmes in the University as part of Higher Education programme.

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BIOGRAPHICAL NOTES

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Academic Record:

2002 onwards	Lecturer, Department of Earth Sciences, Annamalai University, Annamalai Nagar, Chidambaram, India.
2002-2001	Scientist / Principal Investigator, Department of Geology, Annamalai University, Annamalai Nagar, Chidambaram, India - President Project Award, Ministry of Science & Technology (DST-SERCY's) Project “GEMIORD"
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1998-1996	Junior Project Associate, Institute of Remote sensing, Anna University, Chennai (Madras) – Tamil Nadu state Government Project "RECHARGE"
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1995-1990	Doctor of Philosophy in Geology, Highly commended, completed at Bharathidasan University, Tiruchirapalli, India.
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Special Workshop, Training courses, Summer**:** In India: 9 nos. Abroad: 7 nos.
/ Winter Schools attended
Memberships in Academic / Professional Bodies**:** National: 3 nos. International: 5 nos.

International Research Project/Grant:

On-Going Research Project: Rapid mapping of mineral, soils, and salts stores Using IRS-1C PAN Data and Digital Elevation Models, FIG Foundation Grant, Denmark, Position: Principal Investigator, Grant: Rs. 70,000 (2003).

International Major Grant: Development of Geo-Information Technology in Annamalai University Campus, India (Developing Country) under ESRI (USA) FIG (Denmark) Software Grant, Position: Campus Administrator, Grant: in the form of software and online training @ approximate cost of USA $ 2,00,000.

National Research Project:

On-Going Research Project: Geochemical Genetic Model for Iron ore Deposits of Godumalai and Tattayyangarpettai Regions of Tamil Nadu Sate, India, Young Scientist Project – Award of President by Ministry of Science and Technology, DST-SERCY's, New Delhi. Position: Scientist / Principal Investigator, Grant: Rs. 7 Lakhs (2001).

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