

Teaching "Climate Change and Glaciers" Using ESA-Eduspace Material

Athina Karatza^{1*}, Lia Galani¹ and Issaak Parcharidis²

¹Department of Primary Education, National and Kapodistrian University of Athens, Navarinou 13A,
GR-106 80, Athens, Greece.

²Department of Geography, Harokopio University, Eleftheriou Venizelou 70, GR-176 76, Kallithea,
Athens, Greece.

Authors' contributions

This work was carried out in collaboration among all authors. Authors AK, LG, IP designed the research. Author AK Performed the data collection, processing and analysis. All authors read and approved the final manuscript.

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ABSTRACT

According to the literature, satellite imagery has positive effects on the teaching of Geography. Some of the most prominent benefits to students are the development of geographic thinking, the holistic understanding of the world, and the recognition of the problems the active citizen of the future will encounter. The present study forms part of a broader postgraduate work focusing on Satellite Imagery in Education.

Aims: The research undertaken for the present study aimed to determine the appropriateness for the Greek school system of a case study (i.e. theoretical background and worksheet exercises) presented through the European Space Agency's (ESA) website, Eduspace.

Study Design: Quasi-experimental.

Place and Duration of Study: National and Kapodistrian University of Athens, between December 2016 and May 2017.

Methodology: The case study entitled "Climate change and glaciers" was implemented to 19 Greek lower secondary students (control group) as approached by ESA. The purpose was to determine its positive aspects as well as points that could be further improved. Based on the findings of the

*Corresponding author: E-mail: athinakar@primedu.uoa.gr;

implementation, researchers modified the case study proposing qualitative changes to adapt it to the Greek lower secondary school. The modified case study was applied to 20 Greek lower secondary students (experimental group).

Results: Results indicated there were differences in the educational outcomes of the two groups and, more specifically, in the degree of students' understanding of the theoretical framework and the corresponding exercises, as well as their understanding of glaciers as systems influenced by many factors.

Conclusion: Modifications can be made to the ESA case study "Climate change and glaciers" in order for it to be effective and useful in Greek lower secondary school.

Keywords: Satellite images; climate change; glaciers; ESA's case study; Eduspace.

1. INTRODUCTION

The inclusion of satellite imagery in education is an issue that has drawn attention during the last few years. The sustainable management of the environment requires the use of data gathered from the observation of the Earth by satellite. Such remote sensing (RS) data provide important information relating to the interpretation of the space on the planet, thereby facilitating proper planning, decision-making and the taking of appropriate actions by the responsible authorities. In the future, these processes will be the responsibility of the students of today, who should be made aware of the broad potential of RS through the school curricula [1]. When used appropriately in the educational process, satellite imagery can provide a variety of benefits, such as increasing students' interest and motivating them to participate, as well as acquainting them with modern environmental issues, and improving their spatial thinking skills [2]. In addition, when students process and interpret satellite imagery, they also develop skills relating to the use of new technologies, a necessary professional qualification in modern society [2].

Satellite images obtained through RS are included in many modern educational curricula since they are particularly important in science, industry, and everyday life [3]. The information is acquired by satellites with specific sensors, which record the electromagnetic signal reflected by the Earth's surface (i.e. objects, areas, or phenomena), without having physical contact with the objects. This information is transformed into an image, which can be analyzed, processed, and interpreted by various methods [4].

According to the literature, there are positive outcomes deriving from the use of satellite imagery in education. The analysis, processing and interpretation of satellite imagery, under

certain preconditions (e.g. trained teachers, the availability of appropriate educational materials, etc.), can result in the development of students' spatial thinking skills (e.g. identification of spatial patterns) [5,2] since they can better understand the environment through the satellite images. In fact, according to a survey of 110 eighth grade secondary school students in America [5], satellite images were found to correlate with the development of students' spatial thinking, a process which is a common and necessary element of environmental and other sciences.

Dhimitri and Duri [6] surveyed students' acquisition of information from maps and satellite imagery through a questionnaire given to 120 secondary school Geography students (aged 17-18 years old). It was found that students improved both their cognitive abilities and geographical skills when working with satellite imagery, and also expressed a preference for using it. RS provides the classroom with a rich source of up-to-date information for studying phenomena [7]. Ditter et al. [3] argue that satellite imagery aids in the research and management of many modern space-related problems, as well as the enhancement of decision-making skills. In 2008, the views of 64 Geography teachers and 1.657 secondary school students (aged 12-18 years old) were studied through an online questionnaire that concerned the reasons teachers use satellite images in class, the level of students' interest in the lessons, and the improvement of their skills in reading and interpreting images. According to the results of the survey, teachers use satellite images in class because the images encourage students to participate, they are easily and quickly available, they depict a place in almost real time, and they provide a variety of information. The students who responded to the questionnaire indicated a strong interest in satellite images, while the majority stated that they could understand them easily.

The literature contains many references which support the use of satellite images in the classroom: Satellite images depict data in a representative way [8,2,3] with a high degree of descriptiveness [2], and contribute to the faster and more accurate interpretation of geographical data by students [6]. According to Ditter et al. [3], the first priority of using RS at school is to encourage students to solve geographical issues by themselves in order to facilitate the improvement of their spatial skills and problem-solving methodology, while cultivating their practical skills as well [2].

The use of satellite imagery in education also enhances geospatial literacy, which encompasses a variety of skills, such as the ability to understand and communicate knowledge based on maps, to recognize successions and patterns, and to comprehend that Geography is not merely the knowledge of place names, but the basis for organizing spatial information [9].

In contrast, some authors have argued against the usefulness of satellite imagery in education. In their view, comprehending satellite images is a complex process, and appropriate educational software for processing them is absent. Moreover, they conclude that satellite images are often used in school textbooks as mere iconographic elements [8], and only play a limited role in European school programmes [2].

1.1 Satellite Imagery and Educational Material for Schools

Many organizations – such as the National Geographic Society (NGS), NASA, the ESA, United States Geological Survey (USGS), and others – offer a wide range of free material for educational purposes, designed to facilitate the development of students' spatial literacy skills through the use of satellite imagery. Some of these organizations, such as the world's largest space agencies, NASA and ESA, not only offer free material with satellite images on their websites, but also the necessary editing software. Their aim is to educate primary and – mainly – secondary school students in analyzing and interpreting Earth observation data. NASA offers educational material for students and educators containing Landsat images and resources concerning changing Earth and the science and technology of satellite data, among others [10]. Mainly through the Eduspace website [11], ESA focuses its efforts on

European countries aiming to introduce Earth observation techniques in the classroom [12]. A notable difference between Eduspace and other educational websites is the fact that Eduspace provides schools with a comprehensive view of Earth observation applications on a variety of issues on which scientists are currently working [1].

The Eduspace-ESA educational material consists of satellite images collected through RS, which can then be processed by students, using the structured worksheets provided. The main purpose of the website is to provide schools with attractive material and digital tools in order to enhance teaching and learning through the use of satellite imagery [13,12]. The site is organized into three thematic units, entitled "Weather and Climate", "Global Change" and "Natural Disasters". Each unit consists of case studies which provide the necessary theoretical background and worksheet exercises. The material is mainly designed for secondary school and undergraduate students, and is available in various European languages, including Greek [12]; thus, teachers in Greek schools should be able to easily use it.

The Eduspace site is a valuable educational resource, with catalogues of Earth observation images taken from space missions supported by ESA. In addition to satellite imagery and suggestions to teachers on how to approach the material, freeware image-processing packages - ArcExplorer and LEOWorks - are also offered. LEOWorks is an open source software that has been designed for educational purposes with the aim to introduce teachers and students to satellite imagery [1,12].

However, the thematic units offered by ESA have not been piloted in Greek classrooms. Because of the structure of the Greek school curricula, these case studies are likely to require modifications in order for them to be effectively used in Greek schools.

1.2 The Use of Satellite Images in Greek Curricula

Despite the benefits that are derived from the use of satellite images in the development of students' spatial thinking skills, the systematic introduction of satellite images appears to fall short of the mark in Greek primary and secondary schools.

For example, in the Geography curricula of Greek primary school, although students are encouraged to use satellite imagery to identify, describe and observe data [14], no specific satellite images that could be used are proposed to the teacher. Moreover, while the use of satellite images-New Technologies (GIS) by students and the benefits derived from them are mentioned in the theoretical framework of the Greek primary and secondary school Geography curricula for the New School [15], in the corresponding analytical curricula, specific relevant references are few in number. Finally, when satellite images are proposed as a teaching material, they are merely used as a means of visualizing data. Suggestions and instructions to teachers on the type of satellite images that can be used in the classroom, the way they should be used and processed, as well as suggestions for the thematic units to which they can be integrated are absent.

The purpose of the research was the evaluation and implementation of the ESA's topic/case study "Climate change and glaciers" [16] and the formulation of teaching suggestions for modifying the case study in order for it to be effective and useful in Greek lower secondary school called "gymnasium", which comes after primary school and is attended by 12-15 years old students – hereafter mentioned as gymnasium. When mentioning "case study", henceforth, we refer to the theoretical background and the worksheet exercises of the topic "Climate change and glaciers".

The original research had been divided into two parts: The first part concerned the study and analysis of the ESA case study "Climate change and glaciers" based on three criteria: (i) its cognitive goals, (ii) its compatibility with the age/cognitive level of the Greek students, and (iii) the methodology followed. This part of the research has been explicitly analyzed in another published study [17]. The analysis and the modifications proposed for the improvement of the aforementioned case study referred to the theoretical background and the worksheet exercises. No changes were made to the satellite images and the LEO Works software proposed. Based on the results, researchers proposed the following suggestions for improvement: (i) limitation of the concepts to be taught, (ii) teaching of an introductory presentation concerning RS, (iii) the concepts and phenomena presented in the ESA material to be didactically transformed so that they would

correspond to the Greek students' level, and (iv) maintaining the same method (i.e. inquiry-based learning), with some adaptations: (a) enhancing the interpretation of the phenomena presented, (b) integrating hypothesis formulation regarding the phenomena they will study, and (c) verifying their results.

The purpose of the second part of the research, which is presented in this paper, was to determine the appropriateness of the ESA's case study "Climate change and glaciers" for use in Greek lower secondary schools. This research focused on the application of the recommended ESA case study (theoretical background and worksheet exercises as proposed by ESA) to one group of students as well as on the application of the modified case study (theoretical background and worksheet exercises as proposed by the researchers) to a second group. Subsequently, the results of the two groups were compared. In order to serve the aim of this part of the research, the following research question was formulated: As regards the ESA case study "Climate change and glaciers", are better learning outcomes achieved by Greek gymnasium students through the application of the case study which included adaptations by the researchers, compared to the application of the case study as recommended by ESA?

2. METHODOLOGY

The case study "Climate change and glaciers" was chosen based on the following criteria:

1. Greek students come into contact with the topic of climate change through both the elementary school curricula and the media. However, the analysis of global climate change is usually limited to the necessity of taking measures to slow down this change, without a clear estimation of the importance of the phenomenon. Although "melting ice" is an expression commonly used in the media, references to causes and consequences of glacial changes are absent. As a result, Greek students have no background knowledge to interpret aspects of the phenomenon.

2. The ESA thematic unit used in the sample has been translated into Greek, thereby facilitating its teaching in any Greek school, as long as the school is equipped with at least one computer with the LEO Works software.

The sample consisted of two groups of Greek students: the control group (19 second grade

gymnasium students aged 13-14 years old) and the experimental group (20 students at the same grade level aged 13-14 years old). Both groups of students attended the same school, were the same age, and had the same socioeconomic background. As regards their level of knowledge about satellite images, climate change and glaciers, since these phenomena are not taught to students in Greek formal education, the two groups were considered equally knowledgeable. This meant that students of both groups had to be introduced to the same basic elements of satellite imagery in order to be able to work with satellite images.

In this phase of the study, the researchers presented the educational material to the control group by applying the ESA didactical approach and using the ESA worksheets. The qualitative study and analysis of the material, as well as the difficulties experienced by the control group in practice (explained later in the "Results and discussion" section) indicated points to be improved in the ESA approach. Taking these findings into account, a modified didactical approach and worksheet was created by the researchers, with adaptations that would both serve the same teaching goals, and address the weaknesses of the original material in the didactical transformation of knowledge for the Greek gymnasium students. The aim was to evaluate and compare (i) the students' understanding of concepts, and (ii) the degree of achievement of the teaching goals in each group.

The worksheets served the same teaching goals – i.e. those of the ESA case study – and used the same satellite images. The same teaching procedure was used for both groups: Four 45-minute teaching hours were spent on the ESA case study, students worked in pairs on a computer, and were encouraged to collaborate with each other. Both student groups performed two exercises (i.e. Animation and Measurement of area) out of the six proposed by ESA due to the lack of sufficient teaching time, as each exercise was estimated to be completed in about one teaching hour. The four class sessions included the presentation of the case study using the ESA approach and worksheets in the control group, and the modified teaching approach and worksheets in the experimental group.

In order for researchers to evaluate and compare the students' understanding of concepts of the two groups, while they completed their worksheets, students were asked to make a note

of the concepts and phrases they did not understand, in the sections of the theoretical background and the worksheet exercises (i.e. the two exercises performed and the conclusions), which were later studied and analyzed with content analysis. According to Krippendorff [18], content analysis aims to extract valid inferences from texts. The first steps in the process of content analysis are the selection of a text for analysis, and the definition of both the units of analysis and the categories to be used. Subsequently, the text is examined and, finally, the results are interpreted [19].

With a view to evaluate and compare the degree of achievement of the teaching goals of the two groups, once each group had completed their sessions, students were given 20 minutes to respond to the same questionnaire individually.

Since no relevant research had been conducted, the questionnaire was prepared by the researchers based on the ESA educational goals and students' misconceptions relating to the phenomena, as recorded in the literature [20]. It consisted of 11 questions: ten close-ended (i.e. 4-option multiple-choice cloze questions) and one open-ended (i.e. students were required to formulate their own answers). The first two questions dealt with the mechanisms of glacial advance and retreat. The third question examined these mechanisms in relation to the change in the volume of the glacier. The fourth question concerned glacial advance and climate change. The fifth, was about the size of the glaciers during the last few decades. The sixth, dealt with the effect of the rise of average air temperatures on glaciers. The seventh, referred to factors that influence glacial systems. The eighth question contained false color images, and students had to recognize the retreat and advance of the glacier, and also decide whether the glacier had shrunk. In question nine, students had to compare the area of a particular glacial system by using satellite images taken at different times. The tenth question examined students' notions concerning whether and how changes in glacial systems can be detected. The eleventh question was an open-ended one: A time-temperature diagram of the last few decades was given to students, along with satellite images that depicted changes in glaciers and glacial lakes (Fig. 1). Students had to write down their observations and draw conclusions. Concerning its validity, the questionnaire was evaluated by two experts who, after discussion and agreement, proposed relevant corrections.

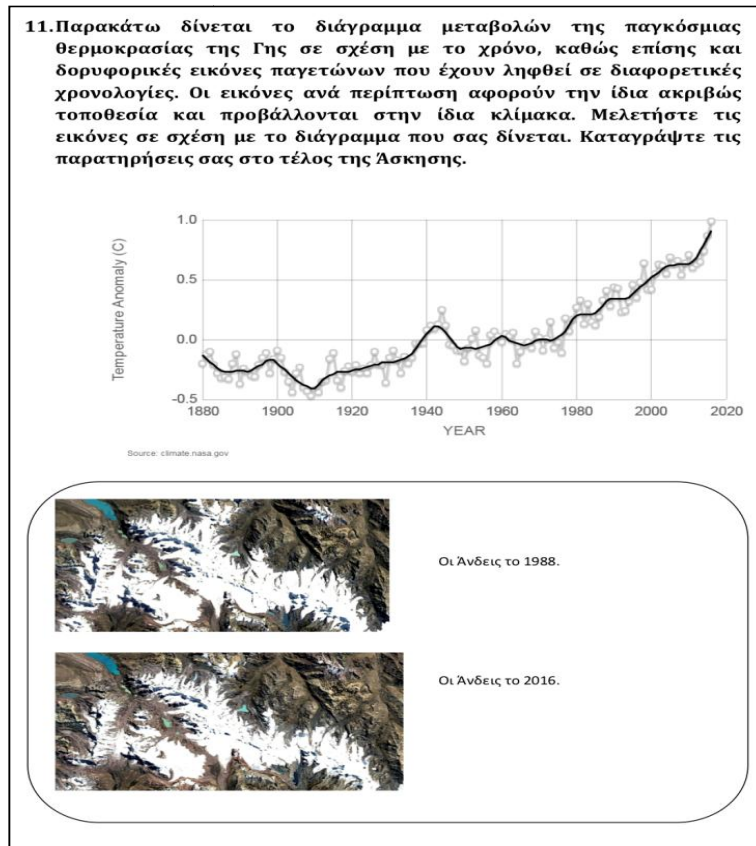


Fig. 1. Part of the open-ended question of the questionnaire (question 11), illustrating the time-temperature diagram and two satellite images of the same area of the Andes in two different chronologies (1988, 2016)

The results were examined through both a quantitative and qualitative approach.

For the evaluation of the ten multiple-choice questions, students' scoring was 1 when providing a correct answer and 0 when answering wrong. In order to evaluate the answers to the open-ended question 11, a "target" answer outlining the information/items that students should have referred to (i.e. observations on data and interpretation of glacial changes) was formulated by the researchers. The answer was given to two coders who were informed on the content of the case study and the teaching goals. Each one coded the answer. The degree of consistency between the two coders was 88% which was considered acceptable [21]. The coders, after discussion, came up with the same "target" answer. The total score for providing the correct answer was one. Four items had to be reported. Each item was rated equally with 0.25. Students' answers were compared with the "target" response and

categorized. The answers were later studied and analyzed by the researchers.

For the quantitative statistical analysis, the data from the questionnaires were processed using the IBM SPSS Statistics 22 programme. The null hypothesis formulated was the following:

H_0 : The average score of the experimental group is equal to the average score of the control group.

3. RESULTS AND DISCUSSION

3.1 Analysis of Students' Understanding of the Case Study

Concerning the understanding of concepts and technical phrases encountered in the theoretical background of the ESA case study, a large number of control group students had marked many concepts and phrases as incomprehensible (e.g. quantifying glacier retreat

and advancement, canton, eccentricity, albedo effect, multispectral satellite images, mass balance, Milankovitch cycle, moraine, etc.). In contrast, in the experimental group, in which the researcher-adapted case study was applied, only two students had marked only a few concepts and phrases (i.e. albedo effect, shrink, glacier retreat) as incomprehensible.

Regarding students' understanding of the worksheet exercises, those in the control group did not manage either to do the exercises on their own, or to use the satellite images which they had been given as the exercise required. In contrast, students in the experimental group did manage to use the satellite images as the exercise required. They were also able to complete both the animated image task (Exercise 2: Animation) and the measurement of the glacial area (Exercise 5: Measurement of area) and, thus, answer the majority of the questions. However, both groups had difficulty in answering a question concerning changes in glacial lakes.

As regards the conclusions section of the worksheet, they had already been formulated in the ESA approach, and focused students' attention on the technical aspect of choosing the appropriate techniques for locating and measuring glacial changes, without the students having to interpret the changes themselves. In contrast, students in the experimental group were able to answer the questions on the adapted worksheet in order to draw conclusions by themselves. However, they found the question on the adapted worksheet concerning the formations (i.e. landforms) created by the movement of the glacier difficult.

3.2 Analysis of the Questionnaire Data

Researchers analyzed the questionnaires of the two groups. In order to test the H_0 hypothesis, we ran Chi-Squared Test for the ten multiple-choice questions. No statistical significant differences in the results were found among the two groups (χ^2 , $P < .05$, $df=1$). Thus, we accept the H_0 , meaning the average score of the experimental group was equal to the average score of the control group.

For the open-ended question 11, a time-temperature diagram was given to students, along with satellite images that depicted glacier changes (Fig. 1). Students had to write down their observations and conclusions. Table 1 presents both the common and different categories of students' conclusions that resulted

from the analysis of the answers of the two groups.

As shown in the table, students used either single or multiple factors to interpret glacial changes. Common conclusions occurred only in the event of single factor interpretations which were used by the majority of students in both groups (11 out of 19 in the control group, and 10 out of 20 in the experimental group). According to the perspective of these students, temperature changes, climate change, or the ozone hole were responsible for glacial changes. Some students reached different conclusions, again based on single-factor interpretation: Local conditions (control group), greenhouse effect, environmental disaster, change of season (experimental group). It is worth noting that the majority of control group students and half of the experimental group students did not recognize glaciers as being systems affected by multiple factors.

Moreover, in the multi-factor interpretation, no common conclusions occurred about the causes of glacial change. Among the different conclusions reached by students, two control group students attempted to interpret the phenomenon of glacial change, citing multiple factors which affect it – i.e., they referred to greenhouse gases and the ozone as leading factors of temperature rise. Three experimental group students also indicated multiple factors affecting glacial change: Two of the students referred to the albedo effect – a factor that was not mentioned at all by the control group – and climate change, while one student recognized the albedo effect and the rise in temperature as factors that impact glaciers.

Subsequently, an interpretation of the results is attempted. Regarding the understanding of concepts, in the experimental group fewer students compared to the control group noted only a few concepts and phrases they did not understand. This was expected, since according to Greek curricula, high school students are not taught about these concepts, as stated in a previous section of this paper. The ESA approach was not appropriate for the Greek students' ages and cognitive level, and therefore the concepts were difficult for students to understand. We attribute the improved outcome of the experimental group to the fact that by modifying the ESA approach and worksheets, the concepts had been thoroughly explained to students and didactically transformed to their age and cognitive level.

Table 1. Common and different categories of conclusions drawn by the groups at question 11

Causes of glacial change according to students	Single-factor interpretation		Multiple-factor interpretation	
	Control group	Experimental group	Control group	Experimental group
Temperature changes	1	4		
Climate change	6	1		
The ozone hole	1	1		
Local conditions	3			
Greenhouse effect		1		
Environmental disaster		2		
Change of season		1		
Greenhouse effect / ozone hole / rise of temperatures			3	
The albedo effect / climate change				2
The albedo effect / rise of temperatures				1

Concerning the exercises, the students of the experimental group were able to form the satellite images according to the instructions given and to answer most of the questions in contrast to the students of the control group. This is probably due to the lack of specific instructions (i.e. the students could not use the computer program's menu tools correctly, they would open the wrong images, etc.) in the ESA approach compared to the detailed instructions included in the worksheet which had been adapted by the researchers. In the latter case, the instructions were given in a form of a bulleted list as a step by step guide. As regards the difficulty in answering the question concerning changes in glacial lakes, it should be clarified that the changes concern the same glacial lakes in two different chronologies given. Some students interpreted the term "changes" in glacial lakes as "differences" among the lakes at each image instead of comparing the same lake in the two different chronologies.

Regarding the difficulty of the experimental group to answer the question of the adapted worksheet concerning the landforms created by the movement of the glacier, it is attributed to linguistic misinterpretation: The term "formations" should be replaced by the term "landforms" or explained in a geographical context, since this scientific meaning of the word differs from the one commonly used in the Greek language.

From the analysis of the questionnaires conducted, it appears that in the multiple-choice questions, the difference in the learning outcomes between the two groups was not statistically significant. It should be noted that part of the non-statistically-significant differences

in the results of the two groups may be due to the responses of classmates to questions posed during the lesson. It should also be mentioned that more guidance was required for the students of the control group in order to understand the concepts and be able to perform the exercises.

It should be noted that only students of the experimental group mentioned the albedo effect as one of the factors that affect glacial systems. A reason that may have contributed to this was the explanation included in the experimental group's modified worksheets relating to the role of the albedo effect in glacial system change and its direct interrelationship with climate change during the last decades. This additional information probably helped students to better comprehend the role of the albedo effect in climate change, and not merely its mechanism. Nonetheless, the majority of the control group students and half of the experimental group students did not recognize glaciers as being systems affected by many factors.

4. CONCLUSION

According to the literature, the integration of satellite images in education can bring about positive learning outcomes for students.

In the present study, the ESA case study "Climate change and glaciers", was implemented to Greek students. The ESA teaching approach and worksheets were applied to a control group of students, and a modified approach and worksheets proposed by the researchers were applied to an experimental group.

From the analysis of the different group worksheets and questionnaires, it was deduced

that there were both similarities and differences in the educational outcomes of the two groups.

To begin with, there were differences between the two groups in the degree of students' understanding of both the theoretical framework of the case study, and the corresponding exercises: Compared to the control group, a lower number of students in the experimental group had marked fewer of the concepts included in the educational material as incomprehensible. Students in the experimental group were able to process images according to the instructions and answered the majority of the questions.

The differences in understanding/educational outcome between the two groups can be seen in their answers to the open-ended item on the questionnaire. When asked to write their observations and draw conclusions about glacial changes based on a time-temperature diagram and satellite images (Fig. 1), students' conclusions which could be grouped into different categories occurred. Both groups had reached common conclusions when attributing the cause of glacial change to a single phenomenon, while some students in both groups attributed the cause to multiple factors. It is worth noting that several students in the experimental group, who had been instructed using the modified approach, included the albedo effect on a glacial system as a reason for glacial changes, an argument that was absent in the control group.

The contribution of the material adapted/created by the researchers for purposes of this study is important since it identified points in the ESA material that could be further improved (e.g. rephrasing questions that students found difficult, explaining some additional terms, etc.) in order to meet the needs of Greek lower secondary school students. Once the additional improvements have been made by the researchers, a future research should focus on piloting the new material in schools of different areas in Greece to examine its efficiency. The final aim is to adapt the educational material offered by ESA and suggest its incorporation in the Greek curricula. This way, the gap between the Greek curricula and the implementation of satellite images would be filled.

Furthermore, the inclusion of other ESA thematic units into the Greek curricula is also suggested. A future research could also focus in the evaluation and inclusion of the ESA material and

worksheets in Greek curricula units. In this process, in-service educators could be involved. Through a bottom-up planning scheme, based on their experience and knowledge, educators could help to create understandable exercises that would increase students' interest and knowledge, as well as develop their higher level cognitive skills. For this reason, the training of teachers about RS and its applications, satellite image processing software (for educational purposes), as well as the ESA material are of great significance for the Greek educational system.

However, it should be stated that the sample was small, and therefore conclusions cannot be generalized. Concerning the quantitative results, a bigger sample would ensure more reliability for the statistical analysis. As regards the qualitative results, other factors or combinations of factors that influence glacial systems might have been referred to by the students in the open-ended question. We also suggest that similar research be conducted in more Greek schools as well as schools in countries other than Greece. This would help identify and/or evaluate possible differentiations as well as to increase the reliability of the methodology and results.

Moreover, due to the large number of concepts and exercises in the ESA material, as well as the advanced educational level which the material addresses, we believe there is a need for an overall re-thinking and adaptation of the material in the ESA thematic units in order to meet the needs of the curricula of different countries. Specifically, the material should: (a) be adapted so as to be appropriate for different levels of education, (b) follow a spiral development of concepts, (c) take into account the available teaching time, (d) include provision for teachers to select the activities, and (e) create a teaching environment which increases students' interest in RS, while at the same time facilitating the development of their higher order cognitive skills.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT AND ETHICAL APPROVAL

All principles and rules of ethics for educational research with children as proposed by the National and Kapodistrian University of Athens were followed. The students knew that they were participating in an anonymous research and their parents had agreed signing a relevant document of participation. No personal information was required.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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