GEOGEBRA SOFTWARE – A NEW POSSIBILITY FOR STUDYING THE ENVIRONMENTAL PROBLEMATICS?

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Abstract: The era that we live in today can be described as the "Information Age". No matter what area of science and technology we look at, it is obvious that we are dealing with an 'information overflow' without precedent in the history of mankind. Environment Sciences are no exception and recent advances in this field would have been unthinkable, unmanageable and unattainable without the support offered by modern information technology, in the sense of Environment Information Systems or, why not, Environment Informatics.

The aim of the present paper is to introduce you a new kind of Environment Information System, special by its perspective in solving the environment problematic, the math software GeoGebra. Also, the work paper describes the possibilities to implement GeoGebra in the context of complex area defined by environment protection and engineering.

Key words: Environmental Information Systems, Environmental Informatics, GeoGebra, pedagogy.

Introduction

In the contemporary society the dynamism of the changes in all the domains of the social, cultural, economic and ecologic life is one of dominant constants. These transformations of the society represent solicitations and challenges that the academic structure and the mankind have to deal with, both through the way in which it organizes the knowledge and the learning, through the quality of the results in the end, and also through the ways in which it distributes them in the society. The answer found by the University of Baia Mare to these requirements was to change the education's priorities, namely: to pass from knowledge as an assembly of information and data, to knowledge as a set of skills, "to know to do, to know to act" [5].

This step from transmitting and memorizing information to informing determined the essential shift of stress on the attitudes-aptitudes-knowledge triad, and implicitly the development of the skills and competences built through an experiential and practical learning.

The amazing progress of the IT&C domain, the improvement and the extension of its applicability in all the other domains of the society in which we live have also led to changes in what concerns the purposes, the objectives and the strategies regarding the process of formation and education [3].

The use of computers in schools and of the educational software in the process of teaching - learning - evaluation has represented and continues to represent the solution offered by the education to the society's progress. It is certain that the computers tend to become instruments used worldwide and Informatics a second maternal language, which makes the formation of digital skills to be a necessity of the educational process in any country worldwide.

These changes will bring high quality results if the teacher has the availability to quit the routine, to acquire the skills to use the computer in the teaching process, to assume the part of ling coordinator, and equally, the responsibilities given by this part. In this case the growth of the results' quality will also be stimulated.

Still, with all these things, through a simple Internet search command we can prove a significant difference between the elaboration and especially the use of the educational software in our educational system and the one from other countries.

At this time it is known the reality that the Romanian educational system is, regrettably, conservatory and that the teachers' training in the computerized teaching the use of the computers in the educational system are only at an experimental stage.

The improvement of this situation imposes the notion and the supporting of all the initiatives that have as object the study, the research, the exchange of new practical experiences in the domain of the new IT&C pedagogic, which have as central objective the involvement of the student as an active and creative participant in the process of learning.

The idea of this present paper has started from the desire to share to other colleagues, environmental science or engineering students, the experience acquired in the use of a new kind of EIS – GeoGebra [6]. To be more exact, we wanted to share general information about the GeoGebra software and some of the didactic opportunities given by its use in the classroom.

The information regarding the creation of other teaching systems in the domain of the Mathematics educational software and also of the Environment Information System, their knowledge and the chance to access them can offer to anyone the chance to find solutions for its research in what regards the mixing of the traditional teaching methods with the modern ones, and to identify the motivation resources that make the students find the use of GeoGebra in everyday life [6]. To say even more, the contact with this information leads to reflection, experimenting, comparisons and analysis with positive effect on the capitalization through symbiosis of the multiple alternatives offered to the didactic activity by the IT&C instruments, and also of the interest manifested without reserves by the young people towards IT.

A short history of the math software GeoGebra

GeoGebra is, first of all, special software dedicated to the study of the Geometry with the help of the computer. The GeoGebra technology was in this case designed and destined to students and teachers, equally, starting from the pre-university education system with the purpose to sustain and to facilitate the necessary efforts to understand Geometry, Algebra, Calculus, etc. [11].

In 2002, GeoGebra was created by Markus Hohenwarter at University of Salzburg, Austria. He implemented a software that have functionalities of DGS (Dynamic Geometry Software) and CAS (Computer Algebra System) [14]. After publishing GeoGebra on the internet in 2002, teachers in Austria and Germany started to use GeoGebra for teaching mathematics.

GeoGebra received the European Academic Software Award, EASA, in 2002. Further development of GeoGebra was funded by a DOC scholarship awarded to Hohenwarter by the Austrian Academy of Science. Since 2006, GeoGebra's development has continued at Florida Atlantic University, USA, where Hohenwarter works in a teacher training project funded by the National Science Foundation's Math and Science Partnership initiative.

GeoGebra software – applications serving Pedagogy

The teaching - learning - evaluation process of the Mathematics means sustained efforts on the part of the teacher taking into consideration the necessity to project and to prepare, depending on the potential of the students group, the theoretical support and the practical applications that assure the conditions of a good understanding of the notions and of the concepts, the achievement of the right figures, the consumption of time required for the mathematical modeling highlighting the difficulty of building components, the concern for practicing and learning geometrical reasoning, cultivation of native skills, etc.

The applications of GeoGebra facilitate learning, being real instruments that help to overcome many difficulties, some of the advantages being: making geometric constructions on the computer's monitor in exceptional graphics, highlighting the component elements and their controlled mobility, animation views, saving and printing drawings, etc. The GeoGebra applications are friendly educational software that can be successfully used for teaching Geometry both in groups and individually.

The browse of the digital process through which are made the geometric constructions, the impact of their possibilities to move, the spatial visualization from different perspectives motivate and challenge the students to explore, to make their own discoveries, to analyze the obtained results. The GeoGebra teaching system has a solid theoretical base developed by specialists in Mathematics. The software's essential quality is that the exploration of the geometrical properties is

possible only with the compliance with all the rules imposed by the theory. The GeoGebra applications assure the interactive teaching.

During learning and solving tasks, students are faced with new situations that incite and encourage them to analyze, to apply theoretical results, to identify or to propose solutions, to issue opinions and argument them, to make calculations and to check them. In this sense, the impact of the use of GeoGebra applications in the teaching Mathematics process, either in the secondary school or in high school has immediate benefits for the students.

Much more, the GeoGebra applications offer the students the necessary instruments for systematic "exploration", for the understanding and deepening of notions, concepts and geometric reasoning.

They have the possibilities to [11]:

- discover the Geometry's fundamental elements (dots, lines, segments, circles);
- understand and differentiate the classes of remarkable polygons, polyhedral and round objects;
- construct simple or elaborate geometric figures and objects and view their different spatial perspectives;
- discover and learn through practical experiment the properties of the geometric transformations;
- determine algebraic equations for planes, they measure angles, perimeters, angles.

In the same order GeoGebra offers to the teachers instruments that help them to:

- design the teaching - learning - evaluation process;
- prepare the activities that introduce new concepts;
- elaborate organization of the learning sequences destined to training, memorizing and recapitulation;
- demonstrate fundamental geometric theories, sentences and properties;
- generate practically the geometric places;
- create work charts that contain: drawings, explanation boxes, example exercises, training, exercises, helping items, short tests;
- solve and print all the files that contain GeoGebra documents and applications, etc.

GeoGebra software offers the teachers multiple possibilities to adapt teaching and learning to the rhythm of the students group and the chance to learn at the right time and place.

The GeoGebra applications offer the possibility that the work tasks to be installed on a single computer or on an entire network (Fig. 1). To increase the efficiency of the things the students learn and to shorten the necessary time for the acquisition of the skills, to launch challenges and to raise the interest in solving the working tasks, the teacher has the freedom to approach the students directly, in groups or individually. Using projection equipment for the computer, there is the chance to involve the entire class in finding individual solution for the same task or problem.

The performances of education software are appreciated after the analysis of the advantages that it brings in comparison to the traditional methods [2]. In its turn, the analysis of the advantages has as base the evaluation of its capacity to meet a set of requirements regarding the pedagogical exigencies, informatics characteristics, ergonomically advantages and the design's quality related to the necessities and the expectations of the two leading actors that collaborate in the process of learning - the teacher and the student.

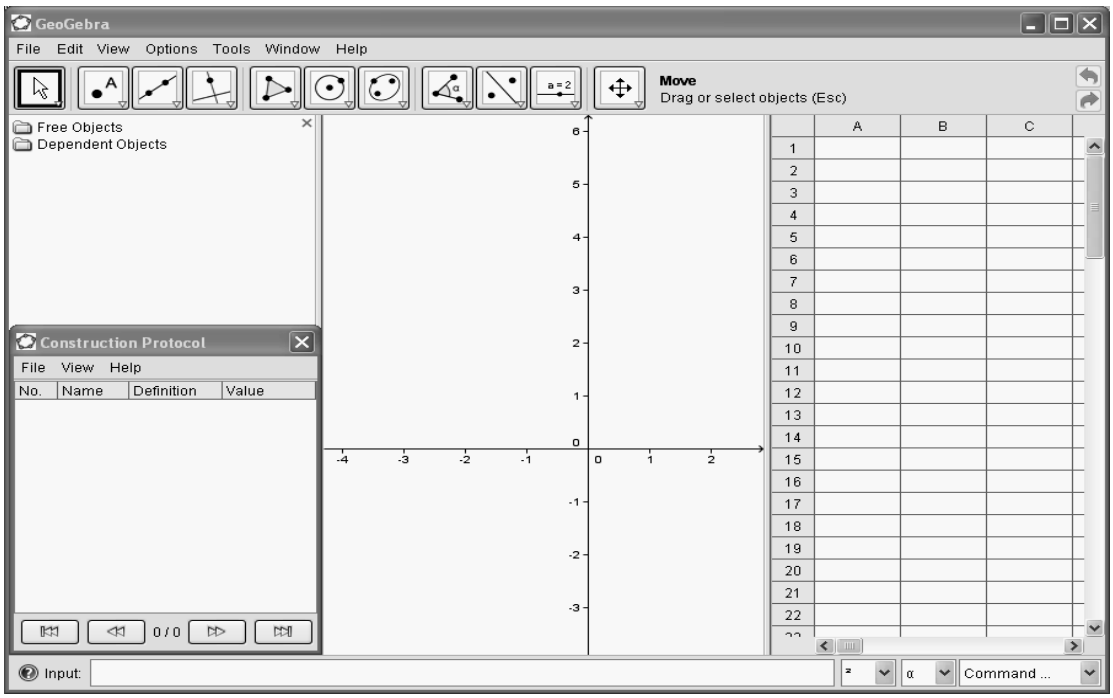


Fig. 1. GeoGebra software screen capture [11].

GeoGebra as an Environment Information System. EIS Applications

The era that we live in today can be described as the "Information Age". No matter what area of science and technology we look at, it is obvious that we are dealing with an 'information overflow' without precedent in the history of mankind. Environment Sciences are no exception and recent advances in this field would have been unthinkable, unmanageable and unattainable without the support offered by modern information technology, in the sense of the modern Environment Information Systems or, why not, Environment Informatics [7].

The aim of the present paper is to introduce to you a new kind of Environment Information System, special by its perspective in solving the environment problematic, the math software GeoGebra. Also, the work paper describes the possibilities to implement GeoGebra in the context of complex area defined by environment protection and engineering [3,6].

There are a few applications realized with help of GeoGebra (Fig. 2-8).

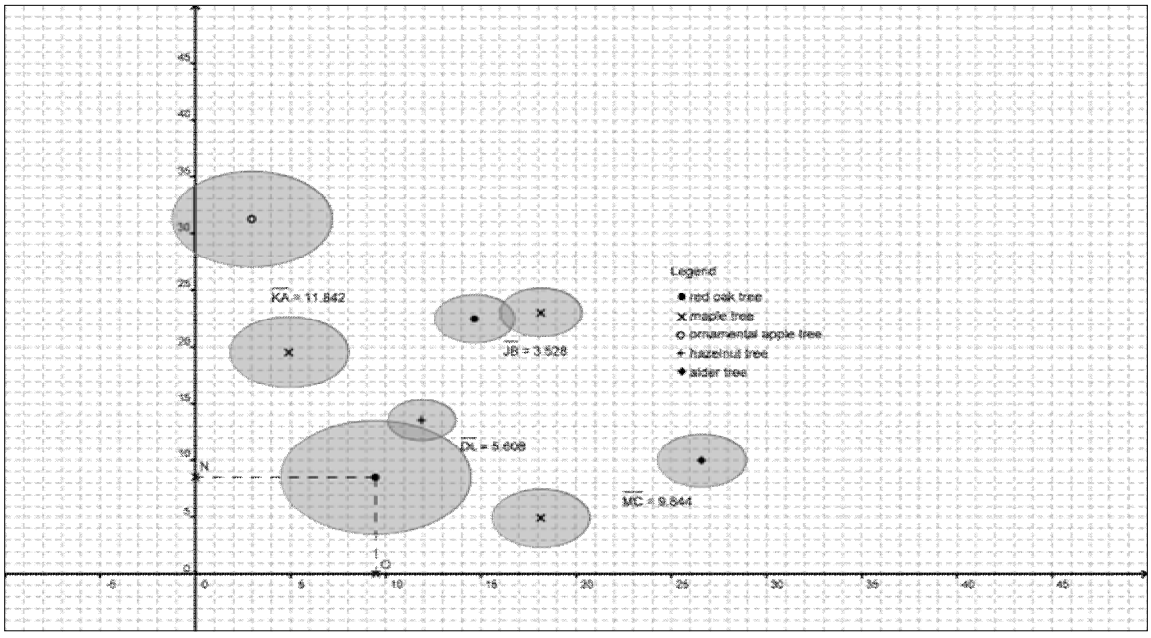


Fig. 2. GeoGebra software - the mapping of the urban vegetation.

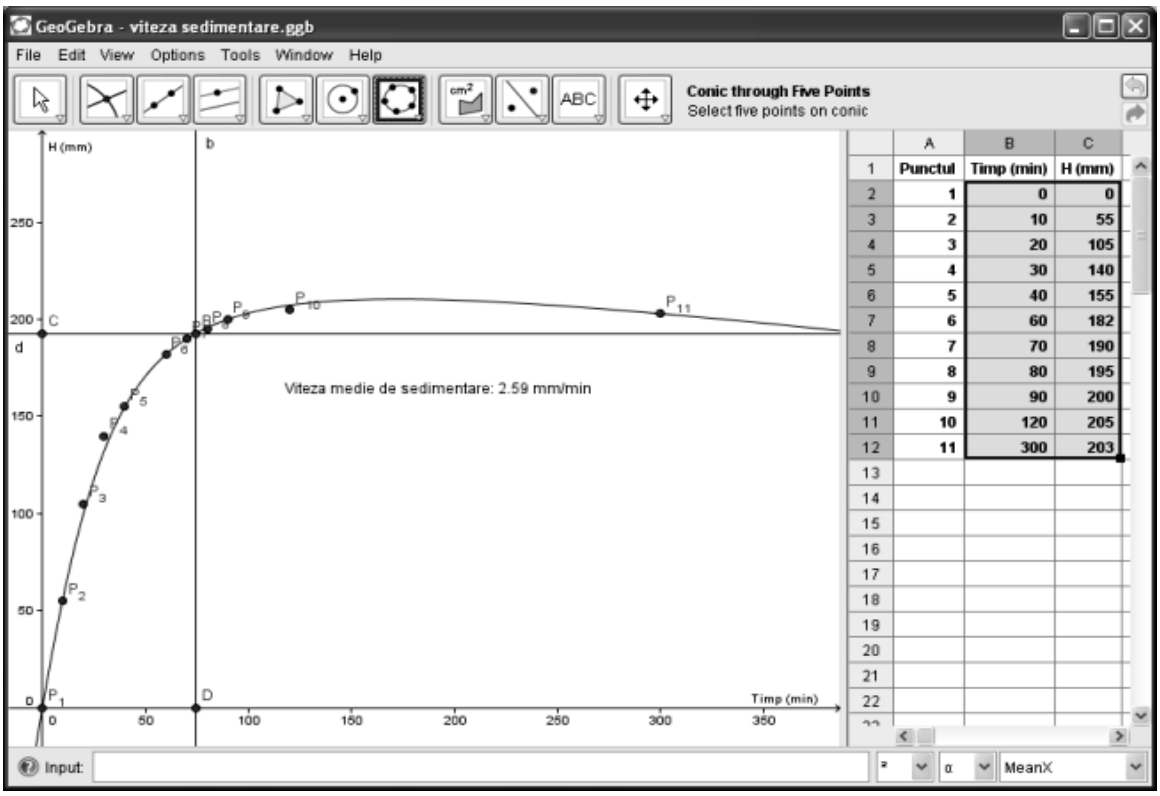
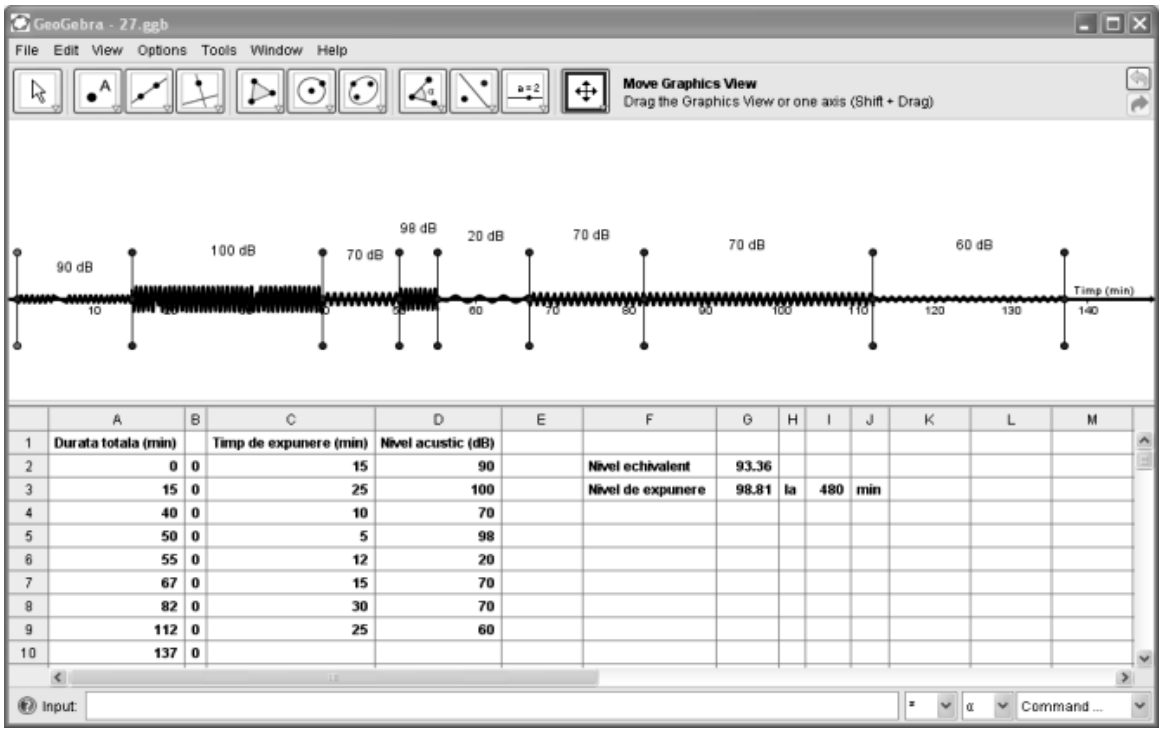


Fig. 3. GeoGebra software - establishing the sedimentary mean speed of the municipal waste sludge (troubleshooting the pollution of aquifer layers; construction of the graphical scheme for characterizing the overall pollution index (Rojanschi method); determination of sound level in different points).



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Durata totala (min)		Timp de expunere (min)	Nivel acustic (dB)									
2	0	0	15	90		Nivel echivalent	93.36						
3	15	0	25	100		Nivel de expunere	98.81	la	480	min			
4	40	0	10	70									
5	50	0	5	98									
6	55	0	12	20									
7	67	0	15	70									
8	82	0	30	70									
9	112	0	25	60									
10	137	0											

Fig. 4. GeoGebra software - establishing of the equivalent and expose sound level.

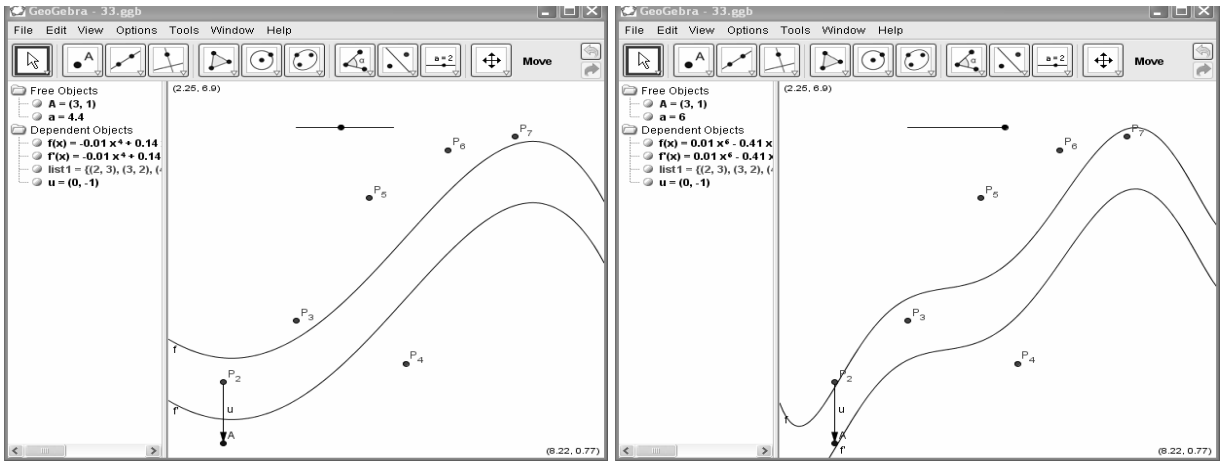
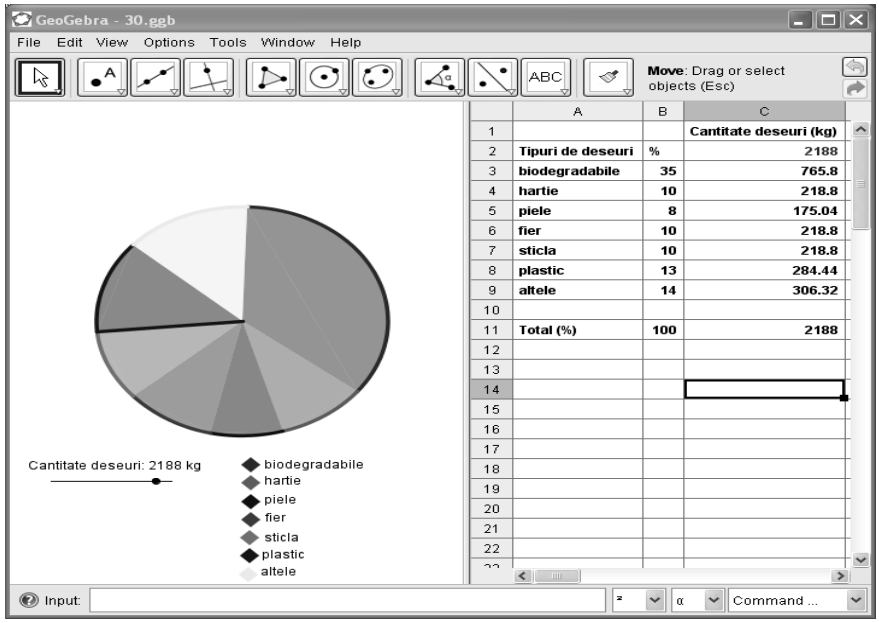
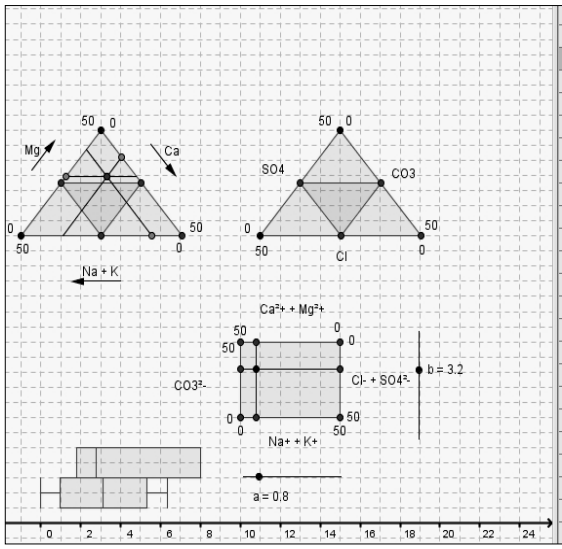


Fig. 5. GeoGebra software - the representing of the variation of a river course in time.



	A	B	C
1			Cantitate deseuri (kg)
2	Tipuri de deseuri	%	2188
3	biodegradabile	35	765.8
4	hartie	10	218.8
5	piele	8	175.04
6	fier	10	218.8
7	sticla	10	218.8
8	plastic	13	284.44
9	altele	14	306.32
10			
11	Total (%)	100	2188

Fig. 6. GeoGebra software - creating the pieslice graphic in accordance with the waste types (the graphic characterization of temperature in different altitude points; determining the direction of the pollutants feather; the calculation flow of a river).



	A	B	C	D	E
1	Ioni	Cantitate (g/l)	Masa echiv.	r	Procente echiv.
2	Cl-	0.0993	35.453	2.80089	11.11325
3	SO42-	0.0864	48.033	1.79876	7.13705
4	CO32-	0.2401	30.005	8.002	31.74998
5	total	0	1	12.60165	50.00029
6	Na+	0.0446	22.9898	1.93999	7.69741
7	Ca2+	0.0866	20.04	4.32136	17.14609
8	Mg2+	0.0769	12.156	6.32609	25.1004
9	K+	0.00055	39.102	0.01407	0.05581
10	total	0	11	12.60151	49.99971
11					
12	TOTAL			25.20316	100
13					
14			Deplasare		
15			a	0.77532	
16	10	7	b	3.175	
17	10	12			
18	15	7			
19	15	12			
20					
21					
22					
23					

Fig. 7. GeoGebra software - the graphic characterization of the results of chemical analysis of a sample of water.

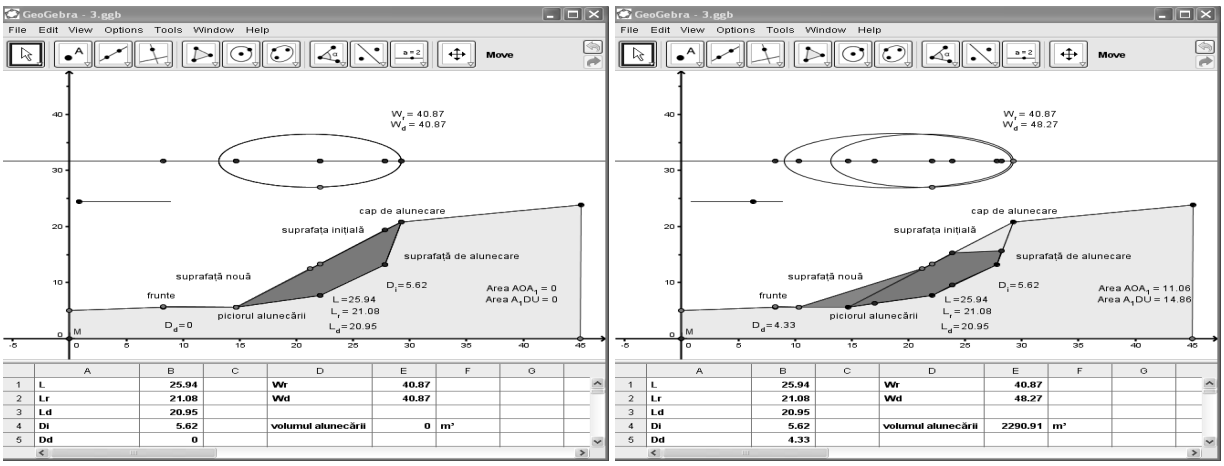


Fig. 8. GeoGebra software - establishing the morphological phase evolution for a removing land.

Computer-based systems, such as GeoGebra software for now on, for processing environmental information have been in use for more years now; so a broad range of applications is covered by these systems, including monitoring and control, information management, data analysis, as well as planning and decision support. Progress in informatics as well as in computational mathematics has made an invaluable contribution to our ability to analyze the biological, chemical and physical processes taking place in the environment.

The size and complexity of environmental data demand advanced computational approaches to integrate information from variety of sources. With Environmental Informatics, new solutions to environmental problems can be found more quickly and effectively, even with the GeoGebra applications. Much more, the users and clients can benefit from the gained higher level of environmental information by more targeted actions and comprehensive view of the phenomenon.

Environmental Informatics focused on research and education using modern computational methods, same to the Geogebra exercises presented, is useful for analyzing and modeling environmental problems and hazards as well as in the development of systems for continuous monitoring of the environment. Obviously, in line with this trend, more information technologies will be taken for addressing the complex environmental concerns that we cannot handle them successfully today. This must rely on fostering and nurturing a new field .Environmental Informatics as a new niche in the area of environmental science and engineering.

Conclusions

The increasing development of the free, open-source dynamic mathematics software joining geometry, algebra, calculus and statistics (GeoGebra) [11] offers so many variations in both mathematics and in fields such as chemistry, physics or the environmental engineering (ecology, hydrology, geology, environmental impact assessment, etc). There is the conviction that the handling of environmental data can be done with GeoGebra, this being the purpose and the present paper [2].

The challenge presented above comes to stress and to define the correlations which can be established between the two areas of interest, environment engineering and GeoGebra, as parts of the environmental informatics.

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