

The Main Issues of Natural Science Education in Madagascar

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Abstract

In Madagascar, a low participation rate in science majors as well as insufficient performance in science subjects in upper secondary education has been recorded over the last three years. This situation has aroused my interest to investigate the main barrier of science education, in particular of natural sciences subject. The objective is to find the main demotivating factors through data investigation and student survey. Open-ended questions as well as Likert scale questions were chosen. In this regard, it was found that poor performance in science subjects is the main reason why female and male students are not motivated. Regarding the teaching, the lack of concreteness is perceived in the natural sciences class but on the other hand the teacher was effective in his explanations according to the students. They are interested in the natural sciences but this field does not correspond to their professional project. There is a gap between the lesson conducted in class and the relevance of that one in society. Finally, the lack of concreteness of the teaching is possibly at the root of this demotivation. Overall, the study also highlights the factors performance and the career plan as important in influencing students' choice in this place.

Keywords: Science Majors, Natural Science, Motivation, Highschool, Madagascar

1. Introduction

Nowadays, there are two competing curricular priorities: science knowledge and science skills. It is important to reconceptualize the nature of science in order to improve students' attitudes towards scientific subjects by considering it as a crucial tool for the development of society. As Pickering (1992) states '*science can not be viewed merely as a body of knowledge but as a particular epistemic, social and cultural practice*' so this science as practice should not be marginalized but considered core of science learning.

Through science practices, science skills can be developed in class so students can better realize the relevance of science in society needs. Actually, science practices involve the collection and analysis of data for particular practices, for instance, of modeling of phenomena (Sibel & Zoubedia, 2014). Furthermore

science practices aims to situate these aspects of science within broader epistemic and discursive practices, such as the creation of "patterns of meaning in data" and the coordination of theory and evidence (Sandoval & Millwood, 2005). With these skills, students are capable of finding the necessity of science in their study as well as their future prospective. Following that, activities including science practices are essential.

These are some examples of scientific practices proposed by Sibel and Zoubedia (2014) :

- Observation: It is the central scientific activity to know the physical world. The Understanding of the world through sensory experience can be practiced.
- Classification: It is a meaningful clustering of experience (Kwasnik, 1999). This operates through particular structures such as hierarchies

and set with epistemic purposes.

- **Experimentation:** In this practice there is a production of new objects, substances, phenomena and processes.

We must not only focus on knowledge, but more importantly, we should allow students to develop their science skills. Holbrook & Rannikae (2007) in table 1 compared two concepts of science education: the first is “science through education”, it is about an approach

where students learn scientist works as knowledge and do not conduct their own research; the second is “education through science” during that students conduct research by themselves to solve a societal problem and develop science skills. In this theory, education through science develops better attitudes and in this context, science is considered widely to develop society.

Table 1. Comparison of two concepts of Science Education

Science through Education	Education through Science
Learn fundamental science knowledge, concepts, theories and laws	Learn the science knowledge and concepts important for understanding and handling socio-scientific issues within society
Undertake a practical work and appreciate the work of scientists	Develop personal skills related to creativity, initiative, safe working, etc
Develop positive attitudes towards science and scientist	Develop positive attitudes towards science as a major factor in the development of society and scientific endeavours
Apply the uses of science to society and appreciate ethical issues faced by scientists	Develop social values related to becoming a responsible citizen and undertaking science related careers

Source: Holbrook & Rannikae (2007)

It is crucial then to conduct a lesson in the form of a problem to solve. The starting point of the lesson should be considered as a relevant socio-scientific aspect in a society (Marks & Eilks, 2009).

After discussing about science education in general, the current situation of science education in Madagascar is analyzed.

Science and its results play a leading part in terms of development for one country. For a developing country like Madagascar, the presence of high-level scientists will be an added value to ensure its development in the coming years. The choice of such a path is already being made in upper secondary schools. However, upper secondary education remains struggling with 15% achievement rate and a 66% dropout rate (UNICEF, 2018). Over the past years, it has been recorded that high school students chose less and less the scientific baccalaureate in their curriculum. As a matter of the fact, only 3% of the candidates registered for the exams opted for scientific majors against 75% for literary baccalaureate majors (Midi Madagasikara, 2017). Nevertheless in 2018, 81.40% of teachers were registered as fully qualified in Secondary Education, in other words have at least a bachelor's degree in their academic studies (World Bank, 2021).

These circumstances sparked my interest and

led me to ask the following research questions: what are the main obstacles to natural science education. And what are the factors that have generated this demotivation? However, according to psychologist Lev Vygotsky, constructivist pedagogy has emphasized the role of active teaching and learning in promoting students to construct their knowledge (Vogel-Walcutt et al., 2011). Regarding this crucial role of education, I adopt the hypothesis in relation to the insufficient quality of teaching, such as the lack of concretization of the lesson, which leads to a limited vision of the relevance of science in society.

2. Methodology

To highlight the situation of science education, three national offices such as the Directorate of Curricula and Pedagogical Research, the Service of Statistics and System Governance and the Office of the Baccalaureate, are asked to provide raw data on the situation of science education. Various raw data are collected: student scores and the proportion of number of students per field in the national examination, enrolment rate by school and finally the result of the national survey on the implementation of the new curriculum. Percentage of students number for each field was calculated.

The second part of the study is to investigate the weak points of the current natural science education by analyzing the attitudes of students. For my work, I focus on students' opinions, thus a survey was designed based on the survey TIMMS & PIRLS (IEA, 2018). The questions were asked to students in the scientific fields and to students in the literary fields in order to get different points of view. The content of the survey focused on the current state of science education, such as instructional materials and teacher effectiveness. I also examined student interests and performance. To obtain meaningful results, I used the Likert scale which has four response choices: agree a lot, agree a little, disagree a little, disagree a lot. The score from 1 to 4 is given following the response. I gave the highest score for the most positive attitude towards the material and the lowest score for the most negative attitude. We can see in Figure 1 an example of student's answer. The attribution of the score is therefore considered in relation to the questions. For

example, the questions in light color asked for their agreement on a good attitude. But some questions in dark color asked their agreement on a bad attitude. Also, open-ended questions were also asked to get an in-depth response to their main choices.

Thus, a survey was conducted manually among the students who were taught by 6 different science teachers. This survey was conducted in June 2021 in one of the 22 regions or territorial divisions of Madagascar, the *Analamanga* region. It is located in the capital Antananarivo, which is among the most populated places in Madagascar. For our purpose, I selected 4 public schools situated in different school districts of the region. This sample was selected with one school located in an urban area and three others located in a rural area because the majority of the population is located in the rural area. Then, I obtained responses in total from 206 students in 12th grade and 11th grade at Highschool.

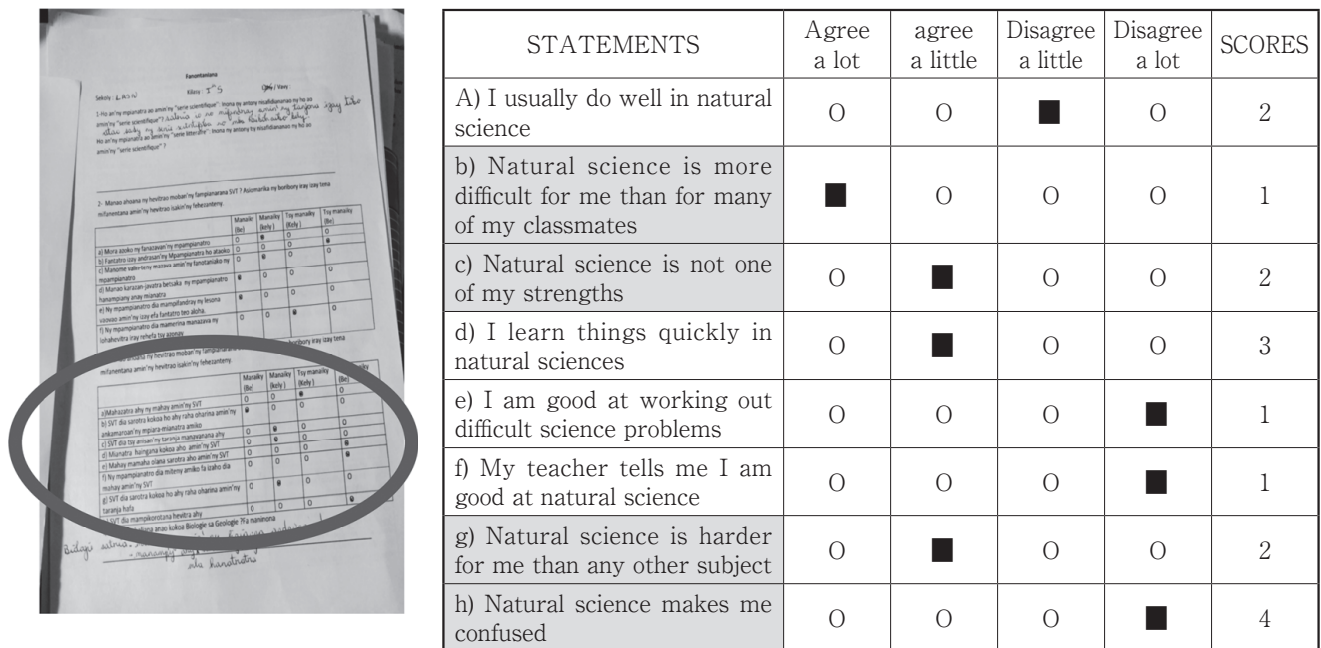


Figure 1. Student responses and scores following negative or positive attitude toward natural science

3. Results and discussions

To highlight the situation of Education, some raw data that I requested from some offices were processed and revealed a lot of information in this context. First, the Ministry's survey on the implementation of the new curriculum revealed that natural science teachers claim strongly the need of teaching resources

and materials to support their teaching according to the original data coming from unpublished survey report (Direction des Curricula et des Recherches Pédagogiques, 2020). This situation affects possibly the quality of science instruction or impacts student motivation in the classroom. In addition, the lack of teaching materials actually disadvantages some courses, especially for science subjects. Secondly, in

some cities, only a few students are motivated to pursue science path. For instance, in the *Analamanga* region, I found over the past three years that 16 to 20 schools in general education had less than 25% of students enrolled in science majors according to raw data from unpublished activity report (Service des statistiques et de la gouvernance des systèmes, 2020). In Madagascar, students are separated at 11th grade following their fields at high school. Students in science major deepen scientific subjects such as mathematics, physics-chemistry and natural sciences. In high school, the natural sciences subject consisted of life sciences (biology), ecology and earth sciences (geology). However, students in other fields of study also take scientific subjects but the contents are likely only in general. Therefore, in connection with this, they study more other subjects in depth. In addition, in recent years a low participation of science students in the national examination was recorded. For example, in the last three years, it was found that the number of students in the science major was less than half of the number of students in literary major. Regarding gender proportions, the number of male students was 20% higher than female students. Thirdly, the score of the students who passed the exam was insufficient for natural sciences subject. For example, the average score of students during last three years in the capital of Madagascar was between

9.16 and 12.62 out of 20 for literary field and between 10, 53 /20 and 12, 62/20 for science field according to the raw data from unpublished activity report (Office du baccalauréat, 2020).

Now, Student responses to the open-ended question were categorized. The graph in Figure 2 shows the different opinions of 100 students who enrolled in literary field. They were asked why they did not choose the science field at high school. The majority of them, around 40 to 50%, both male and female students, answered it was because of their low performance in science subjects. However, these results could be related to the poor quality of science education. On the other hand, 21.67% of the female students mentioned their goal in career plan. This factor is possibly related to the student's interest and also the availability of capital and human resources in the locality. On the other hand, 20% of male students do not refer to their career plan but they are more interested in literary subjects and 15% say that they feel more confident in literary subjects and that is the reason why they want to focus more on them. So, in general, after the factor of bad performance, I can say that the students consider their future career as advantageous in other fields. On the other hand, for male students, the interest in humanities is more important reason. I also noticed that they do not refer to their university studies when they made the choice.

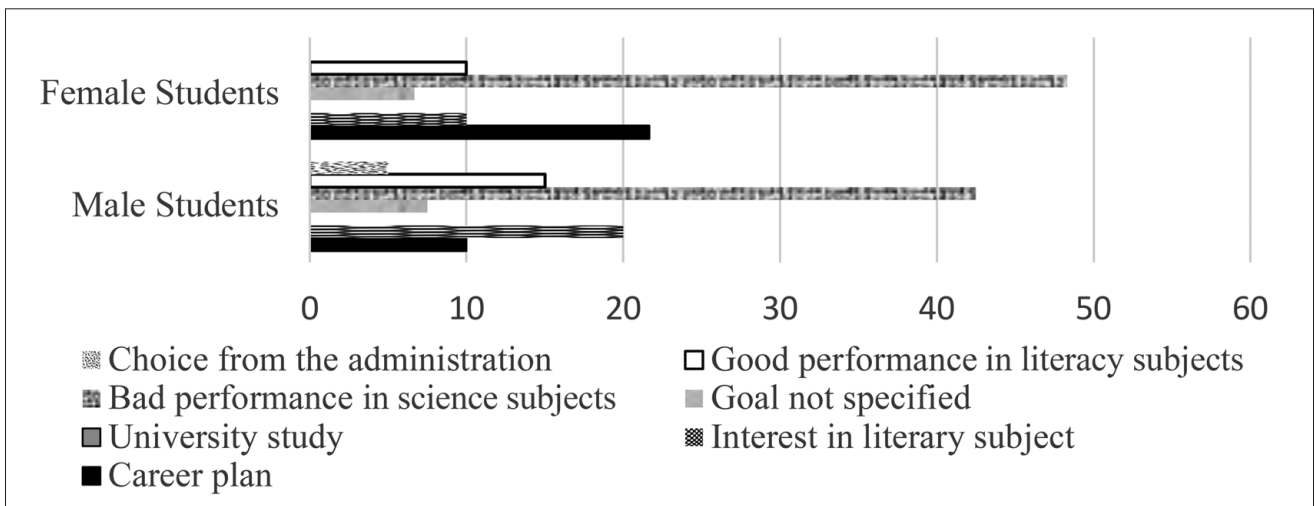


Figure 2. The reason of student non-participation in science majors.

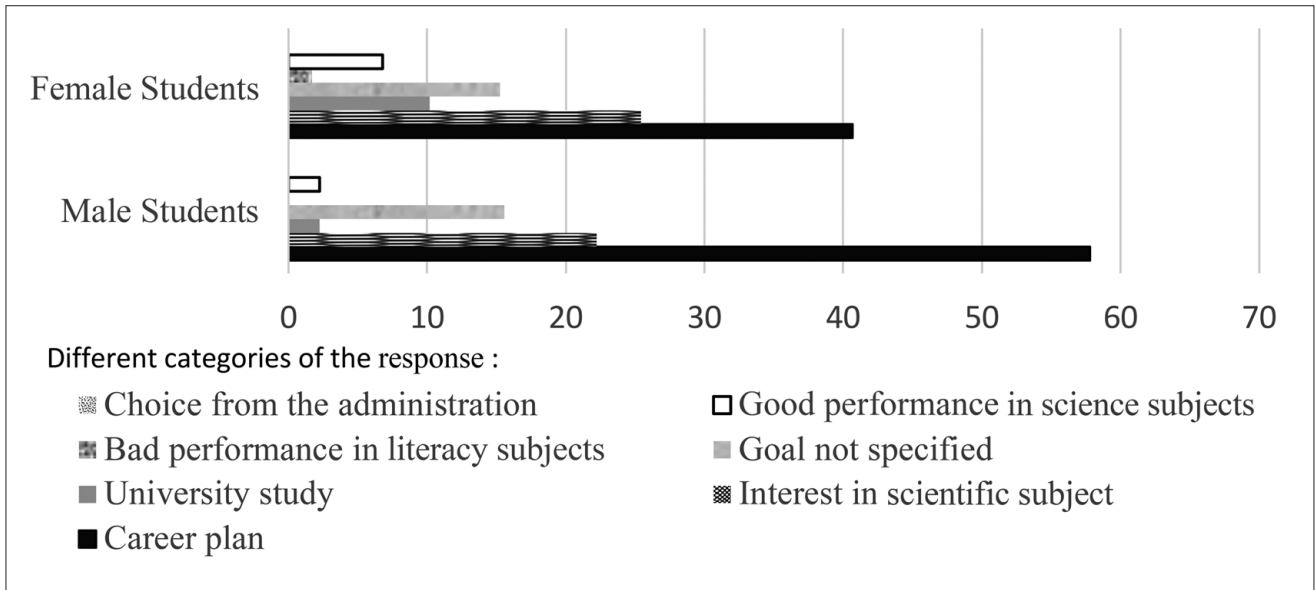


Figure 3. The reason of their participation in science majors.

The survey now focuses on students in science major. 104 students are participated. After categorization, the percentage of their responses is shown in the Figure 3. In contrast to the previous result, they have a large percentage on the reasons related to career plan, especially male students with 57.78%. Interest in science subjects is also significant for both male and female students with 22 to 25%. It is important to note here that only 2 and 6% of male and female students mentioned their good performance in science subjects. In addition, university studies were also mentioned as a reason, with a fairly high percentage among female students.

In view of this data, I can say that students in other fields of study indicate more the reason for their poor performance, but students in the science field of study did not really mention good performance in science, but it appears that they are convinced of the importance of these subjects in their career plans. The interest in science subjects is also an interesting

fact, with a percentage of 22 to 25%.

Regarding the Likert scale questions, here are some comparisons of the responses of students in these two different majors. First, the students' area of interest is examined. The graph in the Figure 4 shows the results with the standard deviation of each mean. Overall, students in science majors or SM scored highly in all areas, with a score of 3.4 or higher. For students in Literary majors or LM, we could see the interest in science in everyday life, its role in the evolution of the world, and the importance of scientific achievement. Despite this, natural science topics do not really seem relevant to their academic studies and professional concerns. This information is completely consistent with the answer to the question discussed earlier. The standard deviation is low for science field students and about 1 for literary field students. Thus, it is understandable that students in the science field perform better and thus the data fairly reflect the majority.

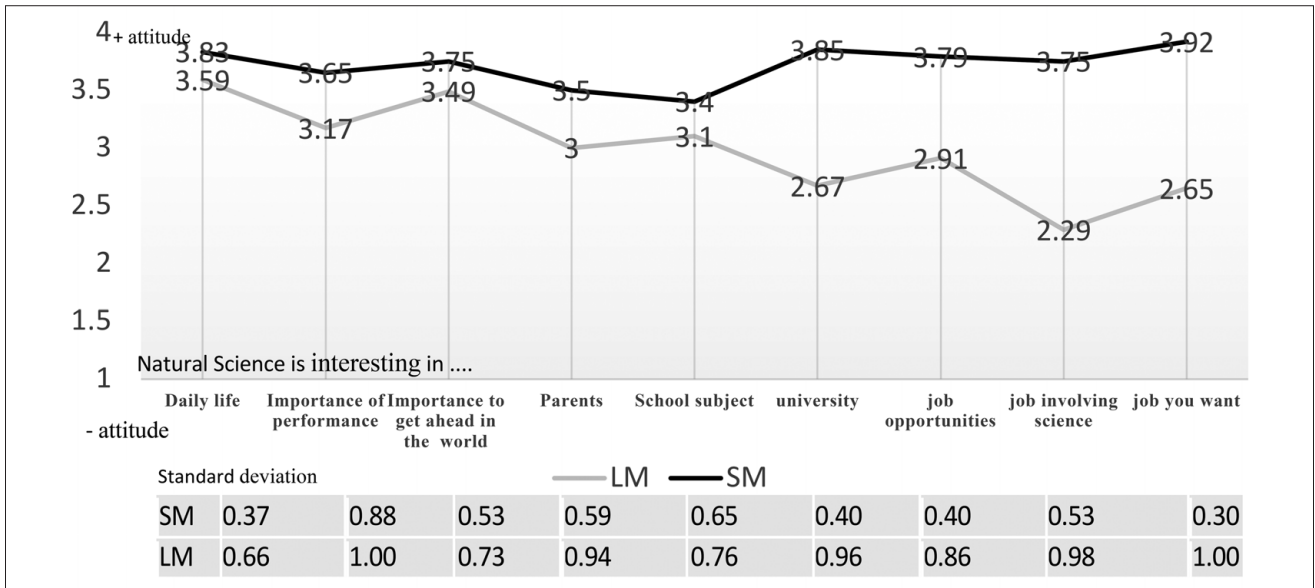


Figure 4. The analysis of interest of student towards natural sciences subjects.

The Figure 5 shows the performance of students in their natural science classes. It is important to say the content of their science courses is not the same and it is more in-depth for students in science major. Graphically, the majority of the students agree that they are good in science, but we can see their attitude seems to be in average, especially for the students in the literary major. They feel less confident in difficult problems with scores of 2.76 and 2.49. Concerning their performance in natural sciences subject compared to other subjects, students in the science major score well and, conversely, students in other major score in average with 2.5 and 2.64 for “science is one of

my strength”. Secondly, they feel that their teachers do not often tell them that they are good at natural sciences, with scores of 2.45 and 2.25. To summarize this section, students in other majors perceive less confidence in natural science subjects, especially compared to literary majors. This occurs even if their lesson is less deep than the science course content in the science majors. Regardless, they states they are not confused with that subjects with the 3.22 and 3.54 scores. The standard deviation is almost high and around 1 for LM. We can understand that the comparison reflects the majority.

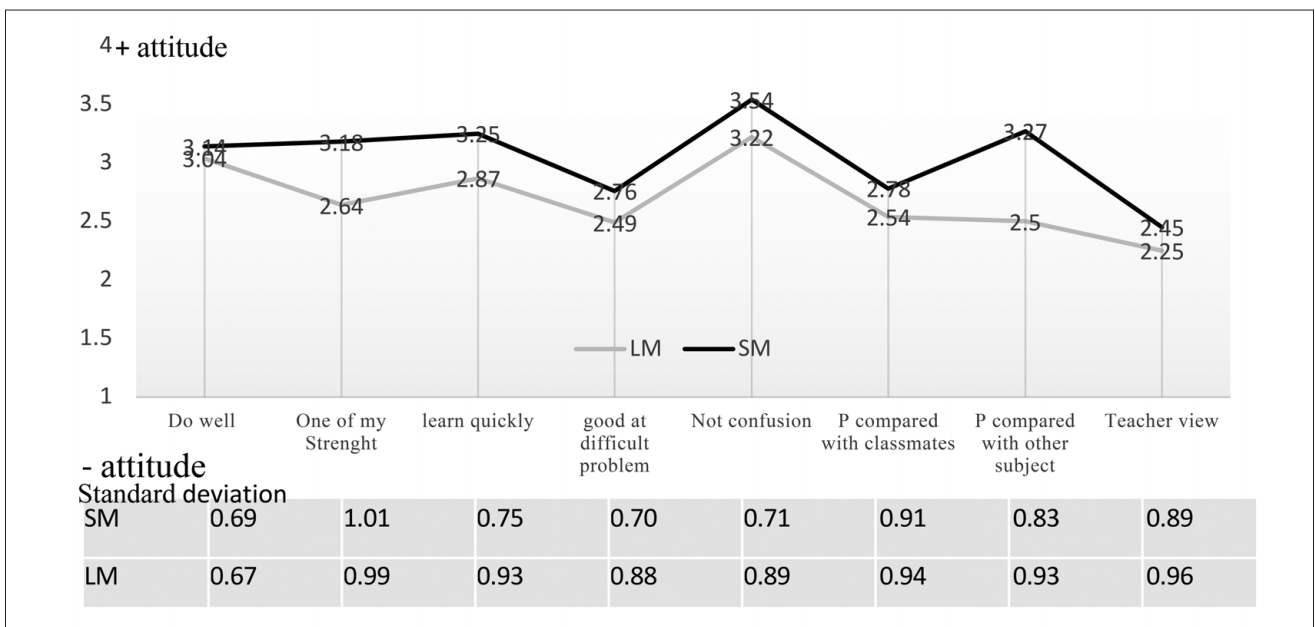


Figure 5. The analysis of Students performance.

The graph in the Figure 6 shows the statements regarding the teaching delivered by the teacher. All the responses are between 4 and 3. We can say they agree with the support provided by the teacher. It seems the teachers are easy to understand and make some efforts to explain the lessons. They have a good

attitude towards the teacher's effectiveness. It is important to say that these 6 teachers indeed are all qualified teachers in terms of degree. The standard deviation is quite similar and under 1. This means that the data is well clustered around the mean.

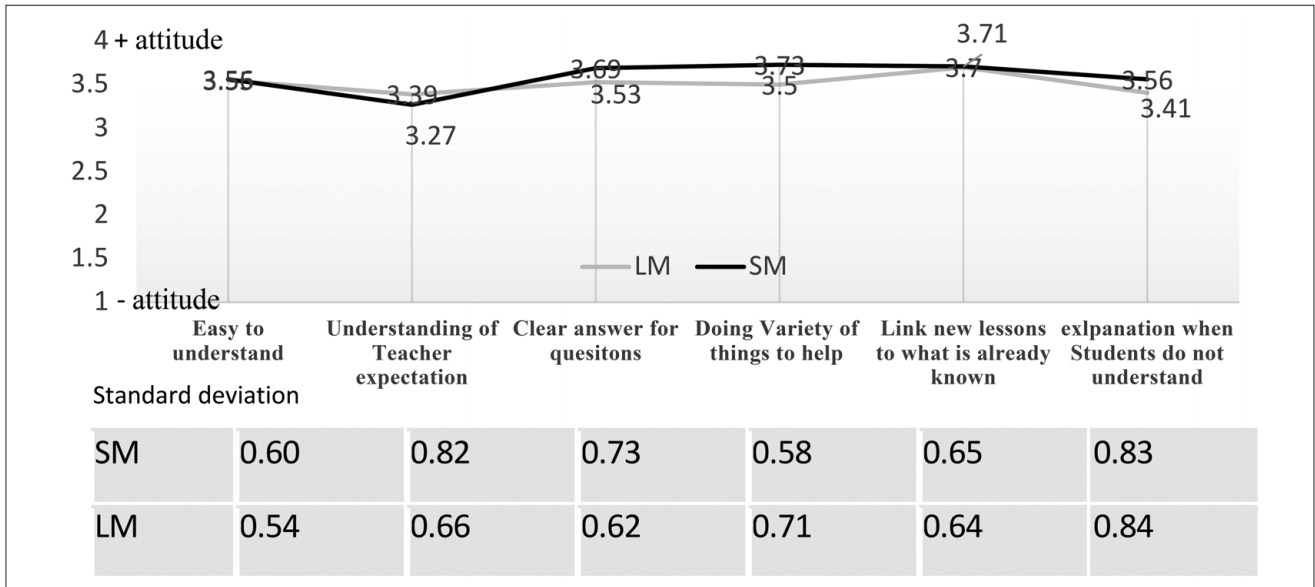


Figure 6: The analysis of the teacher's effectiveness in teaching.

Now the teaching materials are also studied. From here students was not divided following their field. In the following graph, the use of visual aids in class is represented. We can see in Figure 7 that 87.4% of the students mention that the diagrams drawn on the board are used at least once a week. Apart from that, the diagram in the handouts which is represented

in the second block, is used per week to explain the lesson following 48.1% of the students. Also, it was perceived that the pictures and real objects were never used with their high proportion of "Never". We can deduce that the lesson is less concrete. This may be an origin of this demotivation.

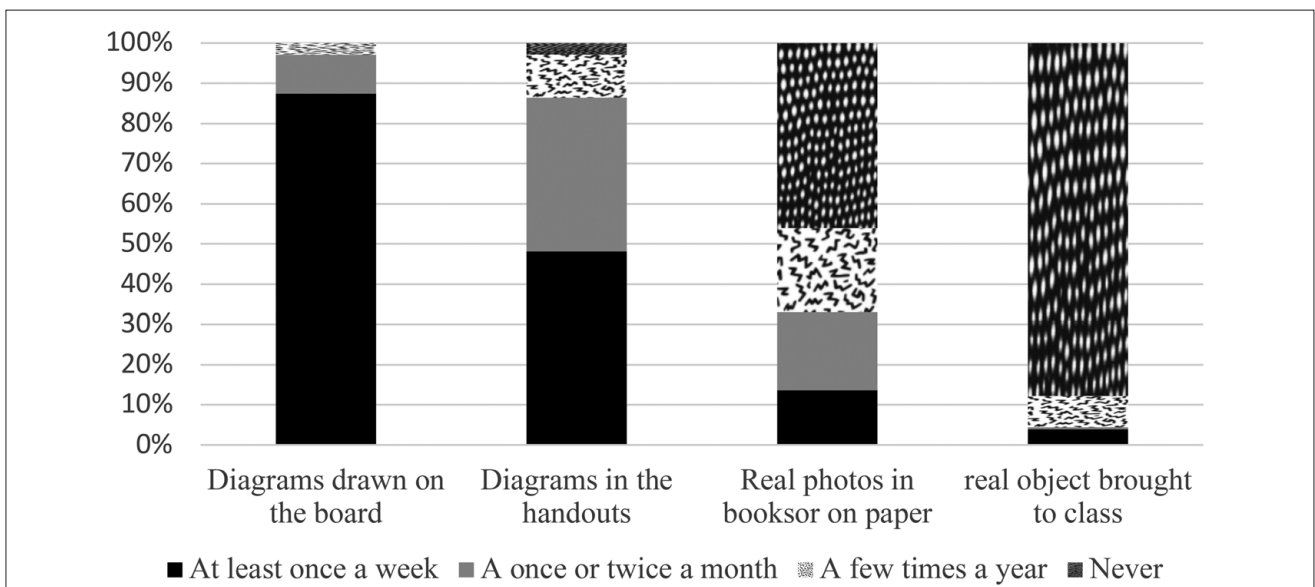


Figure 7. The frequency of the use of visual aids (N= 206 students)

Finally, students were asked about their preferences between science topics and the reasons for those preferences. The percentage of their opinions is shown in the Figure 8. The proportion is not well balanced as 153 students, or 76% of all students, prefer biology. On this, most of them answered because they are interested in the subject of biology content. We can interpret that biology is more relevant than geology.

There may be some failure in the teaching of earth sciences. Anyway, most of the students who choose earth science also have a great interest in the geology topic. It was also noticed that 6% of the students who choose earth science mentioned the poor performance in biology. This fact was not recorded in the biology pie chart. Thus, most of their motivation comes from the interest in the subject of each field.

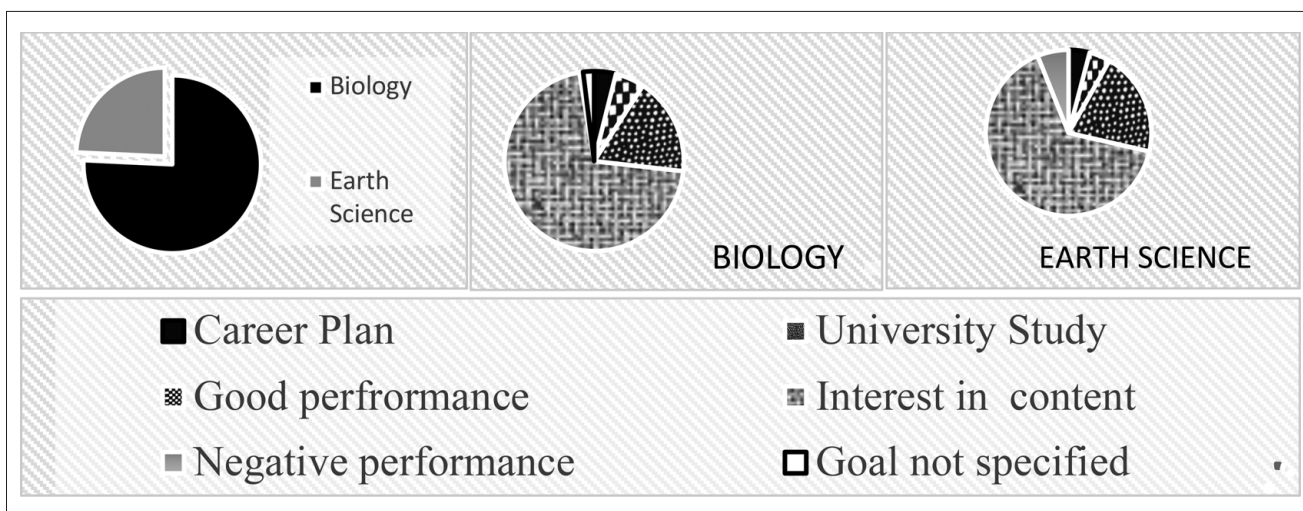


Figure 8. Student's preference between two topics of natural sciences.

4. Potential weaknesses of the study and areas for further study

In Science major, students deepen other subject like Mathematic, Physics, Chemistry. In this study, Natural Science only was the main focus of the study during Likert-scale questions.

For further study, It would be interesting to ask students about their attitude in natural sciences at Primary school and Junior High school so we could observe if there is any change caused by the teaching provided at Senior High school.

5. Conclusion

In conclusion, there is not enough participation of students in science major at high school. Actually, the relevance of science related to the needs of society is crucial to keep students motivated to learn and furthermore to think of the development of their acquired competencies into their prospective futures.

This study examines some issues related to science education, particularly natural science education in Madagascar, through requested raw data and student survey. Low participation in the science major was

actually perceived as well as the poor performance in science. Our investigation of student opinion from the survey leads us to the following interpretations:

Poor performance was the main reason why students did not choose to be in the science field with 42.5 and 48.33%. Then, with 21.67%, career plan was a factor for female students. Also, the interest in literary subjects was significant with 20% for male students. On the other hand, 40.68% and 57.78% of students in science major did this choice due to their career plan and very few students, 6.7% for female students and 2.2% for male students, reported being good at science subjects. Subsequently, the science subject is perceived as difficult but students who find the relevance of science with their career plan are willing to pursue it further and not because of their performance. The scientific career is seen as limited for female students. Concerning the natural science subject, these students showed an interest in this subject, for example in daily life, but in terms of usefulness to their career plan, students in the literary field probably disagree with a score of 2.29 to 2.91 on career concerns. These data confirm the above statement about the low interest in science

subjects in their professional project. The attitude of students enrolled in science majors is very positive in this context. On questions about their performance, they do not show a strong positive attitude but only an average attitude. However, science major students outperform literacy major students in terms of confidence. Students in the literary field show a low attitude regarding their performance compared to other students with a score of 2.54 and their performance in natural sciences compared to other subjects with a score of 2.5. As for the teaching provided by the professor, they all show a good positive aspect with an average between 3.71 and 3.27 for all statements. This is a very interesting fact that allows us to understand the good support from teachers to their students in their difficulties.

However, the teaching materials are poor in concreteness. There is low quality of visualization. The strong preference for biology over geology was also noted. This can be interpreted as a high relevance of biology over geology for students. We can also think there could be failures in geology teaching because there is not enough balance between these two areas.

Concrete material as well as the ability to connect teaching with the needs of society are important and effective elements to encourage motivation, so science teaching in Madagascar in this level has weak points that can demotivate students.

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