



FOSTERING GEOGRAPHIC LITERACY: THE IMPERATIVE FOR INTEGRATING GEOSPATIAL TECHNIQUES IN HIGH SCHOOL CURRICULUM

SAMPURNA BOSE

B.Ed. Trainee Student, Department of B.Ed., Loreto College, Kolkata

Email: sampurnabose1403@gmail.com

Abstract

The study explores the effects of including geospatial techniques in the high school curricula to enhance geographic literacy among students across all boards in West Bengal, India. The prominent gap in the practical implementation of geographic education has been recognized, thus, this research lays emphasis on the importance of hands-on geospatial training to equip students with sufficient skills for pursuing higher studies in this academic field and further pursue career opportunities in arenas of geospatial technologies. The research design integrates both qualitative and quantitative methods, which includes a survey of 51 students, research scholars and educators across various school boards, along with a thorough review of literature on the inclusion of geospatial technologies in education across the globe. The data was analysed using the SPSS software to understand the interrelations between educational outcomes and exposure to practical geographic knowledge. The results reveal that students with practical knowledge of geospatial technologies display enhanced academic achievements and are more prepared for further endeavours in the academic field of geospatial technologies. Additionally, this study discusses recent government policies like the 'National Task Force on Geospatial Education', which emphasizes the integration of geospatial technologies in schools to refine the curriculum. This study culminates with the need for reforms in the curriculum framework backed by Government policies which will ensure that students can adapt to the requirements of the contemporary world by being equipped with relevant skills in geospatial technologies.

Keywords: *Geospatial Technologies, Geographic Literacy, Hands-On Geospatial Training, Academic Achievement, Curriculum Reform*

INTRODUCTION

In the dynamic landscape of education, the integration of geospatial techniques into high school curricula is increasingly imperative, fostering holistic development in the acquisition of geographical knowledge. Within the geographically diverse canvas of India, these geospatial techniques stand as crucial tools, aiding in environmental management, urban planning, and the formulation of informed decisions. To encourage more students to immerse themselves in geospatial techniques, they must become familiar with these methodologies, contributing to the growing community of individuals well-versed in geospatial techniques and analysis.

Geospatial technologies as a term can be utilized to elucidate on the spectrum of modern tools that help in the geographic mapping and study of the Earth and anthropological societies. Following the Second World War and the Cold War, new dimensions were introduced into the sphere of mapping where the mastery of photography imagery depended on satellites and computers. Satellites that circle our planet in outer space are



able to capture images of the Earth's surface and anthropological activities which assist in the refined understanding of land use and land cover of our world. Simultaneously, computers allowed for the storage of these images along with the development of certain digital software that would lead to providing assistance in interpreting such satellite images.

Different geospatial technologies include Remote Sensing, Geographic Information System (GIS), Global Positioning System (GPS), and Internet Mapping Technologies. These technologies provide images captured with the help of airborne cameras and sensors, identify geographic patterns, determine coordinate locations for human and military use, and are used as user interfaces where geospatial information is available to a wider audience.

The school's Geography curriculum at the higher secondary level does include brief information about GIS, however, students must receive hands-on experience in the practical aspect of the subject. Due to the solitary convey of theoretical knowledge at the intermediate levels of school, students are often unable to comprehend the entirety of the field. As a result, students are inept when trying to frame a holistic understanding of Geography as a discipline and often do not take geospatial techniques under consideration while pondering over which specializations they can opt for.

Several scholars have conducted both primary and secondary studies that assess the need for integrating the practical use of these geospatial techniques in the high school curriculum. The conclusions drawn from these studies have mostly stated that educating students and imparting holistic knowledge including practical work, helps them to make informed decisions while making choices for their higher education. It has also been found that a higher number of students get enrolled in GIS-oriented programs if they have prior knowledge of the field, both theoretical and practical. Having systematic material about the intricacies of this branch of Geography can be achieved only if a continuum is maintained from the higher secondary standard instead of from the undergraduate level.

Geospatial technologies have been incorporated into the school curriculum in three different phases which have been implemented in schools in North America, Britain, Asia, Africa, and Latin America (Kholoshyn et al., 2021). India, too, has incorporated these techniques into its curriculum for school students, but practical, hands-on training has not been provided to the students. This lack has led to a fundamental weakening of the basic foundation of knowledge in the case of those students who aspire to continue higher education in the same field.

This study aims to analyze further the extent to which the integration of geospatial technologies at the 10+2 level benefits students. Including hands-on experience in a Geography lab undeniably ensures the initiation of a holistic pedagogical approach, nurturing students toward a profound understanding of the subject matter. This continuum in sharing geospatial information will facilitate the smooth transition of students from high school to undergraduate, postgraduate, and beyond.

NEED OF THE STUDY

The main purpose of this study is to evaluate the pressing need for incorporating the study of geospatial techniques in the high school curriculum across all boards. The presumption that there is an acute dearth in practical education is explored in the study that will eventually help to formulate recommendations leading to the holistic development of each child to fully equip them for future students and career prospects.



This study puts forth a vital lacking in the practical application of the discipline of Geography among high school students. During the higher secondary level of education, students acquire enough theoretical knowledge but not enough practical knowledge. Urban planning, environmental management, among others are developing fields requiring the use of such geospatial technologies. Thus, this paper highlights the perception of students and their academic achievements resulting from the practical experience gathered during their higher secondary stages.

Apart from better academic achievements and subsequent career options, this study also sheds light on how including geospatial techniques leads to superior geographic understanding that is not only confined to theoretical knowledge but explores the realms of practical, hands-on experiences as well.

OBJECTIVES

The **objectives** of this study include:

1. To determine the urgent imperative for integrating geospatial techniques into the high school curriculum.
2. To ascertain whether an in-depth understanding of these technologies influences students to pursue a career in this field.
3. To assess the difficulties and feasibility of implementing geospatial techniques in Indian high schools' geography curricula.

REVIEW OF LITERATURE

Geographic Information System (GIS), has garnered substantial attention for their capabilities in enhancing the facilitation of education, particularly in K-12 settings, although their implementation is presently limited. Humble (2023) emphasizes GIS as a very significant medium for facilitating knowledge in the future where it can be integrated on a vast level into the daily lives through GPS and other tracking technologies. The quality of research and type of research on GIS's education and integration in the curriculum is still emerging and is a field where a number of possibilities are awaiting. The different chances or opportunities include that GIS is easily accessible, its ability for transdisciplinary learning, and its utilization beyond the four walls of the classroom. On the other hand, there are certain limitations involving the requirement for training where teachers can be specialized in the skill of using the GIS tools, and infrastructural support from the end of the institution. A conceptual model was projected to make sure that the utilization of GIS is set on the same track with the educational objectives, offering insights for research to be conducted in the future and applications that can improve GIS integration in K-12 classrooms.

Siljeg et. al., (2022) conducted a study including 30 secondary schools in Croatia analyzing the perceptions of about 611 students and 96 teachers with respect to the integration of GIS into the curriculum. Both the sample groups had displayed positive perceptions towards this integration while more than 80% of the teaching faculty addressed the fact that there is insufficient representation of GIS in the present curricula. They also emphasized on certain obstacles such as lack of access to proper software, insufficient training, and low curricular inclusion as issues leading to inefficient integration or lack thereof. A significant result of the study exposed 77% of teachers revealing that they do not use GIS in their teaching methodology. However, although these challenges exist, both the teachers and the students addressed the fact that there is a dire need for the implementation of GIS and also emphasized the imperative for stronger institutional support where the infrastructure is strengthened in order to support this integration. The findings of this study align with the evolving global trends where the integration of geographic information system faces the similar kind of obstacles yet they offer significant benefits to one's pedagogy.



Peterson et al., (2020), in their paper titled 'High School Students' Experiences with Geographic Information Systems and Factors Predicting Enrollment in the Geospatial Semester' find that students are more likely to enroll in GIS courses at the undergraduate level if they possess prior knowledge and awareness of the subject, coupled with hands-on experience using GIS technologies in the classroom. The research paper extensively elaborates on how students exposed to GIS education are more inclined to specialize in the field during higher education. In addition to the theoretical knowledge imparted in a Geography class, practical work plays a pivotal role in instilling ideas, enabling students to make informed decisions about their professional choices.

McCloughlin (2015) in his paper titled 'The Role of Global Positioning Systems in Education: science, mathematics, geography, and history - a tool for integration' highlights the initiatives undertaken to implement GIS in primary and secondary education, however, the implementation of the same has been extremely sluggish. The incorporation of GIS into secondary education provides a new dimension to school subjects as a more quantitative approach can be learned by the students. Alas, schools at the K-12 level have been unable to implement such innovations to the maximum of their capabilities.

Kumar et al., (2014), in their paper titled 'Capacity Building through Geospatial Education in Planning and School Curricula' states that in the context of India, a nation characterized by diverse topographical features, a variety of climate zones, and rich physical and cultural landscapes, the integration of geospatial technologies into high school curricula empowers students to explore and understand the countless continuous processes unfolding each day. Developing a profound comprehension of RS-GIS technologies requires a continuum of education starting from the high school level, allowing students to seamlessly grasp concepts and practical applications as they progress to undergraduate and postgraduate levels. Recognizing the significance of this, the Indian Institute of Remote Sensing (IIRS) has initiated efforts to enhance understanding regarding space and geospatial techniques among young students at the 10+2 level.

Pandey (2012), in her paper titled 'GIS in Indian school curriculum' underscores the deficiency in the inclusion of geospatial techniques in high school curricula, resulting in students lacking a comprehensive understanding of the subject matter. The author further notes that while GIS techniques are introduced in the final year of undergraduate studies in India, students often struggle due to a lack of a solid foundation from their high school level. Geospatial techniques, which encompass Remote Sensing and GIS, provide a framework for the visualization, analysis, and interpretation of spatial data. Integrating these techniques into high school education enables students to develop skills in interpreting satellite images, paving the way for diverse opportunities and specialization in their professional domains. The practical application of mapping various distributions through these technologies provides students with hands-on experiences, offering them valuable insights into the realm of geospatial techniques.

Tiwari et al., (2011), in their paper titled 'India: Localized Introduction of GIS in Elite Urban Private Schools and Prospects for Diffusion' discusses the importance of integrating GIS into the secondary school curricula. It has been unearthed that although GIS has been incorporated into the school syllabi, it is still in its infancy. The growing demand for GIS-based technologies and individuals who can administer the same is all the more reason behind the amalgamation of GIS into the core curriculum at both public and private schools associated with the national boards. This study, although acknowledges the incorporation of geospatial technology at the high school level, also highlights the discontented inclusion of the sub-branch into the discipline.

Goldstein (2010), in her paper titled 'Integration of Geospatial Technologies into K-12 Curriculum: An Investigation of Teacher and Student Perceptions and Student Academic Achievement' stated that students believed their intellect was magnified upon the addition of geospatial technologies in their school curriculum.



This study conducted quantitative research which was quasi-experimental in its basic design. The inclusion of GIS-based technologies has been proven to be more effective in the academic journey of the majority of students.

Several studies have been conducted on the aforementioned topic which explore various aspects of the inclusion of geospatial techniques in school curricula. The imperative for integrating essentially GIS-related practical tasks in the higher secondary levels of school will support students to develop a panoramic idea of the discipline that will help them make informed decisions while they advance towards acquiring higher education. Sundry scholars have qualitatively and quantitatively approached this study due to the compelling need of the hour, which is to comprehend the extent to which having a robust base in the ground of geospatial techniques will benefit the students from the school level to further themselves in their respective lives.

METHOD

To precisely analyze the imperative for integrating geospatial techniques in school curricula, both quantitative and qualitative approaches have been utilized to fulfill the aforementioned objectives by making use of primary and secondary data. During the initial stages of this research, existing literature on this subject had been reviewed extensively. Following the collection of secondary data, a questionnaire was prepared that was circulated among the respondents through Google Forms and some interviews were carried out over phone calls and video calls as well.

The primary data had been collected using Random Sampling, following which the SPSS software had been used to establish correlations between different components. Finally, from the data collected, conclusions and inferences have been made. In the primary survey conducted, the sample size was 51, where said number of respondents were interviewed to gather their perspectives for the holistic completion of this study. Responses from individuals hailing from West Bengal were gathered who had studied in different boards recognised nationally. The entirety of the data collected has ultimately supported the conclusions drawn with respect to the objectives that had been set initially.



RESULTS AND DISCUSSION

Table 1: Sample Profile of Respondents

I. SAMPLE PROFILE:

AGE				
Age Group	Less than 22 years	22 to 26 years	26 to 30 years	More than 30 years
Percentage of Respondents	4%	80%	12%	4%
OCCUPATION				
Occupation	School Educator	Research Scholar	Private Sector Employee	Student
Percentage of Respondents	5.88%	11.76%	19.60%	62.74%
HIGH SCHOOL BOARD				
Name of Board	West Bengal Council of Higher Secondary Education (WBCHSE)	Council for the Indian School Certificate Examinations (CISCE)	Central Board of Secondary Education (CBSE)	
Percentage of Respondents	47.05%	33.33%	19.60%	
SCHOOL STREAM IN HIGHER SECONDARY LEVEL				
Stream	Humanities	Science	Commerce	
Percentage of Respondents	76.47%	23.52%	0%	
TOTAL RESPONDENTS	51			

Source: Primary Survey, December 2023



II. MAIN FINDINGS:

1. Variable Correlations Analysis:

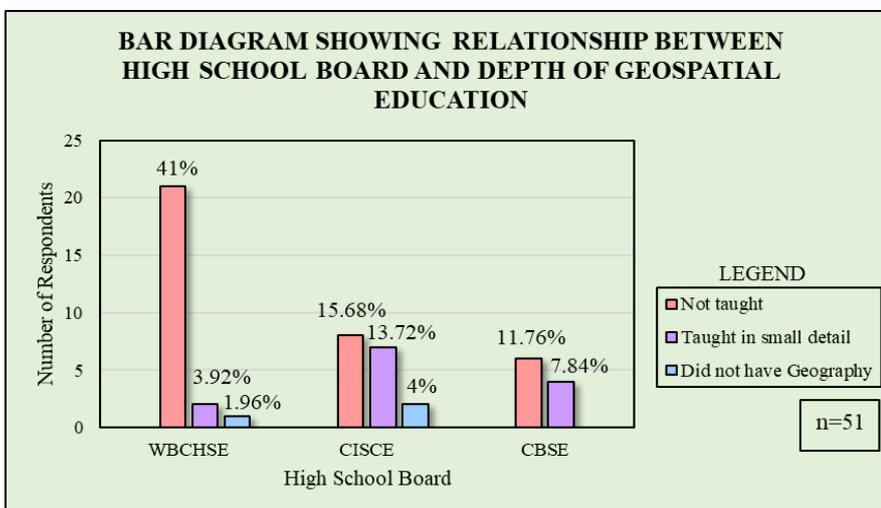
A. School Board Impact on Depth of High School Geospatial Education

CROSS-TABULATION BETWEEN SCHOOL BOARD AND DEPTH OF EDUCATION					
Higher Secondary School Board	Depth of Geospatial Education				Total Number of Respondents
	Not a part of the curriculum	Taught in small detail	Did not have Geography in H.S.		
WBCHSE	21	2	1		24
CISCE (ISC)	8	7	2		17
CBSE	6	4	0		10

Source: Primary Survey, December 2023 [n=51]

A cross-tabulation has been performed to display the relationship between the school boards of the respondents at their high school level and the depth of GIS-based information that was imparted to them during the said high school years. A correlation analysis has been performed where the correlation value is calculated to be $r= 0.224$ indicating that there is a very low but positive relationship between the high school board and the depth of GIS-based knowledge. This implies that certain boards, taking into consideration both state and national boards, have included small sections of geoinformatics in their high school Geography syllabus whereas certain boards have not done the same. Albeit the part of the syllabus included in said boards is constricted only to the theory portions, however, students are at least aware of this field as against students from the other boards who never are made to learn about Geoinformatics in high school.

FIGURE 1: BAR DIAGRAM SHOWING RELATIONSHIP BETWEEN HIGH SCHOOL BOARD AND DEPTH OF GEOSPATIAL EDUCATION



Source: Primary Survey, December 2023

From this diagram, it can be inferred that in the case of the West Bengal State Board (WBCHSE), Geoinformatics had not been taught at all for almost 41% of the respondents who belong to the aforementioned board. 3.92% had said that they were taught about geoinformatics in small details as a part of their high school syllabus, whereas 1.96% of the respondents had said that they did not have Geography in their high school. In the case of CISCE (ISC) board, 15.68% of the respondents had said that they were not taught about geoinformatics, 13.72% had said that they did have geoinformatics as a part of their high school syllabus but they



were taught in very tiny details about the field only in theory, there was no inclusion of any kind of practical work. Finally, 11.76% of the respondents belonging to the CBSE board had said that they did not have GIS in their +2 level while 7.84% of the respondents stated that they were taught only in small theoretical portions.

B. GIS Employment vs. Higher Education Timeline:

CROSS-TABULATION BETWEEN EMPLOYMENT AND HIGHER EDUCATION				
The decision to pursue higher studies in the field and its timeline				Total Number of Respondents
Whether employed in a Geospatial Technology firm		For post-graduation, after graduation	Not applicable	
	Yes	8	0	0
	No	0	43	43

Source: Primary Survey, December 2023

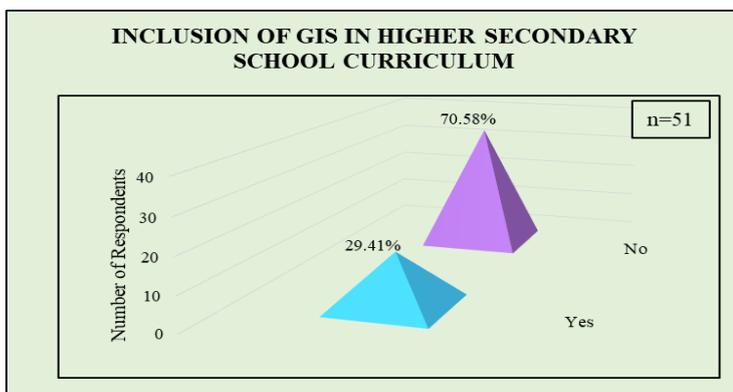
[n=51]

Another cross-tabulation was performed between the field of employment of the respondents and the timeline of when they had decided to take up Geoinformatics for their academic and henceforth, employment pursuits. A perfectly positive correlation value ($r=1$) is obtained from this relationship because all of the respondents who are currently working in Geoinformatics-based firms had all taken up Remote Sensing-Geoinformatics for their post-graduation after the completion of their graduation courses. According to the respondents, they did not have ample information, in few cases, barely any, to have the confidence to undertake the course of Geoinformatics directly after the completion of their high school board examinations. It was only after studying this field in great detail during the undergraduate Geography course that they were able to pursue this subject matter for their post-graduation, and then finally work in a GIS-based company.

2. High School Curriculum and GIS Integration:

A. Inclusion of GIS in the syllabus studied by the respondents:

FIGURE 2: BAR DIAGRAM SHOWING INCLUSION OF GIS IN HIGHER SECONDARY CURRICULUM

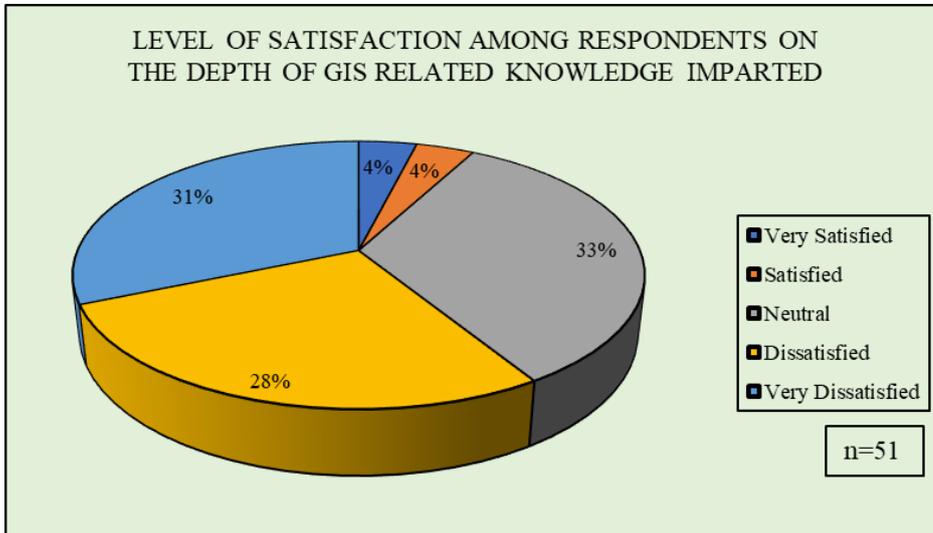


27.45% of the respondents had stated that they had studied theoretical concepts of geospatial technologies, but they had also mentioned that they had received no hands-on practical experience that would have helped them to perceive the geospatial concepts in a better fashion. Unfortunately, 70.58% of the respondents mentioned that they had received no education on geospatial technologies during their high school years as a part of their geography syllabus at all.

B. Satisfaction Levels of Respondents based on the depth of GIS-based education received from +2 level

Source: Primary Survey, December 2023

FIGURE 3: PIE CHART SHOWING SATISFACTION LEVELS AMONG RESPONDENTS ON THE DEPTH OF GIS-RELATED KNOWLEDGE IMPARTED



The respondents who had theories of geospatial technologies covered in the two years of high school education; were asked to rate their satisfaction levels on the depth of knowledge received by them. 31% and 28% of the respondents had stated that they were extremely dissatisfied and dissatisfied with the depth of geoinformatics-based education respectively. This is majorly because although some information was provided to them during their high school years in geoinformatics, it was not enough for them to gather a holistic and comprehensive idea of the entire subject matter. 33% of the respondents stated that they had neutral satisfaction levels with the

Source: Primary Survey, December 2023

depth of education received. On the other hand, 4% of the respondents said that they were satisfied while another 4% of the respondents said that they were extremely satisfied with the depth of the information received by them. This was majorly because they believe geospatial technologies should only be taught in small amounts to the students of the high school level, as it may be difficult for them to comprehend and understand the practical portions well.

3. Respondents' Perception of Integration of Geospatial Technologies

All the respondents unanimously agreed on how geospatial technology-based education should be included in moderate amounts because it will eventually assist in the development of the student's holistic development in the discipline of Geography. Some respondents had mentioned that since GIS is an extremely innovative field that is now slowly and steadily becoming a part of several agencies that assist in the functioning of regular lives, it is essential and imperative for the students to be aware of these concepts, both In theory and practical. High school students should know how to operate basic software applications, eg: QGIS, to at least have the minimum idea of how these applications work in practice. On the other hand, few respondents had mentioned that although GIS should be included in the high school curriculum, it should be made simple and should be included in small amounts so that the students are not intimidated by the high standards of this field.

Considering that only 27.4% of the respondents had studied concepts encompassing geospatial technologies, it was found out upon interviewing them that 45% of the same respondents would have, at some point in their academic career, taken up a course in geospatial techniques or would have committed their specialization to this field altogether. They had remarked how the lack of proper theoretical and practical training had prevented them from developing the skills required to specialize in it during their high school years which, in fact, had delayed their process of diving into this field, sooner or later. On the other hand, 55% of the respondents stated that although Geospatial techniques are an essential section in modern technologies that helps one to navigate through complex, structured technologies, the said field never sparked an interest in them to pursue it academically.



5.88% of school educators were also interviewed in order to analyze the necessity for integrating geoinformatics into the high school Geography syllabus. All three educators shared their opinion when they stated that it is necessary for a better representation of the concept of Remote Sensing and Geographic Information Systems as it will help students grasp the concepts in a more refined manner that will later provide aid when it comes to these students choosing their future prospects.

While in conversation with the respondents, some of them did mention how GIS was comparatively a difficult area for students to well-verse themselves with directly during their high school years. According to them, the complex procedures made use of during the practical work may not be as easy for students to understand in school, as many do not have developed and proper skills to operate the computer itself. Another issue of implementing GIS in high school, as mentioned by some respondents was that many schools, in our state, do not have proper infrastructural facilities to conduct practical classes as a part of the geography syllabus which might result in the students losing out on marks during final and/or board examinations due to their incapability of performing the directed procedures due to lack of access and practice.

CONCLUSION

According to the responses recorded from the 51 respondents, it can be stated that there is an urgent need for the integration of geospatial technologies in the high school geography syllabus, across all boards. Development of these skills among students from a young age will not only enhance their cognition but will also prepare them for undertaking this course for their higher studies. Clearance of basic concepts along with basic computer laboratory work will gear them up, boosting their confidence into believing that they also have prospects in technological fields. However, it should be also kept in mind how the students may not have the capacity to understand all concepts as it may be difficult for them to comprehend it all. Hence, a proper balance should be figured out that will help the students develop these skills and will also be with their understanding capabilities.

An in-depth understanding of this field has influenced them to undertake this course. Since Geospatial technologies are taught as a part of the undergraduate geography syllabus, students are able to understand their potential in this field and take it up for their post-graduation. However, it had also been mentioned by a couple of respondents that if they were taught about these geospatial techniques as a part of their high school syllabus, they might have taken up this course directly after school for their graduation and not waited another three years to study this field in great detail. A couple of the respondents also mentioned how they had decided to specialize in this field after having completed their first post-graduation degree. Hence, it can be established how in-depth understanding and comprehension of a subject might influence students to take up said course earlier.

There are advantages and disadvantages to using geospatial methods in India's high school geography curriculum. Positively, incorporating geospatial technology can improve students' spatial reasoning abilities and create a more dynamic and engaging learning environment. Examples of these technologies include Geographic Information Systems (GIS) and Remote Sensing. They can investigate practical problems, examine geographical patterns, and arrive at wise conclusions thanks to it. However, there are issues with access to technology, teacher preparation, and infrastructure. Many schools may lack the tools and technological know-how needed to integrate geospatial tools into the curriculum in an efficient manner. Additionally, it could be necessary to modify the curriculum to make room for this modern technology. This would necessitate a substantial amount of work in the fields of curriculum creation and teacher preparation. The Ministry of Human Resource Development released a report in 2013 named 'National Task Force on Geospatial Education' recommended four different projects to integrate geospatial technologies into the



general educational curriculum of the entire nation to equip the Indian population to participate in the dynamic industry making use of these geospatial techniques. One of the four projects, namely, the School Geospatial Education Project (SGEP) focused upon the national incorporation of the study of geospatial technologies into the middle and high school curricula respectively. CBSE and NCERT were given the responsibility to carry forward the recommendations of the task force.

Along with recommendations centering upgradation of the school syllabi, the report also laid emphasis on proper teacher training to enable the smooth transfer of knowledge from the teacher to the students in case of such a technical subject at young and tender ages. However, enough practical exercises have not been implemented in the curriculum which has led to a gap in the implementation of this report. Besides, data collected from the primary survey represents the information that schools have autonomy over whether they will teach chapters on Remote Sensing and GIS to the students, and more often than not, it was found that schools avoid exploring these chapters in the classroom.

Certain recommendations for the successful implementation of incorporating geospatial techniques in the high school curriculum are:

1. A comprehensive plan must be devised for the successful integration and implementation of geospatial techniques in the high school curricula.
2. Robust teacher training programs must be conducted for teachers to have essential skills and knowledge to effectively teach school students.
3. investments must be made to improve the infrastructural facilities of schools to ensure smooth and thorough practical training in computer laboratories.
4. Awareness must be spread among students and parents about career opportunities in this field of study so that they do not shy away from this discipline due to its technical nature.
5. Regular upgradation of the curriculum is required so that students can keep up with the dynamic requirements of the world.

REFERENCES

- Goldstein, D. (May 2010). Integration of geospatial technologies into k-12 curriculum: an investigation of teacher and student perceptions and student academic achievement
- Tiwari, C., & Tewari, V. (2011). India: Localized introduction of GIS in elite urban private schools and prospects for diffusion. *International Perspectives on Teaching and Learning with GIS in Secondary Schools*, 131-140. https://doi.org/10.1007/978-94-007-2120-3_15
- Vol 1 (2013a) *NATIONAL TASK FORCE ON GEOSPATIAL EDUCATION*. New Delhi: National University of Educational Planning and Administration.
- Kumar, P., Siddiqui, A., Gupta, K., Jain, S., & Krishna Murthy, Y. V. (2014). Capacity building through geospatial education in planning and school curricula. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XL-8, 1253-1259. <https://doi.org/10.5194/isprsarchives-xl-8-1253-2014>
- McCloughlin, T. (March 2015). The Role of Global Positioning Systems in Education: science, mathematics, geography, and history- a tool for integration
- Pandey, Dr. A. (2016). *GIS in Indian School Curriculum*. Geospatial World. <https://www.geospatialworld.net/article/gis-in-indian-school-curriculum/>



- See how GIS will help in empowering school kids (2018) See how GIS will help in empowering school kids | Smart Cities Council.*
Available at: <https://www.smartcitiescouncil.com/article/see-how-gis-will-help-empowering-school-kids>
(Accessed: 17 January 2024).
- Peterson, E. G., Kolvoord, B., Uttal, D. H., & Green, A. E. (2020). High school students' experiences with geographic information systems and factors predicting enrollment in the geospatial semester. *Journal of Geography*, 119(6), 238–247. <https://doi.org/10.1080/00221341.2020.1824009>
- Kholoshyn, I. *et al.* (2021) 'The application of geographic information systems in schools around the world: A retrospective analysis', *Journal of Physics: Conference Series*, 1840(1), p. 012017. doi:10.1088/1742-6596/1840/1/012017.
- Šiljeg, S., Milanović, A., & Marić, I. (2022). Attitudes of Teachers and Students towards the Possibilities of GIS Implementation in Secondary Schools in Croatia. *Education Sciences*, 12(12), 846. <https://doi.org/10.3390/educsci12120846>
- What's new (2023) AGI India.* Available at: <https://agiindia.com/the-importance-of-geospatial-science-education-at-school-and-university-level/> (Accessed: 18 January 2024).
- Humble, N. (2023). Future paths for GIS in K-12 education: A review of possibilities and constraints. *European Journal of Geography*, 14(3), 79–88. <https://doi.org/10.48088/ejg.n.hum.14.3.079.088>