

GEOGRAPHICAL EDUCATION: HOW HUMAN-ENVIRONMENT-SOCIETY PROCESSES WORK

Sibylle Reinfried

University of Teacher Education Central Switzerland Lucerne

Philippe Hertig

Teacher Training University, State of Vaud, Lausanne, Switzerland

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Summary

Geographical education is a scientific discipline grounded in the domains of geography and education. Geographical education selects and structures geographical content knowledge, skills and attitudes to enable learners to understand the human-environment-society processes in the world and to achieve geographic literacy. Geographic literacy influences people's understanding of place, the interconnectedness of places and the spatial actions caused by various actors. Geographical education also develops and evaluates curricula, teaching and learning objectives, methodologies concerning teaching and learning processes and is involved in initial teacher training and professional development of in-service geography teachers.

Today's conception of geographical education concerns the conception of geographical knowledge, the conception of learning and the epistemology of the discipline, and educational values embedded in the general aims of a school system. With respect to the global problems of the 21st century today's learners will in the future have to act as responsible citizens as regards complex key issues that are of great environmental, social, cultural, economic and political significance. Current trends in geographical education therefore concern integrative geographical concepts that are used to structure educational processes and foster critical thinking, education for sustainable development, citizenship education, the role and teaching of information and communication technology (ICT), the trend to conceive standard- and skill-based curricula, and the increased emphasis on high quality research in geographical education.

In the future, geography will continue to play the role of an essential school subject to address controversially discussed issues concerning human-environment-society interactions. Future endeavours in geographical education require a theory-based development of learning environments that foster deep learning and understanding. The learning environments should reflect the state-of-the-research knowledge in psychology, cognitive theory and geographical education of how children at various grade levels acquire, process, reason with, and learn geography.

1. Introduction

Today, at the dawn of the 21st century, geographical education has to play a crucial role in the general educational systems of all countries around the world. In the forthcoming years and decades, today's learners need to act as responsible citizens with regard to complex key issues that are of great environmental, social, cultural, economic and political significance. Geographical education is one of the educational areas that teach learners the thinking skills required to understand and to act sustainably in the world. Without geography, young people are unprepared for an increasingly global future.

This chapter is a treatise on the subject of geographical education and gives an in-depth perspective on the nature, history, development and state-of-the-art of the field. In relation to its many reference sciences, such as earth science, biology, sociology or economics, the perspectives on geographical education are based on different epistemological approaches. Which approach is emphasized varies from country to country. The authors of this paper are experts in geographical education and are familiar with the epistemological approaches published in German, English and French. This paper allows for differences but it is impossible to give a faithful portrait of all epistemological traditions concerning geographical education employed around the world, especially of those countries whose languages we do not speak or whose scripts we cannot

read.

1.1. What is Geographical Education?

Geographical education is a scientific discipline grounded in the domain of geography and education, which looks into the conditions, principles and methods of domain-specific teaching and learning. Geographical education selects and structures geographical content knowledge, skills and attitudes in such a way as to enable learners to master them. Additionally geographical education develops and evaluates curricula, teaching and learning objectives, as well as methodologies concerning teaching and learning processes in geography. Geographical education is also involved in initial and in-service training courses for geography teachers. The process of education requires an informed interplay between theory and practice, as well as between scientific content and pedagogy. Therefore, geographical education is neither a simplified copy of the science of geography nor a form of subject-related pedagogy, but an independent discipline that is closely related to the scientific fields of geography, pedagogy and psychology.

Accordingly, geographical education is an interdisciplinary field of knowledge. While grounded in the context of geography, the domain of geographical education must take into account research from a wide area ranging from education to the cognitive science and technology development. It is an applied field in which theory and practice interact. Geographical education connects objectives, contents, teaching materials and tools as well as teaching methods with having in mind the function and forms of the geographical knowledge and skills for the learners' recent and future lives. This also includes the theoretical debate on the nature of science (NoS) of the discipline of geography. Epistemological thinking is necessary for a meaningful geographic education in schools, which has to be consistent with the general educational aims of the school system. (Note: In this text the terms "geographic education" and "geographical education" have a different meaning; see glossary). Geographic education on all school levels must reference academic geography explicitly. However, teaching geography is not a question of copying or simplifying the contents of the academic discipline for its use in schools. It concerns more the identification of the academic knowledge that is relevant and necessary to comprehend the geographical concept in question and its structuring according to approaches referred to as upward didactic transposition (Bronckart, 1989) or the model of educational reconstruction (Reinfried, 2007).

Geography as a school subject is often established at all stages of state school education. Due to educational reforms in the last 25 years, associated with rapidly changing curricula, geography is facing stiff competition from other subjects. This occurs whether geography is taught as a single, discrete subject or

as a subject integrated in interdisciplinary subject areas or some other forms of “geographical studies” (rather than geography) in the curriculum. In many countries geography is seen as a vehicle for developing education about sustainable development, environmental concerns, citizenship and even political literacy rather than as a valuable subject in its own right (Butt, Hemmer, Hernando, & Houtsonen, 2006, p. 104f.).

Geographical education is concerned with the teaching and learning of geography in formal and informal contexts by people who are geographically trained. It is a process of equipping individuals with a foundation of geographic knowledge, spatial thinking skills, and intercultural perspectives for life and work in a highly interdependent and interconnected world. This is a lifelong process with respect to the individual learner and a continuous endeavour in the context of the field of geography. The goal of geographical education is to supply society with people, who are geographically literate (Geography Education Standards Project, 1994). Geographic literacy is about understanding how human and physical systems are interconnected and how people and places interact. To achieve these goals geographical education asks the following questions: What should be taught to whom? Why should it be taught? When should it be taught? How should it be taught? How can we measure teaching success?

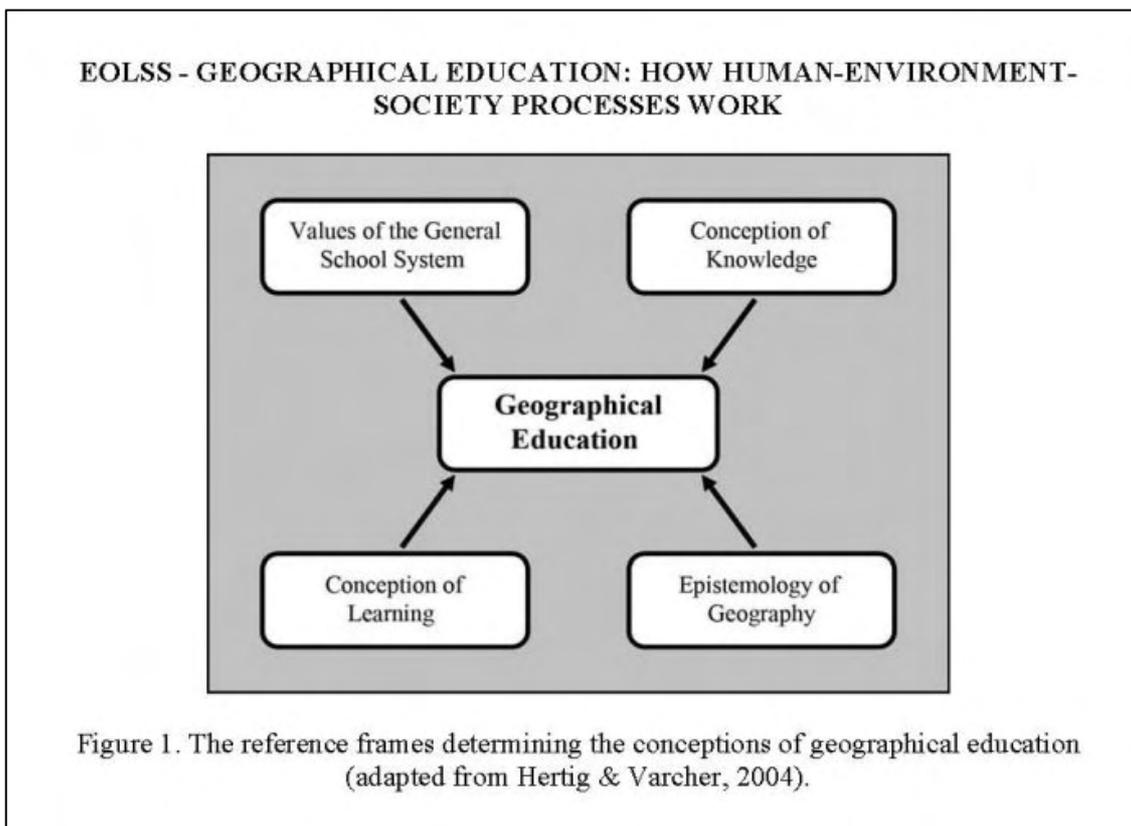
Geographical education is engaged in the structuring of the subject matter and the content- and skill-related application of appropriate pedagogical approaches to induce deep learning and cognitive development. According to Bednarz, Down, & Vender (2003, p. 462) it involves the

- Development of new teaching materials;
- The incorporation of new technologies;
- The creation and implementation of new standards, frameworks, and curricula at local, state and national levels;
- The revision of teacher training programs;
- The expansion of graduate courses and degree-granting programs focused on geographical education;
- The evolution and growth of journals concerning research and practice in geographical education;
- The establishment of university research centres focusing on geographical education;
- The coordination of grass-root activities within geographical education;
- The building of links to national educational organisations; and
- The endeavours to increase public awareness of the importance of geographical literacy.

Geographical education not only aims at promoting pupils’ knowledge of the

world and developing basic geographical skills, but also feels committed to cultivating learners' personal development and encouraging attitudes conducive to full participation in adult life and society. This also includes the clarification and discussion of issues of ethics, values, justice, and morality (International Geographical Union Commission on Geographical Education, pp. 1-8). These issues are concerned with interest for the world and its different cultures; respect and appreciation for the world's physical beauties and diverse living conditions; the quality of the environment and natural and human habitats; intelligent evaluation of current problems, and dedication to contribute to solving these problems; sympathetic feelings towards people and their different ways of life and respect of human rights (Haubrich, 2006, p. 44).

Today's conception of geographical education is influenced by four main parameters which also serve as reference frames (Figure 1): 1) The values which are expressed by the general aims of a school system which find expression in the aims assigned to be taught in geography by the educational institutions; 2) the conception of geographical knowledge; 3) the conception of learning; 4) and the epistemology of the discipline (Hertig & Varcher, 2004). In accordance with these reference frames, the inclusion of geography in the curricula implies that the following three categories of general educational aims are also contained (Audigier, 1995): the aims of heritage and citizenship, aims concerning intellectual and critical discourse, and practical aims. Therefore geography in primary and secondary schools plays an essential role in providing the learners the ability to develop critical thinking skills in order to comprehend the world.



Such thinking skills are concerned with learning how to investigate and to answer questions referring to the relationships of human societies with space and the relationships between different human societies across space (see Raffestin & Turco, 1984).

1.2. What is Geography?

Geography has no obvious place in the traditional classification of the sciences by faculty. “Some parts of geography have their strongest affiliations with mathematics and natural sciences, others with history, philosophy and social sciences. Many sciences study distinctive types of phenomena: geologists study rocks, botanists plants, sociologists social groups, and so on. The work of geographers involves several types of phenomena, each already studied by another science” (Holt-Jensen, 2009, pp. 4-5). This makes it difficult to determine what geography is. Basically, the object of geography is the earth or earth surface. However, a glance on the nature of the science of geography (NoS) reveals that geography recognizes several epistemological approaches. Some geographers understand geography as a science aiming at comprehending the world; for others geography aims at describing and measuring the world; some geographers consider the world itself to be the object of the discipline (physical geography), whereas others think that geography concerns the relationships between humans and space (human geography). These different perspectives become visible in the following chapters.

Geography is the science, which seeks to explain the character of places, the distribution of people, features and events, and the way they occur and develop over the surface of the earth. Geography is concerned with human-environment interactions in the context of specific places and locations. Its special characteristics are its breadth of study, its span of methodology, its synthesis of work from other disciplines including the physical sciences and the humanities, and its interest in the future management of people-environment interrelationships. Geographers ask the following questions: Where is it? What is it like? Why is it there? How did it happen? What impacts does it have? How should it be managed for the mutual benefit of humanity and the natural environment? Pursuing the answers to these questions necessitates investigating locations, places, situations, regions, movements, interactions, people-environment relationships, and spatial distributions (International Geographical Union Commission on Geographical Education, 1992; Natoli, 1994, p. 14f).

The question of what subject matter belongs to scientific geography has been broadly discussed in the second half of the 20th century and even today geographers have not yet come to a general agreement. Nevertheless, a common sense illustration provides us with a general outline of what geography is. In their everyday life all individuals are permanently confronted with space and

interact with others across space (Lussault, 2007; Hertig, 2011). The study of these interactions in space is geography (Raffestin & Turco, 1984). After a time of epistemological, methodological and conceptual crises during which geography went through several paradigmatic changes (Da Cunha, 2006), geographers have at the same time extended their research fields, specified their discourse and their thinking skills by anchoring their discipline in the social sciences (Hertig, 2011). Nowadays, the notion of territory, which is based on the concepts of environment, space and place, is at the heart of geography. From the “concept of territory” viewpoint, geography takes into account “the relationships between social sciences and natural sciences in their spatial manifestations. Geography’s concepts concern knowledge, the perceptions and practices of spatial actors, and the ways the actors produce, organise and alter a territory” (Da Cunha, 2006, p. 3).

From the development of geography as a science during the Greek classical period and until the early nineteenth century, geography consisted mainly of cartography, astronomy and the description of natural phenomena and local or regional features of the earth surface. For a long time geography was involved in the representations of known regions that were to be shared, allocated, and controlled, hence the development of geodesy and cartography. Additionally, geography was interested in the gathering of knowledge of others, e.g. people who lived more or less far away, with an inventory perspective in order to identify resources and commercial partners (Brunet, 1990). These two uses of geography were converging in a third common use of the discipline: the control of the territory of a community with reference to the knowledge of its area, its limits, its resources and its production forces (Brunet, 1990). It was only after the Age of Enlightenment and the rise of the sciences that geography was perceived as a natural science.

Today geography is a “human-environment-society science” (Weichhart, 2003) characterised by an integrative approach (Da Cunha, 2006) that makes use of modern spatial and statistical techniques as well as modern technologies. Such technologies are Geographic Information Systems (GIS), the Global Positioning System (GPS) and Remote Sensing (RS). They help us to understand the complexity of the earth’s system. Geographical education is infused with several key concepts of geography, for example the concept of scale, the impact of humans on the environment, the impact of the environment on humans and change over time and space. Much of geographic analysis is based on the spatial perspective which makes heavy use of maps and related products such as satellite imagery, land surveys, slope maps, and cartograms, to understand location, pattern and relationships of objects and phenomena.

Geography as a discipline integrates a wide variety of subject matter. Almost any area of human knowledge can be examined from a spatial perspective. In

education and research geography is very often organised into two divisions: physical geography which includes the study of soils, eco-regions, climates, vegetation, natural hazards and the like, and human geography which includes the study of population, religions, cultures, languages, human-built structures and the like. However, in practice, geography is a holistic discipline examining a multitude of perspectives and phenomena. Therefore, physical and human geography are often intertwined, and geographic analysis is more often interdisciplinary than not (National Council for Geographic Education, 2011). However, it is important to note that the division between physical and human geography, which is inherited from the 19th century, creates a lot of problems from an epistemological point of view. Because of that division, the discipline obviously suffers from a conceptual instability.

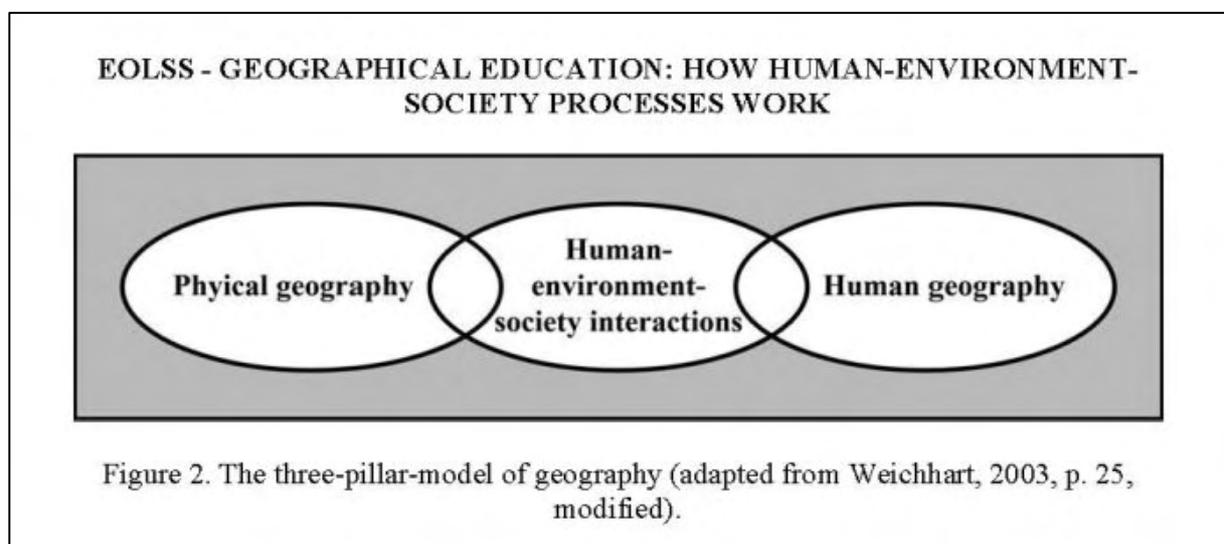
Physical geography (also known as physiography) is one of the divisions of geography, which deals with the study of processes and patterns in the natural environment as opposed to the cultural or built environment, the domain of human geography. Within the body of physical geography, the earth is often split into several interacting spheres or environments, the main spheres being the biosphere, lithosphere, hydrosphere, and atmosphere. These spheres are the basis of the disciplines studied in physical geography, which are biogeography, geomorphology, pedology, hydrology, meteorology and climatology, landscape ecology and urban ecology (Glaser & Radtke, 2007, p. 165ff.; Hagget, 2001, p. 37ff.). Research in physical geography is often interdisciplinary and uses the systems approach.

Human geography (also known as anthropogeography) is a division of geography studying spatial patterns of interactions between humans and their physical environment, as well as spatial patterns of interactions between human societies. Some of the dominant areas of study in human geography include: human society and culture (social and cultural geography); human population (population geography); urban systems (urban geography); economics (economic geography); health, disease and healthcare (health geography); travel and tourism (tourism geography); economic development (development geography); politics and geopolitics (political geography); geographies of the past (historical geography) (Hagget, 2001; Knox & Marston, 2001).

Issues that concern human-environment-society interactions (see Figure 2) include among others ‘the human dimensions of global change’; ‘water resources’; ‘energy resources’; coastal and marine geography; ‘contemporary agriculture and rural land use’; ‘rural development’; and ‘sustainable cities’.

Regional geography is the study of regions throughout the world aimed at understanding or defining the unique characteristics of a particular region, which consists of its culture, economy, topography, climate, politics and environmental

factors such as its different species of flora and fauna. Attention is also paid to regionalization, which covers the techniques of delineating space into regions. Regional geography was pivotal to the geographical sciences during the second half of the 19th century and the first half of the 20th century. It was later criticised for its positivist approach, descriptiveness and the lack of any grounding theory (Gebhard, et al., 2007, p. 68f). Today, regional geography is still part of the curricula of secondary and higher education as a study of the major regions of the world such as Northern and Latin America, Australia, Europe, Africa and Asia and their countries. Regional geography is either occupied with the comprehensive, idiographic analysis of regions or examines certain parts of the earth's surface typologically by classifying its characteristics according to their association with different categories.



1.2.1. Contribution of the Discipline of Geography to Geographical Education

Beyond these subdivisions geography is nowadays a science that opens up new views on the world through geographical questioning. The French geographer Denis Retaillé explains that geographical discourses are based in various proportions on three ways to think about the world. According to Retaillé (2000, p. 273) these three ways to think are at the same time successional and complementary in their mindset. First of all, the world is a planet whose parts are named and characterised (a habitat); then, the world is a dimension that is measured and organised (a framework) and finally the world is a matter whose meaning and finality is explored (a space). In other words, the first way of looking at or thinking about the world consists of considering it as an object to be described; the second way consists of trying to identify localisation rules and spatial organisation to highlight regularities and invariant things; the third way consists of looking at the actors in the world and their intentions and thereby draw the cultural, symbolic and political dimensions of space and of spatial facts

to our attention (Hertig, 2011; Varcher, 2008). One should not consider these three ways of thinking about the world as contemporary trends or well-defined periods in the history of geography (Thémines, 2006). But the model proposed by Retaille (2000) is a very interesting tool for geography teachers enabling them to identify the mode of construction of the geographical knowledge, which they are intending to teach.

In a nutshell, the contribution of the discipline of geography to geographical education consists of the understanding

- That natural and cultural environments have particular characteristics.
- Of how environments are shaped by processes that create spatial patterns.
- Of how the processes that shape natural and cultural environments interact, change over time, occur at different rates, vary in scale from place to place and create spatial variations.
- That the processes which shape cultural environments and to some extent natural environments are caused, sustained and controlled by actors.
- Of how people interact with natural and cultural environments and that these interactions have geographic consequences.

2. How is Geographical Education Relevant to Society and Environment?

Geographical education from colonial times to the space age has provided a window for examining the earth, its people and natural environments and the ways they impact on one another (Solem, 2011). In the 20th century geography was aided by the ability to look back at the earth from space. The concept of the earth as a single “blue planet” in the vast expanse of the universe revealed the uniqueness, fragility and vulnerability of the planet and reminded humankind of its responsibility towards natural and cultural environments for the benefit of present and future generations. As geography tends to look at issues holistically, geographical education contributed to the implementation of the new perspective on planet Earth by introducing concepts into teaching, learning and research that were relevant to increasing people’s awareness of the new paradigm of Earth as the “blue planet”. Such concepts concerned human-environment-society processes, their interdependence and implications at various scales, such as global change, globalization, natural resources, natural disasters, and international (voluntary and forced) population movements or ethnic conflicts.

In the 21st century geography plays an even more essential role in education. Key issues of the 21st century are environmental and societal, such as water

availability and quality, climate change, natural hazards, biodiversity and habitat, energy, political instability and crime, increasing social and economic disparities, family structure, migration, urban sprawl, transportation, agriculture, and sustainability. They are all of increasing global concern and impact on our everyday lives ever more often. Never before have these key issues been in greater demand by the workplace and in decision-making in society than in today's complex and global society (National Council for Geographic Education, 2011). Wolfgang Klafki, one of the most famous German educationalists, considers these key issues the most essential educational matters (Klafki, 1994). In French-speaking countries problems substantial as these are labelled “questions sociales vives”, which means controversial issues. They are controversial because they are debated in society, in the scientific community and in educational contexts. Although they are at the core of a sound geographical education, teachers hesitate or are not willing to bring them up because they are afraid to take up hot political or social topics (Legardez, 2006).

Today, the scientific community of people in geographical education is committed to the proposition that every member of society must be geographically literate. Geographic literacy is the ability to rationally consider and make reasoned decisions about the interconnections between human and physical systems and about the spatial patterns of interactions between human societies. As environmental systems undergo global transitions and rapid local changes in land cover and land use, and as social, economic and cultural systems are also subject to numerous changes, it is necessary that people make personal, civic, and workplace choices that result in sustainability of both the natural and human systems. Thus, the role of geographical education consists in teaching key concepts that help learners, our future citizens, to understand the world by enabling them to build their geographical relationship with the world. This process also includes the acquisition of knowledge of action that can be of use for reflective decision-making when confronted with issues concerning human-space-relationships (Thémines, 2006; Hertig, 2011).

Geographic literacy means analysing and solving geospatial problems. It includes the application of technologies that allow geographic analysis of complex situations, predict consequences, construct plans, and make decisions. One of these new technologies is the Geographical Information System (GIS) that has become increasingly important to society and thus, offers a major opportunity for geographic education. This does not mean that every individual should acquire the level of expertise that GIS professionals have. However, geographic education aspires to train pupils to be able to conduct basic geographic analysis in order to take sound personal, political, and professional decisions. This is not about technology, but about analysis. Every geographically literate citizen should understand how the attributes of a location and its relationship to other locations affect that very location. Every adult

should also understand that his or her actions have predictable effects elsewhere and that what happens elsewhere in turn affects the former, too. Geographic education aims to teach such analytic abilities essential to taking good decisions as to where to live and work, how to ensure personal mobility, what to buy and how to dispose of it again, how to prepare for natural disasters, whether to go to war or not, where to locate a store or factory, and how to market goods abroad.

In accordance with different authors (Da Cunha, 2006; Hertig & Varcher, 2004; Lussault, 2007) geographic literacy influences people's lives in three major ways:

- 1.The importance of place: The human and physical characteristics of a place take influence on whether certain human activities are practical, feasible, or detrimental at a given place. Geography can thus help us understand our place in the world and improve the capability of taking sound decisions by using facts and concepts about people, places, and environments.
- 2.The interconnectedness of places: the surface of the earth is a fabric of interconnected places. Changes in one place have consequences not only for the respective place itself, but for other places as well. The key concepts of scale and distance, geospatial knowledge and skills enable people from all walks of life, be it a scientist or a local citizen, to foresee possible consequences of changes in human and physical systems and find integrated approaches to problem solving.
- 3.The importance of the actors: Spatiality is an essential dimension of the human existence, which is often underestimated, even ignored (Lussault, 2007). Because geography studies the relationships between human societies and space and the relationships between human societies across space (see Raffestin & Turco, 1984), it is essential to emphasize the processes that lead to spatial actions caused by various actors who thereby take into account their imaginations and their intentions.

Changes at the national and global level over the past two decades have placed a greater value upon geographic literacy. The increasing esteem for geographical knowledge has heightened the degree of interest and motivation for the participation in geographical learning at higher levels of instruction in many countries (e.g. Solem, 2011; Otto & Hemmer, 2009). Geographically literate and responsible citizens will provide society with both economic and social benefits. Academic geography departments benefit from better-prepared students who intend on studying geography and geospatial technologies. So, all in all, geographical education not only contributes to general education but also to the preparation and professional development of future geographers thus paving the way for careers in business, government agencies, non-profit organizations, and

educational institutions.

3. The Development of Geographical Education

3.1. Past Trends in Geographical Education

Geography as a school subject was established in many countries in the 19th century. The widely applied model of geographic education was “capes and bays geography” which was associated with colonialism and imperialism. It was important to know the characteristics of the territory of the nation, homeland (aiming at heritage), as well as its history (wherefrom the close relationship between history and geography in educational contexts in some countries originates, in particular in France). The “capes and bays” instructional model focused on content related to distant places and the unique attributes of people living in such places (Stoltman, 2006, p. 24). The content concerned the topographical features of a certain place or region, its resources and agricultural products. Its uniqueness was revealed in customs, language, and indigenous economic systems. In the early 1900s other topics such as economic, commercial, agricultural and regional geography issues began to appear in textbooks (Graves, 2001). Great attention was also paid to the earth science aspect of geography (geology, geomorphology, climates, water bodies; Stoltman 2004, p. 16). In the first half of the 20th century “capes and bays” geography was gradually subsumed into a new curriculum paradigm, known as “the expanding environment”. The expanding environment curriculum developed its content from “near to far” in a concentric way. Pupils at an early age learned about their family and their community, later about their country, region, continent and the world. The acquired knowledge about places and regions concerned mostly with encyclopaedic facts. The “expanding environment” paradigm remained a powerful, widely adopted approach in textbooks and curriculum structures around the world, and continued as an international curriculum model in the 20th century (Haubrich, 1982). This paradigm even found a kind of legitimation in some theories of developmental psychology, for example the theory of the “progressive structuration” of space by young children (Considère, Griselin & Savoye, 1996, pp. 18-19; Pache & Hertig, 2006, pp. 27-28; Piaget, 1947, p. 443). To this very day, the “expanding environment” paradigm can be found as the underlying structure in curricula and textbooks (De Amorim Soares, Ceballos García, Garcia de Martin, & Araya Palacios, 2006, p. 162).

According to Stoltman (2006, p. 26) the period from 1915 to 1960 can be regarded as the early modern period of geographic education. This period was marked by two world wars, decolonization and the cold war. The wars impacted on geography, since wars require tactical and strategic information about the

field of conflict and battle along with geopolitical alignment information. As a result, an increase in knowledge about the world, its physical and human systems and characteristics complemented the “expanding environment” approach of the geography curriculum. During this period, another curriculum model, the “social studies curriculum” (Rugg, 1927), was designed and first proposed in the United States. It claimed to incorporate a much broader sweep of social issues and concerns, including citizenship education, than did geographic education alone. Social Studies followed the “expanding environment” paradigm but required an integrated approach to teaching. This left geography in a peculiar position since its scholarship is in both the social and the physical sciences, which already requires an integrated perspective on the subject. The social studies curriculum initially established itself only in the United States. However, by and by, it was also accepted in other parts of the world. Today, the situation is such that geography in some parts of the world has maintained its status as an independent subject while in others it could barely hold its ground within the forefront of social studies or has even declined (Haubrich, 1982; Mayo, 1964; National Council of Geography Teachers, 1956; Stoltman, 2006, p. 27).

Since 1900 the necessity to know something about the regions of the world and their particular geopolitical interests and relationships has increased dramatically. In addition the two World Wars increased the movement of products between regions. This resulted in a rise of regional geography in geographic education (Graves, 2001) which dominated the field until the 1960s in association with the “near to far” paradigm as the underlying structure. The pedagogy in use in geographical education until then was textbook-dependent, teacher-directed and focused on memorizing facts and recalling information.

During the 1950s and 1960s the quantitative revolution occurred and electronic computing equipped with analytical software programs emerged. Both provided the tools for geographers to systematically study and search for correlations and patterns in geographical subfields such as urbanisation, industrialisation, transportation, and numerous other special topics. Examination of spatial hypotheses with large data sets revolutionized the discipline of geography. These paradigm shifts spread to primary and secondary school geography. Whereas observation was formerly a major goal of geography, the newly found emphasis focused pupils' attention on measurement, data collection from maps, aerial photos, and field studies, and greater accommodation of geographic skills to promote scientific inquiry. This evolution (from the “capes and bays geography” to quantitative geography) corresponds to the first two steps of the model of the three ways of thinking about the world by Retaille (2000; see chapter 1.2.1.). The new geographic pedagogy combined quantitative methods, techniques, and contents, with far-reaching implications for the geography curriculum. During the 1960s the Association of American Geographers

initiated the High School Geography Project (HSGP; 1970) that aimed at introducing systematic geography studies in the high school curriculum (Gunn, 1972; Pratt, 1970 in Stoltman, 2006, p. 30). The HSGP was designed to provide pupils with an overview of the theories of geography, to demonstrate the role of numeracy as an expression of spatial information, and to introduce the ways through which geography was responsive to the study of social and environmental issues. In England and Wales, a group of secondary geography teachers developed the Oxford Geography Project (Kent, Rolfe, Dearden, Rowe, & Grenyer, 1974), which included topics such as urbanisation, settlement, migration, land use, and development to be investigated by inquiry using documents, data, significant questions, and simulation games. Other countries such as the German Federal Republic, Israel, or New Zealand developed projects equivalent to HSGP. On the methodological side electronic simulations were judged significant as the means to teach concepts and processes that demonstrated how people live on Earth and use its resources. The simulations had a clear educational objective and made a substantial impact as the best educational practice at the time.

From the 1960s up to the 1990s a process of rethinking of content and pedagogy in geographical education took place. Topic- and concept-based instruction was viewed as having the greatest educational value. The methods of teaching and activities that engaged pupils in learning and doing geography were extended to encompass hands-on-activities, role playing, drama, values clarification, analysis of attitudes, and participation in civic activities (Slater, 1983). The New UNESCO Source Book for Geography Teaching identified economic values, social values, ecological values, and spatial values as inherent to geography teaching (Pinchemel, 1982) and reflected the UNESCO emphasis on international education during the period which included geography, but had a more defined role in the rationale for social studies in the primary and secondary curriculum (Mehlinger, 1981).

The educational traditions and expectations that had provided geography a place in the curriculum in most countries continued to function. However, at the end of the 1980s major transformation caused school geography to be reconsidered and realigned as curricula were reviewed in many countries after the end of the Cold War (Gerber, 2003). New geopolitics called for the (re)-introduction of democratic ideals and the quest for a civil society as a model for building a representative national government. Worrying environmental conditions on Earth and in particular regions caused concern within the scientific and cultural communities. Geographical education had to attune to the political and environmental challenges. The International Geographical Union enacted the International Charter on Geographical Education with the intent that pupils in all countries develop “increasing international competence in order to ensure effective cooperation on a broad range of economic, political, cultural, and

environmental issues in a shrinking world” (International Geographical Union Commission on Geographical Education, 1992). Till today, the International Charter on Geographical Education has been translated into 22 languages.

3.2. Current Trends in Geographical Education

The end of the 20th and the beginning of the 21st centuries saw geographical education in the light of similar, long-standing questions as well as turning points for the discipline in the school curriculum. According to Stoltman (2006, p. 32) three notable changes were

- The renewed interest in the environment and education for sustainable development;
- A reappraisal of geography's role in education for responsible citizenship; and
- The increased emphasis and quantity of research in geographical education.

This list needs to be expanded by three additional innovations:

- In the context of a systemic conception of knowledge great importance is attached to integrative geographical concepts as structuring elements for any educational process in geography (see chapter 3.3.).
- The role and methodological stakes in information and communication technology (ICT) and teaching are increasingly taken into account.
- The trend to conceive standard- and skills based curricula.

As far as the environment is concerned geography has a long tradition of dealing with environmental content and addressing environmental issues, although, traditionally, geography was viewed much more narrowly as geomorphology or part of the social studies. In countries where geography has still strong relations to geoscience, much of which is considered to be environmental education, is almost the same as what geography educators research into, write and teach. This then explains why geographic educations tackled issues of environmental education, since the essential components are inherent to the discipline and have caught the attention of policy makers and educational decision makers alike throughout the world (Kent & Jackson, 2000; Zhang & Foskett, 2003). In the second half of the 1990s and the first decade of the 21st century the concept of sustainable development, which dates back to the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, has received most attention. The sustainability idea as we know it emerged in a series of meetings and reports during the 1970s and 1980s but gained momentum in 1987 when the UN-sponsored Brundtland Commission released “Our Common Future”, a report that caused widespread concern about the environment and poverty in many parts of the world.

Geographical education's commitment to environmental and citizenship education is expressed in the International Declaration on Geographical Education for Cultural Diversity (Gerber, 2000) proclaimed by the International Geographical Union Commission on Geographical Education (IGU-CGE) in the year 2000. The declaration states that geographic education offers the basis for people all over the world to understand, respect and stand up for human rights and cultural diversity; that geographic research and teaching makes a major contribution to our understanding of the cultural, social and industrial environments of the world; that geographical education contributes to understanding the need to protect the natural environment at local, regional, national and global scales; and that geography curricula develop individuals at various educational levels to protect our planet as a global heritage (Gerber, 2000). Citizenship education includes knowledge of government, civic responsibility as a member of a community and country, and participation working towards the common good. Geographic education makes contributions to citizenship through environmental decision-making, critical thinking about the relationship between citizenship and responsibility, developing a sense of place, and clarifying values relative to ideas about people and countries.

In 2002 the United Nations General Assembly proclaimed the UN Decade of Education for Sustainable Development, 2005-2014, (DESD), "emphasizing that education is an indispensable element for achieving sustainable development" (<http://www.unesco.org/en/esd>). This political will finds expression in explicit incitements to integrate education for sustainable development in the curricula of the countries, which have not done this yet, or to reinforce its position. To underline the commitment of geographical education to education for sustainable development the IGU-CGE enacted the Lucerne Declaration on Geographical Education for Sustainable Development in 2007, which has already been translated in 14 languages. The declaration extends the foundational International Charter on Geographical Education (International Geographical Union Commission on Geographical Education, 1992) with a focus on the contribution of geography to education for sustainable development. It states the criteria for developing geographical curricula for education for sustainable development, and the importance of information and communication technologies (ICT) in education for sustainable development in geography (Haubrich, Reinfried, & Schleicher, 2007; Reinfried, 2009a).

Granting ICT a prominent place in the Lucerne Declaration was imperative because the growth and development of computer cartography, the Geographic Information System (GIS), and Remote Sensing (RS) have contributed numerous applications to geographic education in the last decade. Access to data analysis and mapping as well as portable laptop computers help pupils to reach out to the world wherever they are. The World Wide Web linking individuals with other individuals, databanks, special interest groups, and governmental and

other public reports democratises individual and group decision-making. It is a long-standing premise in geographical education that information enables people to make informed decisions regarding important environmental, social, economic or political issues regarded in their spatial dimensions. A specific value and potential of ICT for geographical education concerns their importance as a resource for information from various, often-contradictory sources. This enables learners to gain a multi-perspective view on geographical issues.

In the last 25 years governments in many countries have introduced a variety of policy initiatives in their attempts to improve education. Since the late 1980s educational reforms have been driven by performance-based education, standards and accountability leading to a tendency to generalize skill-based curricula. Governments wanting to promote literacy and numeracy named core subjects. Pupils' performances in these areas were assessed nationally on a regular basis. Additionally all members of the Organisation of Economic Co-operation and Development (OECD) participated in the Programme for International Student Assessment (PISA) which tested 15-year-old school pupils' literacy in reading, mathematics and science every three years. As a consequence resources and teaching time were concentrated on reading, mathematics and the sciences (biology, chemistry, physics and earth science). Geography, regardless of whether it is taught as a separate subject or as a component of integrated studies, was not included in PISA and thus was marginalized in many countries in Europe, in the USA, Australia and New Zealand and East Asia (Bednarz et al., 2003; Butt et al., 2006; Lam et al., 2006; Robertson & Ferguson, 2006).

Seeking common trends across the world, we noticed that geography, although not included in PISA, was commonly expected to reach national educational goals on the pre-collegiate level. National geography standards, sometimes benchmarked through high-stakes assessments, were developed in many countries in order to secure and improve the quality of geographic education in schools (Examples of national geography standards on the Internet: USA: Geography Education Standards Project, 1994; National Council for Geographic Education, 2011; Germany: Deutsche Gesellschaft für Geographie (DGfG), 2007; Australia: Geostandards, 2011; Singapore: National Institute of Education, 2006, 2008a, 2008; French speaking part of Belgium: Enseignement.be, 2011). Nevertheless, there is little agreement on either the educational aims of or the contents and skills to be achieved by the school subject described as "geography". These vary greatly between countries, as does the number of years of mandatory geographical schooling and the place of geography in the school curricula. Therein, geography appears either as an independent subject or adds an element of integrated courses, such as social studies or integrated humanities, as well as a mandatory or voluntary subject (Finnish National Board of Education, 2004; Lidstone, 2003; Wood, 2009; Yasar & Seremet, 2009).

3.2.1. The IGU-CGE - the Longest-Standing Work Group in International Geographical Education

The Commission on Geographical Education (CGE) of the International Geographical Union (IGU) plays a key role in promoting geographical and environmental education globally. In order to accomplish this goal, the activities of the Commission include the publication of the journal *International Research in Geography and Environmental Education* (IRGEE); newsletters, and conference proceedings; the organisation of international conferences; the coordination of international and regional research projects; and the sponsorship of the Geography Olympiad (see chapter 3.3.).

At regional and national levels there are numerous associations and societies that either exclusively focus on geographical education or incorporate subgroups into geographical education, such as the European Association of Geographers EUROGEO (www.eurogeography.eu/), the Association of American Geographers AAG (www.aag.org/), the Canadian Association of Geographers (www.cag-acg.ca), the British Geographical Association GA (www.geography.org.uk) and the South East Asian Geography Association SEAGA (<http://seaga.webnode.com/>), just to name but a few.

The flagship journal of the Commission on Geographical Education of the IGU is the journal *International Research in Geography and Environmental Education* (IRGEE) founded in 1991. The journal publishes international research studies of high quality in geographical and environmental education. It provides a forum for critique of research studies and the discussion of relevant research issues in geographical and environmental education; encourages the international dissemination of research in geographical and environmental education and demonstrates the relevance of research studies to good professional practice in geographical and environmental education (www.tandf.co.uk/journals/1038-2046).

3.2.2. Research Foci in Geographical Education

Across the world research in geographical education has been conducted for various purposes. The research agendas were defined by the status and appreciation of geographical education in the respective countries, but also by local, regional and international priorities and trends. We (the authors) read work published in English, French and German, but we are unfamiliar with work published in Spanish, Chinese or Japanese. It is therefore impossible to draw general conclusions upon the manifold worldwide activities within this academic field of study.

The emergence of geographical education as a research area is a recent phenomenon. In the 1990s research work in this field became more and more

frequent as a response to institutional needs (e.g. new curricula and programmes of study; considerations concerning evaluation processes, etc.) and as an answer to the paradigmatic changes the scientific discipline of geography underwent.

From the research papers published in IRGEE, in international scientific journals (Science Education; International Journal of Science Education IJSE; Journal of Social Science Education JSSE), in papers and chapters in handbooks on research of earth science education and environmental education (Hart, 2007; Orion & Ault, 2007; Pintó & Couso, 2007) and in conference proceedings of the IGU-CGE (Ida, Ike, Ohnishi & Shimura, 2009; Kent & Powell, 2004; Kent, Rawling & Robinson, 2004; Purnell, Lidstone, & Hodgson, 2006; Reinfried, Schleicher, & Rempfler, 2007), in papers and chapters in handbooks on geographical and/or social science education (Audigier, 1995, 1997; Audigier & Tutiaux-Guillon, 2008; Clerc, 2002; Davaud, 1988; Ferras, Clary & Dufau, 1993; Hertig & Varcher, 2004; Klein & Laurin, 1999; Laurin, Klein, & Tardif, 2001; Legardez & Simonneaux, 2006; Le Roux, 2003, 2004; Mérenne-Schoumaker, 1986, 2002, 2005; Thémines, 2006), we may say that the research in geographical education touches a large number of research areas. Topics of physical geography and the environment, for example, appear to belong as much to the domain of natural science education as to geographical education. Issues of spatial thinking are a field of research of cognitive psychology as well as geographical education.

Research issues concern teaching and learning of geography; curriculum, assessment and evaluation; teaching resources and technology; geographical education in different social contexts; and teacher education. The following list demonstrates the wide range of research in geographical education, illustrated with examples from IRGEE and other sources. We tried to give a comprehensive review of the most important research areas. Nevertheless, the list cannot be all encompassing in terms of research areas as well as researchers who may have published in one or more of the listed fields of study:

- (1) The perception of place (Avriel-Avni, Spektor-Levy, Zion, & Levi, 2010; Haubrich & Schiller, 1997; Reinfried, 2002; Picton, 2008)
- (2) The role of spatial ability in geographic understanding (Liben, 1999; Montello, Lovelace, Golledge, & Self, 1999)
- (3) Studies about children's thinking with maps (comprehensive review by Wiegand, 2006)
- (4) The geographic learning process (Hickey & Bein, 1996; Reinfried, 2006; Reinfried, 2009b; Thémines, 2004)
- (5) Research into teaching resources (e.g. textbooks: Clerc, 2002; Graves, 2000;

Graves & Murphy, 2000; Hamann, 2007; Marsden, 2001) and technologies (e.g. GIS, GPS: Baker & White, 2003; Bednarz, 2000; Carver, Evans, & Kingston, 2004; Kerski, 2003; McMorrow, 2005)

(6) Exploration of the influence of teaching methods on students understanding (Klein, 1995; Lyman & Foyle, 1991; van der Schee, Leat, & Vankan, 2006; Yeung, 2001)

(7) Conceptions of geography and geographical education (Alkis, 2009; Brooks, 2006; Davaud & Varcher, 1990; Hertig, 2011; Hertig & Varcher, 2004; Varcher, 2003; Walford, 1996; Walshe, 2007; West, 2006)

(8) Issues of teacher education and teacher development (Boehm, Brierley, & Sharma, 1994; Dalelo, 2009; Martin, 2008; Thémines, 2006)

(9) Instruction for learners with special needs (e.g. Andrews, Otis-Witborn, & Young, 1991; Hall, Healey, & Harrison, 2004)

(10) Research concerning pupils' and teachers' conceptual frameworks of geographical concepts and conceptual change research (compiled in a bibliography by Reinfried & Schuler, 2009; free download at www.ph-ludwigsburg.de/geographie)

(11) Sustainable development and environmental education in geographical education (Corcoran, 1996; Corney, 2006; Lee & Williams, 2001; Varcher, 2008)

(12) Fieldwork and outdoor education (Chew, 2008; Han & Foskett, 2007; Lössner, 2011; Munowenyu, 2007; Schockemöhle, 2009)

(13) Mental maps (André, 1998; Bailly, MacCabe, & Saarinen, 1995; Saarinen, 1999)

(14) The role of integrative concepts in geographical education (Collet & Hertig, 1998; Hertig, 2011; Hertig & Varcher, 2004; Varcher, 1998; Varcher, 2003)

(14) The state of geographical education around the world (Gerber, 2001; Haubrich 2006)

(15) Curriculum design (Audigier, 2001; Audigier & Tutiaux-Guillon, 2008; Reinfried, 2001)

(16) Research concerning pupils' interests in geographical themes, regions and methods of operation (Hemmer & Hemmer, 2010)

(17) Perception and acceptance of bilingual geography teaching (Meyer, 2003,

2004; Viebrock, 2006; Weber, 1993)

(18) Educational and methodological approaches concerning the use of pictures and images in geography (Collet & Hertig, 1995).

Over the past twenty years school geography has either struggled for survival or fought for a place in the curriculum. Academics in geographical education at colleges and universities were busy developing standards, adapting their curricula to new requirements, editing textbooks, atlases and other teaching materials, in-service teacher professional development programs and much more, in addition to their normal workload. There was and still is a lack of resources in terms of staff, time and money for well-grounded research. This explains why the state of geographical education research is still relatively poor (Downs, 1994; Lambert, 2010). The research can be characterised as small-scale in terms of number of participants, as asynchronous (few longitudinal studies), not controlled and is often descriptive and anecdotal. Attention needs to be paid to the basics of empirical methods: sample selection, hypothesis formulation, data quality, statistical analysis, reporting requirements, research ethics, etc. (Downs, 1994, p. 129ff.). Nevertheless, we agree with Martin & Catling (2004) that past research in geographical education, although it lacks sufficiency, offers a wealth of information that could usefully be synthesised and disseminated in order to provide a sounder basis for decisions about future research.

One of the structural reasons for the lack of sufficient research can be attributed to the split within the geography community itself, i.e. between researchers in the science of geography at colleges and universities and those who teach geographical education. In addition, researchers in educational psychology and pedagogy and educators in geography have rarely been inclined to collaborate with each other. There existed a reciprocal lack of interest and sometimes lack of mutual respect between the various groups and traditions. Recent developments suggest that this split is about to be overcome gradually. Both researchers and practitioners have failed to develop strong links with the theory developed in cognate domains of knowledge, especially the theory in cognitive development and education (Bednarz et al. 2003, p. 474). Now, in some areas, e.g. in spatial cognition and spatial ability (Liben & Downs, 2001) or conceptual development (Reinfried, 2006; 2009b) the connections between geography and the disciplines of psychology and pedagogy are genuinely reciprocal. The purpose of research in geographical education is the study of how geography contributes to education (Lambert, 2010, p. 85). Communicated amongst the academics and researchers in the science of geography, educational professionals, politicians and policy makers and the general public, they strengthen the voice and impact of geographical education.

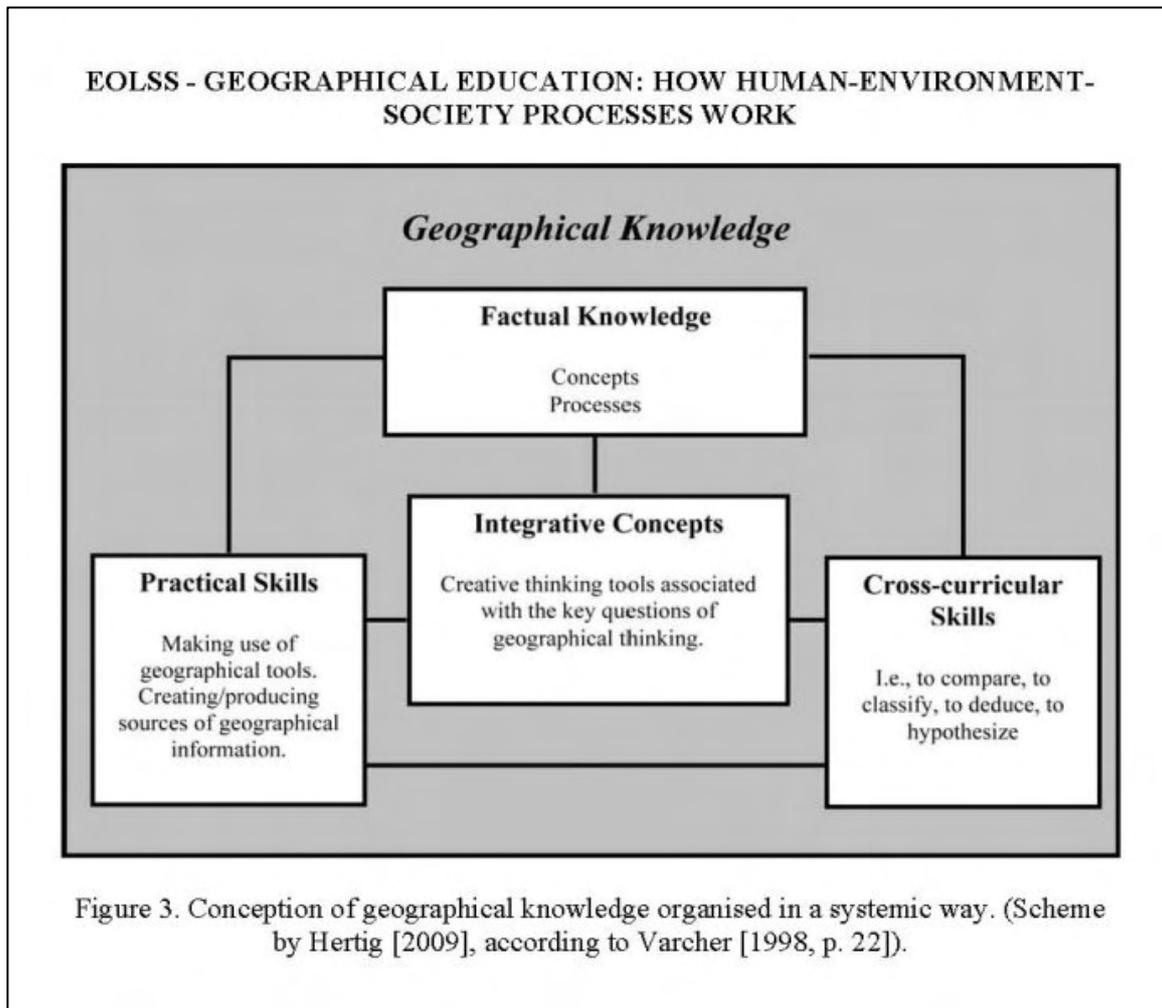
3.3. Current Practices in Geographical Education

The scientific community of people in geographical education recommends that geo-literacy be recognized as an integral component of earth and environmental science and geography. The current credo of experts in geographical education is such that a geo-literate citizen is able to understand a geosystem, to reason critically about the characteristics of a location and its connections to other locations, is able to evaluate situations systematically using the best information available, and is able to make sound decisions concerning the environment and society. Geo-literacy can be developed through the use of traditional materials focusing on geography such as maps, atlases, globes, books, satellite images, CDs, games and simulations or modern state-of-the-art-technologies such as web-based and web-assisted instructions, the global positioning system (GPS) and geographic information system (GIS) which will become even more important in the future. In the 21st century a key component of geo-literacy is the ability to use GIS and other geo-spatial tools and technologies such as digital maps, remote sensing, virtual globes, and other technologies for displaying spatial data to collect, organise, visualise, analyse, and communicate about geographic and location-specific information.

One of the greatest challenges of geographical education concerns the teaching of the great complexity inherent in the topics tackled by geography. Learners have to process huge quantities of information to come to an understanding of such complex issues. There is a great risk that learners feel overwhelmed by the bulk of information and run into difficulties when having to structure their geographical knowledge. Accumulating information is simply not enough for achieving geographical knowledge. Today the constructivist paradigm as well as the call for systemic and complex thinking constitute the reference model for teaching and learning (Morin, 2005). According to the constructivist paradigm knowledge must be constructed (Tobias & Duffy, 2009). Effective knowledge construction is possible if learners are offered learning opportunities in which they can use the necessary cognitive or mental skills such as remembering, questioning, planning, reasoning, imagining, decision making, problem solving, making judgements, etc. However, still today many geography curricula adhere to the positivist tradition. They emphasize “concrete” and “visible” phenomena by sticking to the “capes and bays geography”, geo-possibilistic approaches or traditional landscape geography (in which a region is viewed in the sense of a real existing “container” or entity).

In regard to the complexity of today’s challenges geography teaching should be based on a systemic approach allowing learners to gradually understand the connections and the interactions between the constitutive elements of a given situation (Varcher, 2008). Such an approach seems most promising in order to prepare learners to make sense of the complexity of the world. Hence, geographical knowledge taught in schools cannot just consist of declarative knowledge or facts but should also include practical and cross-curricular skills

that are all organised in a systemic way. An example for such a systemic approach is displayed in Figure 3.



In this conception of geographical knowledge (1) factual knowledge (knowledge of concepts, processes), (2) practical skills such as the use of maps, visual images, statistical data, new technologies, etc. and (3) cross-curricular skills such as the ability to compare, to classify, to analyse, to synthesise, etc., are interlinked in a dynamic way by integrative concepts. The integrative concepts (see Table 1) are “creative thinking tools” specific to the discipline of geography. By dynamically interconnecting factual knowledge, practical and cross-curricular skills the integrative concepts play a central role in organising geographical knowledge and achieving geographical thinking.

The conceptual system explained in Figure 3 and Table 1 marks a true breakthrough for geographical education. According to Varcher (1998, p. 23) each integrative concept can be considered an idea that allows the learners to gradually organise their perceptions and their knowledge. Connecting the main questions central to geographical thinking with the integrative concepts lends the approach the operative dimension sought-after: the integrative concepts stimulate the questioning and the understanding of the reality, thus enabling the

learners to develop real geographical thinking and the understanding of complex geographical issues. This is particularly useful and necessary in primary and secondary schools where the temptation is great to oversimplify things that are in fact complex. The integrative concepts, in their function as creative thinking tools for geography, can boundlessly play the role of structuring elements for learning. (The idea of the integrative concepts is based on the work of Barth [1987, 1993], Bruner [1996], Bruner, Goodnow, and Austin [1956] and Vygotsky [1934/1985]). Furthermore, the integrative concepts also constitute useful elements to elaborate a syllabus.

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Table 1. The integrative concepts and the associated key questions central to geographical thinking (adapted from Hertig & Varcher [2004], slightly modified).

Integrative concepts	Associated questions
Localisation	Where? Why there? What impacts if there? Why not elsewhere?
Actors, intentions	Who are the actors concerned? What are their intentions? In other words: Who is producing space? For whom? What for? When? How?
Spatial actions (production of space)	What kind of spatial actions are caused? Where and how do actors localize given features? Which types of limits do they identify in space? Which types of territory and which types of network do they create?
Scale	What scale am I at while I am working? What other scale(s) should I be aware of in order to think about this issue?
Representation	What are my own representations about the topic? What are other people's representations? How do we understand each other?
Interaction	What are the interactions within the frame of the issue in question? Between which factors? Is there any feedback? Is there any iteration?
Polarization (and hierarchisation)	Why do some activities happen in given locations? What are their leading functions? See also questions pertaining to localization and production of space.
Diffusion (spreading)	How does a certain phenomenon spread? From where? Why from there? To whom? Through which network/channel? Why? Is the diffusion advanced or repressed?

Besides the search for ways of how to teach geography effectively, geography educators have also sought of new venues to promote geographical education in schools and among the public in the last decade. Examples can be found all over the world. Museums, particularly children's' museums, have adopted geographical themes (e.g. www.eureka.org.uk/; www.cmj.jo/); map competitions attempt to improve pupils' skills of out-door observation, map-making and map-use (e.g. The Asahikawa Children's Environmental Map Competition, www.geojuice.org/asahikawa.asp), and Geography Awareness Weeks draw attention to geo-literacy by addressing a specific geographical theme each year (www.mywonderfulworld.org/gaw.html). Other indicators of societal interest in geography are activities of national or international agencies (e.g. NASA, NOAA, ESA) in launching programs to teach geography through curriculum materials, websites, and other formal and informal means (Bednarz et al., 2003, p. 470).

A great opportunity to demonstrate the relevance of geographic literacy to society is the International Geographical Olympiad (www.geolympiad.org) organised by the International Geographical Union (IGU) Olympiad Task Force. The aims of the International Geography Olympiad are to promote geography, to stimulate understanding between young people from different countries via geography and to bring about a higher quality of geography taught in schools globally. It is a competition for the best 16- to 19-year-old learners in geography who have successfully mastered a national competition. The Olympiad consists of three parts: a written test, a multimedia test and a substantial field work exercise. The questions asked focus on a general understanding of everyday life on Earth and address globalization, sustainable development by looking at locations, distributions and interactions. The Olympiad first held in 1996 under the auspices of the International Geographical Union in The Hague, the Netherlands, with five European countries. Since then the number of participating countries has increased steadily. At the Olympiad in Tunis in 2008, their number had already risen to 24 (van der Schee, Notté, & Zwartjes, 2010, p. 278).

4. Challenges for Geographical Education

Despite the achievements described in chapter 3.3 we are still a long way from achieving the goal of general geographic literacy, whilst new challenges arise for geographical education.

The first challenge concerns teacher professional development in geographical education. Today pre-service training of geography teachers differs widely, not only between countries but also within countries if they are federally organised (such as the United States, Germany or Switzerland) where the authority for the

school system is mainly delegated to the states, Länder or cantons. In many countries teachers who have little or no formal preparation in geography or in methods of spatial analysis are in charge of teaching geographic content (Bauriegel & Schrüfer, 2006; Bednarz & Bednarz, 2004; Bednarz et al. 2006, p. 116; De Amorim Soares et al., 2006, p. 162; Hertig, 2009, 2011). A survey conducted in Switzerland that questioned teachers who teach at the lower secondary level revealed that 37% of them had no prior training in geography (Adamina & Mayer, 2004). Gersmehl (2008) reports that many US teachers admit that they have completed not more than one college course in geography or perhaps a workshop in which they received training, sometimes using GIS software. Principals of middle schools in Greece, the UK, Iceland, Mexico, Ireland, Japan, Germany, Italy, Australia, Norway, the Netherlands, and the United States questioned in the PISA survey of the year 2000 declared that out-of-field teaching impairs the learning of 15% or more of their 15-year-old learners in the sciences (OECD, 2002). The lack of professional development of those “out-of-field” teachers might also be one of the explanations why in-service teachers are not always well-prepared for incorporating new geography concepts into their classroom activities (Bednarz, 2003; Bednarz et al., 2006, p. 116). The authorization to teach geography must clearly be bound to a minimum, but yet reasonable amount of geographic content. Teachers should feel confident that they are competent in the content for whose teaching they are responsible.

The lack of scientific qualifications is particularly acute with regard to primary teachers. In many countries these teachers are not trained sufficiently neither in scientific geography nor in geographical education. Although these teachers are all-rounders and do not teach geography as a subject, they work with their pupils on elements and contents that are relevant to geography. They concern in particular tasks related to the structuring of space or activities that help children investigate the natural and societal environment. Although it is common knowledge that especially the first years of schooling stimulate the interest and curiosity concerning science, teachers very often do not introduce their pupils to scientific questioning or provide guidance of how to construct scientific concepts in an age-based manner but teach common sense knowledge. Furthermore, the teaching does not make adequate use of relevant resources, particularly of visual images, but gives simplistic and shortened explanations that favour linear causalities and even include factual or scientific errors. These conclusions drawn from research are also true for secondary schools where much factual knowledge is taught out of context along with too many low cognitive activities. In addition, the assessment procedures in secondary schools mainly favour memorisation and repetition (Audigier, 1998, 2001; Clerc, 2002; Hertig, 2009; Tutiaux-Guillon, 2008a). On this account, teacher professional development should take the first priority above all other reforms policy makers and school authorities are occupied with.

The second challenge concerns research in geographical education. Although research in geographical education has generated a substantial body of knowledge in the last two decades, complaints about the lack of valid and reliable empirical data collected through systematic and rigorous research have been uttered time and again (Downs, 1994; Lambert, 2010; Martin & Catling, 2004). The future research agenda in geographical education concerns as ever, the teaching and learning of geography, curriculum and assessment, and teacher education. However, it is essential that this research leads to a theory of geographical education, to a theory of how geographic literacy can be acquired through geographical education. Research in geographical education may not be practiced as an end in itself but needs to have an impact on policy makers and practitioners. Policy makers can best be convinced of the common public interest of geographical education if they better understand what additional value is connected with education in geography; what the essential character of geographic expertise in terms of contents, skills, and understanding of complex problems includes and how this expertise can best be developed and assessed. Practitioners can best be convinced to apply new concepts, methodologies or tools if they are procured with ready-to-use teachers' and students' manuals and easy-to-apply tools that have been proven to work in practice and generate progress in learning and understanding on a constructivist basis. These materials are to be developed and evaluated by experts in geographical education. To safeguard this, we need to know more of how learners best acquire geographical concepts, skills and attitudes and what methodologies can be used most effectively to promote geographical learning.

The third challenge concerns current teaching materials, practices, pre-service and in-service teacher training programs. They need to be updated to capture the relevant body of cognition research of the past decade and up-to-date geography that focuses on environments and phenomena at different geographic scales (e.g., communities, ecosystems, nations). To adjust and improve teaching practice accordingly teachers need to understand that learning is a process of cognitive construction and development. The integrative concepts referred to as thinking tools that help organise perceptions and geographical knowledge (see chapter 3.3) offer a constructivist approach to teaching and learning that can easily be applied in the geography classroom.

The fourth challenge concerns the adoption of geospatial technologies in secondary education, which has proven difficult for many reasons, especially because of insufficient teacher knowledge regarding the implementation of technologies with classroom instruction. The use of new technologies is often limited to virtual globes or computers and beamers, which serve to illustrate teachers' explanations (Genevois & Jouneau-Sion, 2008), thus contributing to teacher-centred instruction. Bednarz & Ludwig (1997) report that although teaching with GIS and other visualization techniques becomes more common,

there is still a gap between the high growth of demand for people who dispose of skills in geospatial technology and the limited use of geospatial technologies during mandatory schooling. Recent research on the effects of teacher training in GIS revealed that nearly 40% of the teachers do not use GIS following the training session (Baker, Palmer, & Kerski, 2009). This minimal adoption is attributed to several, often-confounding factors that include (1) a lack of computer hardware and software requirements and limited access to data; (2) inadequate time to prepare lessons, inadequate time to become familiar with the software and the paucity of curriculum materials; (3) lack of motivation, reward and institutional support (Bednarz et al. 2003, p. 469).

The fifth challenge concerns the understanding of processes of globalization. Globalization is a revived topic in geographical education that has gained importance. Globalization is a wave of change that affects regional economies, societies, and cultures, and has spread through a global network of political ideas, communication, transportation, and trade. The process concerns the integration of national economies into the international economy through trade, foreign direct investment, capital flow, migration, the spread of technology, but also the transnational circulation of ideas, languages and popular culture. Most places and people on Earth are affected by the direct influence of other places and their residents, even if people are not aware of it. Many processes of change only recently became obvious. Influences providing evidence of global connectivity are apparent such as the movements of people, goods and information or the outsourcing of jobs; indirect influences concern for example the atmospheric transfer of carbon dioxide contributing to global climate change or the broadcast signals for satellite TV. In this area of globalization, education in geography needs to be broadened by including new knowledge and ideas as well as technical and social skills that are relevant to promoting social well being, balanced and sustainable development. Enhancing skills and mastery of technical knowledge based on advanced and current technologies such as GIS, RS and GPS are indispensable, but not sufficient. In order to be able to meet the demands of change the cultivation of skills in the field of humanity are equally essential. They concern the ability to communicate; self-reliance in learning; problem-solving and life-long learning; appreciation for ethical and moral values; creative, innovative and critical thinking; knowledge in managing projects; accountability towards society and the environment; and the ability to lead and form groups.

The sixth challenge arises out of the need for increased public scholarship in communities or regions to address the issues that commonly afflict the residents and the environment. For example, natural disasters not only require a response readiness but also are increasingly viewed as needing mitigation of impacts. Those mitigating activities are deeply dependent on education, and geographical education is a major contributor (Stoltman, Lidstone, & DeChano, 2004).

Preparing learners in geography to know about their local community, the relationship to the environment, and the consequences of certain environmental conditions goes a good way towards responding to natural disasters, but is not sufficient. Specific study and planning by pupils for home, school, and community mitigation actions and preparations are practical applications of geographic education. The frequencies of natural disasters that affect large populations cause increased social and economic costs. Education of both the learners in schools and general populations about living with and preparing for natural events plays an important role in geographic education (Stoltman, 2006, p. 34f.).

5. Future Directions

Geographical education benefits from its dynamic role at the junction where the natural, human, and technical challenges facing societies and the potential developments of the 21st century meet. This fact brings about a number of practical reasons for studying and knowing geography in the 21st century. Teaching pupils knowledge and skills related to the use of technologies that will determine our lives in the 21st century and be indispensable to mitigate or solve future problems is but one aim in geographical education. Another aim concerns the improvement of the educational process in the classroom itself. Future endeavours in geographical education require a theory-based development of learning environments fostering deep learning and understanding, reflecting the state-of-the-research knowledge in psychology, cognitive theory and geographical education of how children at various grade levels acquire, process, reason with, and learn geography. The effects of these learning environments are to be investigated by research to measure the success of geographical learning. Furthermore, such kinds of learning environments are to imbed in improved curricula that focus on in-depth learning and understanding rather than the accumulation of tacit knowledge. Additional requirements are sufficient teaching time, an appropriate infrastructure in schools that allows individualized and group learning, and an abundance in useful teaching materials (e.g. atlases, models, objects) and technological devices (e.g. computers, software). New educational practices can only be implemented through appropriate pre-service teacher preparation and in-service staff development provided by appropriate teacher training programmes.

Geography is one of the school disciplines, which offer the opportunity to address controversially discussed issues. Instead of tackling the challenge quite a number of teachers do not feel at ease with this opportunity. They hesitate to take these issues up because they could possibly point at very sensitive topics concerned with values, ethics, politics and otherness (Clerc, 2006; Tutiaux-

Guillon, 2006, 2008b). Along with the school subjects history, economics, citizenship education and the natural sciences, geography is nevertheless one of the disciplines that ought to tackle these issues, with a view to citizenship education, an educational field that is coherent with the general educational aims of the school system (Audigier, Fink, Freudiger, & Haeberli, 2011; Hertig, 2009, 2011; Legardez & Simonneaux, 2006; Thénard-Duvivier, 2008).

Geography in the 21st century will provide the intellectual and information basis for taking responsible environmental and spatial decisions but has also a central role to play in issues that concern environmental, social, economic and political ethics. The necessity to practice stewardship and sustainability on Earth will be an individual and community enterprises. The change towards sustainability at the beginning of the 21st century will become a global challenge since it is humanity's best option to restore, conserve, and use sustainable resources extracted from Earth's environment. We agree with Solem (2011) that geography's role in the 21st century will be to reclaim and conserve natural and cultural environments for the benefit of present and future generations. In order to achieve this, geographical education is indispensable.

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Glossary

Actors	: Term used in the present chapter for individuals, groups, firms, associations, bodies governed by public law, governments, etc. that take part in actions which have spatial impacts.
Citizenship education	: A school subject or subject area that aims at educating responsible citizens who make a positive contribution to society. It includes the teaching of knowledge on social, political and economic issues at national and international levels (e.g. democracy, justice, responsibilities, human rights, a state's relations with the wider world and so on).
Creative thinking tools	: New, unique, novel, unusual, divergent strategies of thinking for generating possible to potential ideas that may lead to successful solutions

	or resolutions of problems and challenges.
Environment	: The natural or constructed surroundings in which all living beings (plants, animals, humans) live and interact with each other on small to large scales.
Geographic education	: Term referring to the process of teaching geography in schools.
Geographic Information System (GIS)	: Computer file of geographic location data and their traits (e.g. ownership, climate, yield, family income and so on).
Geographic literacy (Geo-literacy)	: Ability to rationally consider and make reasoned decisions about the interconnections between human and physical systems and about the spatial patterns of interactions between human societies.
Geographical education	: Scientific discipline grounded in the domain of geography, which inquires into the conditions, principles, and methods of domain-specific teaching and learning.
Geography	: Scholarly discipline consisting of the three main sectors: physical geography, human geography and regional geography which form a closely interrelated system; as a science geography is concerned with the interactions of humans and the physical, social and cultural environment.
Geospatial technology	: Spatial information technology used for visualization, measurement, and analysis of features or phenomena that occur on Earth.
Global Positioning System (GPS)	: Device that determines localisation by triangulation from orbiting satellites.
Globalization	: The pervasive changes in the global economy and the global society brought about by new communication technologies and the time-space compression that results from there.
Human-environment-society interaction	: The geographical theme that deals with the mutual influence between humans, society and the environment.
Integrative concepts	: Thinking tools that dynamically interconnect factual knowledge, practical and cross-curricular skills.
Model of educational reconstruction	: A constructivist approach to teaching and learning that closely links (1) hermeneutical-analytical research on the science content structure and the educational significance of a topic to be taught, (2) empirical studies on pupils' understanding of this topic and (3) the construction of an appropriate learning environment to teach this topic.
Nature of Science (NoS)	: Consists of the realm and limits of science, its levels of uncertainty, its biases, its social aspects, and the reasons for its reliability.
Place	: The human and natural phenomena that give a location its unique character.
Remote Sensing (RS)	: Observation and measurement of the earth's surface using aerial and satellite photographs, thermal images, multispectral scanners and radar.
Space	: A multipurpose term used in geography that refers to a continuous unlimited area that may extend from local space up to the size of the global surface itself.
Spatial cognition	: Is concerned with the acquisition, organization, utilization, and revision of knowledge about spatial environments.
Spatial interactions	: Flows of people, goods, or information between places.

Spatial patterns	: Distinctive arrangement of features or objects in space.
Spatial thinking skills	: Knowledge, skills, and habits for using concepts of space, tools of representations, and processes of reasoning in order to structure problems, find answers, and express solutions.
Spatial	: Refers to distances, directions, areas, and other aspects of space.
Sustainable development	: Using the earth's natural resources to improve people's lives without diminishing the ability of the earth to support life today and in the future.
Territory	: Term used in the present chapter as a geographical, social and political concept. It refers to the concepts of environment, space and place, with an emphasis on the spatial actions of various actors.
Upward didactic transposition	: A constructivist approach to teaching and learning that begins with the deconstruction of a scientific concept / process / phenomenon in order to identify and select key elements that are pertinent for the learning process. Subsequently, the scientific issues in question are reconstructed from a didactic perspective of learning.

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Biographical Sketches

Dr. Sibylle Reinfried has a degree in geology, physics and chemistry and a PhD in mineralogy from the University of Heidelberg and a degree in geography and geographical education from the University of Zurich. She holds a professorship for geographical education at the University of Teacher Education Central Switzerland, Lucerne, where she is responsible for the initial teacher education and the in-service training of geography teachers in secondary schools. Prof. Reinfried is a distinguished expert in the development of teaching materials and learning environments for geographical education based on educational theories. In her research she is specialized in conceptual-change- and conceptual-development-research in geographical and geoscience education. She is a member of the steering committee of the Commission on Geographical Education of the International Geographical Union (IGU-CGE), a member of the board of the Swiss Association of Geographical Education (VGD-CH) and the extended board of the German Academic Association for Geographical Education (HGD).

Dr. Philippe Hertig has a degree in geography, geology and French literature from the University of Lausanne, where he also earned his PhD degree in geoscience and environment. He holds a professorship for geographical education at the Teacher Training University of the State of Vaud, Lausanne, Switzerland, where he is head of the Department of Human and Social Sciences (UER Didactiques des sciences humaines). Prof. Hertig co-authored two textbooks for geography for secondary schools, and served as the head of the board of reviewers of another textbook. The main focus of his research concerns the contributions of the social sciences to the education for sustainable development, the learning processes of complex subject matters, and educational and methodological approaches regarding the use of pictures and images in geography. He is a member of the board of the Swiss Association of Geographical Education (VGD-CH).

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