



GIS training to pre-university teachers: A holistic approach

Shivananda Chinnappanavar, B Mahalingam

Regional Institute of Education, Mysuru, Karnataka, India

Abstract

GIS has introduced in school curriculum by several countries including India, but it is not successfully educated due to lack of knowledge among the teachers and students. Hence, it is necessary to train the teachers and update them frequently to be effective in teaching a new technology. Therefore, this paper discusses about GIS training given to 21 Pre-University Geography teachers. The survey conducted among the participants illustrates that teachers are eager to learn GIS and willing to adopt this in their classroom teaching. The assessment of participants' GIS knowledge during pre and post training program shows that a proper GIS training with suitable software can increase the knowledge of teachers. The major barriers found to implement the GIS in schools is unavailability of computer lab, inaccessibility of available lab by teachers and lack of computer knowledge.

Keywords: GIS, curriculum, training, geography, QGIS

Introduction

India is one of the forerunners in the field of remote sensing and it is considered as a leader in remote sensing application. Almost all the states in the country have remote sensing application centers, in addition to that all traditional institutions in the country have implemented this technology (APJ Abdul Kalam and YS Rajan). Apart from state and central institutions, remote sensing and its application is performed and educated mainly at university and college level, but the education of these technologies in school level is inadequate.

The importance of GIS in school curriculum has been discussed by several researchers (Ramirez M, 1996; McWilliams H *et al.*, 1997; Meyer J W *et al.*, 1999; Baker T R and White S H, 2007; Solem M and Tani S, 2017) [14, 11, 12, 16]. Integration of GIS in school curriculum may be one way to engage students in the learning process and raise the literacy and intellectual capacity (Goldstein D and Alibrandi M, 2013) [5]. The use of GIS at high school level has provided substantial benefits not only to students, but also to teachers and the school community (Jenner P, 2008). There are several countries that have implemented GIS in their school curriculum (Lay J *et al.*, 2013) including India.

As knowing the importance of remote sensing application in education, National Curriculum Framework for School Education -2000 (NCFSE 2000) introduced GIS in school curriculum as part of Geography at higher secondary stage and it was widened in National Curriculum Framework 2005. This scheme is only applicable to the schools under Ministry of Human Resource Development and CBSE affiliated private schools. GIS curriculum was adopted by some states in the country while few states are lacking behind even after a decade passed since implementation (Pandey A, 2012) [13].

The major constraints of GIS in school curriculum are slow implementation, effectiveness in teaching and learning are unclear (Kerski JJ, 2010), lack of regular teacher practice in handling GIS software, lack of classroom time and lack of simple and copyable lessons including GIS (Hohnle S *et al.*,

2013), lack of GIS software packages that are specially designed for school education (Liu S and Zhu X, 2008), lack of training in GIS (Yap L Y *et al.*, 2008).

Hence, a proper training in GIS using suitable software with proper hands-on exercise and study materials can improve the understanding of map making (Wiegand P, 2007). As GIS maps are dynamic, an appropriate training on this technology may increase the capability of users to explore between two and three dimensions, different map scales, rotate map projections, zoom on map features, measure specific and cumulative distances in a variety of units, and add layers upon layers of data to a fundamental map (Wigglesworth J C, 2007). Therefore, to introduce and increase the knowledge of GIS and remote sensing through hands-on training among the school teachers, a five-day training program was conducted at Regional Institute of Education, Mysuru, for twenty-one pre-university school teachers in Karnataka state in India. The training was given using QGIS software, the major reasons for choosing QGIS are given below,

- It is open source software which can be downloaded from official webpage at any time and from anywhere. The software can be used and distributed without any restriction.
- The QGIS development team is working continuously on its improvement from the time it was developed in 2002 by Gary Sherman. This guarantees that the future of QGIS is bright hence it is worth to learn this software.
- Because of its popularity and higher number of users, there are plenty of literatures available online. A beginner in QGIS can easily get the resources in various formats as books, discussion forums, information written on blogs and videos.
- It is a stable software which has been used in various sectors such as health, urban management and development, transportation, watershed management and education so on.
- The Graphical User Interface of software is simple to

understand and use, hence a beginner can learn the software easily.

- QGIS has capability of exchanging data (import and export) with various other popular GIS and database software which makes user to work without barrier.
- As this software has plugin function in it, additional tools can be brought into it whenever necessary; using which few advance spatial analyses can be performed such as overlay, proximity and 3D analysis.
- The final map outputs of QGIS are pretty good and can be export into different formats.

A well-structured self-explanatory QGIS exercise manual was prepared and handed over to participants to make the learning process easier. The exercise was framed to cover from beginning to advance level in GIS, such as introduction, major fields, different types of data, collection of data, geo-referencing, vector layer preparation, attribute join, preparation of thematic maps, layout preparation, buffer analysis and overlay analysis.

Pre-Training Assessment of Participants

To understand the participant's knowledge in GIS and remote sensing and usage of computer, a pre-training survey was conducted. The information obtained through survey as shows.

- *None of the participants were attended any training in GIS and remote sensing before.*
- All the participants were agreed that, GIS and remote sensing is important for geography teaching in school level.
- The participant's knowledge in handling computer and GIS is poor, especially they are not aware of name of GIS software, name of analysis in GIS and fields in which GIS used.
- Almost all participants have attended the training program willingly to learn the new technology and implement the same in their schools.

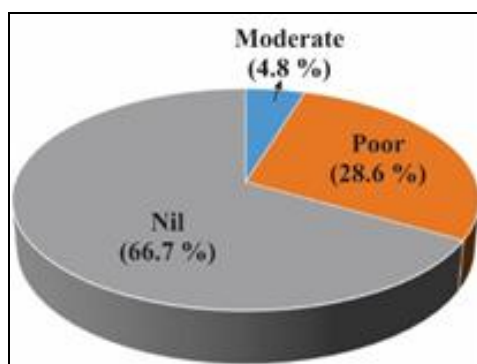


Fig 1: GIS Knowledge of Participants

The above figure illustrates that less number of participants are having moderate knowledge in GIS while higher number of participants are having no or poor knowledge in GIS. Therefore, it can be stated that, the training was given to enthusiastic participants who do not have any previous knowledge or experience in GIS and want to learn GIS for self-improvement and to implementing this technology in their schools.

Systematic Training of GIS

As most of the participants were beginners, the training was started from the basic level as follows,

On the first day, introduction of participants, their knowledge in GIS, their need in GIS and GIS in their curriculum was discussed in the beginning. Then, Introductory lecture was given to the participants which includes i) basics of computers, ii) basics of GIS, iii) components of GIS iv) application of GIS in different fields, v) different GIS software available, vi) commercial and open source software, followed by a lecture on introduction to QGIS software.

Further, participants were guided step by step to download the QGIS software from authorized website and install the obtained software in their computer/laptop. Then, participants were initiated to use the different tools and panels in the software to get familiar Graphical User Interface of QGIS.

The second day of the program was started with exercise of obtaining spatial data and non-spatial data from different sources such as Bhuvan Portal, USGS, GLCF, Diva GIS, Census of India, Indian Meteorological Department and other concern website. The participants were advised to download a taluk wise map of Mandya district from Google Image search to use as a basemap for the training purpose. After the completion of methods of acquiring data for GIS work, a detailed lecture was given on what is raster and vector data, different between them in structure, storage, visualization, suitable analysis, merits and demerits.

Further, the participants were guided step by step to perform geo-referencing in QGIS software using downloaded Mandya basemap. The concept of different units of latitude and longitude representation was explained (Degree Minutes Seconds, Decimal Degrees, Meters) followed by the explanation of Geographical Coordinate System (GCS), Projection Coordinate System (PCS), Root Mean Square Error (RMSE), Transformation type and suitable resampling method.

The third day of workshop was started with step by step guidance of preparing vector layer on the registered basemap. Point vector layer was instructed to create on the location of taluk headquarters, line vector layer was instructed to prepare on the roads and polygon vector layer was advised to prepare for the taluks boundaries of Mandya district. The concept of attribute table, different types of data format (text, whole number, decimal number, date) were explained in detail followed by selection of suitable GCS and PCS for vector data.

Further, participants were guided to download taluk wise population data of Mandya district from Census of India website to perform the joining spatial data with non-spatial data. Then, the downloaded population data was joined with created taluk boundary vector layer using 'Join' option in QGIS. The participants were educated about need of unique ID while joining, problems which may arise which linking table and how to save the joined data in the system.

On fourth day, the participants were guided step by step to prepare a thematic map using linked Census of India population data. The different methods of data classification (categorized, graduated), different modes of classification (equal interval, natural break, standard deviation, quantile and pretty breaks) and choosing suitable method of classification

and mode for specific purpose were explained in detail. Then participants were trained to prepare a layout for created thematic map. The important of map elements, placing scale, legend, north arrow, grids, insert image and title on correct position was explained. Further, participants were guided to export the final thematic map in different file format.

The final day of the training program was started with the introductory lecture on advance analysis in GIS. The participants were educated about different analysis /modelling /queries that can be performed in GIS. Then hands-on advance analysis training was given to participants in QGIS software. The participants were trained step by step to prepare a buffer having 300 mts. around a lake (polygon buffer), a buffer along a road having 200 mts. (line buffer), and a buffer from a bus stand having 1000 mts. (point buffer) distance.

Further, the participants were guided step by step to perform overlay analysis. The task was to identify the suitable area for agricultural activities using quality of soil and availability of water. Different options available in overlay analysis and which analysis is suitable in which situation was explained in detail.

After the completion of five days training program to pre-university school teachers, a post-training program survey was conducted to understand the effectiveness of program, which discussed in detail below.

Post-Training Program Assessment

After the completion of five days training program a survey was conducted among the participants to know their capability in GIS the detailed discussion of result as follows,

- All the participants were agreed that their knowledge in GIS was increased after the training program
- They were also aware of different commercial and open source GIS software, different analysis in GIS and fields in which GIS used predominantly.
- Almost all the participants agreed that they can prepare a thematic map using GIS independently.
- All the participants stated that self-explanatory training manual given to them was highly helpful for their practice

during the training program as well as it will be helpful for their future use.

- All the participants stated that they will use the learned GIS techniques in their class room teaching.
- For the question of barriers to implement GIS in their schools, most of them answered as i) unavailability of computer labs, ii) available computer labs are not accessible, iii) lack of computer knowledge among the teachers.
- For the question of ‘do they need attend advance training program in future’, almost all the participants stated they need advance training to improve the knowledge in GIS.
- Some participants were mentioned that the duration of training program was less in which they could not learn deeply.
- The overall assessment of GIS knowledge among the participants showed significant increase among all the participants.
- Finally, a question was raised to rate the overall performance of training program, for which 52.38 per cent were rated as ‘Excellent’, 42.86 per cent were rated as ‘Good’ and 4.76 per cent rated as ‘moderate’.

Comparison of GIS Knowledge in Pre and Post-Training Assessment

To know the clear picture about how individual’s knowledge in GIS was increased; each participant’s pre and post survey was compared as shown below.

Table 1: Pre and Post Knowledge Comparison

Category	Frequency	Percent
Nil to Moderate	7	33.33
Nil to Good	5	23.81
Nil to Excellent	2	9.52
Poor to Moderate	2	9.52
Poor to Good	4	19.05
Moderate to Excellent	1	4.76
Total	21	100

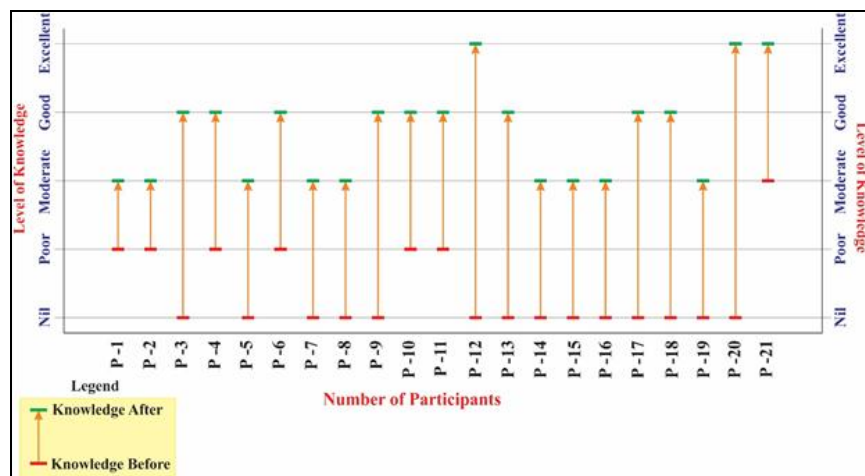


Fig 2: Assessment of GIS Knowledge Before and After Training Program

The result depicts that; 7 participant’s knowledge was increased from ‘Nil’ to ‘Moderate’ level; 5 participant’s

knowledge was increased from ‘Nil’ to ‘Good’ level; 2 participant’s knowledge was increased from ‘Nil’ to

'Excellent' level; 2 participant's knowledge was increased from 'Poor' to 'Moderate' level; 4 participant's knowledge was increased from 'Poor' to 'Good' level; 1 participant's knowledge was increased from 'Moderate' to 'Excellent' level.

Conclusion

The training program conducted to introduce and increase the knowledge of GIS among the Pre-University Geography teachers illustrates that, they are eager to learn GIS and interested to teach Geography through modern technology. The result of pre and post assessment illustrates that, a proper training program using suitable software would increase the knowledge of GIS among the teachers, and which can be brought to school children by them. The major barrier to implement GIS in school is not available of computer labs or the available computer labs are not accessible by teachers, and lack knowledge of computer among teachers. Hence, the implementation of proper computer labs to perform GIS activities and appropriate training to teachers' can make successful of GIS education in schools.

Acknowledgement

The authors are heartily thankful to Regional Institute of Education for their support during the program.

Reference

1. APJ Abdul Kalam, YS Rajan. *The Scientific Indian: A Twenty-First Century Guide to the World around Us*, Penguin Books India Pvt. Ltd, ISBN: 9780143416876, 2010.
2. Richard H, Audet & Joshua Paris. GIS Implementation Model for Schools: Assessing the Critical Concerns, *Journal of Geography*. 1997; 96(6):293-300.
3. Thomas R, Baker & Steven H, White. The Effects of GIS on Students' Attitudes, Self-efficacy, and Achievement in Middle School Science Classrooms, *Journal of Geography*, 2003; 102(6):243-254.
4. Demirci A. Evaluating the Implementation and Effectiveness of GIS-Based Application in Secondary School Geography Lessons, *American Journal of Applied Sciences*, 2008; 5(3):169-178.
5. Donna Goldstein, Marsha Alibrandi. Integrating GIS in the Middle School Curriculum: Impacts on Diverse Students Standardized Test Scores, *Journal of Geography*. 2013; 112(2):68-74.
6. Steffen Höhnle, Jan Christoph Schubert, Rainer Uphues. What are the constraints to GIS usage? Selected results of a teacher survey about constraints in the school context, *International Research in Geographical and Environmental Education*. 2013; 22(3):226-240.
7. Peter Jenner. Engaging Students Through the use of GIS at Pimlico State High School, *International Research in Geographical and Environmental Education*. 2006; 15(3):278-282.
8. Joseph J, Kerski. A National Assessment of GIS in American High Schools, *International Research in Geographical and Environmental Education*. 2001; 10(1):72-84.
9. Jinn-Guey Lay, Yu-Lin Chi, Yeu-Sheng Hsieh, Yu-Wen Chen. What influences geography teachers' usage of geographic information systems? A structural equation analysis, *Computers & Education*, 2013; 62:191-195.
10. Suxia Liu, Xuan Zhu. Designing a Structured and Interactive Learning Environment Based on GIS for Secondary Geography Education, *Journal of Geography*. 2008; 107(1):12-19.
11. Harold McWilliams, Paul Rooney. Mapping Our City: Learning to Use Spatial Data in the Middle School Science Classroom, Paper presented at the annual meeting of the American Educational Research Association in the symposium, 1997.
12. Judith W Meyer, Jon Butterrick, Michael Olkin, George Zack. GIS in the K-12 Curriculum: A Cautionary Note, *Professional Geographers*, 1999; 51(4):571-578.
13. Aparna Pandey. GIS in Indian School Curriculum, an article published on June 25, 2012 by *Geospatial World*, 2012.
14. Monica Ramirez. A Driving Force in Technology Education: Geographic Information Systems GIS, *Tech Trends*, 1996, 34-36.
15. Eui-Kyung Shin. Using Geographic Information System GIS to Improve Fourth Graders' Geographic Content Knowledge and Map Skills, *Journal of Geography*. 2006; 105(3):109-120.
16. Michael Solem, Sirpa Tani. Geography Education, Primary and Secondary: International Perspective, *The International Encyclopedia of Geography*, 2017, 1-11.
17. Patrick Wiegand. School Students' Understanding of Choropleth Maps: Evidence from Collaborative Mapmaking Using GIS, *Journal of Geography*. 2003; 102(6):234-242.
18. John C, Wigglesworth. What is the Best Route? Route-Finding Strategies of Middle School Students Using GIS, *Journal of Geography*. 2003; 102(6):282-291.