

Chapter 1

Geospatial Technology in Geography Education

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Abstract The book is presented as an important starting point for new research in Geography Education (GE) related to the use and application of geospatial technologies (GSTs). For this purpose, the selection of topics was based on central ideas to GE in its relationship with GSTs. The process of geospatial practices (GPs) as the way to learn about GST and with GST marks the central ideas. The sequential presentation of chapters starts with a theoretical approach, followed by the use of GST at different levels in formal education. Teacher education represents an important third topic that analyzes professional development when learning about GST and using GST. The fourth topic focuses on the effectiveness of GST as a tool for teaching and learning in order to assess geospatial thinking in different educational settings. The exploration of trends and recommendations for future development are the final topic of this book. In one sentence, the book touches upon the most important issues on the use of GST in education and includes the most up to date information and discussions related to GST. Although GE is not in the front line of the Information and Communication Technology (ICT) revolution it cannot stay behind as modern education uses technology to prepare better citizens. The importance of this book relies on this basic and fundamental fact.

Keywords Geography education • Geospatial technologies • Geospatial practices

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O. Muñiz Solari et al. (eds.), *Geospatial Technologies and Geography Education in a Changing World*, Advances in Geographical and Environmental Sciences, DOI 10.1007/978-4-431-55519-3_1

1.1 The Importance of This Book

Asked to mention the biggest challenge in their work many geography teachers come up with the digital revolution: computers, internet, e-learning, Google Earth and GIS entering the classroom. Most teachers see it as the biggest change in the recent past and as the biggest challenge for the near future. Sitting in a geography class and fly virtually to New York, Abu Dhabi or Ulan Bator to get an idea how life at different places on planet earth looks like using beamer, computers, tablets or mobile phones and software like Google Earth and Skype, that is geography in optima forma. Combining satellite images with digital maps, YouTube movies and TED talks really can be a good learning experience. *Conditio sine qua non*; however, is a good teacher who can help the learners to structure information, inquiry and evaluate.

Seen the importance of the digital revolution for Geography Education (GE) the Steering Committee of the IGU Commission on Geographical Education decided to make geospatial technologies (GSTs) for GE one its focus points. An important aim is to stimulate research and development in this field and to help to exchange research results and good practices internationally. In recent years many articles and books have been written about GSTs and GE. These publications can be found in journals within GE like *International Research in Geographical and Environmental Education*, *RIGEO*, *Journal of Geography*, *Geographie und Ihre Didaktik* and *Teaching Geography*, but also and in journals outside GE like *Computers & Education*. The Steering Committee of the IGU Commission on Geographical Education wants to help newcomers in the field of GSTs and GE to get an overview of the state of the art in this field. The result is this book. Contributions of almost 30 authors from 10 countries are brought together in 17 chapters. Not the last word as the world and its technology are changing fast, but as we hope an important intermediate point and a good starting point for new research and developments.

1.2 The Process of Selecting Topics to Discuss Central Ideas

GSTs and GE have a strong common ground in the twenty-first century education. Facing a tremendous impact and change with the advent of Internet and Web 2.0, GE has been forced to reconsider its education strategies within the digital networking arena. Information and communication technology (ICT) allowed us to study the earth in its physical dynamic and the world in its human and economic relationship. Data transformation, digital information and interpretation, time/space shrinking impact, and highly relational visual representations show some of the hidden challenges of GST to GE in the geo-enabling environment.

Central ideas to GE in its relationship with GST are the process of geospatial practices (GPs) as the way to learn about GST and with GST. We agreed on

presenting first, certain level of analysis regarding the theoretical base which allows readers to understand what concepts and reasoning are important in GE as related to GST. Spatial thinking, geographical thinking, and geospatial thinking are part of this analysis in GE close related to the technological pedagogical content knowledge. However, to make a concept of spatial citizenship viable when dealing with GST in informal learning the concepts of space are also placed in discussion. Within the accepted absolute space the social space intervenes by creating permanent relational interpretations. The first part of this book introduces these clashing perspectives.

We all agree that the implementation of GST is not only important with new curricula in formal education but also through the complex and increasing practice in informal education. The second part of our book was set to respond to this implementation to see how GE in middle and high school as well as its applications in higher education is performed. Being aware of thousands of individuals, if not millions, engaged in crowd collaborative efforts and practicing with GSTs to resolve problems, place our work in a state of awareness. Informal education is worth the attention as a new trend of knowledge acquisition and we, the editors, consider this as an important task.

Even within the context of a constructivist perspective, teacher education for GST constitutes the first step to generate a sound learning process. The decision to consider teacher education as the third part of the book did not create any discussion. There is a firm agreement on the need for improvement when teacher professional development faces the difficult task of integrating pedagogical practice with technological development. The geo-enabling world paves the way to enhance teacher education yet it creates, with renew emphasis, special demands and efforts to learn new tools and techniques.

How effective is GP in education? This is a question to be answered by evaluation and assessment in our fourth part of the book. We estimate that this section has equal importance compared to the preceding parts. The need for geospatial thinking requires the effort of worldwide research to determine the level of its development. Furthermore, it is without saying that the application of valid and solid geospatial assessment practices has been sluggish. Training seems to be of vital importance when compared to technology availability.

GST has to be understood as a composite of tools and mechanisms to create new ways to teach and learn geography. Ultimately, it is about and with GSTs through GPs to improve the effectiveness of our interpretation and use of the earth. The educational process that is part of this symbiosis with technology has been delivered here as a set of ideas starting with some theoretical propositions; followed by various approaches on the implementation of GST. As a result, we believe that constant and increasing synergy is being built between GST and GE that carries important challenges which in turn oblige us to propose recommendations.

1.3 The Sequential Presentation of Chapters

The book, comprising 17 chapters in five parts, begins with a theoretical background, followed by chapters on implementation, on teacher education for GSTs, and on evaluation and assessment to end with a chapter on trends and recommendations for the future. Titled “Geospatial Practices. Theoretical Background”, part one contains three chapters. Chapter 2 looks at the needs of GE in the twenty-first century and at how these needs can be met with GST by discussing opportunities and challenges that might be faced in the future. One of the most important contributions of GST to GE is its power to enhance spatial thinking skills. Chapter 3 explores the current position of spatial thinking in education including basic definitions, developments, and assessments in teaching and learning. The use of geoinformation (GI) in everyday settings has been increased. Chapter 4 explores the widespread use of GI in society using the concept of Spatial Citizenship and introduces a set of competences as well as a curriculum for in-service teachers to teach their students in secondary school classes how to become a spatially aware society.

One of the important aspects of the book is that it explores the use of GST in formal and informal educational settings. Part two in the book evaluates the use of GST at different educational levels starting with middle and high schools and ending with higher and informal education. Chapter 5 explains why middle school is an extremely age-appropriate opportunity for students to gain many versatile skills through GST and describes theory, research and practice specific to the integration of GST into middle schools. Chapter 6 introduces different teaching methods and effective practices to integrate GST into high school geography curriculum. Chapter 7 discusses the roles of GST and the international trends in the application of GST in higher education exemplifying with a case study from a study abroad program in the islands of Micronesia. The proliferation of GST, many available from the Internet, especially in the last two decades has enhanced the opportunities to learn through informal ways. Chapter 8 discusses the importance of informal learning (IL) about GST and with GST, using a global example represented by volunteered geographic information (VGI).

Professional development for teachers has always been among the most important concerns when it comes to effective use of GST in teaching and learning. Titled “Teachers Education for GST” part three in the book approaches this issue in three chapters. Chapter 9 explores the growing educative role of WebGIS conceptually, technically, and practically and explains how learners and educators can utilize WebGIS in their lessons by taking into consideration new choices and constraints provided mainly by GIS in a cloud-based platform. Chapter 10 evaluates major barriers prior to implementation of GST in classrooms with a specific focus on teachers and introduces six models for in-service teacher training programs for GST with a discussion on effective and useful in-service teacher training programs for the future. One of the most cited benefits for learning of GST is its power to support inquiry based learning (IBL). Chapter 11 explains the role of IBL in GE, and

explores didactic models for integrating GIS in inquiry projects along with frameworks and a model for teachers to design and conduct such projects and to train the necessary teacher competencies.

It is important to evaluate the effectiveness of GST as a tool for teaching and learning in order to develop methods to assess geospatial thinking in different educational settings. The three chapters in part four assess the effectiveness of using GST in education. Chapter 12 first evaluates the potentials of GST for teaching and learning and then discusses whether geospatial practices are actually effective in education addressing different concerns and questions raised in the literature. Chapter 13 assesses the use of GIS in teaching in ten countries with the conditions encouraging and discouraging the integration of GIS usage based on 15 research articles published basically in the last decade. Chapter 14 reviews how geospatial thinking is assessed in high schools first by looking at the literature to identify recent research trends, and then by conducting an online survey on educators involved in high school GE from around the world.

The final part of the book explores the trends in the development of GST and makes some recommendations for the future in order to obtain more benefits and more effective procedures in the process of applying GST in education. Chapter 15 first discusses the opportunities by evaluating three converging trends, namely an awareness of global challenges, the spread of GST to the general public, and the geo-enabling of everything and then evaluates the technological, pedagogical, and administrative challenges for using GIS in teaching and learning. Chapter 16 introduces the Digital Earth concept and examines the changing place of education in it by identifying key stakeholders involved in the development of geospatial industry and their educational needs along with some suggestions of strategies that they should implement to achieve Digital Earth education. Chapter 17, the final chapter of the book, introduces a geospatial science agenda for GE for the future based on the existing and newly emerging opportunities and challenges for using GST in teaching and learning.

1.4 Why GST Matters for Education

GST refers to equipment used in visualization, measurement, and analysis of earth's features, including systems as Global Positioning Systems (GPS), Geographical Information Systems (GIS), Remote Sensing (RS) and digital globes. Many authors see great advantages of using GST in education as geodata availability is much quicker and easier and geodata processing is many times faster and accurate than it was before. Also the opportunities for visualization are huge. In a few decades computers and internet really have changed the world. Although GE is not in the front line of this revolution it cannot stay behind as modern education should prepare students for the world of today and tomorrow. For GE it offers many opportunities. GSTs have the potential to enhance students' twenty-first century skills and can stimulate a new way of learning or at least offer better opportunities

to develop higher order thinking skills. Modern GST can help learners to gain a better view of the world and offers opportunities for learners to better understand planet earth and reflect on the near future.

The question is; however, does education keep in pace with the geospatial revolution? Most of the geospatial revolution takes place outside the classroom, not inside. Many young students are using GST while playing games and using all kind of applications on tablets and mobile phones. To get education more involved in this active process the role of the teachers is vital. Do they use GSTs in school and if so, how do they use them? Do they use it in the way they are used to when working with paper maps and schoolbooks? Or do they introduce new ways of learning like virtual fieldwork and inquiry projects using web atlases and GIS? Do they know how to maximize the advantages of GSTs not only in a technical way but also for higher learning goals? Finally, how can teachers use GSTs effectively to help students to reflect about phenomena and processes on planet earth?

GSTs have a big potential but they are tools, not more and not less. Modern geographers in education that ignore GSTs so far should have a try and eat a piece of the cake. Not only by reading chapters in this book but, even better, by participating in projects in which students use GSTs like GPS and GIS.

1.5 How This Book Will Be Helpful to Use GST for Education

The target group of the book is broad. It addresses teachers, professionals, scholars, and policymakers who are interested in using GST in education. The book will help teachers in primary and secondary schools as well as professionals in higher education to learn different strategies, methods, and approaches to incorporate GST into their work environment. It provides, at the same time, with some examples and case studies from different countries to understand real problems. The book touches upon the most important issues on the use of GST in education and includes the most up to date information and discussions.

Understanding the recent developments and discussions in this field, especially in the academic world is crucial for scholars to conduct research effectively. The book, therefore, is useful for scholars who are interested in teaching and learning with GST to broaden their understanding, follow the most recent research results and discussions, and become aware of the areas where further or new research is needed. Another important target group of the book is the policymakers in the education business. The book will be helpful for the policymakers to understand that GST is developing very fast and provides immense opportunities to educate society. Reading the book, policymakers will understand that GSTs are already present in our everyday lives. All policymakers need to do is look around. They will

understand the power of these technologies and will want to utilize them for education. Including many examples from around the world, the book will also provide policymakers with a range of effective strategies they can use to benefit GST in education.

1.6 Challenges and Recommendations

The decision to close this book with an analysis of trends and recommendations was based upon the belief that opportunities and challenges are equally necessary to measure as a result of a geo-enabled world with a constant transformational technology in place. As part of this revolution, GSTs impact and transform formal education and informal learning environments alike, yet geo-capacity building in education is still behind unless trans-disciplinary strategies to learning and teaching are accomplished. In this regard, we were right in our decision to pursue a set of recommendations. There are no strategies in place to initiate new curricula in secondary and higher education for increasing geospatial capacity building; tactics that require an organized as well as consistent thrust to guide teachers and students about how to learn GSTs and use them to conduct efficient GPs.

We agree with our contributors to this book that the world faces complex challenges which are global in nature yet creating constant and permanent impacts on our daily individual lives. These challenges are intermixed with increasing technological development that forces individuals, communities, and society as a whole to acquire new knowledge overloaded by geospatial components. What is interpreted as the landscape of GSTs in education characterized by a full spectrum of opportunities is also recognized as plenty of challenges that instigate recommendations of equal importance.

Recommendations vary among important issues, some of which demonstrate the heavy weight that GST practitioners are carrying in formal education. Curriculum is one these issues that places great emphasis on the process of spatial thinking as the major and sole preoccupation. Another issue is the need to resolve bottlenecks concerning abilities to master GST integrative skills by teachers or facilitators participating in active and collaborative learning. It is not only geospatial literacy an important issue to tackle as crucial to build teacher capacity but also the reduction of the digital divide between new and older generations. For this purpose the concept of community of practice plays an undeniable role to create collaborative environment.