

Article

Sustainable Development in Geography Education for Middle School in China

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Abstract: Education for Sustainable Development (ESD) had become a priority in many school systems. Geography has a tradition of investigating human-environment interactions and geography education is vital in order to make sense of sustainable development (SD). In this paper, the authors aimed to contribute to the implementation of ESD and SD in middle school geography, in The People's Republic of China. This research employed a series of methods to analyze the content in (SD) in middle school geography standards and textbooks. The research surveyed geography teachers (n=237) and assessed geography students (n=246). Results exemplified both positive and negative conclusions from the data. Primarily, the findings suggested that geography education was important to ESD implementation, although the requirements for SD are low in Chinese middle schools. The SD content was reflected clearly in the content standards and textbooks, but it was not evenly distributed in geography education. Many geography teachers in China have ample geography and interdisciplinary knowledge and they can use textbooks and other teaching methods to teach SD. The students' performance, in a sample of four key schools, was considered "OK", however there was still room for improvement. Most students were familiar with people, resources, environmental problems and climate change, however most were unable to grasp the factual knowledge about SD, such as international events and documents, latest predicted data and research on global warming, as well as the indicators used in the specific SD assessment. Suggestions include providing students with more practical activities and a chance to do hands-on experiments, as well as building student organizations and clubs; improve Teachers' knowledge and understanding through teacher training program and build a platform for communicating ideas of SD through modern communication technology. Ideas of SD should be integrated into students' daily life.

Keywords: sustainable development; geography education; implementation; China

1. Introduction

China, as the world's most populous state, has achieved steady and rapid economic development. From an educational standpoint, China is currently faced with a series of major challenges that have potential to slow this rapid economic growth. Geography education in China, has been a mandatory subject in school as it inspires student response to challenges, and it introduces the students to worldwide perspectives. Since 1904, Geography has been a part of the curriculum in elementary and middle school education in China. The basic education curriculum, in China, has experienced eight waves of change since the founding of the new China in 1949[1]. At

present in China, the specific content focus on geography begins in middle school when students participate in their first specialized Geography course. As an obligatory course in middle school, geography can be studied as a stand-alone subject or as part of an integrated approach for Grade 7 and Grade 8. When study of geography is subject specific, such as a specific geographical region, there are usually two classes every week for approximately ninety minutes. Geography education is high-stakes, especially in high school; where college entrance examinations are required. In short, all Chinese students are required to study geography to successfully complete the required state exams. In all, the above reasons broadly illustrate why geography in China has potential to support Education for Sustainable Development (ESD).

The author's primary goal in this research was to analyze and assess the situation and implementation for ESD in geography education for middle school in China. Assessing the progress and implementation of Sustainable Development (SD) and Educational Sustainable Development (ESD) was one of the objectives in 2012 United Nation Conference on Sustainable Development [2].

Guiding Research Questions

This research was guided by four questions, they were:

How do geography standards and textbooks reflect the SD content in China?

What challenges face the practice of SD in Chinese geography education?

What are some ways to improve SD in Chinese geography education?

2. Literature Review

The concept of SD was first formulated at the 1972 United National Conference on the Human Environment in Stockholm, Sweden. According to Brundtland Report [3], modern concepts of SD, met the needs of the present without compromising the ability of future generations to meet their own needs. Although the term SD is used widely by educators, economists and politicians, it is often interpreted differently by independent interest groups [4].

In 1994, China's Agenda 21 makes China the first country in the world to formulate a national-level SD plan. China's Agenda 21, emphasized geography, as an important discipline related to supporting SD [5]. In Chapter 6, this report illustrated "content regarding resources, ecology, environment and sustainable development should be integrated into "nature" of elementary school, "geography" in the secondary school and other courses." [5]

ESD enables students to develop the knowledge, values and skills needed to influence and understand decisions regarding the way we do things individually and collectively [6]. ESD also enables both local and global entities, that will improve quality of life without damaging the planet for the future [6]. ESD can impact student learning outcomes in terms of their sustainability consciousness. [7] The purpose of ESD is to support the younger generation in acquiring the knowledge, skills, attitudes and values necessary to shape a more sustainable future [8,9].

ESD seems to have been insufficiently implemented in secondary science education in many countries in general due to lack of suitable experiments, coupled with missing teaching and learning materials and insufficient teacher professional development [10]. Geography as a discipline has an important role in teaching SD [11,12]. While notions of people and the environment have long been associated with school geography [13,14], an explicit remittance for geography educators to teach about SD is more recent [15,16].

School geography provides a suitable context for exploring pupil's experiences of ESD. In China, there has been some research into the relationship between geography and ESD. Through the holistic analyzation of the geography curriculum, many researchers argue that geography, with specific and decisive content regarding SD in schooling, is a core subject in middle schools. Implementing SD into geography helps provide students with a better understanding of the importance of the topic. Some teachers only instruct on the part of textbook that explains the ideas of SD [17]. Some teachers suggest employing three teaching strategies, including; inquiry-based

learning, experience-based learning and practice-based learning [18]. Wang has been analyzing the literature regarding geography teaching and SD since 2001. Wang investigated content about SD in the geography textbooks, the evaluation of SD, and the environmental literacy of geography teachers. He concluded that there is still much need for improvement [19]. There are no systematic or comprehensive analyzations regarding SD content in the geography textbooks.

There are increasing expectations put on young people to acquire the ability to engage with the concepts of SD. This engagement is highly relevant to individual life experience [20]. However, there still appears to be relative scarcity in published research regarding the implementation of SD in middle school, as well as the aim of exploring school students' understandings of sustainability [21].

Corney and Reid [22], Chalkley, Blumhof, and Ragnarsdóttir [23] highlighted the widespread recognition of the major contributions of geography teaching in ESD, specifically within England. Perhaps more importantly, these authors highlighted pedagogy that is often characterized by geographical inquiry [24,25]. In turn they concluded that based on constructivist approaches to learning students acted as dynamic co-constructors rather than passive recipients of knowledge within and outside the classroom [22].

There are a number of pedagogic approaches or research for ESD in Higher Education. A list of strategies which include; developing teachers' competencies models [26], integrating existing ESD theoretical frameworks into teacher education curriculum [27], role playing and simulation activities, group discussions [28], and stimulus activities (such as watching a video or looking at poetry to initiate reflection or discussion: e.g.[29], debates, use of case studies, critical reading and writing [30], problem-based learning and fieldwork) [4].

3. Materials and Methods

This research applied a range of assessment techniques to illustrate a detailed perspective of SD in geography education within The Peoples Republic of China: The method design consisted of three phases.

Phase 1—analysis of the geography standards and textbooks

Standards and textbooks are the primary source for the learning of subject knowledge and understanding which pupils need to develop during their schooling [31]. The authors primarily analyzed the Geography Curriculum Standards for Compulsory Education, published by the Chinese Ministry of Education in 2011. As well as Geography Textbooks in Grade 7 and Grade 8 which were published by People's Education Press in 2012.

In order to gain a holistic view of the distribution of ideas regarding SD in geography education in middle school, the authors employed content analysis. Ten categories of SD were designed to analyze the standards and textbooks. The ten categories of SD were designed according to the "Lucerne Declaration on geography education for sustainable development." [32] The ten categorizes were 1) place in textbooks, 2) fundamental ideals, 3) international documents, 4) instruments of interstate regulation, 5) indicators, 6) fundamental issues, 7) theoretical knowledge, 8) empirical knowledge, 9) aspects of education, and 10) methods and approaches on geographical education for sustainable development. (See Appendix A)

In each category, the authors list aspects of SD and ESD that are reflected within the instruction of Chinese middle school geography. For example, fundamental ideas (Category #2) have twenty aspects (see Fig.1).

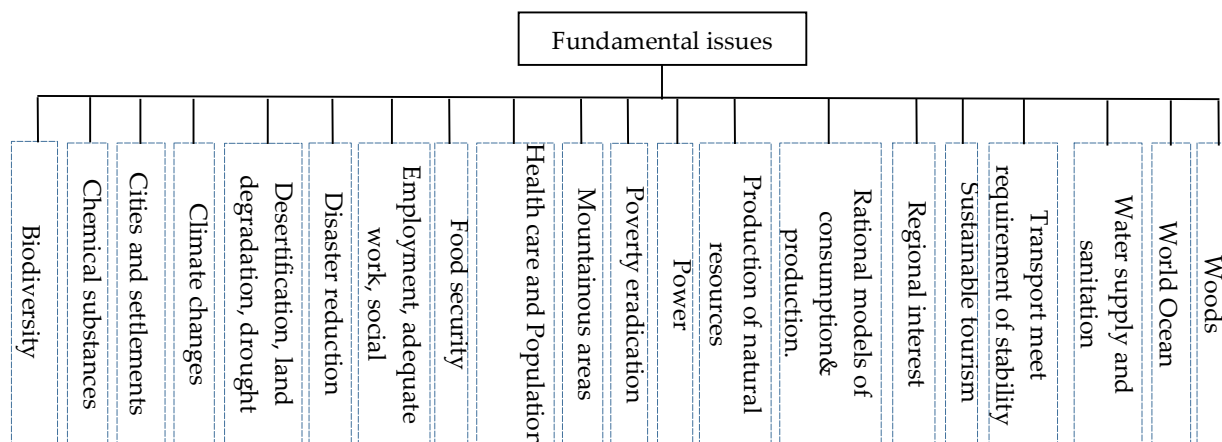


Figure 1. The framework of fundamental issues

Phase2—Survey the geography teachers using questionnaire and interview

The research employed an online survey of geography teachers in 29 provinces through an online network community called a QQ group. Data were collected in the QQ group by means of a questionnaire. The questionnaire employed a standardized format designed to gather information about the opinions and behaviors of individuals [33].

Specifically, the questionnaire gathered information regarding teachers' backgrounds, teachers understanding of standards and textbooks, teaching methods, and teacher suggestions. A pilot study employing a sample of 10 teachers, was used to ensure clarity and readability of the survey questions and employ face validity to the research instrument [34]. Comments and feedback from the participants led to modifications of the wording within the questionnaire. The questions decreased from 22 to 19 items, to simplify the process for the teachers(See appendix B). For example, participants were asked to state their extent of agreement using a 4-point Likert-type scale, ranging from 1 (strongly disagree) to 4 (strongly agree).

When the teacher finish questionnaire, they will say "I am done" in the QQ group. The authors will check the questionnaire and talk them mainly with the last question (See appendix B) online through QQ (Similar to Skype). That make the authors more information in detail.

The 19-item questionnaire was administered to the geography teachers (n=237). Most teachers had more than six years teaching experience and had a bachelor's degree in geography or a similar discipline. The authors implemented this questionnaire as a random sample survey of geography teachers. Geography teachers were free to take part in survey. The authors primarily employed descriptive analysis for the data statistics.

Phase3—testing the sustainable development capability of students in four middle schools

The research in Phase 3 tested students. The 24-short answer questions and 1 multiple-choice question, originally developed by Olga Khlebsova [35], was used in five distinct items (See appendix C). Each item was given scores from 1 to 6. The total score of 25 items is 100. The test was mailed to the geography teachers, and then teachers employed the techniques and returned the questionnaires.

Based on the test, the authors divided the scores into four levels, 0-17, 18-50, 51—80, 81-100. The students who scored more than 18 earned a passing score, those who scored higher than 81 were considered very good.

246 students from four middle schools were examined for approximately forty minutes. These selected schools were the top schools throughout all school districts in the selected regions. Therefore, most of the students have proven themselves to be outstanding among their peers.

There were 140 students from Shanghai, including 20 students from Middle School A, 30 students from Middle School B, and 90 students from Middle School C. There were 106 students

from Middle D in Hebei province which is also top high school in Qinhuangdao. The average age of the participants was 16, and students ranged in age from 14 to 19-year-olds. The student population sample contained slightly more girls (62.6%) than boys (37.4%). Therefore, incomplete surveys were not removed from the data set. This method was useful for the reflection of the holistic levels of students' understanding of SD.

For the data analysis, the authors employed a difficulty analysis, discrimination analysis and descriptive statistics table.

4. Findings

4.1. Sustainable development of geography standards and textbooks

In this part, the authors present the findings in terms of categories (see appendix A) and specific content analysis. Overall, the content analysis partially met the needs of the international documents for SD in terms of the ten categorizes of SD (previously described above). Category 1 clearly reflected in the content of the geography standards for middle schools in China. In China, geography standards are a source for guidance in the compiled textbooks of; geography teaching, learning, and evaluation. In the 33-page geography standards for middle schools, there are nearly 60 sentences of content standards related to SD.

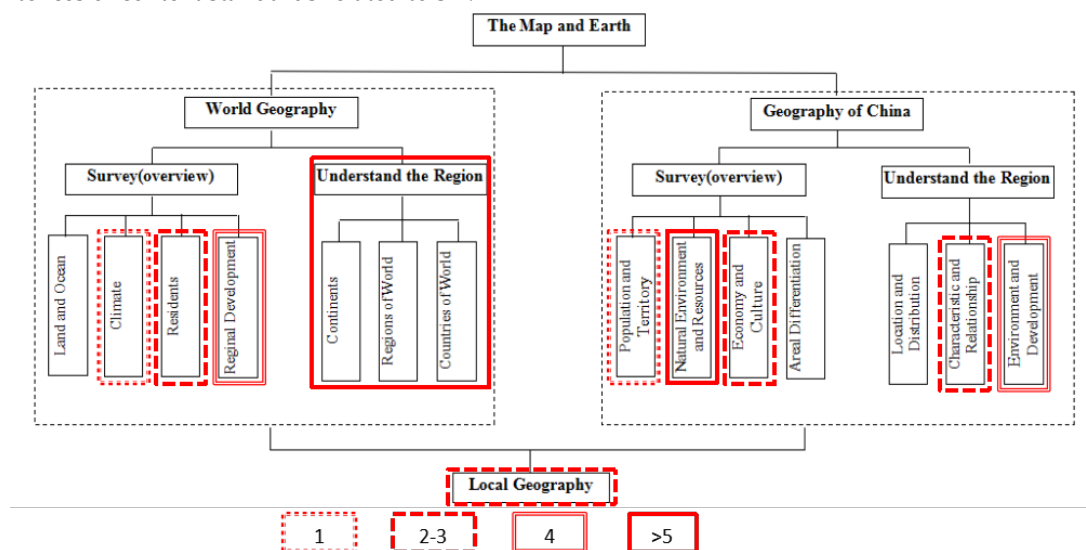


Figure 2. The number of standards regarding SD in each topic of middle school

The content regarding SD were not evenly distributed within the geography standards. “As you can see from figure 2, different lines indicated the number of standards regarding SD within each topic. The content standards for China follow a grade-to-grade progression with 100 specific geographic content standards as addressed in Chinese middle schools [1,36].” The content analysis findings related to SD for the geography standards are summarized in Figure 2: “Understand the Region” and “Natural Environment and Resources.” This includes more than the five content standards related to SD. That being said, “Regional Development” and “Environment and Development” have four standards regarding SD. However, there are no content standards related to SD in “Land and Ocean”, “Areal Differentiation” or “Location and Distribution”.

In China, the textbooks are nearly identical to the standards. This is especially true for the first semester textbooks in Grade 7 and Grade 8. The other two textbooks are World Geography and Geography of China. These textbooks investigated several regions in China to meet the requirement of “Understand the region” in geography standards.

In China, Geography textbooks have specific content standards related to SD; nearly 90 pages. In addition, these content standards are closely related to SD in four geography textbooks. There is more SD content in Grade 8, which focuses on Geography of China. From the topic of global scale,

ESD content in geography is mainly elaborated in Sub-Saharan Africa, Brazil, India, Southeast Asia, and Australia. From the geography of China, SD is most related with physical resources and the physical environment in China. From perspective of sub-region, ESD in geography in China focused on ecological and environment regions; such as the Loess plateau, in Sanjiangyuan.

SD is one of the objectives within geography education. In the geography standards, the Ministry of Education of the People's Republic of China, reported that "knowing the environment and development issues, enhanced the patriotic emotion, develop preliminarily global consciousness and ideas of SD and is part of the general objective.[36]" SD in Geography mainly focuses on issues of environment and development, highlighted the process of geographical thinking and solutions of geographic questions, and cultivated the scientific development view of the man-earth relationship. There were many key ideas of SD mentioned in the textbooks and the standards. These include; cherish and save physical resources, the concept of adopting measures suiting local conditions, harmonious world and harmony between man and earth, Ecological civilization, and scientific development etc.

In categories 3, 4, 5, 7, & 10 the content regarding theoretical knowledge, international documents, instrument of interstate regulation, indicators, and methods and approach of SD were all inadequate. For example, the content does not address theoretical knowledge, doctrines or theories, regularities, or hypotheses within these geography textbooks. There is only a brief mention of a few related SD concepts; such as tree planting and grass growing, returning arable land into forest, social and economic development, returning farmland to lake, ecological benefits, environmental benefits, and economic benefits. Furthermore, there were many international documents about SD that were not found in the geography textbooks. These textbooks only mentioned a Convention Concerning the Protection of the World Cultural and Natural Heritage (1972); a convention on the global ban of whaling (1986), the Antarctic Treaty (1959), and the Arctic Environmental Protection Strategy (1991).

Although cartographical methods, statistical methods, comparative and geographic methods were used to present SD, geographical modeling and forecasting, geospatial technologies, environmental approaches and interdisciplinary approaches were not mentioned in the textbooks.

For categories 6, 8, & 9, the content about SD in geography education is still in need of revision, although the fundamental, empirical knowledge and aspects of education, have illustrated many positive characteristics. The textbooks use facts, figures, and examples of countries to illustrate empirical knowledge. Many aspects of education are important for geography as well as SD, such as risks and prevention. Furthermore, nearly all the fundamental issues, found in standard 6 (see Figure 1, same as the table A6 in appendix A), were integrated into geography textbooks. This is true, except for poverty eradication, food security, employment, decent work, social protection and chemical substance education.

In a deeper analysis, the authors identified additional thought-provoking findings as well. The following thought-provoking findings are described below:

First, the requirements of SD are low for middle school students in China. In most cases the content that is associated with SD is brief. For example, the standards state the importance of illustrating the experience and lessons of a country's natural resource development and environmental protection [36]. The textbook, on the other hand, provides an introduction regarding the mining industry in Australia. Only in the "Reading Material" does the textbook focus on SD. The text implies that "Australians pay more attention to environmental protection during mining, and this shift towards ESD has formed a culture of the human-environment integrated relationship."

Second, through analysis of textbook pages which have SD content, there are 26 themes regarding SD presented in the textbook. Figure 3 illustrates SD content regarding agriculture, water resources, inequality and cooperation. For example, the content regarding agriculture included agriculture development according to the local conditions, as well as employing science and technology. The content that related to inequality and cooperation included developmental differences as well as inequality between developing and developed countries.

In addition, some topics, such as Management and Protection of the Yangtze River, the Yellow River, natural resources, land resources, exploitation and protection of tropical rain forests, wetlands, population problems (India, China), earthquake warnings and prevention (Japan and China), drought, and gas (west-east gas pipeline), were given more attention within textbooks.

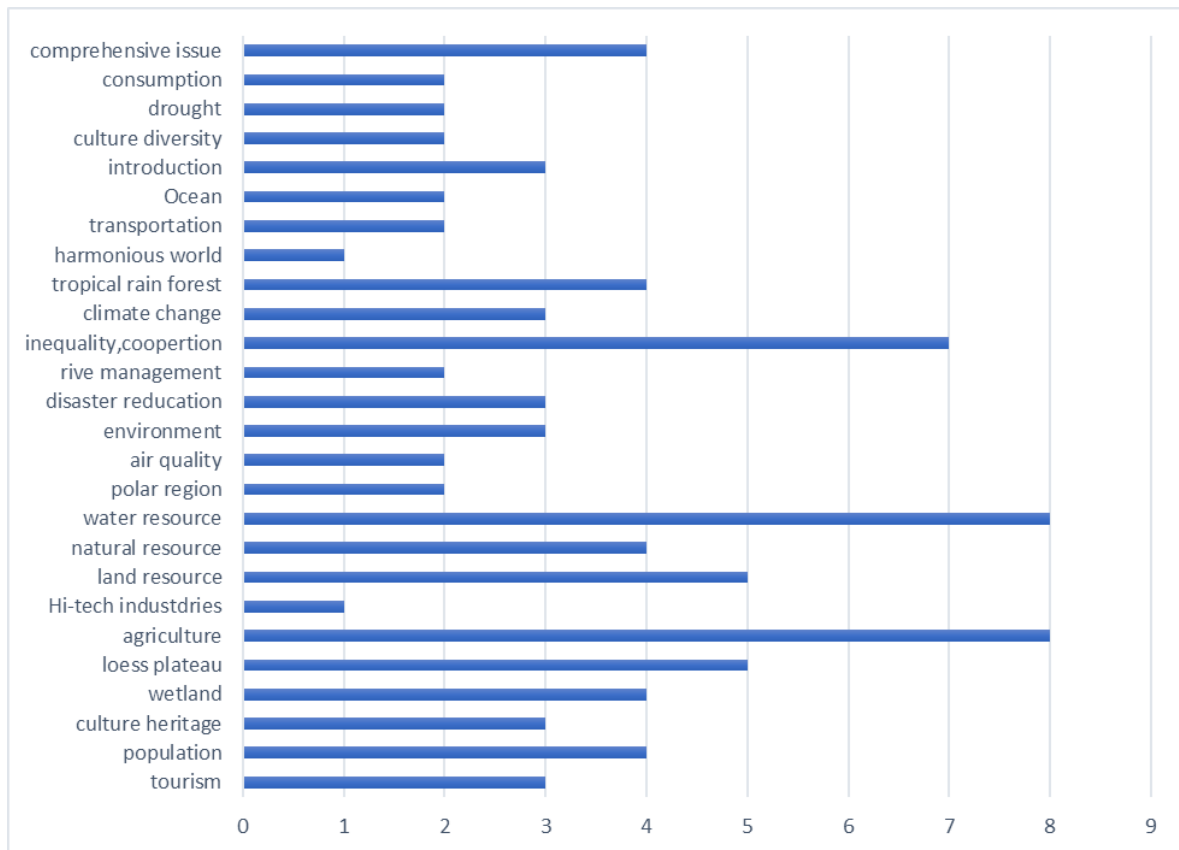


Figure 3. Themes and pages which have SD contents in geography textbook

Third, most content related to SD is presented as an activity. This content was not simply narrated with factual information, within the geography textbooks. The textbooks provided many ways to teach SD, such as role playing, seminars, giving speeches and so on. For example, when examining Southeast Asia, the textbook provided the activity “Organize the seminar based on the topic of eating less instant noodles, and you will be helping in protecting the environment.”[37]

The textbooks [38] presented the activity regarding land resource as follows, this interesting activity was used to cultivate students’ awareness of SD by role playing. For example, there is Activity “Understanding our national land policy” in the geography textbook.

Understand our national land policy[38]

Basic national policies offer suggestions to rational utilization and protection of land combined with national conditions clarifies understanding within SD.

“land specialist clinic”

If you are a “land doctor”, please make a “effective prescription” for land.

Table 1. The prescription for Arable land

"Arable land" clinic	
"diagnose"	"prescription"
1.excessive deforestation	.
2.Deforest and reclamation	.
3.Serious soil erosion	.

Table 2. The prescription for Construction land

"Construction land" clinic	
"diagnose"	"prescription"
1.pell-mell development	.
2.extensive management	.

"the planning of land expert"

If you are a "land planner", you are to implement measures of reasonable utilization and protection against land which is difficult to use, such as deserts, high mountains.

Dessert and Gobi,

Snow Mountain

Cold dessert

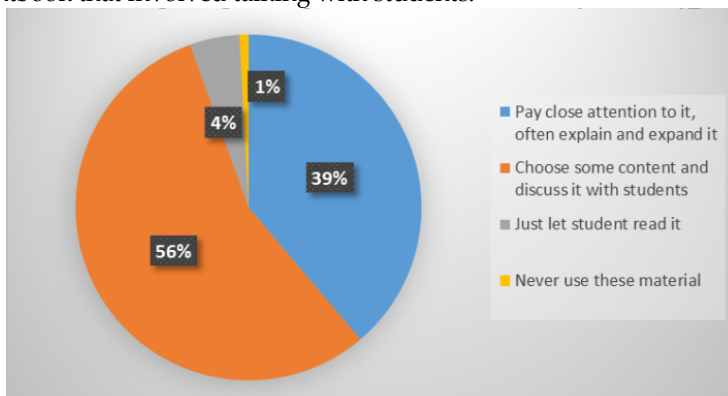
Rocky Mountains

June 25th is the day of "land conduct propaganda" in China. If you are a volunteer, please find the topic of this year and advertise to the public around you.

4.2. Teachers' viewpoint and student's Sustainable Development capability.

Teacher opinions are one of the aspects of SD in the standards, programs, textbooks, and methodical recommendations. First, the findings suggested that most geography teachers surveyed have ample knowledge and ability to teach SD. Eighty-seven percent of the geography teachers who participated in the research, believed that the geography standards explicitly stated the SD content. Only about one and a half percent of the teachers did not explicitly identify the content regarding SD. This was true with both the standards and in textbooks. Ninety-eight percent of geography teachers who participated in the research, believed that students develop ideas of SD when they are involved in preparing SD lessons. Ninety-four percent of teachers, who participated in this research, could apply interdisciplinary knowledge required to implement SD standards into their curriculum.

Second, the geography teachers used the Activities and Reading Material in the textbooks, and extended the content based on the standards. Teachers' experience is very important. An experienced teacher can help students better articulate the concept of SD. Although eighteen percent of geography teachers never used the Activities and Reading Material, due to limited class time, half of the participants often completed the Activities based in the textbooks. As illustrated in the figure 4. More than half of the geography teachers, who participated in the research, choose content in the textbook that involved talking with students.

**Figure 4.** How to use Activities and Reading Material in textbook

Third, teachers with more than 10 years' experience were able to organize freely and teach the required content (Fig. 5). These teachers didn't, completely follow the textbooks and standards, but they were able to explain the key content at length to their students. This was accomplished through choice and the implementation of their own unique teaching styles. It was also discovered that only about four percent of the participants completely followed the standards and textbooks when teaching SD.

Finally, as is shown in figure 5, the research found that there may be a correlation between teaching ability for SD and teaching age. Among the groups of student's ages 6-10 and 11-20, employed more than twenty teaching groups. The teaching ability increased with years of experience. However, the authors were unable to determine why there was a high proportion in the 0-5 teaching age group. In the interviews, the authors concluded that many new geography teachers were able to use multi-media and website resources. They wanted to teach everything about every topic, but students' results were not as positive. Therefore, young teachers do understand student' learning levels, and how to teach up to ten years later. For example, one questions was; which knowledge should be supplemented when teaching new courses?

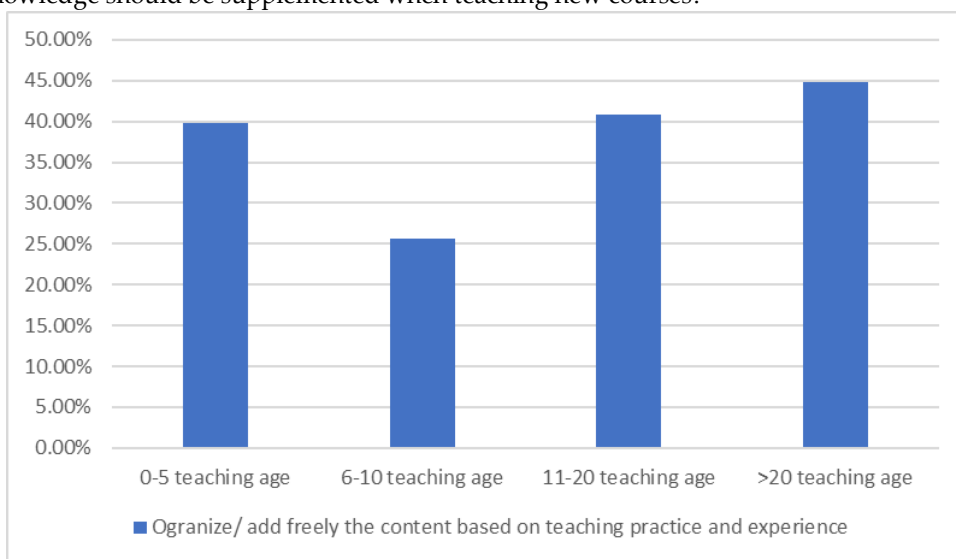


Figure 5. Ratio of teachers who can organize/add freely to the SD content based on their teaching practice and experience

Teaching methods and case studies were the most popular method in implementing SD. As shown in the Figure 6, geography teachers adopted various methods for this implementation. In the interviews, some teachers said they organized student debating contests or presented videos related to SD, and then let the students narrate and talk about their experience.

Challenges for SD in Geography

There remain challenges for SD in geography, for example formalism in the implementation of SD in geography teaching and lack of systematic SD knowledge by teachers, are issues that need to be addressed. Many challenges can be seen in the questionnaire and interviews. For example,

Participant 20 said "teaching resources are not enough, and content about SD is unclear, the students are not interested in old material"; Participant 217 said " Learning and life is out of touch, while talking about Sustainable lifestyle , students still use disposable chopsticks."

Finally, the survey option of "studying new and effective ideas of SD" is shown to be the most effective way to improve teachers' teaching abilities. Nearly thirty percent of the participants (Figure 7) selected this option. Twenty-nine percent of participants illustrated that geographic information technology and other information communication technology is also an important way to improve teaching ability about SD. In addition, the research found that teacher education and peer communication are also considered effective. There are also other suggestions, for example, geography teachers should increase their study efforts in regards to the curriculum standards and

textbooks. The teachers should contribute more effort in reading related material regarding SD and interdisciplinary SD teaching.

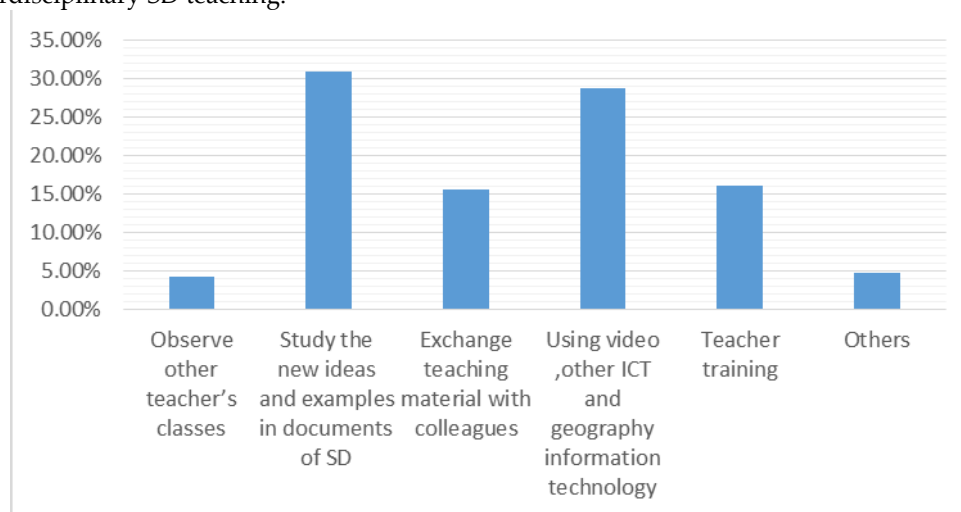


Figure 7. Effective ways for teacher's SD capability

4.3. Students' sustainable development capability in the middle school

The test results illustrated student's performance as currently being "OK." The results also illustrated that students did have a basic conception of SD, however there is still room for improvement. Eighty-three percent of the respondents earned a passing score, twenty-eight percent of which were considered "good." The highest score was 74, and the lowest score was 0. The difficulty index of the test was 0.38; which means the examination was not easy for the students.

The authors employed the Person Correlation to compare the results for each question as well as the total score. Most items were worth more than 0.4. This means the discernment of questions were very good (see table 3). However item 1.1 and item 2.4 are lower than 0.2, therefore, the discernment of questions was not considered good. One potential reason for these lower scores may be related to the inability to sort the instability factors which influence SD (see the item 1.1 in figure 8). In item 2.4, the difficulty index may be higher than it should be (see item 2.4 in figure 8). Most students didn't know the exact temperature rise or the sea-level rise caused by climate change, at the end of 21 Century.

Many students hold the misconception that global warming is the primary cause for all of global change. To describe in more detail, students could not understand the impact of several factors regarding the world's instability. For example, in item 1.1, about five percent of the students were able to sort the factors correctly. Around nineteen percent of the students knew that natural factors and human factors were the most important factors that affected the world's instability. Some students had a dialectical view on the relationship between social economic development and ecological environment. For example, participant 88 reported: "the initial development of the social economy depends on nature. After industrialization, economic development, has caused more and more ecological problems. The development of world politics affects the development of economy."

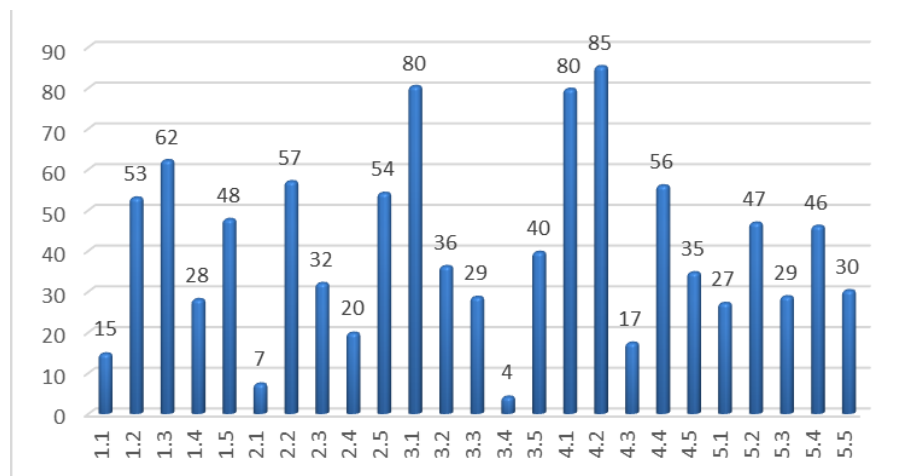


Figure 8. The difficulty index of all the items

First, more than eighty percent of students correctly identified an SD indicator and listed the SD problems from local to global in terms of scale (see Item 3.1, 4.1 and 4.2 in figure 8). However, only slightly more than half of the students could explain the global problem more clearly (see 4.4 in figure 8). Although most of the students couldn't fully and reasonably explain the problem, some students gave more interesting answers in item 4.4. Item 4.4 states: Give a short description of a global problem using the following questions: 1) What are the basic causes? 2) Is it typical of your country? 3) Can it be solved and how? (Both locally and globally) For example:

Participant 65: "1) Issues 17, save forest; this is caused by the pursuit of economic growth, and deforestation. 2) This is a typical problem in China. 3) From the perspective of the world, the United Nations should formulate laws and regulations to restrain countries from over foresting. In addition, our country should make laws and regulations and strictly supervise the implementation of these laws and regulations."

Second, most students were familiar with people, resources, environmental problems and climate change, however many of the participants could still benefit from improvement in their knowledge of SD. In the test, more than half of the students answered correctly for items 1.2, 1.3 and 2.2, 2.5 (see figure 8). Item 1.2 is about population, and most students were able to provide the correct answer ("uneven distribution of wealth inside the country, poverty"). Many of the students were able to write "overpopulation and/or migration." In addition many of the students were able to supplement other correct answers such as "population growth, low population quality, gender ratio imbalance, and aging." According to item 2.2 and item 2.5, students believed that climate change could cause a lot of problems. For example,

Participant 162 reported: "the change of grain output may be the cause for food shortage. As well as a lot of climate refugees seeking shelter from El Niño and extreme weather events. However, when asked about the causes of climate change, most of students were only able to identify two factors. One individual indicated: increasing amounts of greenhouse gases and deforestation. None of the students answered with the following statement: "increasing the amount of atmospheric aerosols;" This could be due to the fact that the standards and textbooks did not address these issues.

Third, most students were unable to grasp the factual knowledge about SD, such as international events and documents, and the examples of indicators used to assess additional aspects of SD. As shown in figure 8, the difficulty index of item 3.4 and 2.1 was less than ten percent. This inferred that less than ten participants in one hundred, indicated the correct answers for these items. Item 3.4 describes the example of SD indicators, which is the lowest score in the questionnaire, having an average score of 0.21, (see table 4). The total score is 5. Although the students scored highest in item 3.1 (identify the main SD indicator), most of the students left Item 3.4 blank. Perhaps the students did not know the specific indicators (coefficients, indexes) to assess SD. Some of the students simply used words in order to explain the various indicators or they provided a vague

answer; such as Engel coefficient, CPI, Green GDP and ecological footprint. For item 2.1, there were 213 student participants that knew nothing of the international documents regarding SD (published in 1992, 2002 and 2012). Several students were able to write other documents, such as Kyoto Protocol and Copenhagen Accord. It should be noted that none of students were able to complete all the information correctly.

Table 4. The Descriptive statistics of Item 3.4

ITEM	N	Minimum	Maximum	Mean	Std. Deviation	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
3.4	246	0	3	.21	.035	.553
Valid N (listwise)	246					

5. Discussion

As above mentioned, ideas of SD were identified in geography standards and textbooks, however the implementation was not optimal. This is primarily due to the fact that geography has not paid enough attention to the subject areas of the high school entrance exams. The research illustrates the importance for students to understand the significance of SD. Furthermore, the content regarding SD were not specific. This made teachers and students think abstractly, however they rarely talked about it. In the author's opinion, geography standards, and geography textbooks should pay more attention to SD issues. A geography teacher should expand more knowledge about SD for a deeper level of learning.

The authors have identified several suggestions to improve the quality of SD in geography education.

First, in the lead author's opinion, the most appropriate content and the most appropriate resources of SD were not integrated well into the geography curriculum. Many global and/or local problems could be better guided from geographic perspectives. For example: "Where is it? What is it like? Why is it there? How did it happen? What impact does it have? How should it be managed for the mutual benefit of humanity and the natural environment?"[39]. Per reports and documents in China and other countries, we can update the content about SD. This is especially true in terms of multimedia resources, which were highly supported by teachers within the survey. In addition, it may be a good idea to develop a school-based curriculum about SD which would complement the standards and textbooks. This informational knowledge can be added into the man-nature's short history about SD which is meaningful. Or independent chapters about SD can be developed in the geography textbooks.

Second, many teachers in the survey believed that the best way of teaching was to provide students with more practical activities and a chance to participate in hands-on experiments, as well as building student organizations and clubs. For example teacher (X) said "Students can get close to nature, experience life and develop new ideas of SD, or, teachers can collaborate with other teachers to organize visits to a museum. Collaboration can lead to increased value in field work learning. By participating in these practice activities, students are able to realize that human beings are not the master of nature, but are simply a part of nature. Humans should not only learn to respect nature and reverence for life, but also should have morality and responsibility of protecting and improving environment.

Third, develop SD training programs for geography teachers. Every geography teachers' knowledge and understanding is immensely important to their success as an educator. As shown in Figure 7, over fifteen percent of the teachers (who participated in this research) needed additional training. Therefore, teacher education, supporting new teachers and career professional development activities are an excellent basis for providing high-quality education in SD.

Forth, building a platform for communicating ideas of SD in different ways, especially modern communication technology. For example, WeChat in China is a popular social software with more than one-billion users. This social organization, along with the teachers, can create Official Regulations that infuse the ideas of SD into geography curriculum. The SD content should be interesting with less text, and more exciting videos from scientific sources; such as Chinese National Geography, National Geographic, research report, etc..... Mobile apps and computer games are also useful ways to educate the worldwide population on SD. Modern technologies have changed both student populations and overall education dramatically. Today's students are no longer the people our educational system was designed to teach [40]. Inventing and improving educational video games will be a progressive way to improve students' ideas of SD.

Lastly, ideas of SD should be integrated into students' daily life. Most of the time a student's lifetime is spent outside of the classroom. Ideas of SD can be integrated into daily life in more discrete ways. TV, canteen, public transportation services are excellent methods in exerting a subtle influence on people's behavior.

Developing public advertising by internet, radio, television or in public places will be useful in building awareness of SD. The content is based on the sorts of social, economic, environmental issues faced both locally and globally. For example, green commuting, endangered species, and water pollution are directly related and highly important to SD.

6. Conclusions

This research has identified two major concerns. The first concern is that the standards, especially in Chinese middle school textbooks, may lack sound content and knowledge of SD. This is the case in China and it seems reasonable to assume that this may be a problem in other countries. The second concern is that ESD in geography has a problem of formalism, in the form of doctrine. Teachers lack systematic knowledge and support within the implementation of SD. Students know little about international efforts and statistics for SD, and students' SD capabilities need to improve because the results of test were not positive

The basic knowledge and theories regarding SD, such as fundamental ideals, basic documents, indicators, theoretical knowledge, and empirical knowledge for SD were not mentioned in the textbooks. The contents associated with SD were brief and were only mentioned in Activities and Reading Material of the textbook, which may be neglected by teachers and students. In addition, due to lack of appropriate assessment about SD, the school leaders and teachers paid little to no attention to the instruction of SD. These concerns raised questions about young student's knowledge of SD. It is important to note that schooling empowers students to develop their best understanding to be informed members of their local, national, and international communities.

This research analyzed the geographical knowledge and content which contributed to SD in geography standards and textbooks of China. The research inquired as to how geography teachers fostered students' SD abilities and assessed 16-year-old students with a test. Regarding problems with the implementation, the authors attempted to provide some suggestions and recommendations to improve SD in geography in accordance with the realities of life in China. The recommendations were given to the Geography Teaching Professional Commission of Chinese Society of Education, and The panel for geography standards revision. More importantly, this research reinforced the need for more complete and deeper research into the breadth, depth and prospective of primary teachers' knowledge and understanding. The next step will be to continue researching geography teacher education in the field of SD, as well as supporting career and professional development. All of which are the basis for providing the high-quality education for geography students.

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Appendix A

Analysis of sustainable development contents in geography school course

Table A1. Position of ideas of sustainable development in the content of geography school course

The main units of the content of geography school courses (middle school)	Issues of the unit connected with the ideas of sustainable development	Basic content

Table A2. Fundamental ideas of sustainable development

Fundamental ideas	Detailed content	Sections of the content of geography school courses
The Earth is the home of humanity, we have to take care of it together		
The Earth is given to us and to the future generations, we have to be responsible for the use and enhancement of its riches		
Sustainable development is based on balance of economic, ecological and social interests of society		
Sustainable development is the only strategy which makes survival of humanity on Earth possible		
...		

Table A3. Basic documents on sustainable development in the content of geography school courses (middle school)

List of documents	Detailed content	Sections of the content of geography school courses
World strategy of nature conservation (Ashgabat, 1979)		
World charter of nature (1982)		

Rio declaration on environment and development, Action program. The agenda for the XXI century, Convention on biodiversity (1992, Rio de Janeiro)		
Political declaration on sustainable development, Plan of implementation of solutions of the World summit for sustainable development (2002, Johannesburg)		
The future we want (2012, Rio de Janeiro)		
...		

Table A4. Instruments of interstate regulation for sustainable development

Instruments of interstate regulation	Detailed content	Sections of the content of geography school courses
1. Implementation of international investments and credits (the largest creditors – the World bank, the International bank of reconstruction and development, the International Monetary Fund submit to recommendations of the UN)		
2. Economic and political isolation of the state (caused by the introduction of restrictive conditions of the World Trade Organization before the economic blockade of the state by the UN)		
3. Target financial, intellectual and innovative support (grants, new technologies, patents, consultations of experts)		
4. Obligatory ratification of Contracts and Conventions		
5. Control through the special Commissions and remotely		
...		

Table A5. Indicators of sustainable development

Indicators	Detailed content	Sections of the content of geography school
1. Social		
2. Ecological		
3. Economic		
4. Institutional		

Table A6. Fundamental issues / subjects / problems

Fundamental issues / subjects of a sustainable development	Sections of the content of geography school courses	Detailed content
1. Poverty eradication		
2. Food security		
3. Water supply and sanitation		
4. Power		
5. Sustainable tourism		
6. Transport meeting the requirements of stability		
7. Cities and settlements meeting the requirements of stability		
8. Health care and population		
9. Employment, adequate work, social protection		
10. World Ocean		
11. Regional interests (small island developing states; least developed countries; developing countries which don't have an outlet to the sea; Africa; regional efforts)		
12. Disaster reduction		
13. Climate change		
14. Woods		
15. Biodiversity		
16. Desertification, degradation of lands, drought		
17. Mountainous areas		
18. Chemical substances		
19. Rational models of consumption and production		
20. Production of natural resources		

Table A7. Theoretical knowledge of sustainable development

Theoretical knowledge	Detailed content	Sections of the content of geography school
1. Doctrines, theories, regularities		
2. Hypotheses		
3. Concepts		

Table A8. Empirical knowledge of sustainable development

Empirical knowledge	Detailed content	Sections of the content of geography school
1. Facts		

2. Figures		
3. Examples of the countries, cities, regions		
...		

Table A9. Aspects of education, important for geography and for sustainable development

Aspects	Detailed content	Sections of the content of geography school
1. Environmental management, resource depletion, environ- mental pollution		
2. Growth of the population, development of economy, escalation of regions and countries inequality		
3. A place as a focus of interaction and contradictions in The Nature – Economy – Population system		
4. Interrelations in The Nature – Economy – Population system at global, national, regional level		
5. The conflicts concerning ecological, economic and social stability and arising due to the contradictory purposes		
6. Risks and their prevention		
...		

Table A10. Methods and approaches on geographical education for sustainable development

Methods and approaches	Detailed content	Sections of the content of geography school courses
1. Cartographical method		
2. Methods of geographical modeling and forecasting		
3. Complex geographical description		
4. Comparative and geographical		
5. Statistical method		
6. Geospatial technologies (GIS, etc.)		
7. Environment approach		
8. Interdisciplinary approach		
9. Analysis of various points of view		
...		

Appendix B

Questionnaire for geography teachers

Introduction:

This questionnaire is for teacher who teach geography in middle school. we are interested in learning about implementation of sustainable development in geography, needs and suggestions of teacher.

Your responses are voluntary and confidential. Your answer may be used only of statistical purpose and may not be disclosed, or used, in identifiable form for any other purpose.

Most question can be answered by marking the one most appropriate answer. It is estimated that it will require approximately 20 minutes to complete this questionnaire. Thank you for the thought, time and effort you have put into responding to this questionnaire. We greatly appreciate your contribution to the study.

When in doubt about any aspect of the questionnaire, or if you would like more information about the questionnaire or the study, you can reach us by email...

Thank you.

Background Information

(these question are about you, you education, teacher and the textbook you used. In responding to the question, please mark the appropriate choice or provide the figure when necessary)

1. Are you female or male?

1 Female 2 Male

2.Which province or city are you come from?

3. What is the highest level of formal education you have completed?

- 1 College's degree or below
2 Bachelor's degree
3 Master's degree
4 Doctoral degree or equivalent

4. What is your specialty?

1 Geography 2 Social studies/Social science 3 Science 4 Other subject

5. By the end of this school year, how many year will you have been teaching altogether (geography)?

_____ years

6. Which version of geography textbook you used?

1 People's Education Press 2 Other Publishing house

QUESTIONS ABOUT SUSTAINBALE DEVELOPMENT

The sustainable development in standards, Textbook and your preparation.

7. There are clearly explain the Ideas of Sustainable Development(SD) in geography standard.

1 Yes 2 No

8. You can identify the contents about SD in geography standard and textbook.

1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree

9. You are familiar with the related contents and ideas of SD.

1 Strongly disagree 2 Disagree 3 Agree 4 Strongly agree

10. While prepare lessons, you think how to cultivate the students' ideas of SD.

1 Always 2 Often 3 Sometime 4 Never

How do the teachers deal with content and methods of SD in teaching process?

11. In geography class, you teach the content of SD

- 1 Follow the standard and textbook
- 2 Add other material appropriately besides follow the standard and textbook
- 3 Organize/add freely the content based on teaching practice and experience
12. Regarding theoretical knowledge about SD in geography class, you have taught or discussed (multiple choice)
- 1 Definition of SD
- 2 Main ideas of SD
- 3 Basic principle of SD
- 4 Indicator of SD
- 5 Main documents of SD
- 6 Key questions of SD
- 7 Other, please specific _____
13. Regarding reading material in textbook, you usually
- 1 Pay close attention to it, often explain and expand it.
- 2 Choose some content and discuss it with students
- 3 Just let student read it
- 4 Never use these material
14. You organize and develop the activities in geography textbook
- 1 Always 2 Often 3 Sometime 4 Never
15. Which activities you used to cultivate the students' ideas of sustainable development?
- 1 Seminar 2 Give a speech 3 Investigation
- 4 Write a thesis 5 Role play 6 Discussion
- 7 Other, please write _____
16. You used knowledge or principle of other subjects when you teaching SD in geography.
- 1 Always 2 Often 3 Sometime 4 Never

Some personal perspective about SD in geography

17. Which is most effective for sustainable development in geography education for you?
- 1 Observe other teacher's classes
- 2 Study the new ideas and examples in documents of SD
- 3 Exchange teaching material with colleagues
- 4 Using video ,other ICT and geography information technology
- 5 Teacher training
- 6 Others, please write _____
18. List the main ideas of "sustainable development" which you consider as the most important for teaching
- _____
- _____
- _____

19. Which problems about geography education for SD in middle school, and what's your suggestion?
- _____
- _____
- _____

This is the end of the questionnaire.

Thanks again for your participation and cooperation!

Appendix B

Test for students

Dear participants, the survey aims at assessing SD knowledge and skills. The results will be used only for research and statistic goals. The test includes 5 modules, each contains an introductory text with tasks that need a free and precise response. The maximum number of points for all is 100 (two points is given for each tasks)

Thank you for your ideas, time and efforts. We appreciate your contribution to the research. Appeal to organizers if necessary.

Before beginning, please, write down some of your personal info:

1. Gender
2. Age
3. Country, locality
4. Institute
5. Full name (unnecessary)

NOTE: Read the introductory text before you do the task. Then read the task. Do not rewrite them. Please, put down the number of the question and give a short answer on your form.

We wish you good luck!

Part 1

The Future of the Earth

The Earth is an integral part of universe. Its future is determined by space processes such as formation of new galaxies or their clusters, collision with comets and asteroids, increase of solar activity and others. However, in foreseeable future the existence of the planet and humanity depends on the ability of the world community to keep social, economic and ecological aspects of the evolution under control. According to scientists, the main reasons for “instability” are

- A. Climate changes and decrease of biodiversity
- B. Catastrophes (both natural and anthropogenic)
- C. Demographic changes
- D. Production and emission of contaminants, depletion of resources

Tasks:

- 1.1. Place the instability factors according to their impact on sustainable development (please start with the most significant one).
- 1.2. Enumerate the most important demographic changes bringing to social instability.
- 1.3. Fill in the gaps:

Factors of fluctuation need (1)____, (2)____ of future, and (3)____ of the world community to realize the most (4)____ scripts of sustainable development – conscious control over interaction between mankind and nature.

- 1.4. Enlist examples of utopic and realistic “scripts” of human future.
- 1.5. Describe the most realistic “script”. What types of interaction does it include?

Part 2

International cooperation

The World's Summit held in New York in September 2015, defined "the road map for mankind, planet and prosperity". The Resolution of UN(O) Transforming our world: the 2030 Agenda for Sustainable Development pointed out 17 primary goals of sustainable development:

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Goal 10. Reduce inequality within and among countries
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12. Ensure sustainable consumption and production patterns
- Goal 13. Take urgent action to combat climate change and its impacts
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Tasks:

2.1. Most of goals were discussed earlier. Fill in the table A1 below with main events in SD:

Year	Event	Location	Documents
1992			
2002			
2012			

2.2. In December 2015 the World Summit in Paris dealt with urgent measures to combat climate change (goal 13). Write down the number of SD goals (see the text) mostly associated with climate change.

2.3. Intergovernmental climate change expert group released data declaring that the world's average temperature increased by 0,85°C between 1880 and 2012. Write down the main anthropogenic reasons for that.

2.4. Several scenarios exist depending on rate of global warming. Fill in the gaps in text below:

According to the latest data the world's temperature will increase by (1)____ °C by the end of XXI century if no urgent measures are taken. As well as the temperature of the ocean will rise, ice caps will continue melting. The average sea level will go up by (2)____m. Most consequences of climate changes will remain for centuries.

2.5. Explain the way the world temperature affects mankind.

Part 3

Ecological footprint

How can we assess anthropogenic impact on our planet? What can we do to reduce it?

Canadian scientists W. Riss and M. Walkernegel were the first to dwell on it in their book "Our ecological footprint" in 1996. They offered a method to calculate the square of biologically productive territory and water area needed to produce resources consumed by man as well as to annihilate and recycle our waste. According to the latest recalculation, the square is 1.8 gha/pers a year while the total population is about 6 billion.

According to UN 2009 data, human needs (our ecological footprint) are 1, 4 higher than the planet's capacity and equal to 2,6 gha/pers. States form their own "footprint" differently.

Here are the average ecological footprints (gha/pers) for some countries:

UAE – 10,3, Qatar – 9,9, USA – 9,0, New Zealand – 7,6, Great Britain – 6,1, Switzerland – 5,6, Russia – 4.4, Kazakhstan – 4.4, Germany – 4.0, Ukraine – 2.7, China – 1.8, Uzbekistan – 1.7, Somali – 1.5, Congo – 1.0, Vietnam – 1.0, India – 0.8, Venezuela – 0.5.

The value of the ecological footprint means wherever a country has (or does not have) ecological resources enough to provide social standards of living, and is also a criterion to define "countries-debtors" and "countries-creditors".

Tasks:

3.1. Define the indicator group described in the text:

- A. Social
- B. Economic
- C. Ecological
- D. Institutional

3.2. Group out the countries mentioned in text in two groups according to their part in consuming ecological resources:

- A. "countries-debtors"
- B. "countries-creditors"

3.3. Define the number of your country's ecological footprint. Compare it to the planet's capability and to other countries' footprints. Draw a conclusion. Explain what this number is formed by.

3.4. Give examples of indicators (coefficients, indexes) used to assess different SD aspects.

3.5. Modern ecological footprints on-line-calculators deal with different aspects of human life that influence our planet, including consumption of food, power sources, transport and others. Suggest ways of its reducing.

Part 4

SD key issues

International documents determine key issues necessary for sustainable development of humanity:

End poverty in all its forms everywhere

End hunger, achieve food security and improved nutrition and promote sustainable agriculture
 Ensure availability and sustainable management of water and sanitation for all
 Ensure access to affordable, reliable, sustainable and modern energy for all
 Eco-tourism
 Eco-transport
 Cities built by terms of SD
 Public health service
 Promote sustained, inclusive and sustainable economic growth, full and productive
 employment and decent work for all
 Save ocean
 Save sea-locked states
 Help emerging nations
 Africa
 Local efforts
 Lower disaster impact
 Lower climate changes
 Save forest
 Save biodiversity
 Lower the speed of desertisation, land degradation and drought
 Help mountainous area
 Lower chemical waste
 Rational model of consumption and production
 Improve upstream
 Ensure inclusive and equitable quality education and promote lifelong learning opportunities
 for all
 Achieve gender equality and empower all women and girls

Tasks:

- 4.1. Mark numbers of global problems from the list above which you think should be the first on the line to solve.
- 4.2. Put down (with their numbers from the list above) the problems most urgent in your country.
- 4.3. Explain how much solving global problems can affect every single human.
- 4.4. Give a short description of a global problem using the following questions:
 - (1) What causes it?
 - (2) Is it typical of your country?
 - (3) Can it be solved and how? (Both all over the world and your country)
- 4.5. Say if the next statement is true or false: "Ecological problems are formed by the society's socio-economic and political development".

Part 5

Cities with SD principles

Almost 3.5 billion of people live in economically, scientifically, culturally and socially advanced cities. The cities cover 3 per cent of land and are main energy consumers (60-80 per cent) and carbon dioxide suppliers (about 75 per cent).

Most cities have the following common problems such as:

Overpopulation
 Shortage of funds
 Housing demand

Retrogression of infrastructure

SD index can be used to assess positive (and negative) changes in urban life. SD index allows to describe quantitative changes on next criteria:

- Subjective well-being
- Efficiency of resources use
- Purity of environment
- Cities infrastructure

SD in future

There are many cities with SD principles all over the world. In China, Leading positions in the Sustainable Cities in the eastern part of China. In 2013 China Sustainable index report, Top-10 was presented by capitals (Beijing ,Hangzhou, Changsha), coastal cities (Dalian, Xiamen, Yantai), central cities of regions (Shanghai, Guanzhou).

Tasks:

5.1. Which of the problems mentioned in the text above (A-D) are typical of your city?

5.2. The Table below describes 3 criteria used to form SD cities index (from the list 1-5 in the text above). Fill in the table A2:

Criterion	Comment
	Efficiency of municipal service (including water and power usage), waste treatment based on “reduction, recycling and utilization”
	Access to safe drinking water, enough floor space, qualitative public health service and education
	Access for all citizens to “green” area, public service vehicle and qualitative rationally built housing

5.3. Comment on the other two criteria off the table (from the list 1-5 in the text above).

5.4. Say what unites cities that have leading positions in the China Cities Ranking List.

5.5. What is “comprehensive strategy” for planning and building SD cities from the standpoint of (1) metropolis citizen, (2) ecologist?

Thanks for cooperation!

References

1. Guo, F.T.; Stoltman, J.P.; Duan, Y.S.; Bourke, T. A comparison of content standards documents for geographical tuition in china and the united states. *Mitt. Osterr. Geogr. Ges.* **2016**, *158*, 289-308.
2. NDRC, T.N.D.a.R.C. The people's republic of china national report on sustainable development. The National Development and Reform Commission, M.o.F.A., Ministry of Science and Technology, Ed. Beijing, 2012.
3. Gro Harlem Brundtland, e. *Our common future*; World Commission on Environment and Development: 1987.
4. Scott, W.; Gough, S. Oral evidence to the house of commons environmental audit committee's enquiry into sustainable development. *University of Bath* **2003**.
5. PRC, T.P.s.R.o.C. *China's agenda 21-white paper on china's population, environment and development*. Beijing, 1994.
6. CEE, C.f.E.E. A report to dfee/qca on education for sustainable development in the schools sector from the panel for education for sustainable development. <http://webarchive.nationalarchives.gov.uk/20080305115859/http://www.defra.gov.uk/environment/sustainable/educpanel/1998ar/ann4.htm>

7. de Pauw, J.B.; Gericke, N.; Olsson, D.; Berglund, T. The effectiveness of education for sustainable development. *Sustainability* **2015**, *7*, 1-25.
8. De Haan, G. The blk '21'programme in germany: A 'gestaltungskompetenz'-based model for education for sustainable development. *Environmental Education Research* **2006**, *12*, 19-32.
9. UNESCO, U.N.E.S.a.C.O. Unesco and sustainable development. 2005.
10. Garner, N.; Siol, A.; Eilks, I. The potential of non-formal laboratory environments for innovating the chemistry curriculum and promoting secondary school level students education for sustainability. *Sustainability* **2015**, *7*, 1798-1818.
11. Haubrich, H.; Reinfried, S.; Schleicher, Y. Lucerne declaration on geographical education for sustainable development. *Interaction* **2008**, *36*, 39.
12. Grindsted, T.S. The matter of geography in education for sustainable development: The case of danish university geography. In *Transformative approaches to sustainable development at universities*, Springer: 2015; pp 13-24.
13. Morgan, J.; Lambert, D. *Geography: Teaching school subjects 11-19*. Psychology Press: 2005.
14. Naish, M.; Rawling, E.; Hart, C. *Geography 16-19: The contribution of a curriculum project to 16-19 education*. Longman: 1987.
15. Rawling, E. *Changing the subject: The impact of national policy on school geography 1980-2000*. Geographical Association Sheffield: 2001.
16. DfEE&QCA, D.f.E.a.S.Q.a.C.A. Geography: The national curriculum for england, key stages 1-3. Her Majesty's Stationery Office: London, 1999.
17. Wu, C. Sustainable development concept education in geography teaching. *Modern Education Science* **2010**, *1*, 2.
18. Zhou, H. Teaching strategy of sustainable development education in geogrpahy curriculum. *Modern Primary and Secondary Education* **2005**, *7*, 4.
19. Wang, H.; Xu, B. The literature of environment education and sustainable development educaton in secondary school geography. *Journal of inner mongolia normal university (education science edition)* **2008**, *8*, 4.
20. Walshe, N. An interdisciplinary approach to environmental and sustainability education: Developing geography students' understandings of sustainable development using poetry. *Environmental Education Research* **2016**, 1-20.
21. Rickinson, M. Researching and understanding environmental learning: Hopes for the next 10 years. *Environmental Education Research* **2006**, *12*, 445-457.
22. Corney, G.; Reid, A. Student teachers' learning about subject matter and pedagogy in education for sustainable development. *Environmental Education Research* **2007**, *13*, 33-54.
23. Chalkley, B.; Blumhof, J.; Ragnarsdóttir, K.V. Geography earth and environmental sciences: A suitable home for esd. *Sustainability education: Perspectives and practice across higher education* **2010**, 93-108.
24. Taylor, L. Key concepts and medium term planning. *Teaching Geography* **2008**, *33*, 50-54.
25. Roberts, M. *Geography through enquiry: Approaches to teaching and learning in the secondary school*. Sheffield: Geographical Association: 2013.
26. Bertschy, F.; Künzli, C.; Lehmann, M. Teachers' competencies for the implementation of educational offers in the field of education for sustainable development. *Sustainability* **2013**, *5*, 5067-5080.
27. Cebrián, G.; Junyent, M. Competencies in education for sustainable development: Exploring the student teachers' views. *Sustainability* **2015**, *7*, 2768-2786.

28. Cotton, D.R. Teaching controversial environmental issues: Neutrality and balance in the reality of the classroom. *Educational research* **2006**, *48*, 223-241.
29. Oulton, C.; Day, V.; Dillon*, J.; Grace, M. Controversial issues-teachers' attitudes and practices in the context of citizenship education. *Oxford Review of Education* **2004**, *30*, 489-507.
30. Stibbe, A. Words and worlds: New directions for sustainability literacy. *Higher Education and the Challenge of Sustainability: Problems, Promises and Good Practice* **2007**, *5*, 283.
31. Lee, J.; Catling, S. Some perceptions of english geography textbook authors on writing textbooks. *International Research in Geographical and Environmental Education* **2016**, *25*, 50-67.
32. Reinfried, S.; Rempfler, A. Lucerne declaration on geographical education for sustainable development. *Geographiedidaktische Forschungen* **2007**, *42*, 243-250.
33. Williams, A. How to ... write and analyse a questionnaire. *Journal of orthodontics* **2003**, *30*, 245-252.
34. Boubonari, T.; Markos, A.; Kevrekidis, T. Greek pre-service teachers' knowledge, attitudes, and environmental behavior toward marine pollution. *The Journal of Environmental Education* **2013**, *44*, 232-251.
35. Khlebosolova, O., Munich, Nella.,Guo, Fengtao.,Duan, Yushan. *Sustainable development in the school geography education: Current state and trends case studies in russia, china and the ukraine*. "GolosGubernii" Pubilsher Moscow-Ryazan, 2016.
36. MOE&PRC, M.o.E.o.t.P.s.R.o.C. Geography curriculum standards for compulsory education. Beijing Normal University Press: Beijing, 2011.
37. Yuan Shuxi, L.j. *Geography textbook for second semester in grade 7*. People's education press: Beijign, 2012.
38. Yuan shuxi, D.r. *Geogaraphy textbook for first semester in grade 8*. People's education press: Beijing, 2012.
39. Union, I.G. *Internaiional charter on geographical education*. 1992.
40. Prensky, M. Digital natives, digital immigrants. *On the horizon* **2001**.