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Impact of ecological exploration processes on the development of scientific investigation approach (DIS) and personal action projects among high school students: A tool for reflection on classroom practices Case of an ecological school trip in a natural environment

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Abstract

The teaching of SVT in general offers learners an environment that allows them to explore and explain natural phenomena, to understand different spatio-temporal scales, to understand the world around them so that they can decide and act responsibly. It is interesting to note that the scientific ecological outing (SES) is an integral part of the SVT teaching program, at both college and qualifying secondary level, and that teachers are called to organize these outings in agreement with the programs as recalled by the circulars of the MEN. However, the SES allows the real observation and the execution of experiential practices in the field, it is the opportunity to place the learner in a learning situation according to a reflective and investigative scientific approach from his confrontation with reality Cariou J (2013), (2015) Offers a didactic framework and formalizes evaluation criteria for the implementation and management of a scientific investigation process. So that he can make connections with what the learner acquires as abstract knowledge in class in order to be able to decide and act responsibly and critically on the scale of everyday situations as an Eco citizen.

Keywords: school ecological outing, investigative process, experiential learning and reflective practice.

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Introduction

School ecological outings (SES) occupy a privileged place in the teaching of life and earth sciences (SVT). It aims to develop scientific investigation approaches and experiential field learning (Learning by doing). At the same time, the new pedagogical orientations 2007 never cease to proclaim the importance to give to DI as a powerful vector for the development of scientific skills. These pedagogical approaches based on the experiential learning model of (Kolb, 1984) allow learners to be given the opportunity to be an autonomous and responsible actor in the process of building scientific skills. This approach will be mobilized in its multifactorial aspects: Attitudes, behavioral behaviors (posture: a kind of scientific way of thinking) and cognitive strategies (procedure). These cognitive functions will be brought into play in an articulated scientific approach: exploration, reflection, abstraction, verification and regulation according to Grangeat M (ed.). (2011).

The investigative study of the natural ecosystem (bouskora forest) will have as its ultimate purpose the scripting of a personal ecological action project updated in a conscious, reasoned and responsible manner. The recommended scientific investigation activities to develop reflective practices in students who become not only passive learners, but their own actors in their learning, aimed at solving a complex and authentic problem "problematic, novel and significant situation". The apprentices formulate basic hypotheses, participate in the design of resolution strategies, formalize the appropriate tools and procedures for the verification and regulation of the personal project.

The teacher plays the role of an educational mediator, who works upstream and anticipates potential questions from his students, by calling on the process of self-regulation of his actions. Likewise, this ESS also aims to educate the eco-citizen of tomorrow on the issue of eco-citizenship and sustainable development (health, economy and environment).

Problem

Excursions on ecological and geological grounds are a good site for supporting students in investigating the natural environments outside the walls of the school. Our object of study aims to show the impact of school ecological exploration approaches on the development of investigative skills and reflective practices in high school students. Likewise, the study will aim to identify the constraints which hinder the achievement of such an objective and to propose adequate solutions for a better quality of learning in SVT.

Being aware of the importance of SES by teachers in the development of the investigative process in SVT learners.

Faced with this new educational concern, how can educational actors script and evaluate the investigative process to create favorable learning conditions? Does this central question encourage actors, trainers and researchers to highlight conceptual and methodological avenues for reflection? That is, studying the effects of investigation on learning: reflections on the links between theoretical knowledge and praxeological knowledge (cognitive and behavioral).

This work aims to meet the following objectives:

- Identify the different purposes specific to DIS.
- Establish the conditions required for the realization of this DIS in SVT.
- Highlight the difficulties and obstacles relating to the ISS investigation.
- Suggest solutions to overcome obstacles in order to re-establish an iterative DIS cycle.

Literature Review

This work lies at the intersection of two fields of educational research: the didactics of disciplines and the environmental sciences. It is part of a scientific approach and aims to identify the conditions so that students can independently engage in investigative work in a field class in ecology.

In this regard, Carretier B. et al. (2002). have defined an ecological school trip as being: “a group of pupils accompanied by one or more adults leaves the premises of the establishment from time to time to an hour, half a day or a day during school time ” Eddif A., et al. (2016). Defined the ecological outing as "a set of activities within the framework of an investigation process, guided by objectives related to the SVT program. The learners study the ecological phenomena of an ecosystem outside the school for half a day or a day to several days depending on the planned destinations, under the pedagogical supervision of educational actors (teachers) and / or others)"

At the end of this theoretical insight, we can retain that the school investigation approach aims at the development of scientific skills in the teaching of life-saving, the attributes used to define this process: activities, investigation approach, life-saving programs, learners, actors and phenomena ecological aspects of an ecosystem Hasni, A. et al. (2011).

It should be noted that this SES concept is polysemous, complex and diversified in its modes of expression and implementation in the curriculum, the pedagogical orientations of SVT (2007 - 2009) and in scientific publications.

In the United States, the "scientific method" was incorporated into science curricula over a century ago. The 2013 recent standards (Next Generation Science Standards) (NGSS Lead

States, 2013) have chosen another expression to designate the integration of scientific processes in school and to replace the concept of scientific inquiry: scientific and engineering practices.

In France, the experimental approach was replaced by "investigative procedures" between 2002 and 2010 and in a derivative form known as "practicing scientific and technological procedures" (Ministry of National Education, Higher Education and Research, 2015, p. 184) Calmette et al. (2015).

While in Quebec the DIS are specific to scientific disciplines, in France, the ministry seems to favor the generalization of these to a large number of disciplines, including science and technology and mathematics Astolfi J (1991)..

These field trips give another meaning to learning by offering learners direct and real-time contact with the environment than classroom experiences and paper or digital documentary supports (TIC), because they do not generate the same skills, the same discoveries and the same emotions.

They confront the representations of learning with reality and reality increases (AR) it is "a set of coordinated ideas and coherent, explanatory images, used by learners to reason in the face of real problem situations. » (Giordani,1987), cited by (Astolfi,2008).

Methodology

Field trips illustrate the interest of the investigative didactic approach in SVT, they can serve as a means of discovery and sustainable management of the environment, development of technical and strategic skills, the goal is to motivate students by mobilizing their curiosity. to easily and efficiently access new knowledge and technologies which will be quickly memorized and integrated. Agostini M, et al. 2012

The teaching of ecology at the secondary level qualifying for the common scientific core also calls for carrying out practical work in the laboratory as for direct observation of natural environments.

For the majority of Moroccan teachers of SVT, rarely have recourse to the SES, because they are content to talk about and use them theoretically based on very complicated models and already prepare, The majority of Moroccan teachers, If we do not mention the totality, consider that this activity is likely to be definitively excluded from reflective teaching practices, given the constraints with which they are confronted. Although the referential framework for educational outings encourages the strengthening of school life sciences programs while improving multidisciplinary learning projects (curriculum direction 2007), in fact the pedagogical directives and specific programs for the teaching of Sciences of Life. Life and Earth in the qualifying secondary cycle insist on the need to organize an ecological excursion for the Scientific Common Core (Direction des Curriculums, 2007). Indeed, the first semester (which equals 17 weeks) is dedicated to the study of ecology, hence the need for such an outing. The methodology implemented is based on the analysis of the skills acquired by the students during the ecological exploration process, as well as on the analysis of personal and collective action projects.

We therefore scripted a learning device and an evaluation method describing the different investigative tasks.

The results obtained show that the design of situations allowing students to engage in investigative work results from a dual approach:

- a didactic approach which leads to the explanation of a scientific process of ecological exploitation so that it can play its role as a tool for the conduct of a scientific investigation process Bächtold M (2012)..

Therefore, this clarification allows students to use the model as a "tool for thinking and interacting with the environment" Agostini M & Ginestié J, 2012.

- an instrumental approach, focusing on the uses of ICT, ie. Identify the geographic coordinates of the forest using technical and technological geolocation tools (by Google Maps and GPS) Amigues René & al. (1994).

The skills targeted by (SES):

- Cultural skills.
- Methodological and strategic skills.
- Technical and technological skills related to the field study.
- Appropriation of eco-citizen values and choice education to enhance a collective activity report.

To carry out this work, the study is organized into 3 main stages:

a) Preliminary investigation stage 1: the ecological outing will be started in class by the teachers with the students to explain the procedures for using the SES.

b) Stage 2 of investigation and exploration in the field: allows the development of reflective and experiential practices in an investigative process.

c) Step 3 of exploitation of the results (self-assessment): by highlighting solutions to the ecological problems encountered (highlighting).

The analysis grid that we use corresponds to a typology of the tasks of an investigative process, it allows us to locate the work carried out by the students and to analyze the learning through the foundations of the students' argumentation.

Sampling is represented by 8 classes (228 students) from the French international scientific common core participated in this study (as well as 10 SVT teachers and two research professors). These outings took place in the morning one day apart in 24 groups of 10 students. The study is spread over a period of two weeks (two ecological outings per week for an hourly volume of 3 hours), thus our study either representative and reasonable, eight samples were chosen in four schools run by Sidi Bernoussi, AREF in Casablanca. Figure 1 shows the distribution of this sample:

Table 1. The sample of the population studied by the educational establishment.

	Public high school						Private high school:	
	TCS1	TCS2	TCS3	TCS4	TCS5	TCS6	TCS7	TCS8
Number of students	36	33	35	38	39	40	25	22
Class average out of 20	11.75	10.23	14.04	12.76	13.39	10.89	15.03	14.66
Total students by school	181						47	
Total	228							

- Technical and methodological sheet of the stages of the investigation of the SES:

To carry out the report of the ecological trip. The learner would be led to respect the chronology of the stages of ecological exploration according to the three aforementioned stages, But our research will on my focus on the last two stage, because these are the fields of appearance of the investigative skills, for the first step was carried out in class (documentary study: conceptual and theoretical).

- Field investigation and exploration step 2

It contains four different investigation situations depending on the scientific (ecological), didactic and educational content of the outing.

1) Investigation situation1 (station1): geolocation: the student must be able to identify the geographic coordinates of the bouskora forest using the technical and technological tools of geolocation (by Google Maps and GPS) and must be able to discover the study area by mentioning a historical, socioeconomic, tourist and environmental overview of the forest.

2) Investigation situation 2 (station 2): The exploitation of an aquatic environment, a watercourse: the student must be able to examine the floral procession of the lake, trace the horizontal distribution of the plants of the lake then to explain this distribution by deducing the notion of the limiting factor.

The student measures the physicochemical constants of the lake water and determines the nature and role of the soil near the lake by explaining the absence of trees in the lake. The student must carry out the census of plant groups and animal species around the lake, explaining the high density of the junk around the lake by including the climatic factor in this distribution. They must determine the consequences of irrational exploitation of this water resource by humans? And how can we rationally manage this environment.

3) Investigation situation 3 (station 3): Exploitation of the tree and shrub layer: The student must compare this data with the characteristics of the environment, by determining the ecological factors that govern the life of the community that inhabits the area. Environment. Then he would be asked to describe the distribution of trees and shrubs in a vertical direction and deduce the abundance dominance of the species. The student carries out the census of

plant species, determines the nature of the soil of the station, identify the different relationships trophic between different species, deduce the notion of the flow of matter and energy in a forest.

4) Investigation situation 4 (station 4): Carrying out surveys (inventories) and census of species: The student must carry out surveys based on the quadra method, determine the floristic procession, deduce the minimum area of the surveys, conclude the homogeneity or heterogeneity of this ecosystem and must be able to create a herbarium.

Table 2. Correspondence ratio between the Stages of the Learning Cycle of scientific investigation and the targeted skills

Stages of the learning cycle of the scientific investigation process		Targeted skills
Explorer	Q1	Recognize the properties of lake plants
	Q2	Research the role of the lake in the distribution of plants present in the station.
	Q3	Prospect the study station
	Q4	Determine the abundance dominance of species (the abundance of each species and its mode of distribution).
	Q5	Examine the floristic procession.
Formulate	Q1	Make assumptions about the high density of the junk around the lake.
	Q2	Suggest hypotheses to understand the attachment of certain animal or plant species on / and under the substratum.
Realize	Q1	Measure the physico-chemical constants of water (PH, temperature, Salinity, Transparency)
	Q2	Carry out an inventory of plant groups around the lake.
	Q3	Carry out the census of animal species around the lake.
	Q4	Measure the length of tree species using a dendrometer
	Q5	Carry out the inventory of arborescent plant species.
	Q6	Take surveys based on the quadra method arranged within the study area
	Q7	Geolocate the buskora station using a telephone GPS.
	Q8	Trace and diagram the horizontal distribution of the plants in the lake.
	Q9	Calculate the minimum area of the readings.
	Q10	Make a herbarium.
	Q11	Draw the vertical stratification of this ecosystem
Check and regulate	Q1	Justify this variation in the distribution of plant species.
	Q2	Compare the different trophic relationships between these species.
	Q3	Monitor the place where lichens attach to tree trunks and see the direction of non-polluting winds
	Q4	Control the nature and role of the soil in the peripheries of the lake and these physico-chemical properties
	Q5	Prove the nature of the existing relationships between the nature of the soil, the climate and the distribution of living beings
	Q6	Test the nature of the station's soil.
Communicate	Q1	Explain the horizontal distribution of the lake's plants.
	Q2	Interpret the minimum area of the surveys
	Q3	Expose your herbarium.
	Q4	Correlate between the vertical stratification of this ecosystem and the brightness in the forest.
	Q5	Share processed satellite digital images with all groups in the output.
	Q6	Argue orally at the court of the ecological exit.
	Q7	Match a relevant internet search with other members in order to improve your reporting.
Conceptualize and abstract	Q1	Develop a relationship between the distribution of plants and the nature of the soil.
	Q2	Abstract the notion of the limiting factor for the distribution of plants.

	Q3	Develop a diagram explaining the absence of trees in the lake and their presence in the forest.
	Q4	Standardize a management plan to facilitate the accumulation of water in the lake without risk on vegetation in relation to climatic factors.
	Q1	Conceptualize the existing relationship between living beings in the forest and the flow of matter and energy in this ecosystem.
	Q2	Synthesize the different trophic relationships between the living beings of the forest.
	Q3	Mobilize methods, knowledge and techniques to make a report of the output.
	Q4	Intellectualize the relevant information during the release to establish a plan for exploiting the results obtained.
Adopt ethical and civic behaviors	Q1	Cooperate and collaborate with his group in the forest (field).
	Q2	Identify the impacts of human activities on the environment.
	Q3	Identify the roles played by humans in the balance / or degradation of the tree stratum.
	Q4	To base responsible choices for the protection of the environment.
	Q5	Understand individual and collective responsibilities on the environment.
	Q6	Conclude the homogeneity or heterogeneity of this ecosystem (notion of ecosystem balance).
	Q7	Respect safety rules: What are the consequences of the irrational exploitation of natural resources by man.
	Q8	Managing ecosystems rationally.

The actual practices of the scientific investigation approach	The skills targeted	Station investigation	Very useful	Quite useful	Not very useful	Not at all useful
Exploration	Recognize, search, prospect, determine examine...	S1	41 %	29%	23%	7%
		S2	45%	26 %	16 %	13 %
		S3	46 %	34 %	12 %	8 %
		S4	40 %	32%	21 %	7%
		M	43%	30,25%	18%	8,75%
Formulation	Make hypotheses, suggest hypotheses...	S1	11%	24%	39%	26%
		S2	11 %	14 %	40 %	35 %
		S3	9 %	15 %	30 %	46 %
		S4	12 %	17 %	40 %	31 %
		M	10 ,75 %	17,5 %	37,25 %	34,5 %
Realization	Measure realize, perform, execute, practice, geolocate, plot, calculate, draw ...	S1	61%	20%	14%	5%
		S2	47%	28 %	17 %	8 %
		S3	45 %	30 %	18 %	7%
		S4	60%	22%	12%	6 %
		M	53,25 %	25 %	15,25 %	6,5 %
Verification and regulation	Justify, compare, monitor, control, prove, test...	S1	16%	14%	45%	25%
		S2	15%	15 %	44 %	26 %
		S3	11%	19 %	43 %	27 %
		S4	13%	18 %	40 %	29 %
		M	13,75 %	16,5 %	43 %	26,75%
Communication	Explain, interpret, expose, correlate, share, argue, correspond...	S1	11%	13%	24%	52%
		S2	10 %	15 %	22 %	53 %
		S3	9 %	11 %	26 %	54 %
		S4	8%	14 %	20%	58 %
		M	9,5 %	13,25 %	23 %	54,25%
	Elaborate,	S1	9 %	14 %	13%	64%

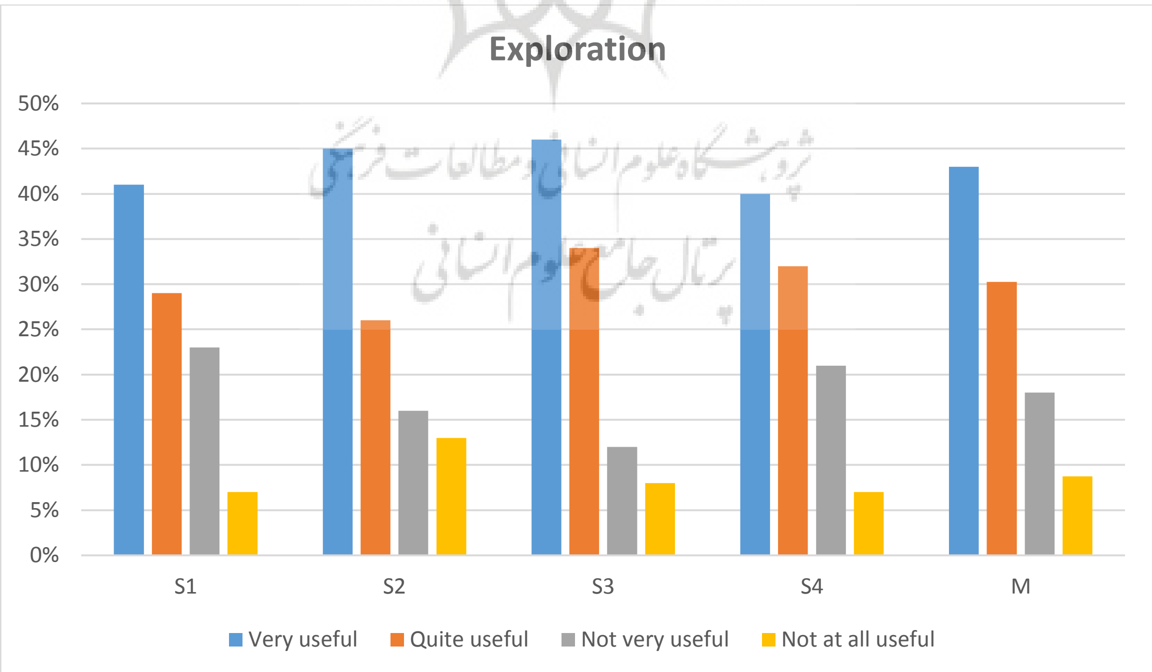
Conceptualization and abstraction	standardize, abstract, conceptualize, synthesize, mobilize, intellectualize...	S2	6 %	15 %	17 %	62 %
		S3	7 %	11 %	15 %	67 %
		S4	5 %	10 %	16 %	69 %
		M	6,75 %	12,5%	15,25 %	65,5%
Adaptation of ethical behaviors and citizenship	Cooperate and collaborate with your group, identify impacts, base choices, understand, conclude, respect, manage, have attitudes, express an opinion, base responsible choices, understand individual and collective responsibilities, respect safety rules...	S1	6 %	10 %	47 %	37 %
		S2	5 %	13 %	48 %	34 %
		S3	5 %	14 %	52 %	29 %
		S4	3 %	15 %	54 %	28 %
		M	4,75 %	13%	50,25%	32%

Results

Analysis and discussion of results

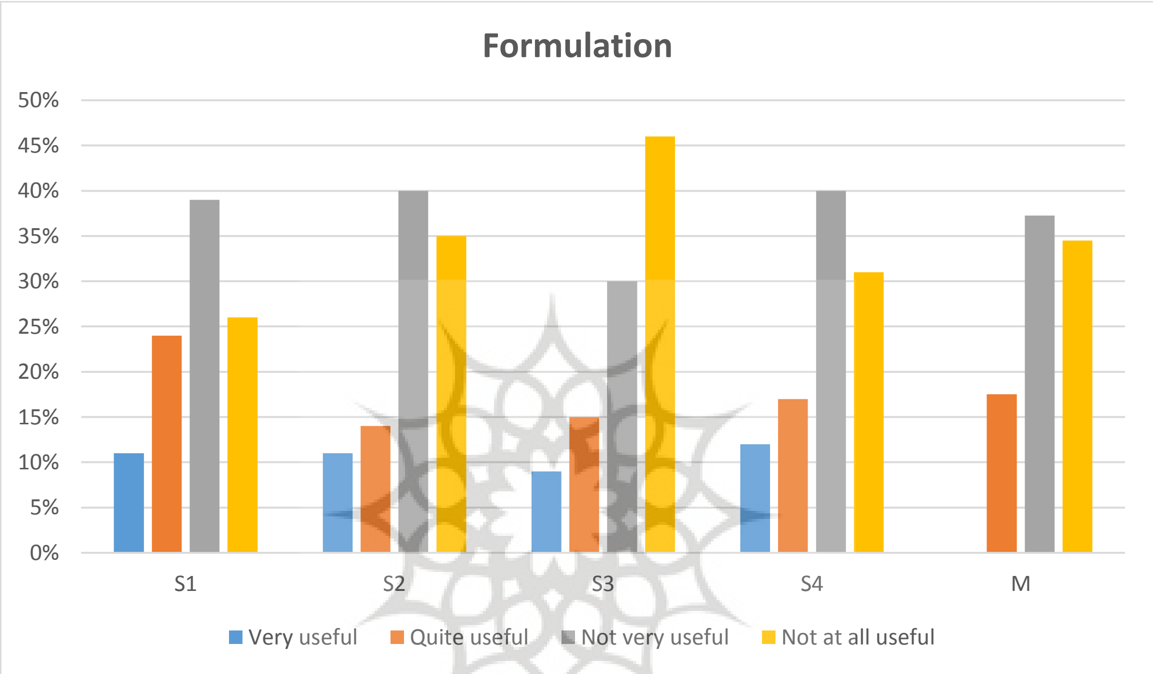
This type of analysis involves a variety of prior knowledge and skills in ecology and svt in general that could be a barrier to the conceptualization in science for DIS.

The exploitation of the results of this teaching-learning situation for a cycle of DIS revealed that the stages of the DIS study in SES have important differences and gaps in the mastery of students of these stages:



Exploration: a large number of students master this step without any difficulty (73.25%), recognize the properties of the plants of the lake, research the role of the lake in the distribution of plants present in the station, prospect the study station, determine the abundance dominance of species (the abundance of each species and its mode of distribution), examine the floristic procession.

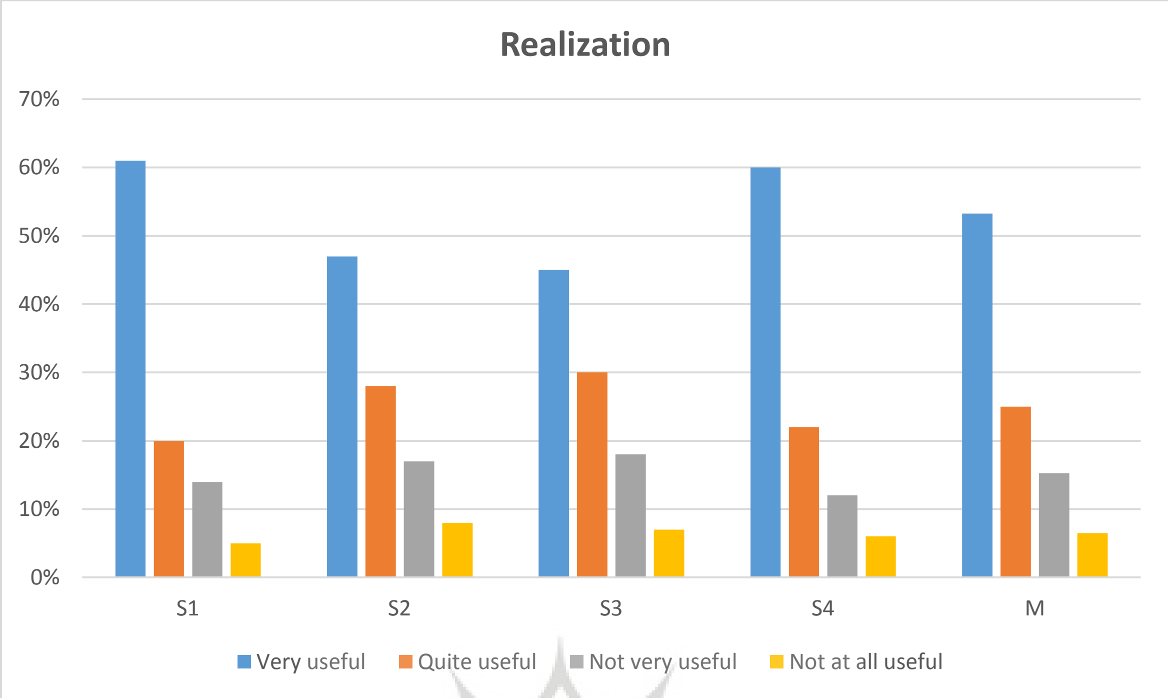
This allows us to say that this stage of the investigation is easy to carry out, and does not represent any obstacle for the mastery of this approach in the scientific learning process.



The formulation of hypotheses: Several students experienced significant difficulties in formulating hypotheses (71.75%): explaining and interpreting real ecological phenomena in the field such as the abundance and density of eucalyptus.

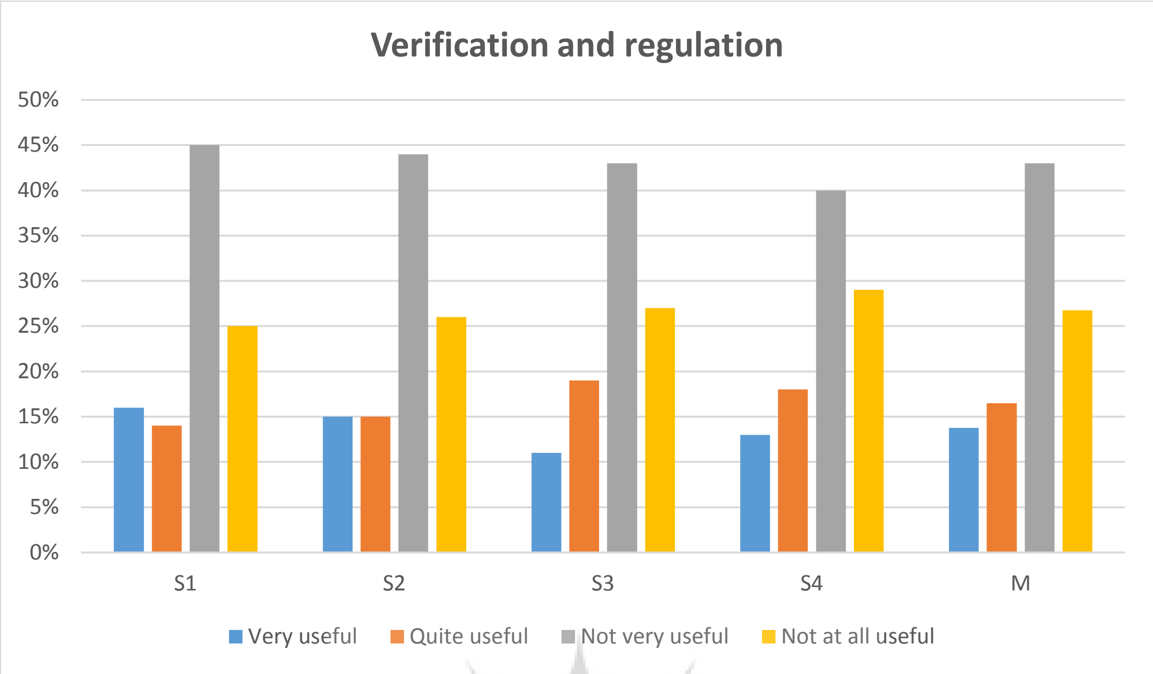
Interpret the absence of the shrub stratum around this type tree, and the accumulation of water in the lake, make hypotheses for the high density of the junk around the lake, suggest hypotheses to understand the attachment of certain animal or plant species on / and under the substratum...

These results show us that students find it enormous difficult to formulate a hypothesis that will explain such a scientific phenomenon... and this slows down the completion of the investigation cycle, even if it is understood by the use of this approach in pedagogical debates, but the cycle of this approach is not completed, one of the essential steps is almost absent in the majority of learners.



The realization: The majority of students experience this step without any problem (78.25%): Measure the physico-chemical constants of the water (PH, temperature, Salinity, Transparency), carry out the census of plant groups around the lake, carry out the census of animal species around the lake, measure using a dendrometer, the length of tree species, carry out the census of tree plant species. Practice surveys based on the quadra method arranged within the study area, geolocate using a telephone GPS the bouskora station, trace and schematize the horizontal distribution of the plants of the lake, calculate the minimum area of the surveys. Make a herbarium, draw the vertical stratification of this ecosystem...

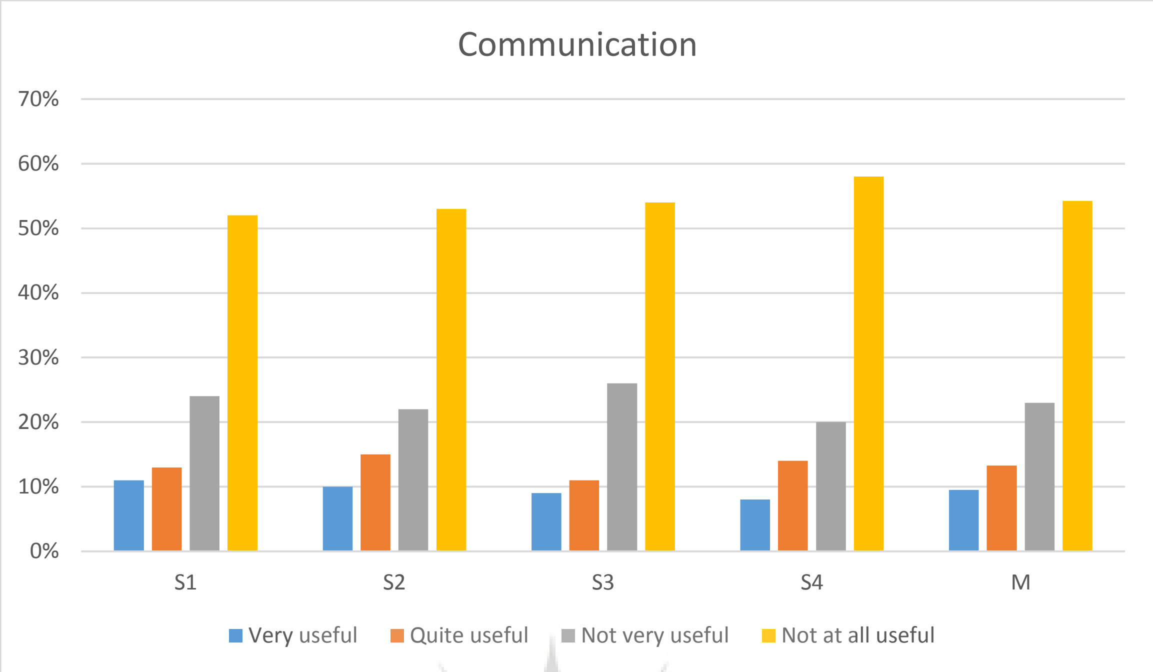
These results show us that students master this stage of investigation that allows them to carry out and practice with technical and methodological skills certain tasks that are already acquired in class or through previous years, but it does not allow to complete the cycle of investigation, because these stages depend on each other.



Verification and regulation: A significant part of the learners have enormous obstacles with regard to the verification of hypotheses (69.75%): Justify this variation in the distribution of plant species, compare the different trophic relationships between these species, monitor the place of the fixation of lichens on tree trunks and note the direction of non-polluting winds, control the nature and role of the soil in the peripheries of the lake and these physico-chemical properties.

Prove the nature of the existing relationships between the nature of the soil, the climate and the distribution of living beings, test the nature of the soil of the station... To verify and justify these hypotheses by proposing experiments or the use of knowledge and measurement techniques and sampling to test in class (Practical Work) these real ecological phenomena in the field such as the action of light on the life of earth glasses in the ground ...

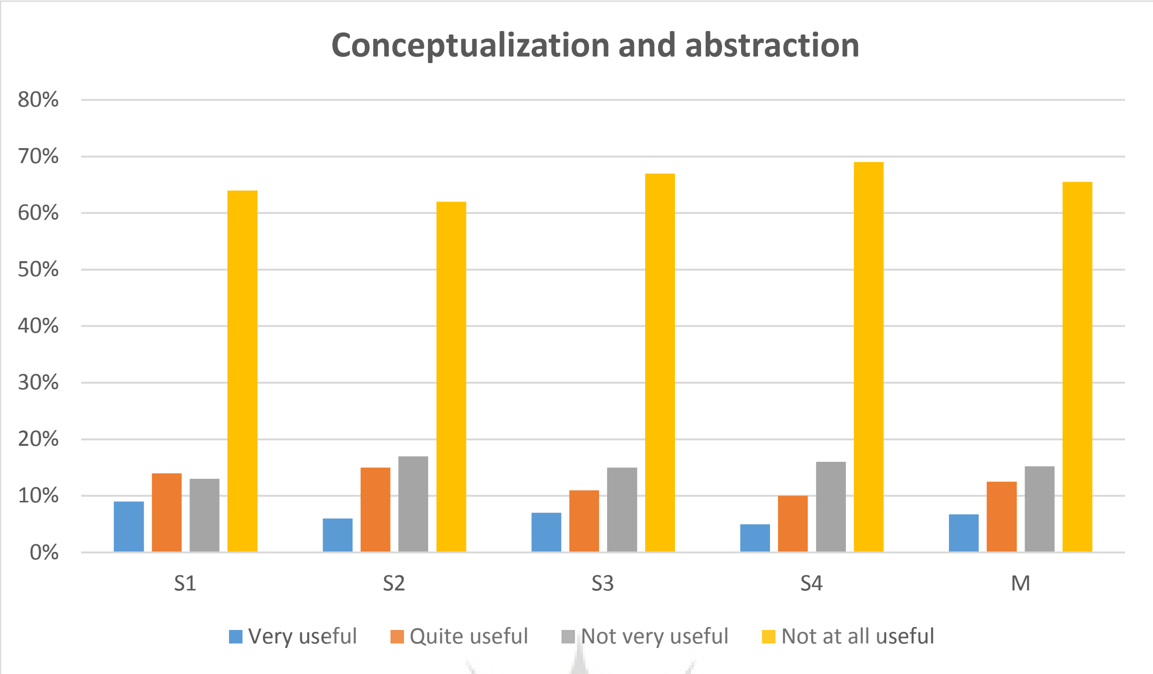
These results reflect that students have a conceptual level regarding this stage of investigation that allows them to verify by proposing explanations of the experiences and suggestions... to solve certain scientific problems.



Communication: (53.25%) present significant difficulties in scientific oral communication to express their opinions, attitudes, and describe complex scientific phenomena (vertical stratification of plants, interspecific competition between eucalyptus and fir...), in different types of communication situations (individual communication situation, two-way communication situation, two-way communication situation, group communication).

The appropriation of scientific oral language conduct is a complicated process that is part of the long-term. It is not limited to mastering the main structures of the language and its main acts of language. However, there are factors that complicate the field and that can be a source of blockage for students such as the association between verbal and gestural, emotional traits and the implicit conveyed by scientific oral and all forms of interaction.

The mastery of scientific oral communication in DIS is often estimated through its fluidity in primary exchanges: ability to speak continuously, without necessarily using elaborate formulations and the enrichment of scientific vocabulary in ecology, for example. However, we must not neglect the various forms of oral textuality, more elaborate than any practical learner on a daily basis. Developing oral scientific expression, and therefore new language behavior by making learners communicate in the most natural and authentic way possible, remains the primary objective of the scientific investigator approach.

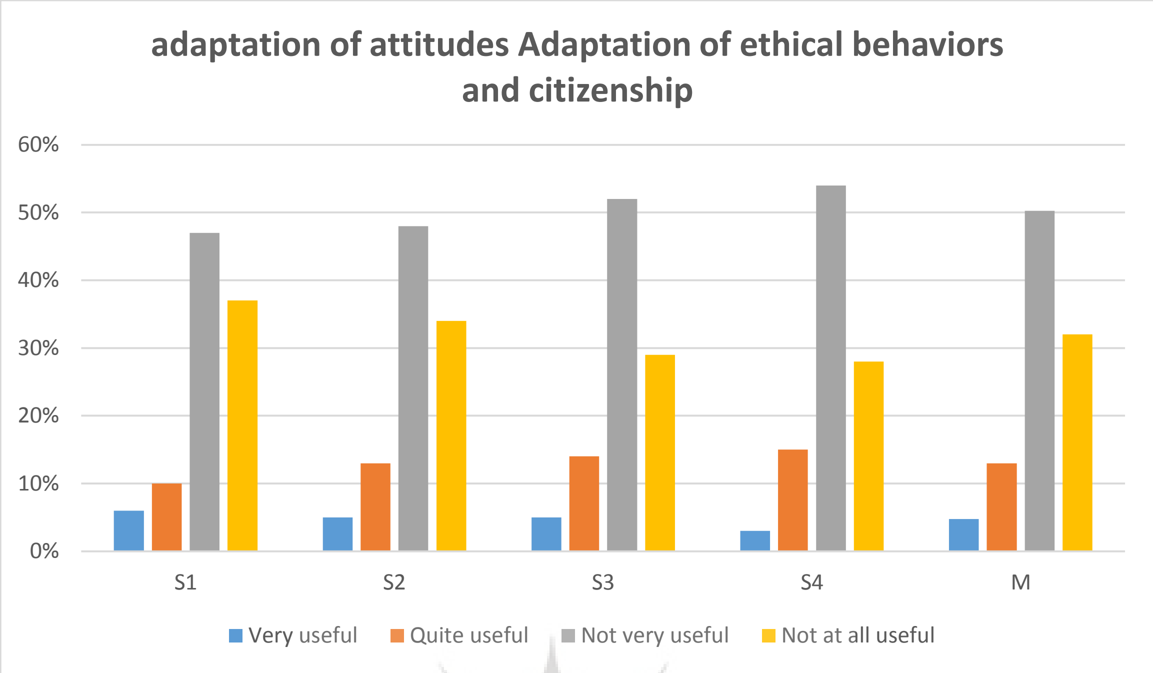


The conceptualizations and abstraction: (65.5%) of students showed significant difficulties in the theoretical and procedural conceptualization carried out in this ecosystem. During this stage of abstraction, the apprentices revealed conceptual and methodological inadequacies to confirm or refute the initial hypotheses. In correlatively the students propose the same incorrect answers on a recurring basis which results in destabilized knowledge in this situation of abstract conceptualization. For example, mastering the concept of the flow of matter and energy in an ecosystem for example is very difficult. Contextualized to the flow of matter and energy, it is defined by categorization energy not being a form of matter and does not participate in the production of energy and living matter of the links in the food chains. The perceptual obstacle of energy in an ecosystem leads to a devaluation of concepts belonging strictly to the field of physics as well as to the ecological and biological field.

As a result, we advocated for a mediation and tutoring approach to help learners reorganize their ideas in conscious and reasoned ways.

They are beginning to appropriate the tools and techniques of comparison, generalizations and transfer of theoretical and methodological knowledge to map and model the different study stations.

It is pointed out in passing that students' intuitive conceptions appear to be the major obstacles to the understanding and use of new ecological concepts and the use of new approaches to experiential learning and scientific investigation.



The adaptation of attitudes Adaptation of ethical behaviors and citizenship (82.25%) of students present significant difficulties in the adaptation of ethical attitudes and behaviors and citizenship vis-à-vis the principles of work in this extracurricular situation. The analysis indicators thus constructed allowed us to identify variable registers of implications and postures related to the code of ethics (commonly shared charter of values) set.

Here we confirm the hypothesis of the difficulties and obstacles encountered in setting up a community project analyzed in terms of the principle of collaboration, accountability and adaptation. New knowledge closely related to the environment, society, economy, geography.

- Educational practices (problem solving, debates, collaborative approaches, projects, etc.) modifying usual practices and posing evaluation difficulties.
- Epistemology at odds with school culture (complexity, non-determinism, uncertainties, importance of knowledge's eco-citizenship).
- Aims: values of responsibility and solidarity; explicit relationship to society and experience (change behavior, get involved), civic education, geography but clashes with the dominant deontology in SVT (ecology).

This type of research can be an opportunity to improve some investigative skills that are often used in svt. It would be possible to agree with svt teachers to work together on certain aspects of dis, such as the planning, management and evaluation of learning.

It would be important to identify the main knowledge involved in this situation and to distinguish the prior knowledge that students must appropriate to understand the problem and engage in the task, using the cognitive and behavioral mechanisms of dis.

As some students testify to the difficulties of formulating plausible hypotheses about the horizontal and vertical distribution of plants in the forest. As well as the accumulation of water in the lake and the determination of the ecological factors responsible for this distribution (biotic and abiotic factors). If one does not have prior knowledge about the ecology of plant and animal species (for example, eucalyptus secretes a substance toxic to all other plant species; etc.). This information should be provided in the student's guide.

The analysis of the data deserves special attention, since the results obtained are not of the same nature as what is obtained in the usual laboratory experiments. In the case of experimenting with the action of the caliptole on the distribution of other plant species is a key case study to build the concept of interspecific competition. In this register the students will be led to reason in probabilistic terms: we cannot think that it would be possible to eliminate all plant species by eucalyptus.

The concept of interspecific competition is at the heart of a reflexive debate: some students could attribute too much importance to the physical or chemical effect of the environment (direct action of the soil, climate, etc.) or to an internal will of the tree to defend itself against other competing species (eucalyptus secretes eucalyptol to ensure a comforting and permanent nutrition zone).

In another register, the observation of everyday phenomena may lead students to approach them using common sense and not the scientific rigor required for observation and experimentation. One of the main challenges would be to make them aware of the problem in its conceptual and methodological complexity.

It should be noted that (73.25%), students engage in the practices of exploration, DIS and find difficulties in analyzing and interpreting the observations made. The analysis should go beyond the simple description and should lead to the formulation of clear and explicit statements such as: "as eucalyptus trees develop, they constitute an area of nutritional protection against competing species"; "some tree species such as pine resists eucalyptus by height by accessing the light in mask the latter vis eucalyptus notice", etc.

Conclusion

The learning cycle of DIS among learners seems to vary from one situation to another and from one stage to another, which may constitute a limiting factor to the development of this scientific approach in a global and harmonious way.

In this research, we studied the implementation of the scientific investigation approach advocated by the new SVT curriculum in 2007. The study looked at the analysis of dis's learning cycle. To sum up, we analyzed four steps of this process. We therefore tried, as a first step, to answer the question: What are the difficulties and obstacles relating to the investigation in SES? And what are the solutions to overcome the obstacles in order to put back in place an iterative DIS cycle? It is a question of determining the levels of effectiveness of this scientific approach that the designers of the programs have chosen to highlight in the national pedagogical orientations. We have been able to see, through our analysis of the investigation approach from a methodological point of view, that the types of constraints and suggestions by field observations, through the different stages are not accomplished, which blocks the completion of the cycle of realization of the DIS in terms of SVT.

The analysis of the study data, we noted that a high efficiency was revealed in the phase of exploration and formulation of the problems investigated by the students.

The second major register of analysis focuses on the experimental phase, that is to say the development of an experimental protocol of the investigation, we noted a timid mobilization of subjective experience and the putting into play of a clear and methodical experimental plan, which shows the importance given to learning the empirical-inductive investigation approach.

Finally, with regard to the phase of regulation and evaluation based on the implementation of a hypothetical-deductive approach, which calls for the questioning and construction of knowledge through active experimentation Kolb (1984). Our analysis revealed that half of the learners showed abilities for reasoned collaborative exchange, relevant evaluation and data synthesis in this ecological context.

Let us also note in passing that the production of this article is part of our concerns on the curricular reflection in engineering of pedagogical and didactic devices in svt "scientific skills DIS", in order to share with school actors our reflections on a central question of learning and teaching approaches to scientific investigation. From the outset, the study does not claim to provide a recipe for a supposed "idealized" DIS procedure to be routinely applied in the classroom. It is above all a conceptual and methodological tool, which proposes avenues for reflection based on the analysis of the most important publications in scientific awakening and their integration into teaching practices.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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