

Evaluation Short Term Learning Effects of the 'Learning with Nature' Environmental Education Programme in Mauritius

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Photo on cover: Ile aux Aigrettes © Mauritius Uncovered

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Summary

The island Mauritius is part of the biodiversity hotspot 'Madagascar and the Indian Ocean Islands'. The flora and fauna have relatively high diversity and endemism. Unfortunately, many species have disappeared during the past 400 years due to human colonisation (e.g. the Dodo). The Mauritian Wildlife Foundation tries to conserve the endangered endemic plants and animals of Mauritius. They are involved in 25 different projects in Mauritius, and one of these is the islet Ile aux Aigrettes. In addition to conservation, the Mauritian Wildlife Foundation is taking care of education on this islet. An environmental education programme 'Learning with Nature', which is a conservation education initiative of Chester Zoo, UK, developed in partnership with the Mauritian Wildlife Foundation has been running since mid-2009. As it is important to have an ongoing evaluation with education, the main goal of this study is to verify the quality of the 'Learning with Nature' education programme and to find out how this programme could be improved. This research was conducted by assessing the main aim of the programme: 'to gain an understanding of what pristine Mauritius was once like' while taking into account three concepts; (1) Flora and Fauna, (2) Human Impact, and (3) a Balanced Ecosystem. All data were collected from April to June 2011 on Ile aux Aigrettes, in Mauritius. To be able to assess this aim, two methods were used: Personal Meaning Mapping (PMM) and pre- and post-questionnaire. For the PMM two different scoring systems were developed to be able to compare their results, as not much information about scoring the PMMs was available. All data were collected from students of Secondary Schools that visited Ile aux Aigrette. In total 71 PMMs, 148 pre-questionnaires and 139 post-questionnaires were collected. In both of the methods used there was an increase before and after the visit of 6% (on a scale from 0% to 100%) in the 'understanding of what Pristine Mauritius was once like' on average. In the pre-PMM the students gained a mean mastery (total) score in Scoring System 1 and 2 of respectively 24% and 20% and in the post-PMM this was respectively 30% and 27%. In the pre- and post-questionnaire the students gained a mean (total) score of respectively 41% and 47%. This increase of 6% however was not enough to let the students have an acceptable (60%) 'understanding of what pristine Mauritius was once like', so the nature trail is not effective in achieving its aims. To confirm these results it is recommended to carry out further research where it is recommended to use the questionnaire in this type of study. Taking this into account and to offer a high quality tour in high quality circumstances (e.g. optimal group size, breaks, etc.), the Mauritian Wildlife Foundation should invest in adaptations to the nature trail. According to this it is recommended to adapt the nature trail to the different school levels, to achieve a maximum effectiveness of learning per school level and to offer different types of trails to the schools. Furthermore, schools should be more active in the pre- and post-processing of the education programme to be connected to the learning matter at school. The Mauritian Wildlife Foundation could stimulate this by developing complete learning activities/ packages that can be used directly by the teacher in school.

List of Abbreviations

| | |
|-------|---|
| BIAZA | British and Irish Association of Zoos and Aquaria |
| CSR | Corporate Social Responsibility |
| IUCN | International Union of Conservation of Nature |
| LWN | Learning with Nature |
| MWF | Mauritian Wildlife Foundation |
| NGO | Non Governmental Organisation |
| PASW | Predictive Analytics Soft Ware |
| PMM | Personal Meaning Mapping |

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1. Introduction

Off the coast of Mauritius there is a small islet of just 7 hectares, covered in coral reef, named Ile aux Aigrettes. This islet is maintained by the Mauritian Wildlife Foundation and opened to the public to show the natural heritage of Mauritius. Many species living in Mauritius cannot be found anywhere else in the world, and many of them have already become extinct; e.g. the Dodo.

On this islet, an environmental education programme has been running since mid-2009 to educate students about the natural heritage that occurs and used to occur in Mauritius. This education programme is called 'Learning with Nature' and is a conservation education initiative of Chester Zoo in the UK, in partnership with the Mauritian Wildlife Foundation. It is wished by the Mauritian Wildlife Foundation to let the education programme be subject to on-going evaluation (which is also advised by WAZA, 2005). This research is carried out to verify the quality of the 'Learning with Nature' education programme and to find out how it could be improved in the near future.

Evaluation is necessary to measure the success of a project and to suggest improvements for the future, wherefore the aims and goals of the education programme should be measured (Jacobsen *et al.*, 2006). Therefore this research focuses on the main aim of the programme which is presented in the next paragraph.

The evaluation was carried out using a method that has not been used very often and is always used in combination with other methods, like interviews or questionnaires: Personal Meaning Mapping (PMM). This method was developed by Falk and researchers at the Institute for Learning Innovation (Falk *et al.*, 1998) and is used to evaluate the learning activities of children towards a project or activity.

The Personal Meaning Mapping has mainly been carried out over the last few years by Falk and collaborators; Falk & Dierking (2000), Falk & Storksdieck (2005a), Falk & Storksdieck (2005b), Moussouri (2004). The techniques of the PMM are also used as a basis by Bowker (2007), Bowker & Jasper (2007), Lelliott (2007a), and Lelliott (2007b). Unfortunately, none of these authors discusses the exact way of scoring PMMs and all of this research was carried out in museums.

Within this study the PMM method was used for the first time directly in the field (it was used before in schools by Esson *et al.*, 2010) as part of an environmental education programme. During this evaluation this method was used as an experiment for using it outside museums. It is more common to use questionnaires in an evaluation of an environmental education programme, e.g. Kuhar *et al.* (2010); Engels and Jacobson (2007). Therefore, questionnaires were still carried out to be able to compare the outcomes of both methods.

1.1.1. Research aim

This research aimed to gain insight in the influence of the education programme 'Learning with Nature' on Ile aux Aigrettes of the students who are visiting this islet. This was done by researching the main aim: "to gain an understanding of what pristine Mauritius was once like". The change in this understanding is measured with the following research questions:

1. To what extent is the education programme 'Learning with Nature' on Ile aux Aigrettes effective in achieving its aims?
 - a. What kind of change is observed in the students' understanding of what pristine Mauritius was once like, before and after their visit to Ile aux Aigrettes?

- b. How does the comprehension of the understanding of what pristine Mauritius was once like vary between the students' different school levels, before and after their visit to Ile aux Aigrettes?
 - c. How does the comprehension of the understanding of what pristine Mauritius was once like vary between the students' different sexes, before and after their visit to Ile aux Aigrettes?
- '*Pristine Mauritius*' means nature with endemic plants and animals, a balanced ecosystem, with no exotic species and no human impact around 400 years ago, before colonisation took place.
 - The '*visit on Ile aux Aigrettes*' is the time from the moment the students arrive on Ile aux Aigrettes until the moment they take the boat back to the mainland.
 - '*Effective in achieving its aims*' means that the participants have 'an understanding of what pristine Mauritius was once like' and can be measured as a sufficient score (60% or more) in the PMM and the questionnaire.
2. What are the differences between the two research methods, Personal Meaning Mapping and the pre- and post-questionnaire (collected from students who visited Ile aux Aigrettes), and do these lead to the same conclusion?

1.1.2. Structure of report

In order to answer the research questions this research consists of 6 chapters, starting with this introduction of the research report. Subsequently some background information is given about Mauritius, the work of the Mauritian Wildlife Foundation, and about the set-up of the 'Learning with Nature' education programme and its nature trail. After this, Chapter 3 describes the research methodology, study area, and how the data were collected. The next stage is Chapter 4 where the results are presented, firstly all outcomes of the PMM and next the outcomes of the questionnaires. This is followed by the discussion and in turn the conclusion. The research is completed with a list of recommendations.

2. Background information

In this chapter some more background information about Mauritius and its role in biodiversity is described, followed by a short description of the Mauritian Wildlife Foundation and their work. Finally, the 'Learning with Nature' environmental education programme is described in more detail.

2.1. *Mauritius*

The Republic of Mauritius is a group of islands in the South West of the Indian Ocean, consisting of the main island of Mauritius, Rodrigues, and several outer islands that are located at a distance greater than 350 km from the main island (Republic of Mauritius, 2005).

Mauritius was formed by volcanic activity and has a central plateau which is about 400 metres above sea level and is almost entirely surrounded by coral reefs. The island is 58 km long and 50 km at its widest and in total it covers 1,865 km² (Mauritius Island Online, 2011; Mauritius UK Connection, 2009).

Globally, there are thirty-four different biodiversity hotspots. 'Madagascar and the Indian Ocean Islands' is one of these hotspots and Mauritius is part of this particular one. Due to the location, age, isolation and the varied topography of the island, the flora and fauna have a relatively high diversity and endemism (which means they cannot be found anywhere else on the planet); 40% of the mammal species, 80% of the bird species, and 94% of the reptile species are endemic to Mauritius (Republic of Mauritius, 2005). Of these animals 40% are already extinct. In Mauritius 315 endemic plant species occur, of which 63% is threatened (ranked by IUCN) and Mauritius may have already lost 70 plant species (MWF, 2009^a). Most of these species have disappeared during the past 400 years because of the human colonization (Ministry of Environment and Sustainable Development, 2010), which resulted in deforestation.

2.2. *The Mauritian Wildlife Foundation*

The Mauritian Wildlife Foundation was established in 1984 and tries to protect endangered species and their habitats in Mauritius (MWF, 2009^a). The Mauritian Wildlife Foundation is the only Non-Governmental Organisation (NGO) in Mauritius to be exclusively concerned with the conservation of the endangered endemic plants and animals of Mauritius.

The Mauritian Wildlife Foundation is involved in 25 different projects in Mauritius. One of these projects is the islet Ile aux Aigrettes, which is one of the 49 islets that surround and belong to Mauritius. It is a 27ha Nature Reserve situated 800 metres off the coast of Mauritius, laying in the shelter of Mahébourg Bay and crucially inside the protection of a coral reef. The islet is made up of coralline limestone and was exposed after a drop in the sea level some 30,000 years ago. (Esson *et al.*, 2010; MWF, 2004; MWF, 2010)

The Mauritian Wildlife Foundation works closely together with other parties like the Government of Mauritius (e.g. National Parks and Conservation Service, Ministry of Environment, and the Rodrigues Regional Assembly) and is advised by a number of scientific associates from various organisations (e.g. Durrell Wildlife Conservation Trust, the North of England Zoological Society, the International Zoo Veterinary Group, The Perigrine Fund (USA), the World Parrot Trust, the New Zealand Department of Conservation and the Natural History Museum (London)) (MWF, 2009^a).

On the islet Ile aux Aigrettes the 'Learning with Nature' education programme is carried out. A lot of species occur or have occurred in Mauritius in the past that can be found nowhere else on the world. The Mauritian Wildlife Foundation has an important role in communicating this to the participants that come to Ile aux Aigrettes for the 'Learning with Nature' programme.

2.3. 'Learning with Nature'

As a partnership between the North of England Zoological Society - Chester Zoo (UK) and the Mauritian Wildlife Foundation an education programme has been developed on Ile aux Aigrettes, called 'Learning with Nature' (LWN). This education project was awarded the 'Best Educational Project' at the British and Irish Association of Zoos and Aquaria Awards in 2009 (Biaza, 2009).

The 'Learning with Nature' involves a nature trail, called 'Le Sentier du Dodo', which leads all around the islet, takes about 2.5 hours and includes a 1.5 km hike with two boat trips of about 800 metres (± 7 minutes each) to and from the islet back to the mainland. The nature trail has been developed for Secondary School students at the age of ± 14 years old (Form II students) but it can be adapted for other school levels as well.

A specially trained guide accompanies subgroups of students (12-15 students) during the visit, where the students are able to experience the wildlife as it existed before the arrival of Man. The main topics covered in the nature trail are defined as follows (MWF, 2009^b):

- The Mauritian Wildlife Foundation; its roles and importance as a conservation charity - a Non-Governmental Organisation (NGO);
- The human effects on the environment; deforestation, soil erosion, pollution (water, air, land), and the introduction of exotic species;
- Conservation: endemic plants, endemic birds, reptiles, and natural habitats;
- Protection: how humans (including local people) can act to protect nature and save the environment.

Le Sentier du Dodo

'Le Sentier du Dodo' is the nature trail of about 1.5 km. It is proposed to walk this nature trail in small groups of 15 students at maximum and takes about 2 hours.

The nature trail starts with a short introduction by the ranger at the first stop: the Tortoise Nursery. In total eleven more stops are made where observations and activities are carried out

(for more information about the nature trail see Appendix I). The nature trail ends in 'Le Nid des Aigrettes' (Figure 1), where the students review the key topics of the nature trail and where they can read the interpretation. Figure 2 shows a map of the complete 'Le Sentier du Dodo' nature trail and Figure 13 and Figure 14 in Appendix I show a photo impression of the twelve stops made during the nature trail.

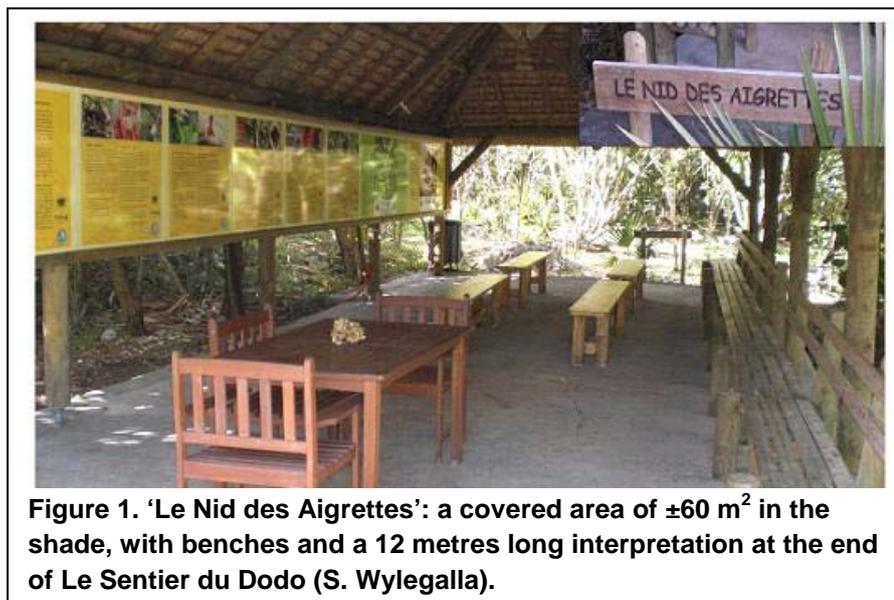
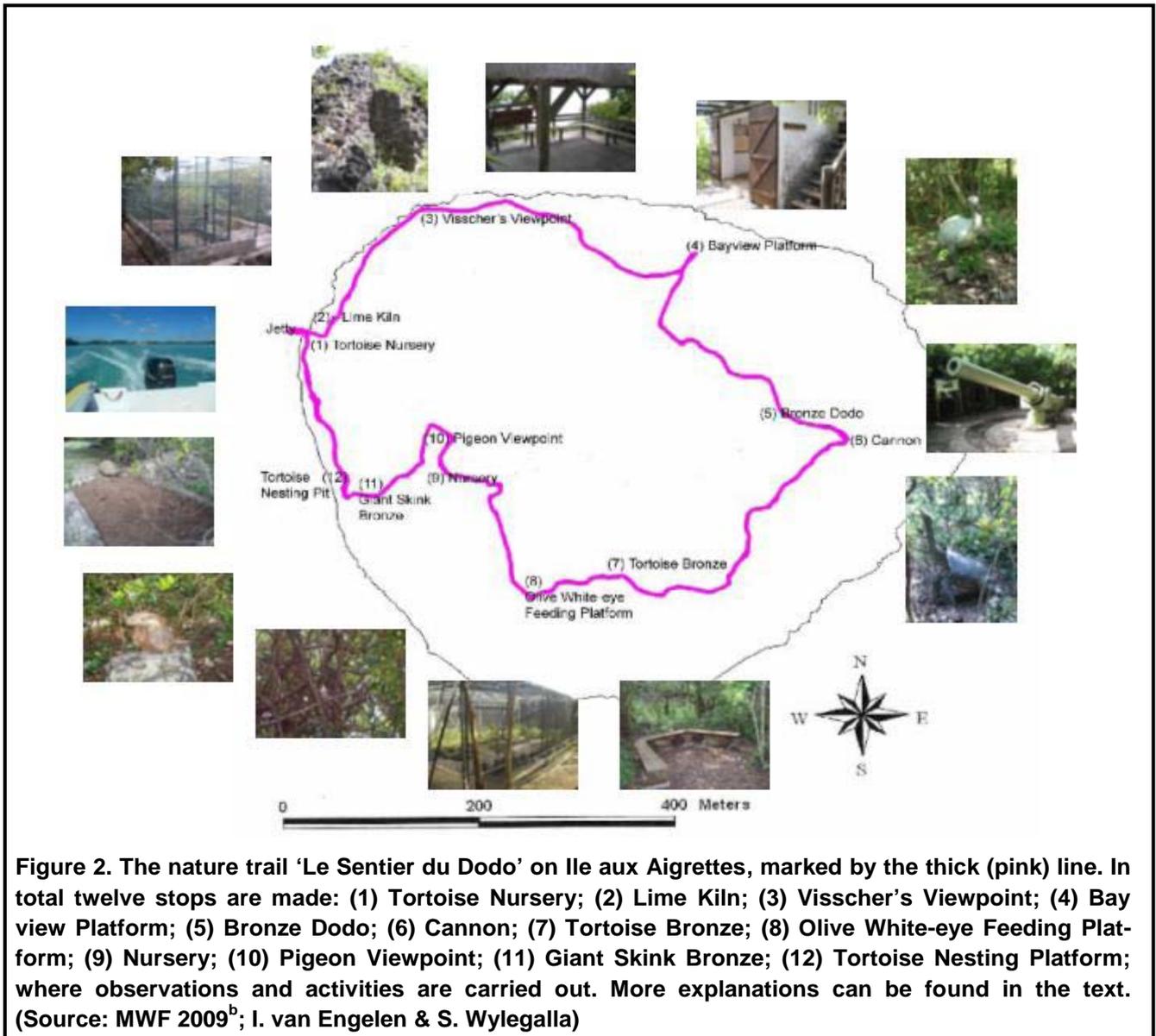


Figure 1. 'Le Nid des Aigrettes': a covered area of $\pm 60 \text{ m}^2$ in the shade, with benches and a 12 metres long interpretation at the end of Le Sentier du Dodo (S. Wylegalla).



2.3.1. CSR funding

The 'Learning with Nature' programme is sponsored by the Corporate Social Responsibility (CSR), which encourages companies all over the world to make a contribution towards sustainability and competitiveness. This can be achieved by integrating social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis (Commission of the European Communities, 2006). In Mauritius, the CSR funding is obligatory and regulated by law as a tax. This makes it possible for schools to apply for the 'Learning with Nature' programme so schools are able to come to Ile aux Aigrettes for free.

Not every school applies (or is able to apply) for the nature trail with CSR funding (e.g. private schools), but they are still able to come to Ile aux Aigrettes by paying approximately 1.60 pounds per student.

3. Methodology

The research aim was achieved by evaluating the effect of the education programme 'Learning with Nature'. The aim of the programme is *to gain an understanding of what pristine Mauritius was once like*. This was achieved by using two different methods: Personal Meaning Mapping (PMM) and a questionnaire both taken before and after the nature trail at different school levels from Primary Schools up to A-levels.

This chapter describes the use of both of these methods (PMM and questionnaire). Subsequently the study area, the data sampling and data collection are described. Finally the method of analysis is described, and the scoring of the PMMs is explained in detail.

3.1. Personal Meaning Mapping

Personal Meaning Mapping or PMM "...is a quantitative analytical method which is an evaluation tool for measuring and assessing learning in a flexible way" (Lewis, 2004). It measures the individual learning and change of the participants, even though each participant goes through a different learning process. The personal thoughts and feelings are assessed. Falk *et al.* (1998) states: "... PMM is designed to measure how a specified 'educational' experience uniquely affects each individual's personal conceptual, attitudinal and emotional understanding." It is not necessary that all participants have comparable knowledge and experiences, neither can an answer be 'right' or 'wrong'.

A PMM represents words, ideas, pictures, etc. linked to a central specific concept, which includes a level and breakdown of individual detail that enables information to be organised in meaningful ways (Lewis, 2004). At the centre of a blank page some words are written down, and the participants are asked to put down their ideas related to these words.

The information on the PMM can be factual information, ideas, beliefs, or any other related opinions, and is drawn in a specific colour on the paper. These drawings are interpreted in different variables (see Appendix IV a-b) and result in qualitative data, which is analysed in a quantitative way to measure and determine how much was learned by the different participants.

For this research an A3 sheet was made with the following words encircled located in the centre of the sheet: "*Nature on Ile aux Aigrettes 400 years ago*" written in English as well as in French to prevent a language barrier (Appendix II). By using these words, the students were totally free to draw anything they like about the nature on Ile aux Aigrettes 400 years ago. Two different colours were handed out (green in the pre-PMM and blue in the post-PMM) to be able to see the difference between the pre- and post-PMM.

In this case the choice was made to ask the participant to create as many drawings as they could, related to the words in a circle at the centre of a blank page. This was done due to a language barrier between the participants and the authors, and to prevent bias through an interpreter. English is the official language of Mauritius, but Creole is spoken by 80.5% of the civilians, followed by Bhoiphuri (12.5%) and French (3.4%), according to the Central Intelligence Agency (2011).

With the PMM a pre- and post-measurement was done. The PMM was taken from the same student of a group before and after attending the education programme 'Learning with nature' on Ile aux Aigrettes. Falk *et al.* (1998) mentions: "...it is crucial that the original paper is given back to the subject, rather than asking them to fill a new one. It ensures that they do not feel that the investigator is 'wasting their time' by asking them to repeat what they have already done, and it allows them to alter their original ideas" (in Lelliot, 2007^a).

3.2. Questionnaire

Questionnaires are quite flexible in what they can measure, however they are not equally suited to measure all types of data. The use of questionnaires produces nearly no costs and is uncomplicated in organisation (no need of extra materials) and is realisable in a high number in almost every place (e.g. in the field, on the street, at school etc.) (Mayer, 2002). In addition, questionnaires are comparable with a wide range of different other methods used to assess Environmental Education programmes, like in this case in comparison with the Personal Meaning Mapping (Mayer, 2002).

In the questionnaire for this study three key factors were influencing the design. The first one concerned the contents of the nature trail, by dividing the questions into three concepts: (1) Flora and Fauna, (2) Balanced Ecosystem, (3) Human Impact. These concepts were formed with a special focus on five subjects discussed during the tour: conservation, history, geography, phenology and biology.

Secondly, the wide range of ages of the respondents in the tour was taken into account by designing the questionnaire. Schnell *et al.* (1999) developed rules concerning the topic of how a questionnaire should be created: 'The understandability of the questions should be the main concern rather than aesthetic criteria'. Thus the pictures used – in question one, two and four - were designed not only to make the questionnaire more attractive but also to increase the understandability for the students. Furthermore the age-appropriate method of using pictures or short sentences or words as answers to the questions (Schnell *et al.*, 1999; Holm, 1986) more clearness was given to the students.

Mayer (2002) pointed out that it is advisable to use questions from the same application area in a row, which gives more clearness to the respondent. To do so and to create attractiveness, different kinds of questions were used. Children of this age (13 years old) have a short attention span and can get distracted easily because of other influences (Keller, 2005). In addition, only one question per discussed topic was asked. Of course it was possible to ask more than two questions per concept but this leads to a longer questionnaire (now the questionnaire fills two pages) and would have made it more time consuming.

The third reason behind the actual questionnaire design in this study was the analysis of the data afterwards, therefore closed questions were used. This makes the analysis much easier than by using open questions, because it gives more control over the given answers (Diekmann, 2000). Especially in this case the closed questions were able to deliver a sense of security to the students. Furthermore, a language barrier had the potential of making an optimal answering of the questions difficult because the students might be unsure about their understanding of the questions or the formulation of their answer (Holm, 1986). To prevent those problems the questionnaire was also translated into French.

Another reason for choosing closed instead of open questions was that the students would have needed more time to fill out the questionnaires while making up their own answers (Mayer, 2002).

To ensure that all questions could later be rated equally – considering the fact that all questions come from different designs and have a different number of possible answers (e.g. question one had two right answers and question five had five possible answers) - each of the three parts was counted into a scoring system. In this scoring system each of the six questions was coded into a

score of five possible points. When these were added up it was possible to obtain ten points for each of the three concepts, so a total of thirty points in the end.

3.3. Study area

The study area of this research, Ile aux Aigrettes, is one of the surrounding islets of Mauritius, and approximately 27 ha and situated in Mahébourg Bay. Ile aux Aigrettes is one of the seven Nature Reserves in Mauritius and all of these Nature Reserves and National Parks are managed by the Mauritian Wildlife Foundation. This islet has been open to the general public for several years and is used by the Mauritian Wildlife Foundation to conserve endemic and endangered species. Because of its isolation from the mainland (Mauritius), Ile aux Aigrettes seems to be the perfect place (or seems to have the perfect conditions) to re-introduce endangered species, to do research and to use for educational activities.

The Mauritian Wildlife Foundation created several facilities for the visitors: e.g. a souvenir shop, toilets, and a meeting point called 'Le Nid des Aigrettes' (Figure 1). In 'Le Nid des Aigrettes' people have the opportunity to get extra information about the flora and fauna on the islet and its heritage through an interpretation and explanations by the ranger. The interpretation of 12 metres long covers 'Le Nid des Aigrettes' on one side; and there are some benches and a table available.

The PMM was performed at 'Le Nid des Aigrettes' and the questionnaires were performed at the front side of the souvenir shop (which is about 10 metres from 'Le Nid des Aigrettes') as these were the best locations taking the relatively high temperatures into account. The interpretation in 'Le Nid des Aigrettes' was covered with cardboard to prevent the students looking at it while making the PMM. Both study areas are shown in Figure 3.



Figure 3. The study areas, where the PMM and the questionnaires were carried out; on the left 'Le Nid des Aigrettes' with the covered interpretation where the PMMs were carried out and on the right the front side of the souvenir shop where the questionnaire were carried out (I. van Engelen).

3.4. Data sampling

Both of the methods were carried out with different school groups with a variation of 15 up to 105 students. These school groups were divided into smaller sub groups (around 20 students each), and (1) one of the subgroups carried out a PMM, (2) while another sub group carried out a pre-questionnaire, (3) and another sub group carried out a post-questionnaire.

The data collection took place in a selected way, mainly due to lack of time. Most of the schools did not have any extra time, just the time that was calculated for the nature trail. So it was only possible to carry out the PMM with one of the sub groups. The other sub groups carried out either a pre-questionnaire or a post-questionnaire.

Table 1 shows the fixed rota for the sampling order for different school group sizes (>60 students, ±45 students, <40 students). Due to this rota it was possible to collect all of the data in such a way that no extra time of the school or of the rangers was needed.

Table 1. Sampling order for different group sizes; a) shows the sampling order for a group of more than 60 students, b) shows the order for a school group of around 45 students, and c) shows the sampling order for a school group less than 40 students.

a) Sampling order for a group of >60 students

| Group | Before visit (Pre) | After visit (Post) |
|-------|--------------------|--------------------|
| Gr. 1 | PMM | PMM |
| Gr. 2 | Questionnaire | |
| Gr. 3 | | Questionnaire |
| Gr. 4 | Questionnaire | |

b) Sampling order for a group of ±45 students

| Group | Before visit (Pre) | After visit (Post) |
|-------|--------------------|--------------------|
| Gr. 1 | PMM | PMM |
| Gr. 2 | Questionnaire | |
| Gr. 3 | | Questionnaire |

c) Sampling order for a group of <40 students

| Group | Before visit (Pre) | After visit (Post) |
|-------|--------------------|--------------------|
| Gr. 1 | PMM | PMM |
| Gr. 2 | Questionnaire OR | Questionnaire |

Study population

Originally 'Le Sentier du Dodo' nature trail was designed for Form II students (students of ± 14 years old) and so the contents of the nature trial reflected the skills and aims of this school level. Even so, the nature trail is used for all school levels from Form I to Form VI. This research focuses mainly on the Form II students, while taking the other school levels into account as they are doing the (same) nature trail as well.

Implementation

Because of the fact that there were two researchers (the authors of this report) involved in this research; who are responsible for the data collection and in order to create a higher comparability, each of the researchers was specialised in one method. One carried out all the PMMs and the other carried out all of the questionnaires with the students. This way ensured that the same explanation was used for different school groups; all groups who carried out a PMM were instructed by the same person, just as for the questionnaire.

For the PMM it was necessary that the students filled in their names, because they needed to receive them back after the trail to add, delete or change things in their drawings. To guarantee anonymity of the students, the names were removed after the data collection and were replaced by numbers (this was not the case for the questionnaires, where students only filled out the questionnaire once).

3.5. Data collection

The data were collected from 12 April 2011 until 13 June 2011. Mostly collected on weekdays (mostly on Monday, Wednesday, and Friday), but occasionally it happened to be on a Saturday.

During this period there were 34 school bookings (11 in April, 13 in May, 10 in June) in total, of which 20 schools participated in this research (4 of them were part of the pilot study). The other 14 school groups were cancelled or had other reasons for not participating (e.g. teacher did not agree, bad weather conditions, time-schedule problems, etc.).

Of these 20 school groups who cooperated in the research, the data of 6 groups were invalid due to several reasons (e.g. subgroups were too big, cardboard was not in use yet, further adaptation of questionnaire, etc.) so from 14 school groups the data were collected the way they were supposed to. These 14 school groups represented a total of 749 students of which 616 students participated.

A total of 232 pre-questionnaires, 231 post-questionnaires, and 153 PMMs were collected from these 14 school groups. Even so, out of these 14 school groups, it turned out that 5 school groups did not do the 'Le Sentier du Dodo' nature trail (which was found out afterwards), so in the end 9 school groups could be used for data analysis. From these groups, 148 pre-questionnaires and 139 post-questionnaires were collected, of which respectively 50 (34%) and 33 (24%) were filled out by Form II students. In addition 71 useful PMMs were collected of which 37 (52%) were made by Form II students.

3.6. Data analysis

For the analysis of the PMMs the statistical programme IBM (International Business Machines Cooperation) SPSS Statistics 19.0.0 was used. To find out if there were statistically significant differences (all tests were considered statistically significant at $p \leq 0.05$) between the mean scores of the pre- and post-PMM for each of the four dimensions, the Paired Samples T-test was performed.

For the analysis of the questionnaires, the statistical programme PASW (Predictive Analytics Soft Ware) Statistics 19 was used. The Independent-Samples T-test was performed to find out if there was a statistically significant difference (all tests were considered statistically significant at $p \leq 0.05$) between the 'understanding of what pristine Mauritius was once like' before and after the 'Le Sentier du dodo' nature trail.

3.6.1. Measuring effectiveness

To be able to give an extent of effectiveness in gaining an 'understanding of what pristine Mauritius was once like' of the students in the questionnaire and to measure this in their total scores - before and after the visit - a mean score of 18 points (60%) out of the 30 possible points would be counted as a 'acceptable' 'understanding of what pristine Mauritius was once like'. If a score of 24 points (80%) out of 30 possible points was obtained the 'understanding of pristine Mauritius' of the students would be counted as 'excellent'.

Equally, to be able to give an extent of effectiveness in gaining an 'understanding of what pristine Mauritius was once like' in the PMM, the students had to obtain a mean total score – before and after the visit – of 10 points (60%) out of 16 possible points. This would be counted as an 'acceptable' 'understanding of what pristine Mauritius was once like'. When a score of 13 points (80%) out of the 16 possible points was obtained the 'understanding of what pristine Mauritius was once like' of the students would be counted as 'excellent'.

3.6.2. Dimensions of the PMM

Even though much research has been carried out over the years using PMM (like mentioned before), no analysis or evaluation of the technique of the PMM has yet been published. So in this case the published information about the techniques of Falk *et al.* (1998) could only be used as a basis. To be able to score the PMMs two different scoring systems were developed based on the original method of Personal Meaning Mapping. These scoring systems contain direct guidelines to score the PMMs to make the possibility of interpretation and holistic judgements as small as possible.

It is necessary to mention again that the method was adapted in such a way that students were only allowed to draw while in the original method; words are written down, so these scoring systems are based on drawings instead of words.

Scoring System 1 took into account every single drawing that was presented in the PMM, assuming that every single drawing has a relationship to the understanding of pristine Mauritius. Bowker (2007) mentions that professionals cannot determine the themes but these have to be created following the students' drawings. According to this theory, all different contents that were drawn were listed and divided into the three main themes: (1) Flora and Fauna, (2) Balanced Ecosystem, and (3) Human Impact.

Scoring system 2 only took into account drawings relevant to the contents of the nature trail. Unlike scoring system 1, only the contents that could be drawn (and were relevant to the nature trail) were listed and divided into the three main themes: (1) Flora and Fauna, (2) Balanced Ecosystem, and (3) Human Impact. Both of these scoring systems are described in detail in Appendix IV.

Table 2. Summary of the four dimensions: extent, breadth, depth, and mastery and the way of scoring these in the PMMs.

| Dimension | Description | Range | Scoring System 1 | Scoring System2 |
|----------------|---|--|--|--|
| Extent | The number of drawings in the pre- and post-PMM where the second one contains the score of the pre-PMM as well. | 0 - 5 points | Every single drawing is counted; the participants have determined the most important types of drawings by creating them. | Only relevant drawings to the nature trail are counted; the researchers determined the most important types of drawings. |
| Breadth | The number of different concepts used in the PMM, divided by the main concepts: - Flora and Fauna; - Human Impact; - Balanced Ecosystem. | 0 - 6 points (2 for each main concept) | In total eighteen different concepts have been distinguished by the participants, divided by the three main concepts. | In total seven different concepts were distinguished by the researchers, divided by the three main concepts. |
| Depth | Each of the drawings is scored on a five-point-scale (very poor to excellent) per concept. | 0- 5 points | The <i>quality</i> of the overall drawing and their detail is scored per concept, on a five-point-scale. | The <i>quantity</i> of the drawing is scored per concept, on a five-point-scale. |
| Mastery | The change in overall facility with which the students describe pristine Mauritius. | 0 - 16 points | All previous points are added up to come to an overall score from 0.00 to 16.00. | |

In both scoring systems the change across four dimensions was analysed; the extent, breadth, depth, and mastery were assessed. In this way it was possible to compare each individual's pre-visit of what pristine Mauritius was once like with their post-visit understanding. These dimensions are explained below and summarised in Table 2.

Dimension one - Extent

Dimension one gives an indication of the extent of someone's understanding of what pristine Mauritius was once like, measured by the change in the quantity of different kind of drawings made. It measures the most basic aspect of an individual's understanding of a topic, the degree to which they can describe their understanding with drawings (Falk & Storksdieck, 2005).

When scoring the PMMs, the number of different types of appropriate images used was counted; in Scoring System 1 every single drawing was counted while in Scoring System 2 only drawings relevant to the nature trail were counted (see Appendix IV-b for the conditions of a relevant drawing). For the pre-visit there is a particular score of the counted drawings and the score for the post-visit included the score for the pre-visit in addition to the number of new images. The change in extent is the increase in the quantity of drawings made (Bowker & Jasper 2007).

Five categories were created in both scoring systems which correspond with the score that could be collected in the dimension extent. This means when the PMM contained zero drawings, the extent score was zero; when the PMM contained the maximum amount of drawings (out of the total PMMs per scoring system), the extent score was five. This extent score was added with the breadth and depth scores which related into the mastery score. Appendix IV explains this process in more detail.

Dimension two - Breadth

Dimension two looks at the breadth of someone's understanding while measuring the change in quantity of appropriate concepts used. Different themes (or concepts) can be drawn in the PMMs and breadth relates to the quantity of appropriate themes used in a drawing (Bowker, 2007). It measures a fundamental aspect of learning that an idea can be understood in more than one way (Falk & Storksdieck, 2005).

In Scoring System 1 the relevant concepts (or themes) were determined after an overall-look of the PMMs and divided into the main concepts (1) Flora and Fauna, (2) Balanced Ecosystem and (3) Human Impact. In total eighteen different concepts were distinguished and divided by the three main concepts. In Scoring System 2 the concepts were determined by the authors and based on the concepts of the nature trail. In this scoring system a total of seven themes were divided by the three main categories. When analysing the PMM and counting the breadth score the numbers of relevant concepts (or themes) were considered and the present concepts in both pre- and post-PMM were counted (which ranges from zero to eighteen in Scoring System 1 and ranges from zero to seven in Scoring System 2).

A range from zero to six points could be collected for breadth in both scoring systems, where six points were collected when all concepts were present and zero points were collected when none of the concepts were present in the PMM. The breadth score was added up to the extent score and together with the depth score this related into the mastery (total) score. For a more detailed explanation see Appendix IV.

Dimension three – Depth

Dimension three looks at the depth of someone's understanding; the change in how deeply and richly the children understood the used concepts which is measured by the quality and detail of

the drawing (Bowker, 2007). The change in degree of understanding within each breadth category is measured. Increased depth occurs as individuals are able to provide not only more examples within a concept, but also better examples and demonstrate a deeper, more sophisticated understanding of a specific conceptual category (Falk & Storksdieck, 2005). A five-point scale (very poor to excellent) is used to indicate depth of understanding.

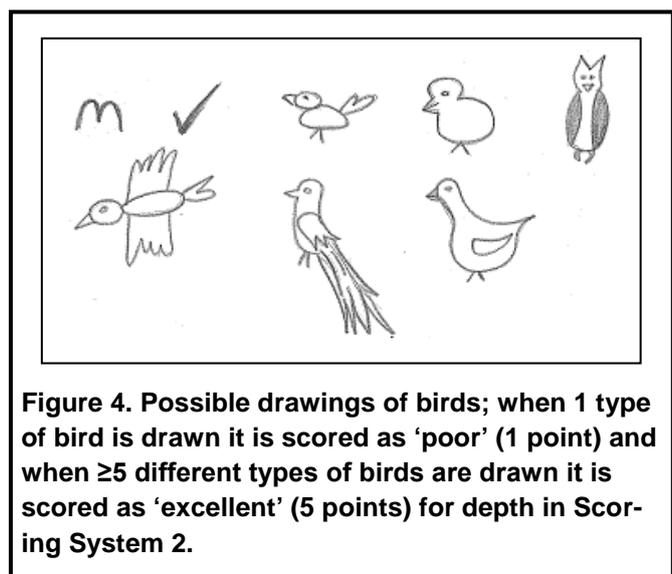
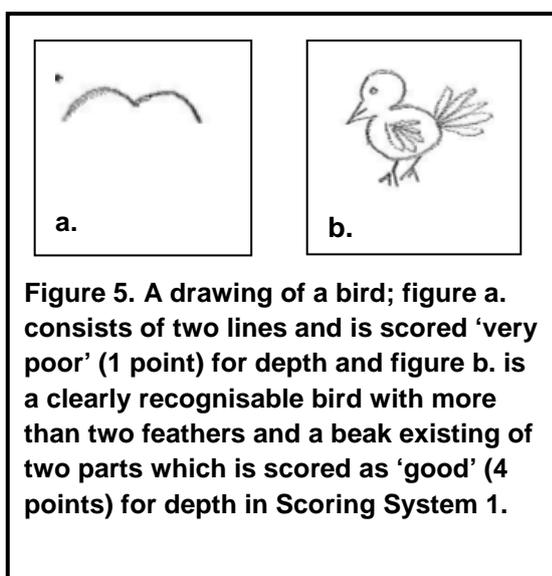
Scoring system 1 was based on Bowker (2007) where the *quality* of the overall drawing and their detail was scored. More points could be collected when a drawing contains more details, assuming a participant was able to draw more details when the concept was understood in a better way. E.g. when a bird was drawn that only consists of two lines (Figure 4a) the concept of a bird was less understood than when a bird was drawn with feathers, a beak and legs (Figure 4b).

In scoring system 2 the *quantity* of the drawing was scored per concept. More points could be collected when a concept contains more different kinds of drawings, assuming a participant has understood the concept better when he was able to draw different things. E.g. when only one type of bird was drawn the concept of a bird was less understood than when 3, 4, or even 5 different types of birds were drawn (Figure 5).

Dimension four – Mastery

The fourth dimension is mastery. Bowker (2007): “Mastery is a holistic judgement taking into account the scope of the students, both before and after their visit experience”. It is the change in overall facility with which the students to describe pristine Mauritius (Bowker & Jasper, 2007) and is designed to take into account all of the things an individual has drawn (Falk & Storksdieck, 2005).

The mastery is scored by taking into account the extent, breadth and depth, both before and after the visit, by adding up the given points for each of the dimensions. As described above, five (5) points can be collected for extent, six (6) points for breadth, and five (5) for depth, which makes a maximum mastery score of sixteen (16) possible.



4. Results

In this chapter the results are presented. Firstly the results of the PMM are presented, where all of the four dimensions; (1) extent, (2) breadth, (3) depth, and (4) mastery are described separately. Secondly, the results of the questionnaire are discussed by using three concepts to determine the different parts – related to the contents of the nature trail – of the questionnaire: (1) Flora and Fauna, (2) Balanced Ecosystem, and (3) Human Impact.

4.1. PMM results

The collected PMMs (n=71) were analysed in two scoring systems: Scoring System 1 and Scoring System 2. Both scoring systems use the four dimensions; extent, breadth, depth, and mastery, but the main difference is the way of scoring breadth and depth as explained in the previous chapter. The first three dimensions are scored to come to an overall mastery score of a maximum of sixteen points; 5 points can be collected for extent, 6 points for breadth, and a maximum of 5 points can be collected for depth. The two authors scored each of the PMMs while using the two scoring systems with an inter-rater reliability of 76% for Scoring System 1, and 67% for Scoring System 2.

Each of the four dimensions (extent; breadth; depth; and mastery) were analysed by comparing their mean scores of the pre-PMM with their mean scores of the post-PMM. Besides, a paired samples t-test was performed to calculate the statistically significant difference between the mean outcomes of the pre- and post-PMMs for each of the four dimensions in the two different scoring systems. These results are presented in Table 3 and Table 4 and will be discussed below when describing each of the four dimensions separately.

Table 3. The average score of each of the four dimensions split up in the pre-and post-PMM for scoring system 1 (n=71) including the results of the Paired Samples T-test.

| Dimensions | Possible range | Mean Pre-PMM ± S.E.M | Mean Post-PMM ± S.E.M | Mean Change ± S.E.M | P |
|------------|----------------|----------------------|-----------------------|---------------------|--------|
| Extent | 0 - 117 | 20.7 ± 1.9 | 30.7 ± 2.6 | 9.9 ± 1.0 | <0.001 |
| Breadth | 0 – 6 | 1.8 ± 0.07 | 2.2 ± 0.07 | 0.4 ± 0.04 | <0.001 |
| Depth | 0 – 5 | 0.8 ± 0.06 | 1.0 ± 0.04 | 0.2 ± 0.02 | <0.001 |
| Mastery | 0 – 16 | 3.9 ± 0.13 | 4.8 ± 0.16 | 0.9 ± 0.09 | <0.001 |

Table 4. The average score of each of the four dimensions split up in the pre- and post-PMM for scoring system 2 (n=71) including the results of the Paired Samples T-test.

| Dimensions | Possible range | Mean Pre-PMM ± S.E.M | Mean Post-PMM ± S.E.M | Mean Change ± S.E.M | P |
|------------|----------------|----------------------|-----------------------|---------------------|--------|
| Extent | 0 - 126 | 19.8 ± 1.9 | 28.5 ± 2.5 | 8.7 ± 1.1 | <0.001 |
| Breadth | 0 – 6 | 1.6 ± 0.11 | 2.4 ± 0.15 | 0.8 ± 0.11 | <0.001 |
| Depth | 0 – 5 | 0.4 ± 0.03 | 0.5 ± 0.04 | 0.1 ± 0.03 | <0.001 |
| Mastery | 0 – 16 | 3.2 ± 0.2 | 4.3 ± 0.2 | 1.2 ± 0.2 | <0.001 |

Extent

In the dimension extent the total number of relevant drawings was scored with a minimum possible score of 1.0 drawing. The number of drawings is counted in the pre-PMM as well as in the post-PMM where the number of drawings in the post-PMM includes the ones of the pre-PMM.

Scoring System 1

In the first scoring system the minimum number of drawings in the pre- and post-PMM was respectively 3 and 5. The maximum number of drawings found in the pre- and post-PMM was respectively 97 and 117. There was a difference found of 9.9 drawings on average between the pre- and post-PMM and this was statistically significant ($P < 0.001$).

Scoring System 2

In the second scoring system a minimum of 1 drawing was found in the pre-PMM and in the post-PMM this minimum was 2 drawings. The maximum number of drawings in one PMM was 126 in the pre-PMM and in the post-PMM this number was 144 drawings. On average, 8.7 drawings were added in the post-PMM.

Breadth

In the dimension breadth the presence of the different sub concepts that are part of the three main concepts was scored: Flora and Fauna, Human Impact, and a Balanced Ecosystem. A minimum possible breadth score was 0.0 and the maximum possible score was 6.0, of which each concept had a score of 2.0 points.

Scoring System 1

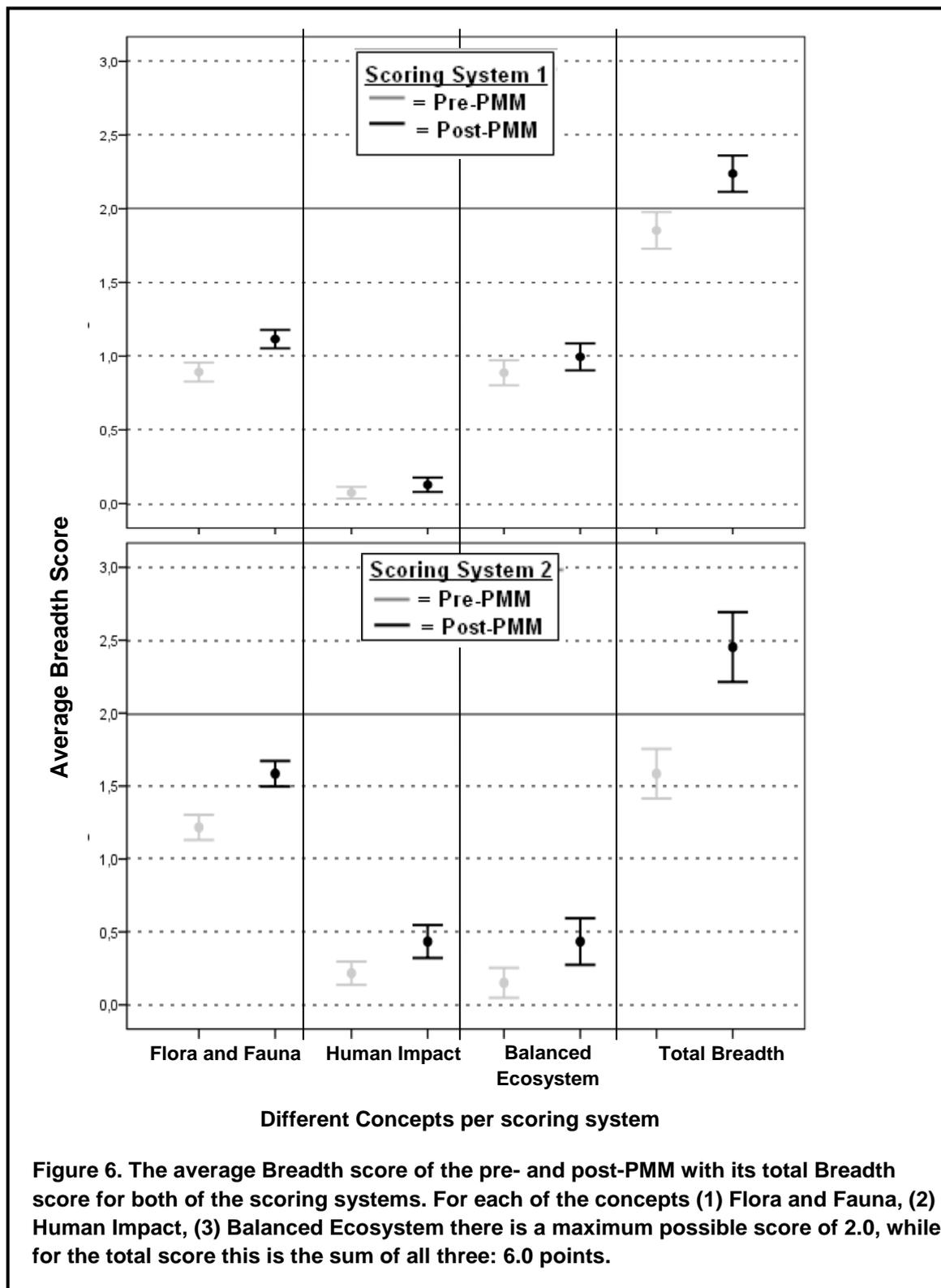
The minimum breadth score in the pre- and post-PMM was respectively 0.7 and 0.9. The maximum breadth score in the pre- and post-PMM was respectively 3.1 and 3.4. Between the pre- and post-PMM was an increase of 0.4 and was statistically significant ($P < 0.001$).

In Scoring System 1 a total of eighteen different sub concepts are determined; ten of them are part of Flora and Fauna, four are part of Human Impact, and another four are part of Balanced Ecosystem. Figure 6 gives an overview of the average breadth score per main concept. All of the main concepts show significant increases ($P < 0.001$) and the graph shows that the concept Flora and Fauna shows the highest average breadth score and the highest increase.

Scoring System 2

The minimum breadth score for both the pre- and post-PMM was 0.5. The maximum breadth score in the pre- and post-PMM was respectively 5.0 and 6.0 (which means that in some occasions all sub concepts were present in a PMM).

In total a number of seven sub concepts were determined in Scoring System 2, where four of the sub concepts are part of Flora and Fauna, two are part of Human Impact, and one sub concept represents a Balanced Ecosystem. In Figure 6 the average breadth score is shown per main concept, of which all three main concepts show a significant increase ($P < 0.001$). Again, the concept Flora and Fauna shows the highest average breadth score and the highest increase as well.



Depth

In the dimension depth, the understanding of the breadth themes was scored, when the quality and detail of the drawing (Scoring System 1) and the quantity of different types of drawings within one sub concept (Scoring System 2) were scored. A five-point scale was used to indicate depth of understanding; 1: very poor; 2: poor; 3: acceptable; 4: good; 5: excellent. A minimum score of zero (0) was possible (when the sub concept is absent, depth scores zero points) and a

maximum score of 5 (excellent) was possible. More information about the rating scale and how the PMMs were scored can be found in Appendix IV.

Scoring System 1

In Scoring System 1 a number of eighteen different sub concepts were determined and divided by the three main concepts (Flora and Fauna, Human Impact, Balanced Ecosystem). All these sub concepts were scored separately on depth.

On a scale from zero to five the minimum depth score was in the pre- and post-PMM respectively 0.2 and 0.3, and the maximum depth score was respectively 1.5 and 1.7. Figure 7 shows an overview of the different mean depth scores per concept that all have a significant increase. This graph shows that Human Impact scores a lot lower for depth than Flora and Fauna and Balanced Ecosystem.

Scoring System 2

In Scoring System 2 a number of seven different sub concepts were determined and divided by the three main concepts, and all three were scored on depth. The minimum depth score for both the pre- and post-PMM was 0.04, with a maximum depth score in the pre- and post-PMM of respectively 1.3 and 1.8.

Figure 7 shows an overview of the different mean depth scores per concept that all have a significant increase. It can be seen that Flora and Fauna has a higher depth score than the other two concepts. All three main concepts show a significant increase between the pre- and Post-PMM.

Mastery

The mastery score takes into account all the different dimensions mentioned before to come to a possible overall score of 16.0; a maximum possible score of 5.0 for extent, 6.0 for breadth and 5.0 possible points for depth. The extent scores as described in this chapter as the number of drawings have been divided into five equally distributed categories (from zero to five). This extent score is added up to the breadth and depth scores to come to the overall mastery score.

Scoring System 1

A total of 16 points could be collected with extent, breadth, and depth where the minimum number of collected points in the pre- and post-PMM was respectively 1.9 and 2.2. The maximum number of collected points in the pre- and post-PMM was respectively 6.9 and 8.5. There was a difference of 0.9 point between the pre- and post-PMM scores and this was statistically significant ($P < 0.001$) (Figure 8).

Scoring System 2

Again, a maximum possible score of 16 points could be collected with extent, breadth, and depth where the minimum score in both the pre- and post-PMM was 1.5 points. The maximum mastery score was in the pre- and post-PMM respectively 7.3 and 8.8. There was a difference of 1.2 point between the pre- and post-PMM scores which was statistically significant ($P < 0.001$). Figure 8 shows the average mastery score for both of the scoring systems.

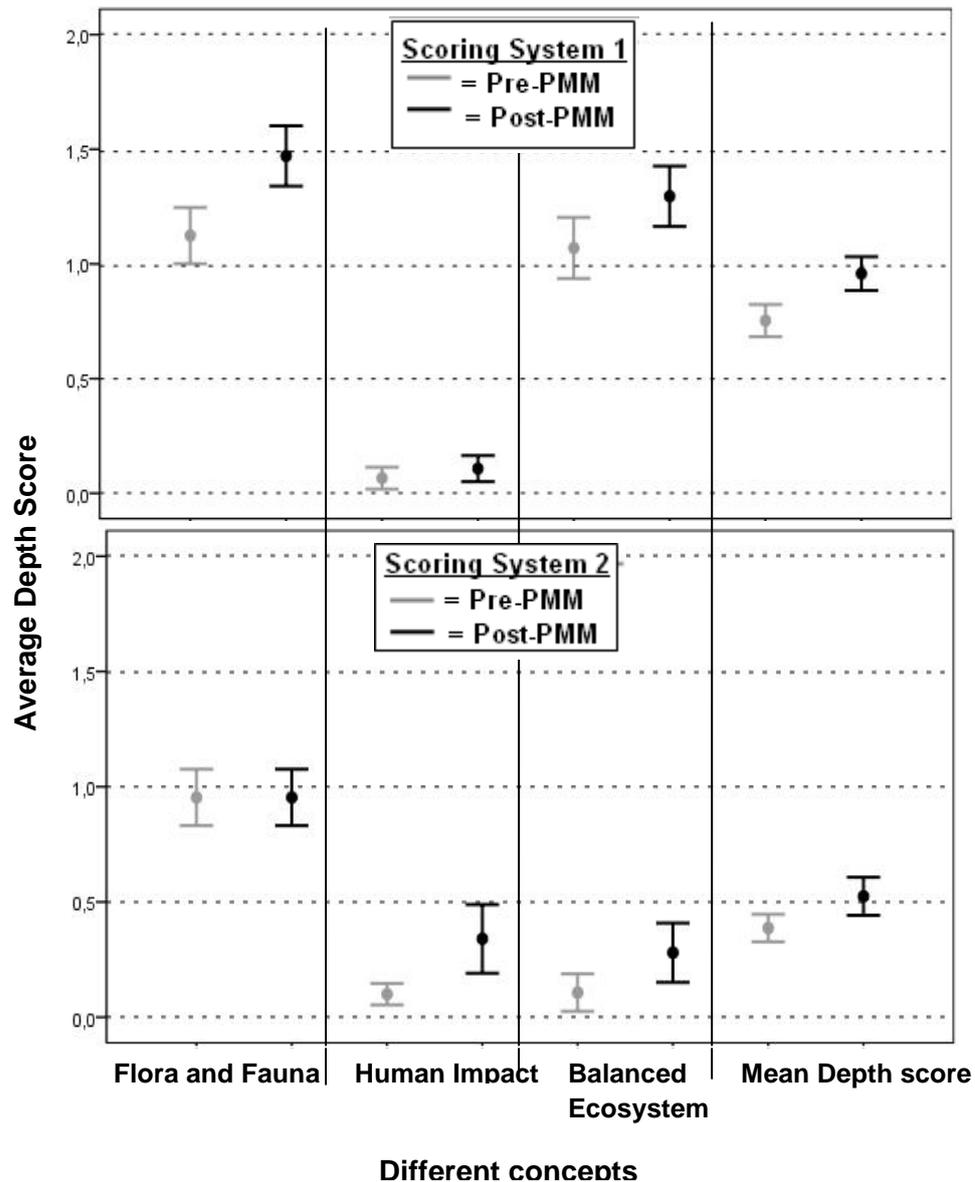
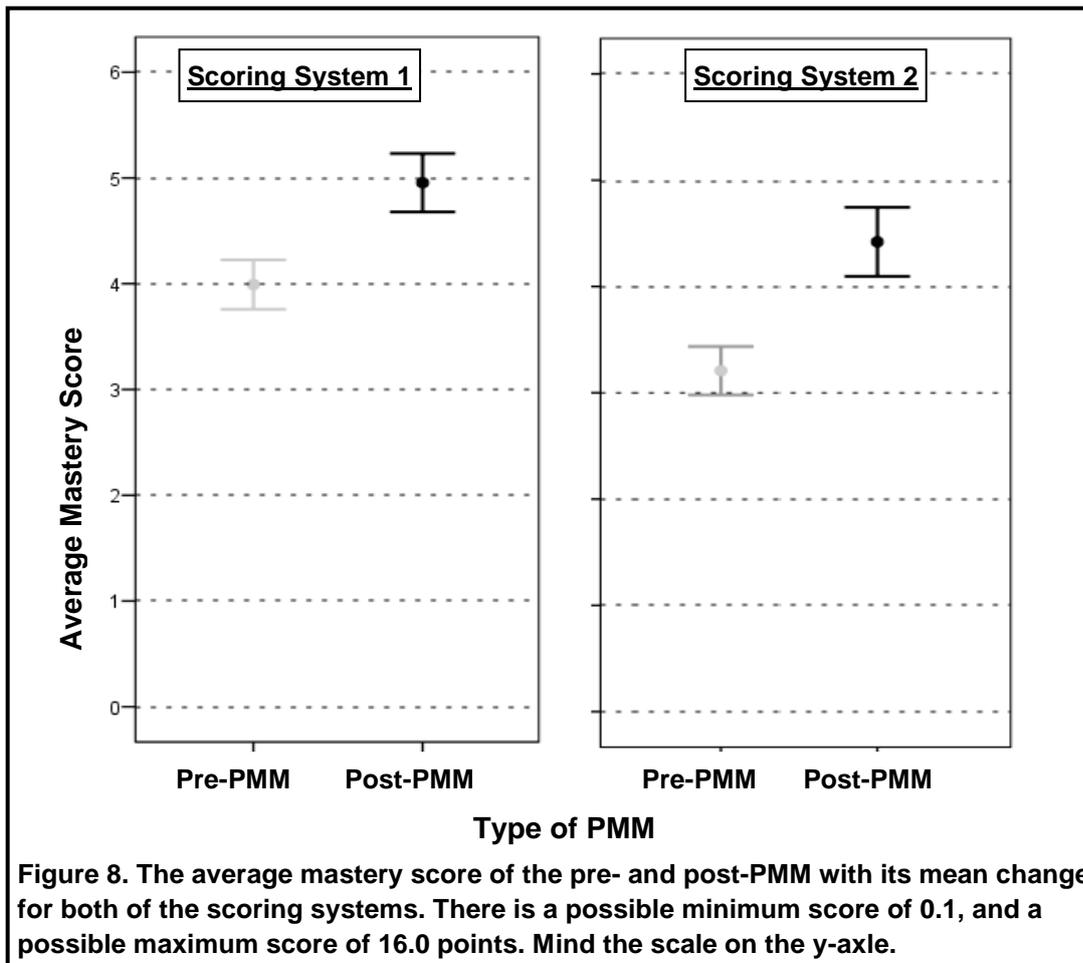


Figure 7. The average depth score of the pre- and post-PMM for each of the three main concepts (1) Flora and Fauna, (2) Human Impact, and (3) Balanced Ecosystem, and the overall score. Both scoring systems are represented separately. There is a possible minimum score of 0.0 (absence of sub concept) and a possible maximum score of 5.0 points (all sub concepts scored 'excellent' for depth). The 'Mean Depth score' shows the average points for the pre- and post-PMM of all three concepts together.



4.1.1. Different school levels

The PMMs were made by students from different school levels, of which 25 by Form I students, 33 by Form II students, and 6 by Form V students. The mean Mastery score was calculated for each three of these school levels for both of the scoring systems, where the minimum possible score is 0.0 and the maximum possible score is 16.0.

Scoring System 1

All of the mastery scores in the pre- and post-PMMs of the three different school levels showed a statistically significant increase. The scores of the Form I students (N=25) ranged from 1.9 to 6.9 points (out of a maximum 16.0) in the pre-PMM and from 3.5 to 8.5 points in the post-PMM. The mean change between the pre- and post-PMM of the Form I students is 1.3 points and is statistically significant ($P < 0.001$). Figure 9 shows that the Form I students had an overall higher score than the other two school level. In addition they show the highest increase in the mastery score.

The mean change between the pre- and post-PMM of the Form II students (N=33) is 0.7 points and is statistically significant ($P < 0.001$). In these pre- and post-PMMs the minimum score was 2.2 and the maximum score was respectively 5.8 and 7.1 points.

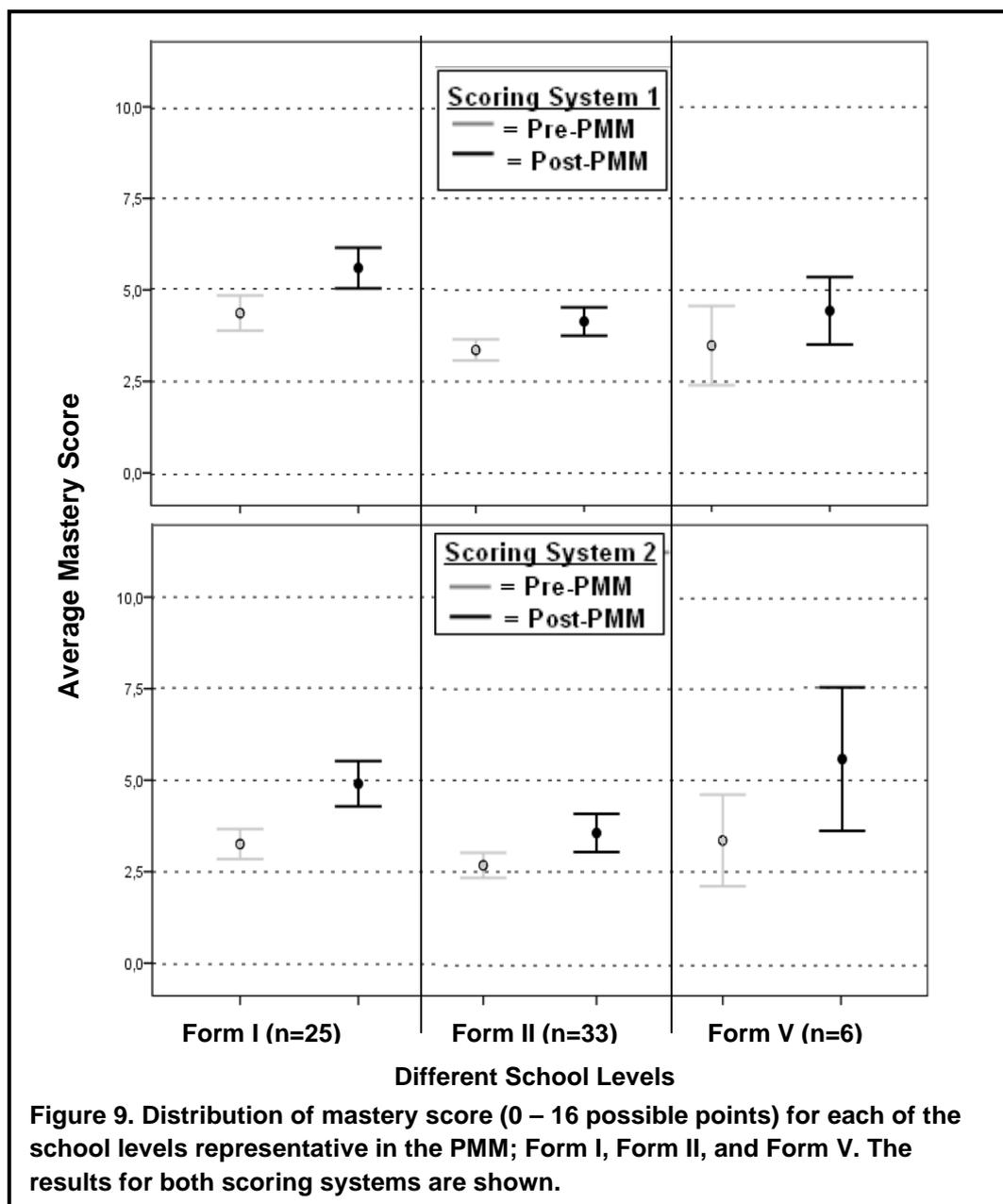
The minimum mastery score of the Form V students (N=6) in the pre- and post-PMMs was respectively 2.0 and 3.8, and the maximum mastery score was respectively 4.6 and 6.1. The average change between the pre- and post-PMM, for this school level was 0.9 and statistically significant ($P = 0.041$). See Figure 9 for an overview of the mean mastery scores per school level.

Scoring System 2

As well as in scoring system 1 the PMMs showed a statistically significant increase for all of the three different school levels that carried out a PMM. Figure 9 shows that the Form V (N=6) students showed the highest mastery score for the pre- and the post-PMM and the highest increase of 2.2 points, and this is statistically significant ($P=0.005$). The mastery score ranged from 2.1 to 5.1 point in the pre-PMM and from 3.1 to 8.8 in the post-PMM.

The lowest mastery score was scored by the Form II (N=33) students and showed the least increase as well of all three of 0.8 point and was statistically significant ($P<0.001$). The minimum score in the pre- and post-PMM was 1.5 points and the maximum score was respectively 6.3 and 8.0 points.

The Form I students (N=25) showed an increase of 1.6 points between the pre- and post-PMM and this was statistically significant ($P<0.001$). The minimum mastery score in the pre- and post-PMM was respectively 2.2 and 2.7 and the maximum score was respectively 6.3 and 7.7. Figure 9 gives an overview of the overall mastery scores per school level.



4.2. Questionnaire results

Approximately two thirds (60.2%) of the 287 students who participated the 'Learning with Nature' education programme in the spring of 2011, were female. Nearly one third (29.2%) were male and 0.4% did not specify their sex.

In total, eight different school groups took part in this study, mostly governmental schools. The programme was originally designed for Form II, but the forms that actually participated in the study were quite mixed (Form I to V).

The questionnaire consisted of six questions, two by two combined in three concepts and together they measured the 'understanding of what pristine Mauritius was once like' of the students. Out of the six questions, two were related to the endemic (1) Flora and Fauna (question one and two), two were related to the (2) Human Impact (questions three and six) and two of the questions were related to (3) a Balanced Ecosystem (questions four and five). For each of the three concepts there was a maximum possible score of 10 points and resulted a maximum possible score of 30 points for the complete questionnaire.

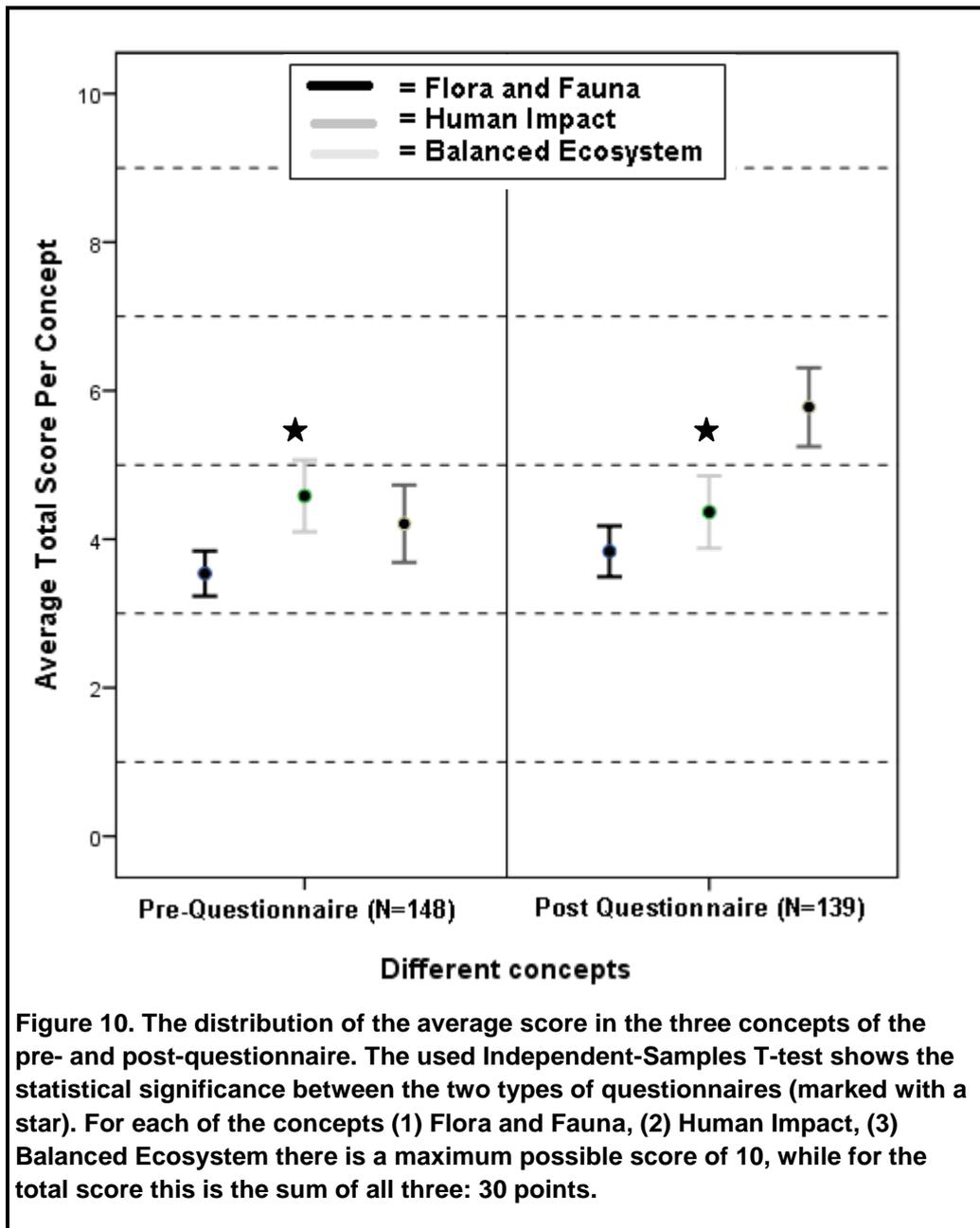
4.2.1. Distribution of scores in concepts

Figure 10 shows in concept (3) Balanced Ecosystem a significant difference in the pre- and post-questionnaire with 4.3 to 5.7 points with a mean difference of 1.4 score points ($P < 0.001$; $n_{pre}=148$; $n_{post}=139$). The third of the concepts showed the highest difference between pre- and post-questionnaire of the three concepts.

In the 'understanding of what pristine Mauritius was once like' for concept (1) Flora and Fauna in the pre- and post-questionnaire the students showed respectively 3.5 points and 3.8 points out of a possible score of 10 points. There was a difference of 0.3 score points between the pre- and post-questionnaire of this concept, which was not statistically significant ($P=0.332$; $n_{pre}=148$; $n_{post}=139$).

In the pre- and post-questionnaire a score decreasing from 4.6 to 4.3 points in concept (2) Human Impact was shown. In this part the 'understanding of what pristine Mauritius was once like' indicated a non-significant difference ($P=0.533$; $n_{pre}=139$; $n_{post}=131$), with also a mean difference of 0.3 score points between pre- and post-questionnaire out of 10 possible points.

The next step in the data analysis was made to get an idea about the difference of the total score. The average score was calculated of all three concepts together. In the 'understanding of what pristine Mauritius was once like' the students obtained an average score of 12.3 points in the pre-questionnaire and in the post-questionnaire 14 out of 30 possible points, which showed a significant difference ($P=0.10$; $n_{pre}=139$; $n_{post}=131$). In the total score the mean difference between the pre- and post-questionnaire was 1.7 points. With their answers the students did not reach half of the total possible score of 30 points on average and so scored not enough to gain an acceptable (60%) 'understanding of pristine Mauritius' because of the 'Learning with Nature' trail.



4.2.2. Distribution of scores in school levels

As shown in Figure 11 the students in Form II obtained the highest mean score, with 15.6 points in the pre-questionnaire (n=50) and 17.9 points in the post-questionnaire (n=33) out of 30 possible points. A significant difference between the two measurements with a mean score of 2.3 points (P=0.043) was shown.

Form III and V students scored equally in their mean difference between the pre- and post-questionnaire with 4.5 points. Form III students obtained a mean score of 10.2 points before the nature trail and 14.7 points after, which showed a statistically significant difference (P=0.047; npre=15; npost=8). Form V scored in mean in the pre-questionnaire 9.9 and in the post-questionnaire 14.4 points, which showed a significant difference (P<0.001; npre=39; npost=36).

In the 'understanding of what pristine Mauritius was once like' Form IV showed a score of 10.6 points in the pre-questionnaire and in the post-questionnaire 12.8 points with an increase of

2.2 points with a non-significant difference between pre- and post-questionnaire ($P=0.288$; $n_{pre}=8$; $n_{post}=25$).

Furthermore, the score of Form I students decreased from the pre- to the post-questionnaire. In the 'understanding of what pristine Mauritius was once like' they 11.8 points obtained in the pre-questionnaire and decreased in the post-questionnaire to 9.5 points with a non-significant difference of 2.3 points ($P=0.111$; $n_{pre}=26$; $n_{post}=27$).

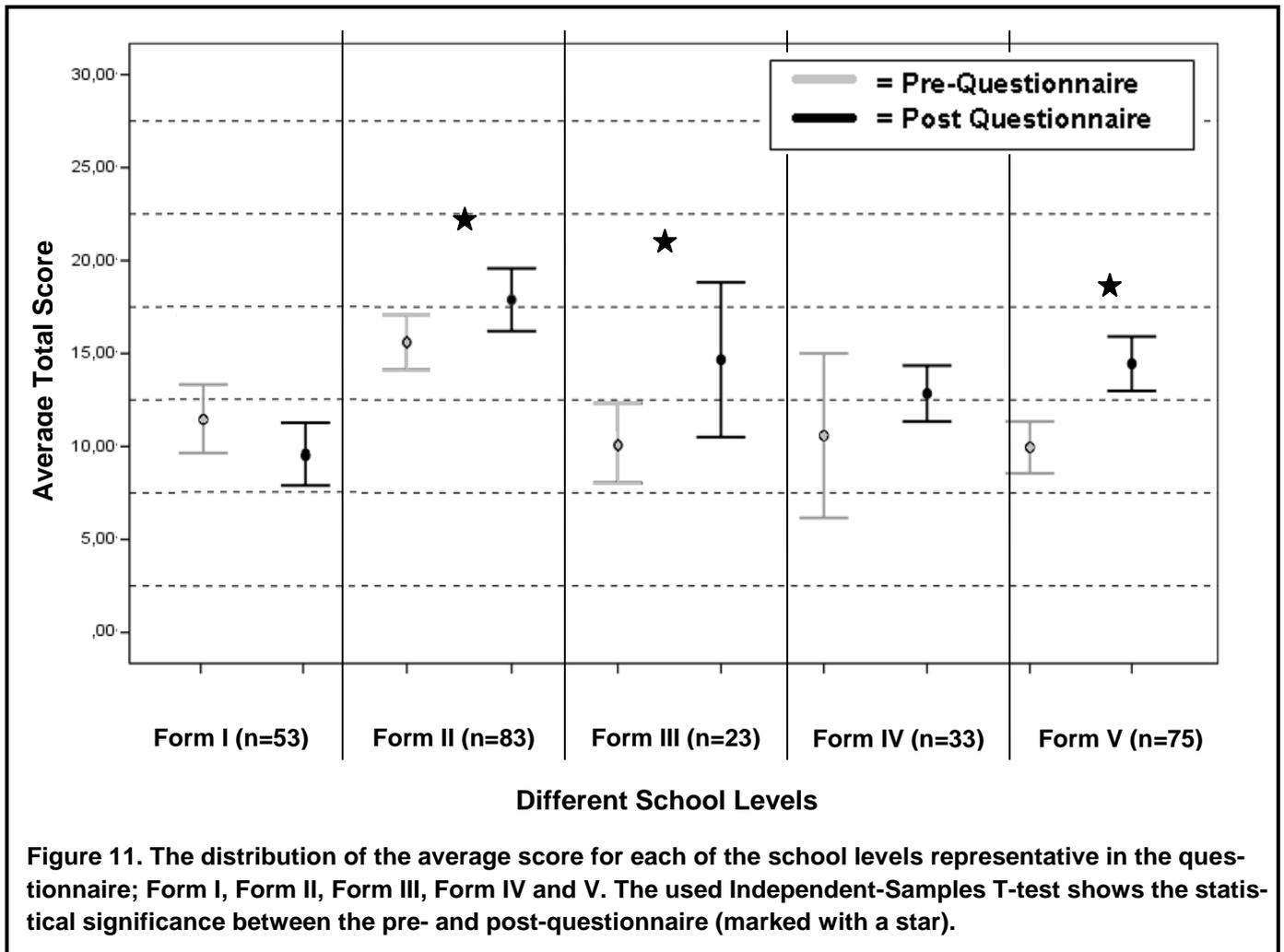


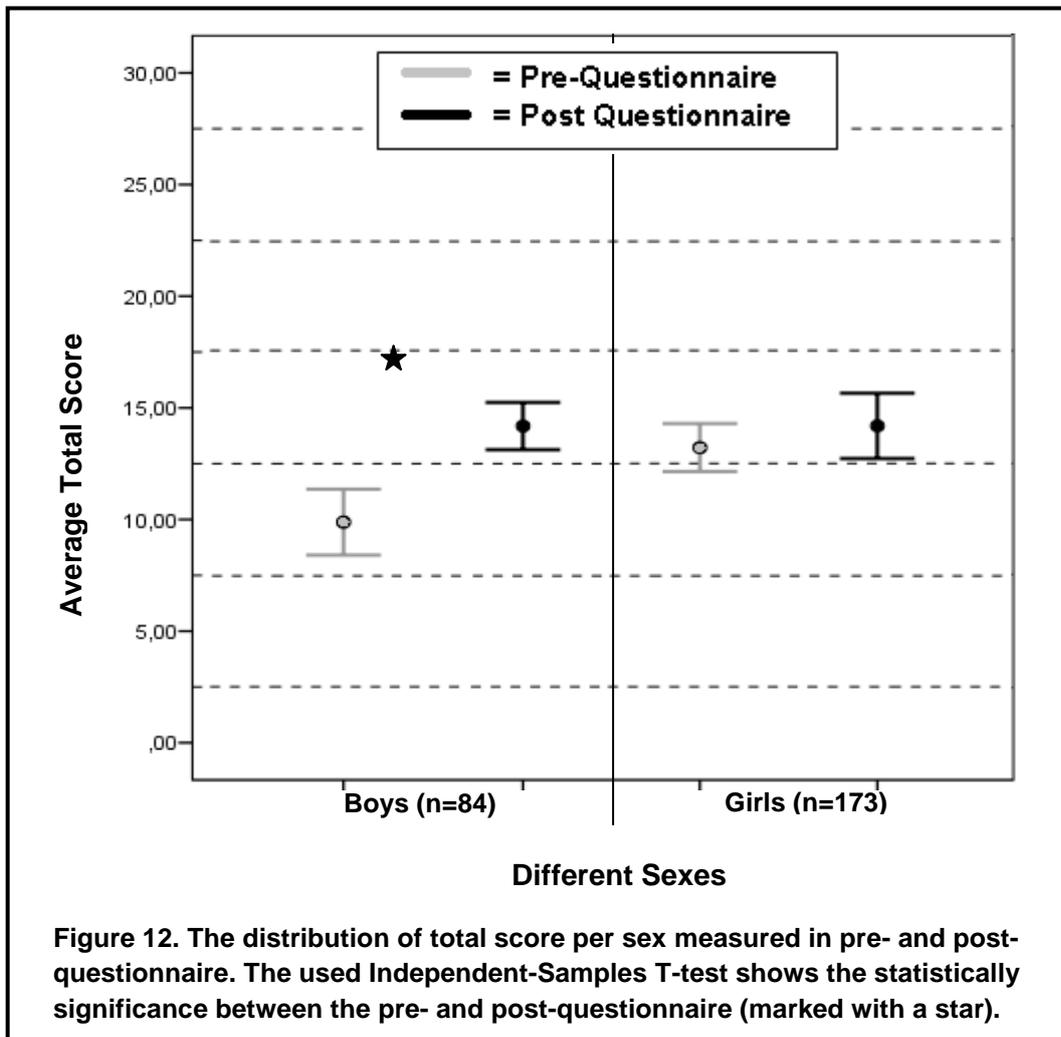
Figure 11. The distribution of the average score for each of the school levels representative in the questionnaire; Form I, Form II, Form III, Form IV and V. The used Independent-Samples T-test shows the statistical significance between the pre- and post-questionnaire (marked with a star).

4.2.3. Distribution of scores in sex

Figure 12 shows that the boys and the girls both scored the same in their post-questionnaire. There was a difference in scores in their mean difference and in their pre-score.

The girls on average scored higher from the pre-questionnaire with 13.2 points to 14.2 points in the post-questionnaire out of 30 possible points, which showed a mean difference of 1.0 point ($n_{pre}=101$; $n_{post}=72$). In the 'understanding of pristine Mauritius' there was no statistically significant difference between the score in the pre- and post-questionnaire ($P=0.075$).

In contrast the boys scored 9.9 points in the pre-questionnaire and 14.2 points out of 30 possible points in the post-questionnaire, with a mean difference of 4.3 points ($n_{pre}=35$; $n_{post}=49$). They scored with a statistically significant difference ($P<0.001$) in the pre- and post-questionnaire.



5. Discussion

This chapter will discuss each of the two methods in this research separately in the way of use, design and implementation during this study. First the PMM as a method used to evaluate environmental education programmes will be discussed. The second part concerns the discussion of the questionnaire.

5.1. PMM

In contrast to the originally presented method of the PMM by Falk *et al.* (1998) no interviews were carried out during this research. Basically it was not possible to carry out interviews in the given circumstances (e.g. time limit, groups of participants instead of individuals, etc.).

Some of the concepts used to measure the 'understanding of what pristine Mauritius was once like' were quite difficult to measure with just the PMM. An example was concept (3) Balanced Ecosystem (including the topic biodegradability; question 5), which could easily be measured by a question that had to be answered by the participant. In the PMM, an apple next to a tree can be interpreted in many different ways and does not necessarily mean that the participant has understood biodegradability.

To be able to compare the results of the PMM a pre- and post-questionnaire was carried out next to the PMM. This was mainly done, to see whether the PMM is a useful method to evaluate an environmental education programme by comparing its results to a commonly used method (questionnaires). When it would turn out the PMM did not work, a good evaluation would still have taken place.

Analysing the PMMs knew more difficulties, especially when the drawings had to be interpreted. For example, when (different types of) birds were presented in the PMM it was difficult to decide whether the bird represented a native species or not. The interview could have resulted in the explanation of certain (native) species. Nevertheless the results of PMM and questionnaire were comparable and it showed that both methods together formed a valuable method to measure the 'understanding of what pristine Mauritius was once like' by the students.

Scoring Systems

To be able to analyse the PMMs in the most reliable way, and as there was nearly no published information available about the Personal Meaning Mapping originally presented by Falk *et al.* (1998), two different scoring systems were developed. By designing two scoring systems, these results could be compared as well. Generally, the outcomes of the two scoring systems of the PMMs were quite comparable and no major differences could be distinguished. In this study all of the four dimensions (extent, breadth, depth, and mastery) showed a significant, but a very small, increase in both scoring systems. In addition, the results of the PMM were comparable to the results of the questionnaires, so it might be assumed the PMMs were properly analysed.

In this study all of the four dimensions (extent, breadth, depth, and mastery) showed a small significant increase in both scoring systems. The extent measured the number of proper drawings, and increased in Scoring System 1 and 2 with respectively 8% and 6%.

In the dimension breadth, the concept (1) Flora and Fauna was on average the highest representative with 0.9 and 1.1 points (out of a possible 2.0) in respectively the pre- and post-PMM in Scoring System 1. This means, there is an increase of 10%. In Scoring System 2 this concept scored 1.2 and 1.5 points (out of a possible 2.0) in respectively the pre- and post-PMM, which

means an average increase of 15%. Both of the other concepts (Human Impact and Balanced Ecosystem) have quite a low score and both of them are very difficult to draw.

Because the concepts (2) Human Impact and (3) Balanced Ecosystem were difficult to draw, and so difficult to score in Breadth, this is true for the depth score as well. In Scoring System 2, the third concept (Balanced Ecosystem) was just represented by one sub-concept which explains the relatively high depth score. Even so, almost all concepts showed a statistically significant increase. In Scoring System 1, the three concepts increased respectively with 7%, 0.8%, and 5%, and in Scoring System 2 respectively with 0%, 5%, and 3%.

In the pre-PMM the mastery score in Scoring System 1 and 2 was respectively 3.9 and 3.2 points and in the post-PMM 4.8 and 4.3 points (out of a possible 16 points). In both scoring systems the mastery score increased with 6% between the pre- and the post-PMM. This showed that even though the scoring systems were completely different in scoring the PMMs, the outcomes are very similar.

Overall, the scores in this study showed a statistically significant increase between the pre- and post-PMM (except for the depth of Flora and Fauna in Scoring System 2). An increase in these scores could mean that there was an increase in the 'understanding of what pristine Mauritius was once like' which was of course the assumption in this study. Even so, participants could also have an increase in their scores because the students thought they were obliged to do the assignment, which resulted in adding drawings if they got the PMMs back after the nature trail was done. The students might be used to assignments because in schools it is normal practice to carry out assignments, which could have an impact on the PMM results (even though an informal setting was created).

Different school levels

Looking at the results it was remarkable that Form II students had the lowest mastery score in both scoring systems, even though the nature trail was originally designed for this school level. In Scoring System 1, the Form I students had the highest average mastery score, whereas in Scoring System 2, this happened to be for the Form V students. Even so, the participation divided over the school levels was quite different. Form V students for example only participated with 6 individuals in this study, and for the two other Forms which were analysed, the participation was different too (Form I n=25; Form II n=33). Furthermore, not all school levels that participated in this study could be used for the analysis (e.g. nature trail was not done, dimension of groups, etc.). Due to this lack of data, Form III, IV and VI students were not included at all, so the scores cannot give a representative statement of the 'understanding of what pristine Mauritius was once like' per school level but can be used as an indication.

5.2. Questionnaire

The students who completed a pre- or a post-questionnaire collected less than half of the possible 30 points. In the pre- and post-questionnaire the students scored respectively only 12.3 points (41%) and 14.0 points (47%) on average. There was a mean difference of 1.7 points (6%), which is only a small increase and not enough to gain an acceptable 'understanding of what pristine Mauritius was once like' by the students.

These numbers are worrying and definitely not what was expected before this research started. Because the results of the questionnaire are quite similar to the results of the PMM it is assumed that the method was quite reliable. Even so, it could have something to do with something else.

Firstly, the high information diversity could have influenced the low scores in the questionnaire. The nature trail contained twelve stops, that all took about 7 – 10 minutes each, where different kind of information was delivered to the students (either interactive or not). While walking the trail, there was also information delivered to the students. During an excursion it can be hard for some students to keep track on the main theme of the tour. In addition, excursions have their own dynamic related to learning, depending on the manner of the intervention used for the topics and not every student is capable of dealing with the dynamic of excursions (Sauerborn and Brühne, 2009). When students were confronted with a wide range of different topics in a short amount of time, like shown in the nature trail, the topics of the excursion might not be fully absorbed and the extent of doing so could be highly different between individuals.

Furthermore, the attention span, the time spent continuously on one task, of the students could have been an important factor that resulted in the low total scores in the questionnaires. The attention span, of course, varies with age; older children are capable of longer periods of attention than younger children (Ruff and Lawson, 1990). Keller (2005) mentions that the average attention span of a child or young adult (which is the research population in this research) is about 20 to 30 minutes. Because the nature trail took about 2 – 2.5 hours (with no breaks in between) in extreme conditions, like the hot and moist climate, it is likely the students were not able to attend the whole tour with their full concentration.

Another factor that might have influenced the low scores in the questionnaire could be a lack in pre-processing in schools. Sauerborn and Brühne (2009) mentioned that interactive pre- and post-processing of the experiences at school is necessary to gain a full capacity of the excursion. The experience cannot be connected with the overall learning matter at school without this processing. The teachers of (almost) all schools in this research indicated to have come to Ile aux Aigrettes without any kind of introduction or plans for a post-processing.

Nevertheless there is always the possibility that the used questionnaire was not suited for the students who were attending. Some reasons could be that (1) the questions were too difficult to answer in the given time or (2) the scoring system used to count the points of the given answers was too tight in its judgement. But due to the performed pilot study of one week and the adaptations of the questionnaire in discussions with the supervisor Mr. Tatayah (in Mauritius), the possibility of a not suited questionnaire could be seen as relatively low.

Different school levels

The 'Learning with Nature' education programme was originally designed for students of Form II (14 years old), but in reality the tour was performed for students of Form I to VI (13 to 18 years old). When students of a higher level (like Form V and VI) came to Ile aux Aigrettes, the tour was only adapted in such a way that the activities were skipped. For the rest, the tour was kept the same, so in this research it gives quite a reliable view of the 'understanding of what pristine Mauritius was once like' for all school levels.

It turned out that the Form III and V students obtained not the highest score of all school levels attending, but their difference between pre- and post-questionnaire was the highest measured with 15%. Form I students obtained the lowest of all scores, they showed a decreasing difference of 2 points (7%) in the 'understanding of pristine Mauritius' between the pre- and post-questionnaire. Remarkable was that the Form II students obtained the highest total score in the pre- and post- questionnaire of respectively 15.6 and 17.9 points, out of a possible 30.0 points. The difference between pre- and post-questionnaire was 2.3 points (8%), which is low in consideration with the other school levels. This means the nature trail was not effective for Form II

students, whom the tour was designed for. This seemed to be explained by the fact that the nature trail was not sufficient adapted to the school levels. Sauerborn and Brühne (2009) mentioned that children learn in an optimal way if the learning matter is adapted to their age and skills.

It is difficult to explain the exact reason of this spread in total scores per school level. It could relate to the relatively low number of participants per school level, because the number of participants ranged from 8 participants (post-questionnaire of Form III) to 39 participants (pre-questionnaire of Form V). In addition, the participants in each school level represented either one, two, or three school groups which is obviously not representative enough to draw general conclusions.

Different sexes

In analysing the total scores between the different sexes, the girls obtained an average score of 13.2 points and the boys 9.9 points in the pre-questionnaire. Remarkable are the results in the post-questionnaires, where the boys and the girls obtained the same average score of 14.2 points. So the girls showed an average increase of only 3% while the boys showed an average increase of 14%. It seems that the nature trail was more effective to the boys than to the girls in terms of an increase in the 'understanding of what pristine Mauritius was once like' between before and after the visit.

Elliot (2011) mentioned that girls learn differently from boys and girls have different interests than boys. Taking this into account, it seems logical that students of both sexes scored the same after the tour, because for both sexes possibilities were created to obtain an 'understanding of what pristine Mauritius was once like'.

Probably more data specified on the participants' sexes is necessary, because in this research the boys were only represented by 35 of their sex in the pre-questionnaire and by 49 in the post-questionnaire. In addition, boys were only represented by 3 different school groups which were not representative enough to draw general conclusions.

6. Conclusions

The results indicate a statistically significant increase in awareness between the pre- and post-visit to Ile aux Aigrettes by students. Even so, the environmental education programme 'Learning with Nature' is not at all effective in achieving its aim in gaining an 'understanding of what pristine Mauritius was once like', because the results are a lot less than acceptable (acceptable was chosen to be 60%).

In the pre-PMMs the students gain a mean mastery score of respectively 3.89 (24%) and 3.16 points (20%) in Scoring System 1 and 2 and in the post-PMM this is respectively 4.8 (30%) and 4.3 points (27%). In both scoring systems there is an increase between pre- and post-measurement of around 1 point (6%). In the pre- and post-questionnaire the students gain an average total score of respectively 12.3 (41%) and 14 points (47%), with a increase of 1.7 points (6%). This means there is a relatively small increase of 6% in the students' 'understanding of what pristine Mauritius was once like', before and after their visit to Ile aux Aigrettes in both of the methods used.

Different School levels

In the PMM, data were only collected of Form I, II, and V students and the participants were not equally representative. The results of the PMM show that Form I students obtain the highest mean mastery score of 4.4 points (28%) in the pre-PMM and 5.6 points (35%) in the post-PMM in Scoring System 1. These students also show the highest increase of 7.5% between the pre- and post-PMM, whereas the Form II students (to whom the education programme originally was designed) show the smallest increase of 4%. The Form II students obtain the lowest score in the pre- and post-PMM of respectively 3.4 (21%) and 4.1 points (26%).

In Scoring System 2 of the PMM the Form II students, again, show the smallest increase between the pre- and post-PMM of 6%, where they score respectively in the pre- and post-PMM 2.7 points (17%) and 3.6 points (23%). The highest increase between the pre- and post-PMM is shown by the Form V students with 2.2 points (14%) with a mean mastery score of respectively 3.4 points (21%) and 5.6 points (35%). This all means that according to the PMM method, the education programme is not effective for none of the school levels even though they show a significant increase.

The number of participants in the questionnaire is higher than in the PMM, but still not equally distributed by the different school levels. The results of the pre- and post-questionnaire indicate that the students of Form III and V show the highest 'understanding of what pristine Mauritius was once like' of 15% between the pre- and post-questionnaire. Form II students, to whom the education programme was originally designed, have the highest total score of respectively 15.6 points (52%) and 17.9 points (60%). Even so, the results show a mean increase of 2.3 points (8%) and the students of Form II do not obtain an acceptable 'understanding of pristine Mauritius'. Neither do the students of Form I who show a decrease between the pre- and post-questionnaire of 8%; from 11.8 points (39%) to 9.5 points (32%). Although the Form II students obtained an acceptable 'understanding of pristine Mauritius' their increase between the pre- and post-measurement was relatively low in consideration with other school levels in this study. This all means that according to the questionnaire method, the education programme is not effective for none of the school levels even though some of them show a significant increase.

Different sexes

In this study the data analysis for the different sexes was only done with the results of the questionnaire. It should be taken into account that fewer boys attended this study (n=84) than girls (n=173). The collected data show that the boys and girls score equally in the post-questionnaires with 47.3%, whereas their scores are different in the pre-questionnaire (girls: 44%; boys: 33%). The increase between the pre- and post-questionnaire show that 'understanding of what pristine Mauritius was once like' of the boys has a higher increase due to the tour; the boys have a increase of 4.3 points between the pre- and post-questionnaire in contrast to the girls who show a increase of 1 point.

PMMs compared to questionnaires

Both of the methods used show a similar total score and increase of the 'understanding of what pristine Mauritius was once like' by the students who visited Ile aux Aigrettes. In this study the results differ for the school levels between the two methods, but because not enough data were collected, no general assumptions can be made. So based on the information collected in this study, it can be concluded that the Personal Meaning Mapping and the questionnaire lead to the same conclusions.

7. Recommendations

To improve the 'Learning with Nature' education programme in the near future, some recommendations are explained in some detail in this chapter. One of the major recommendations is to carry out another study (of this kind) to evaluate the 'Learning with Nature' education programme. On the whole the results of this study are clear, but still some elements influenced the results in this research and some questions remain, as discussed in Chapter 5. Therefore, it seems necessary to improve the way of implementing both of the methods.

Learning with Nature

As the 'Learning with Nature' trail is not effective according to the results of this research, and there is a major difference in the effectiveness of the nature trail between the different school levels, it would be recommended to adapt the nature trail to the different school levels. This could give the opportunity to offer different types of nature trails, focused on different subjects, which means that schools can come back several times with the same school group. In addition, the duration of the tour could be adapted to the particular school levels, to make sure all students can concentrate the whole tour and to gain an optimal increase in learning. In this way an optimal education programme can be offered to the different school groups and the education programme could become more effective.

Furthermore, schools should be more active in the pre- and post-processing of the education programme to be connected to the learning matter at school. The Mauritian Wildlife Foundation could stimulate this by developing complete learning activities/ packages that can be used directly by the teacher. Now the teachers have to prepare the students themselves by looking at the website of the Mauritian Wildlife Foundation, which could be too time-consuming for the teachers. When the teachers can use a package (which could be sent to the school) it might be easier to actually use it. The 'Learning with Nature' education programme could become more effective when pre- and post-processing is stimulated in schools.

The small-sized population of school levels in this study – which were mostly proven as statistically significant – showed all a relatively low difference between before and after the visit. Further research is recommended, after improvements of the nature trail to confirm the results of this study and to give a better insight in the capability of the different school levels and sexes, so that more detailed recommendations could be given.

PMM

The PMM is not a commonly used method to assess environmental education programmes and according to this study it cannot be clearly proven as a statistically representative method yet. The drawings must be coded and converted into statistical data, and because no scoring systems have been presented so far, it is difficult to do so. It also allows many possibilities for personal interpretation. In addition, the method itself is quite time-consuming, especially when interviews are carried out next to the PMMs. Therefore it would not be recommended to use the PMM in this kind of research until further improvement of the method has been published. Because the results of the PMM were quite comparable to the questionnaire results, it is a lot easier and less time-consuming to use a traditional questionnaire to assess knowledge in this kind of research. Even so, with a PMM it is possible to assess an individual's progress and so it could be very useful in some occasions, e.g. psychotherapy.

If the PMM is used as a statistically method in despite of the objectives mentioned, another method must always be used in combination with the PMM as shown in this study (e.g. a ques-

tionnaire). Furthermore, a reliable scoring system must be developed in advance of the study. It must be very obvious how to score the dimensions (depth in particular), so personal judgements are made as small as possible. This could be developed in cooperation with a psychologist/therapist specialised in analysing children's drawings.

When used directly in the field, as in this study in a nature reserve, more recommendations should be taken into account. The participants should be able to work in peacefulness where they are not interrupted by anyone (e.g. visitors passing by, teachers, rangers, etc.), which could be a closed area where students have some separate space. It would be even better to carry out the PMMs before any of the activity/ visit has started, e.g. a day/ week/ month/ year before the actual visit. In the case of school students this can easily be done in their school. In this study the students were already on the islet when the pre-measuring started and that influenced the results in some way.

In addition, it is advised to communicate the necessary time for the PMM to the participants so they can decide themselves whether to investigate their time in the evaluation or not. Visitors who are in a hurry should not be assessed, because that could have an influence on the results.

Questionnaire

This study showed that this method was very useful for an evaluation of an environmental education programme, and would be definitely recommended in the future. Then it is recommended to make sure that the students have no possibility to be disturbed in any way (e.g. by fellow-students, teacher, ranger, etc.) during the measurement. In addition, the students need sufficient space with a possibility to write and to sit on, to be able to concentrate in the best possible way.

As well as for the PMM, the questionnaire should be carried out before any part of the programme (including the preparation package or any pre-process at school) has started. In the case of the 'Learning with Nature' trail the measurement should be done before the arrival on Ile aux Aigrettes (e.g. on mainland or at school), so reliable results of the pre-knowledge can be assessed.

A pilot study is crucial for measuring properly; checking the standard of the questions and the understandability of the answers. A longer pilot study than this one should be done where time is available to adapt the designed questionnaire. Furthermore, it is recommended to develop a scoring system before the actual study starts; this should be done to be able to score the questionnaires in a reliable way.

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Appendices

1. **Appendix I: 'Le Sentier de Dodo' nature trail**
2. **Appendix II : PMM**
 - a) Appendix II-a: PMM English
 - b) Appendix II-b: PMM French
3. **Appendix III: Questionnaire**
 - a) Appendix III-a: Questionnaire English
 - b) Appendix III-b: Questionnaire French
4. **Appendix IV: Scoring system for the PMM**
 - a) Appendix IV-a: Scoring system 1 for the PMM
 - b) Appendix IV-b: Scoring system 2 for the PMM

Appendix I: Le Sentier du Dodo nature trail

1. Tortoise Nursery (10 minutes)
 - The baby tortoises are shown and related to the conservation work of the Mauritian Wildlife Foundation.
2. Lime Kiln (5 minutes)
 - There is a short History of Ile aux Aigrettes and Mauritius.
 - The Dutch and French period is highlighted while referring to the lime kiln.
 - The concept of food-chains is introduced and there is an activity about the food-chain; there are six laminated pictures of Ebony fruit, Giant tortoise, Ant, Day Gecko, Telfair's Skink, and the Kestrel given to different students which they have to put in the correct order.
3. Visscher's Viewpoint (10 minutes)
 - Students distinguish noise coming from nature and man-made noise when listening carefully to the different noises.
 - The concepts of biodegradable and non-biodegradable materials are introduced with an activity; different materials are handed out (e.g. banana skin, plastic bag, paper, plastic bottle, glass bottle, etc.) and the students have to decide which ones are biodegradable and which ones are non-biodegradable (actually they had to make a line from the material that takes the shortest amount of time to biodegrade until the material that takes the longest amount of time, but apparently this was too difficult for the students after which the activity was changed).
 - On the way to the next point plant diversity is discussed (ecology, history, economic value, etc.).
4. Bay view Platform (15 minutes)
 - Students can read the interpretation.
 - On the platform the geography of the surrounding areas is discussed (Mahébourg Bay, Grand Port).
5. Bronze Dodo (10 minutes)
 - Brief information about the Dodo is given in relation to extinction and conservation.
 - The conservation of nature is highlighted and related to the Mauritian Wildlife Foundation's work.
6. The Canon (5 minutes)
 - The canon is introduced in relation to the history of the islet, the Second World War, and the effects on the flora and fauna.
 - On the way to the next stop, the attention is drawn to the Ebony forest.
7. Tortoise Bronze (10 minutes)
 - The Tortoise bronze is observed when the ranger explains the adaptation of the Giraffe Tortoise to its environment and the mass killing of tortoises by early settlers.
8. Olive White-eye Feeding Platform (10 minutes)
 - Students are introduced to the concept 'phenology' where they do an activity; the students get handed out a book with a total of 21 pages (A5), of which they will use four pages with an exercise on each page, about leaf arrangements, leaf margins, leaf tips, venation, and a phenology monitoring sheet is filled out (This concept was added during this research).
 - On the way to the plant nursery, the students can observe the Bois de Fer (approximately 170 years old tree and one of the only five adult trees left on the islet).
9. Plant Nursery (10 minutes)
 - The nursery is explained with the seed preparation, potting, and moving according to shade and watering when relating to the plant conservation work of the Mauritian Wildlife Foundation.
10. Pigeon Viewpoint (10 minutes)
 - The students are allowed to observe the birds while the ranger describes the different characteristics.
 - The concept of endemic and exotic birds is introduced when attention is drawn to the different endemic birds on the islet (Pink Pigeon, Mauritius Fody, Olive White Eye, etc.).

- On the way to the next stop, the students can observe the nesting pits for the Telfair's Skink with an explanation that is linked to the Tortoise nursery at the beginning of the nature trail.

11. Giant Skink Bronze (5 minutes)

- The bronze model of the Giant Skink is observed where the reason of its extinction is discussed.
- The Telfair's Skink is introduced and linked with the conservation work of the Mauritian Wildlife Foundation.

12. Tortoise Nesting Platform (5 minutes)

- The importance of the nesting pit and the necessary conditions for successful nesting are explained.



Figure 13. Photo impression of Le Sentier du Dodo trail, showing from top left to bottom right the first seven stops: Tortoise Nursery, Lime Kiln, Visscher`s Viewpoint, Bay view Platform, Bronze Dodo, Cannon, and the bronze Tortoise (I. van Engelen).



Figure 14. Photo impression of Le Sentier du Dodo trail, showing from top left to bottom right the final five stops: Olive White Eye Feeding Platform, Plant Nursery, Pigeon Viewpoint, Giant Skink Bronze, and Tortoise Nesting Platform (I. van Engelen & S. Wylegalla).

Appendix II-a: PMM English

Nature on Ile aux
Aigrettes 400 years ago

Name:

Appendix II-b: PMM French

La nature à L'Île aux Aigrettes 400 ans de cela

Mon nom:.....

Appendix III-a: Questionnaire English

Hello,

Could you please fill out these questions, you would help us enormously to complete our research about nature. Just tick the boxes in each question that you think gives the correct answer to the questions. Sometimes you can tick more than one answer!

Thank you!

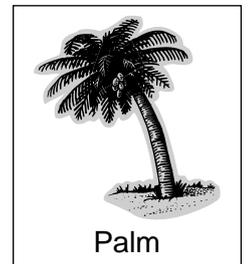
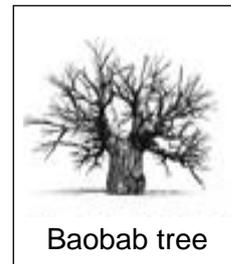
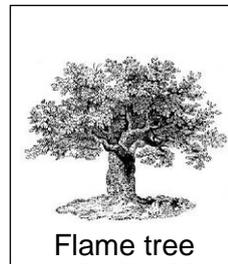
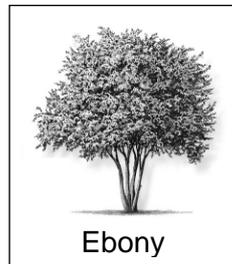
Ingrid and Sarah

Please write down your school level:

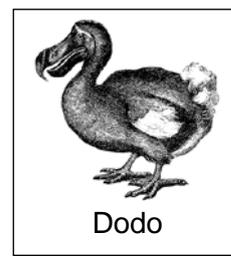
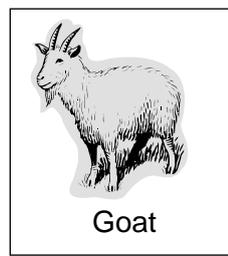
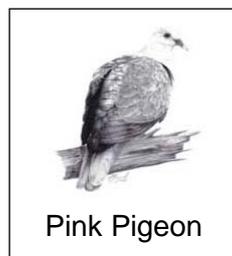
I am a boy

I am a girl

1. Which native trees lived in Mauritius 400 years ago? You can tick more than one image.



2. Which native animals lived in Mauritius 400 years ago? You can tick more than one image.



3. How was Mauritius damaged by human impact 400 years ago? Choose one of the possibilities.

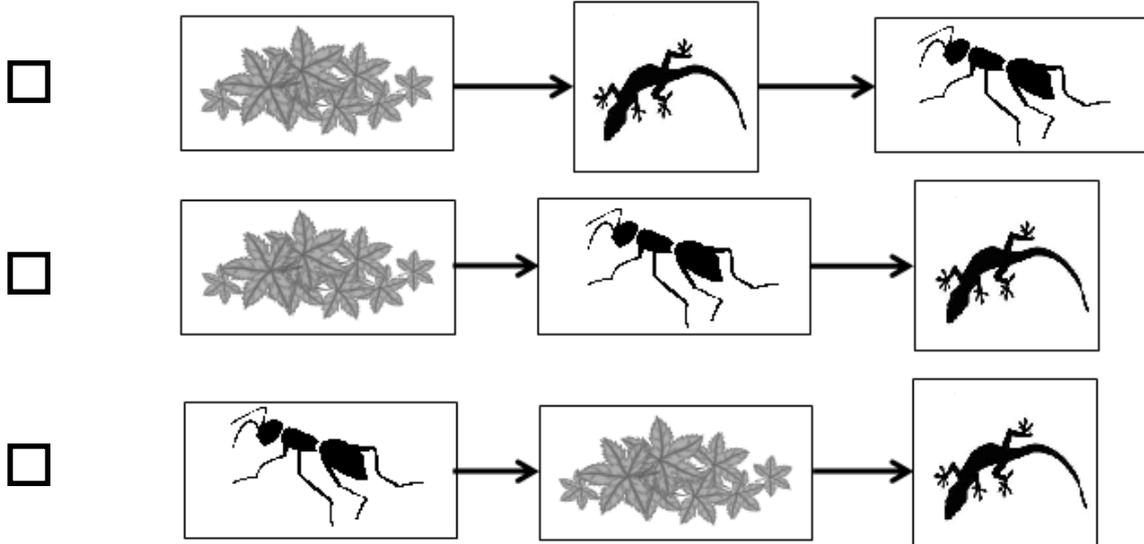
1. Settlers destroyed the forest to make space for agriculture.

2. Tourists destroyed the forests for the textile industry.

3. Settlers built the highways and the airport.

4. Mauritius was destroyed during the Second World War.

4. Which of these food-chains is correct? Choose one of the three possibilities.



5. Which of these objects are biodegradable (decomposable)? You can tick more than one answer.

- | | |
|--|---|
| <input type="checkbox"/> 1. Plastic bag | <input type="checkbox"/> 6. Seeds |
| <input type="checkbox"/> 2. Banana skin | <input type="checkbox"/> 7. Paper |
| <input type="checkbox"/> 3. Painted wooden stool | <input type="checkbox"/> 8. Fishing line |
| <input type="checkbox"/> 4. Leaves | <input type="checkbox"/> 9. Take-away container |
| <input type="checkbox"/> 5. Glass bottle | <input type="checkbox"/> 10. Egg shell |

6. What does the Mauritian Wildlife Foundation do to conserve nature? Please indicate how much you agree or disagree with the statements below.

| The Mauritian Wildlife Foundation... | Totally disagree | Totally agree | Strongly disagree | Strongly agree | Disagree | Agree | Don't know |
|--|------------------|---------------|-------------------|----------------|----------|-------|------------|
| a. ...allows me to discover nature. | | | | | | | |
| b. ...restores historical buildings. | | | | | | | |
| c. ...saves dolphins. | | | | | | | |
| d. ...protects nature reserves. | | | | | | | |
| e. ...saves threatened plants and animals. | | | | | | | |

Appendix III-b: Questionnaire French

Salut!

On te prie de répondre à ces questions. Ton aide est très précieuse pour notre recherche sur la nature. Coches le ou les casiers que selon toi correspondent aux bonnes réponses.

Merci!

Ingrid et Sarah

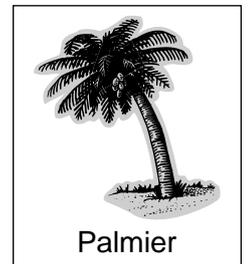
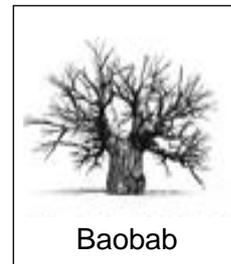
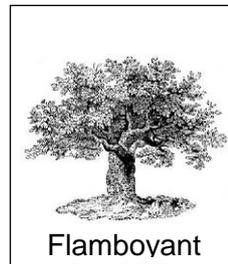
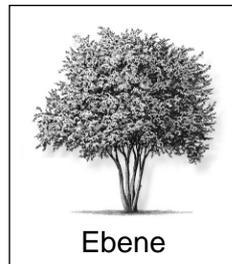
Tu est dans quelle classe:.....

Sexe :

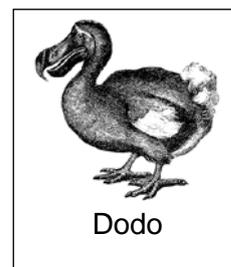
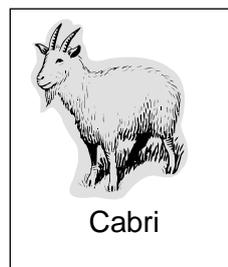
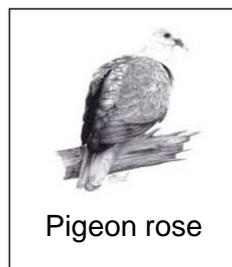
Garçon

Fille

1. Laquelle (ou lesquelles) de ces plantes ci-dessous étaient présentes a Maurice 400 ans de cela? Tu peux cocher plus d'une image.



2. Lesquelles de ces animaux étaient présents a Maurice 400 ans de cela? Tu peux cocher plusieurs réponses.



3. Quels sont les dégâts causés par l'homme 400 ans de cela? Choisis une de ces réponses.

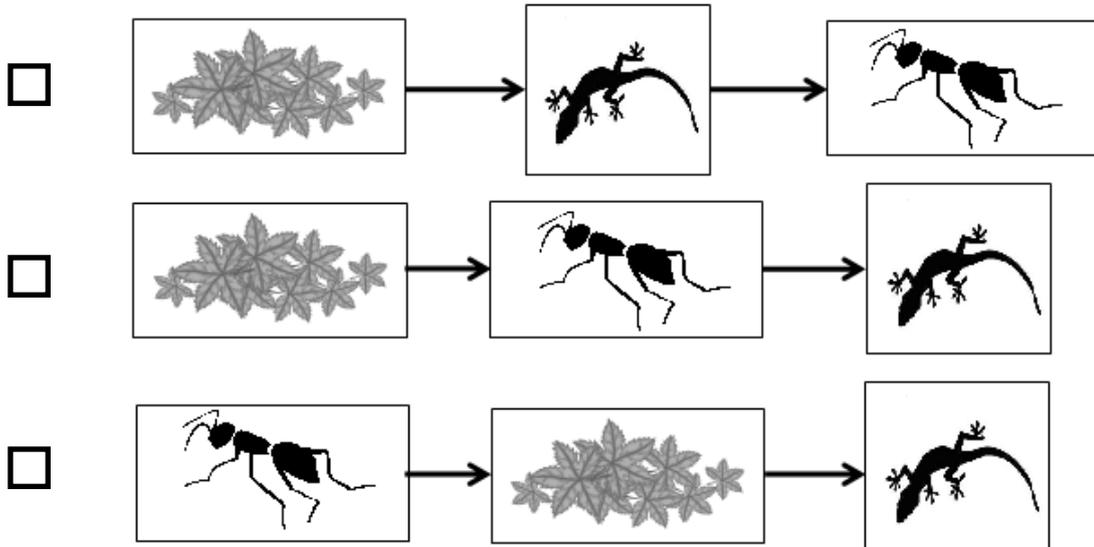
1. Les colonisateurs ont remplacé la forêt par l'agriculture.

2. Les touristes ont détruit la forêt pour faire place aux usines de textile.

3. Les colons ont construit les autoroutes et l'aéroport.

4. Maurice fut détruit pendant la deuxième guerre mondiale.

4. De ces trois chaînes alimentaire, quelle est la bonne?



5. Coches les objets biodégradables dans la liste ci-dessous?

- | | |
|--|--|
| <input type="checkbox"/> 1. Sac en plastique | <input type="checkbox"/> 6. Graines |
| <input type="checkbox"/> 2. Peau de banane | <input type="checkbox"/> 7. Papier |
| <input type="checkbox"/> 3. Banc en bois peint | <input type="checkbox"/> 8. Ligne de peche |
| <input type="checkbox"/> 4. Feuilles | <input type="checkbox"/> 9. Boîte à emporter |
| <input type="checkbox"/> 5. Bouteille en verre | <input type="checkbox"/> 10. Coquille d'oeuf |

6. La Mauritian Wildlife Foundation conserve la nature dans lesquels de ces buts? Indiques ton accord ou desaccord avec ces declarations.

| La <u>Mauritian Wildlife Foundation</u> ... | Pas du tout d'accord | Pas très d'accord | Pas d'accord | Sais pas | D'accord | Très d'accord | Entièrement d'accord |
|---|----------------------|-------------------|--------------|----------|----------|---------------|----------------------|
| a. ...me permet de découvrir la nature. | | | | | | | |
| b. ...restaure les bâtiments historiques. | | | | | | | |
| c. ...sauve les dauphins. | | | | | | | |
| d. ...protège les réserves naturelles. | | | | | | | |
| e. ...sauve les plantes et les animaux en danger. | | | | | | | |

Appendix IV-a: PMM Scoring system 1

This scoring system is developed with the characteristic that every single drawing is counted and scored.

1. Extent

Every single drawing is counted as well for the pre- and the post-PMM. The extent is the difference in the number of drawings (n).

- A single drawing is recognised when lines are attached to each other; it is counted as one drawing unless it is clearly noticeable that 2 or more different types of drawings are represented;
- All M- or V-shaped lines that represent a bird are counted as one drawing;
- All drawings that represent a substrate, e.g. rocks/ stones, grass, and water, are all counted as one drawing;
- Drawings that have been adapted in the post-PMM are counted again for the post-measuring;
- When PMMs contain text, it is recorded;
- When PMMs contain text, still every single drawing is counted but the text is used to understand the PMM better.

2. Breadth

Every different sub concept is counted in the pre- and post-PMM and marked as present (1) or absent (0). These sub concepts are possible ones drawn by the participants in their PMMs, so not determined by the authors or the education staff. After an overall-look of the PMMs, eighteen sub concepts were distinguished. All of these sub concepts were divided by the categories 'Flora and Fauna', 'Human Impact', and 'Balanced Ecosystem', due to the fact that 'The understanding of what pristine Mauritius was once like' was defined into these three categories (see Table 5).

In this case each participant can get a maximum score of eighteen (18) when all sub concepts are part of the drawing and a minimum score of zero (0) when none of the concepts are present.

When there was doubt about scoring a drawing into one of these categories, because the drawing was not clear enough, it was scored in a separate category: indefinable. By scoring some drawings in this way, the interpreting factor was kept as low as possible.

3. Depth

Bowker (2007) used a five-point scale (very poor to excellent) to indicate depth of understanding; the quality of the overall drawing and their detail was scored. Based on these ideas a five-point scale was developed, so that judgements are brought to a minimum (Table 6). When drawings contain more details, a higher score can be gained. Examples of drawings are shown in Figure 15, Figure 16, and Figure 17 and these have to be used in combination with Table 6.

4. Mastery

This dimension takes into account the extent, breadth, and depth, both before and after the visit. All three dimensions will be scored and the total will end in the mastery score.

• Extent:

The maximum scored extent is 117, so five categories are made from 0 to 125 and each category will be scored differently from zero to five. These new scores are created into two new variables;

Mastery Extent Pre and *Mastery Extent Post*:

- Extent = 0 → 0
- Extent = 1 – 25 → 1
- Extent = 26 – 50 → 2
- Extent = 51 – 75 → 3
- Extent = 76 – 100 → 4
- Extent = 101 – 125 → 5

- **Breadth:**
First all concepts are scored, where 2 points are divided between their sub-concepts
 - The concept *Flora and Fauna* is scored with 2 points, divided between *Trees, Plants, Substrate, Birds, Fish, Insects, Invertebrates, Mammals, Reptiles/ amphibians, and Native Species*. Every sub-concept is worth 0.2 point in this concept.
 - The concept *Human Impact* is scored with 2 points, divided between *Conservation, Deforestation, Dwellings, and Humans*. Every sub-concept is worth 0.5 point in this concept.
 - The concept *Balanced Ecosystem* is scored with 2 points, divided between *Climate and Weather, Foraging, Geography, and Relation Ecosystem*. This sub-concept is worth 0.5 points in this concept.
 Then the sums of these scored categories are calculated and scored into five categories which relate into the new variables *Mastery Breadth Pre* and *Mastery Breadth Post*:
 - Breadth = 0 → 0
 - Breadth = 0.1 – 1.0 → 1
 - Breadth = 1.1 – 2.0 → 2
 - Breadth = 2.1 – 3.0 → 3
 - Breadth = 3.1 – 4.0 → 4
 - Breadth = ≥4.1 → 5
- **Depth:**
The change in the average depth score per concept is calculated, and scored into five categories and relates into the new variables *Mastery Depth Pre* and *Mastery Depth Post*:
 - Average depth = 0 → 0
 - Average depth = 0.01 – 1.0 → 1
 - Average depth = 1.01 – 2.0 → 2
 - Average depth = 2.01 – 3.0 → 3
 - Average depth = 3.01 – 4.0 → 4
 - Average depth = ≥4.1 → 5

A total mastery score is possible from zero to sixteen, where fifteen means that the extent is 101-125, all sub-concepts are present in the drawing, and all drawings in the (sub-)concepts have scored 'excellent' for depth.

Table 5. Different concepts and sub-concepts of Scoring system 1.

| | |
|----------|--|
| 1 | Flora and fauna |
| • | Trees |
| • | Plants |
| • | Substrate (e.g. water, sand, grass, rocks, etc.) |
| • | Birds |
| • | Fish |
| • | Insects |
| • | Invertebrates |
| • | Mammals |
| • | Reptiles/ amphibians* |
| • | Native species (specific native species; e.g. dodo, giant tortoise, etc.) as a total from all other drawn plants and animals |
| 2 | Human Impact |
| • | Conservation (e.g. fenced areas) |
| • | Deforestation (e.g. trees and plants cut down) |
| • | Dwellings (human dwellings; house, boat, etc.) |
| • | Humans (people) |

| 3 Balanced Ecosystem |
|---|
| • Climate & weather (weather influences; e.g. sun, clouds, rain, etc.) |
| • Foraging |
| • Geography (place on earth; e.g. island, surrounding countries, etc.) |
| • Relation ecosystem (no. of combination of themes of animals, plants; and environment (e.g. animal in tree/ sky) |

* **Reptiles and amphibians are put into one category because the difference between the two types of animals is mostly not visible.**

Table 6. Scoring system ‘depth’ PMM in words which is used in addition to the “Scoring system version 1 ‘depth’ in drawings”

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|--------------------------------|--|--|---|---|---|
| Flora and Fauna | | | | | |
| Trees | Outer lines that represent a tree | Lines/ stripes representing the top part of the tree attached to a trunk OR depth 1 with fruits/ bird nest | Outer lines of branches that represent the top part of the tree attached to a trunk OR depth 2 with fruits/ bird nest | ≥5 leaves and/or branches that represent the top part of the tree attached to a trunk OR depth 3 with fruits/ bird nest | ≥5 detailed leaves (leaf-vein) and branches (thick line) that represent the top part of the tree (could be with fruits) attached to a trunk |
| Plants - <i>Bush/ plant</i> | - Outer lines that represent a bush/ plant | - Outer lines that represent a bush/ plant with coloured inside | - ≥5 stripes attached to each other pointing at a slightly different direction which are at least half the size of the nearest drawn tree | - ≥3 different recognisable leaves | - ≥3 different recognisable detailed leaves (leaf-veins) |
| - <i>Flowers</i> | - Outer lines that represent a flower, could be with a calyx and/ or with a flower stalk | - Outer lines that represent a flower (with a calyx) and a leaf attached to the flower stalk | - ≥5 petals which are one-dimensional and attached to a flower stalk | - ≥5 petals which are two-dimensional with a leaf attached to the flower stalk | - ≥5 petals which are two-dimensional with a detailed leaf (leaf-veins) attached to the flower stalk |
| Substrate | Empty substrate part ¹ which represents grass, sand or water | A substrate part which represents grass, sand or water filled with lines | A fully coloured area which represents grass, sand or water OR ≥5 outer lines that represent stones/ rocks | ≥5 sets of stripes/ lines that are part of the grass OR ≥5 neatly closed lines that represent stones/ rocks | ≥5 sets of stripes/ lines that are part of the grass AND ≥5 neatly closed lines that represent stones/ rocks |
| Birds | Lines that represent a bird | Outer lines that represent a bird (with an empty space in the middle), which could include an eye | A clearly recognisable bird with outer lines of feathers/ wings | A clearly recognisable bird with more than two feathers and a beak existing of two parts | A two-dimensional bird with more than two sets of feathers and a beak existing of two parts AND recognisable aspects of a certain (endemic) species |
| Fish | Outer lines that represent a fish | Outer lines that represent a fish with an eye | A clearly recognisable fish with an eye and outer fins | A clearly recognisable fish with outer fins and gills | A clearly recognisable fish with outer fins, gills and which is fully scaled |

Continuation of Table 6. Scoring system 'depth' PMM in words which is used in addition to the "Scoring system version 1 'depth' in drawings"

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|--|---|---|--|---|---|
| Flora and Fauna | | | | | |
| Insects | Outer lines that represent an insect | Outer lines that represent an insect with eyes | A clearly recognisable insect with added details on the body | A clearly recognisable insect with a segmented body and added details on the body | A two-dimensional insect that contains all details of its body; segmented body, legs, set of wings, antennae, eyes. |
| Invertebrates | Outer lines that represent an invertebrate | Outer lines that represent an invertebrate with eyes | A clearly recognisable invertebrate with legs ² that exist of ≥ 2 lines | A two-dimensional invertebrate | A two-dimensional invertebrate with ≥ 2 different types of details (segments in legs/body) |
| Mammals | Outer lines that represent a mammal | Outer lines that represent a mammal with eyes | A clearly recognisable mammal with ≥ 2 added body parts (ears, legs, tale, etc.) | A mammal that contains all body parts of that specific species existing of ≥ 2 lines | A two-dimensional mammal that contains all body parts of that specific species in detail |
| Reptiles/ Amphibians - <i>Tortoise</i> - <i>Skink/ gecko</i> | - Outer lines that represent a tortoise - Outer lines that represent a skink/ gecko | - Outer lines that represent a tortoise with eyes and scales made out of roughly lines - Outer lines that represent a skink/ gecko with eyes | - A clearly recognisable tortoise with legs existing of ≥ 2 lines and scales made out of lines drawn precisely - A clearly recognisable skink/ gecko that contains 4 basic legs with recognisable toes | - A clearly recognisable tortoise with legs existing of ≥ 2 lines and separated scales - A clearly recognisable skink/ gecko that contains 4 legs with ≥ 3 toes each | - A two-dimensional tortoise with detailed scales and legs - A two-dimensional skink/ gecko with 4 detailed legs with ≥ 3 thin toes each AND a skin structure |
| Recognisable native Species (out of the previous concepts) - <i>Dodo</i> - <i>Giant tortoise</i> - <i>Pigeon (any)</i> - <i>Skink/ Gecko</i> | Average score of all drawn native species scored for each different type of flora and/ or fauna, rounded off upwards. | | | | |

Continuation of Table 6. Scoring system 'depth' PMM in words which is used in addition to the "Scoring system version 1 'depth' in drawings"

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|--|--|--|--|---|---|
| Human Impact | | | | | |
| Conservation | Number of conservation objects (e.g. fenced areas) with a maximum of 5 objects/ points | | | | |
| Deforestation | Number of deforestation drawings (e.g. fallen trees) with a maximum of 5 drawings/ points | | | | |
| Dwellings | Outer lines that represent a human dwelling existing of one part | Outer lines that represent a human dwelling existing of ≥ 2 different parts | A clearly recognisable dwelling existing of ≥ 4 different parts | A two-dimensional dwelling existing of ≥ 4 different parts | A two-dimensional dwelling existing of ≥ 4 different parts AND ≥ 3 added details |
| Humans | Outer lines that represent a human | Outer lines that represent a human with eyes | A recognisable human with eyes containing ≥ 2 details like hair, hands, feet, etc. | A clearly recognisable human containing a detailed face, hair and hands. | A clearly recognisable human who contains all detailed body parts (hands, feet, hair, etc.) and fully dressed |
| Balanced Ecosystem | | | | | |
| Climate and weather | empty sky(*) | coloured sky OR a solitary sun/ cloud | sky contains clouds OR a detailed sun | sky contains clouds AND a sun | sky contains detailed clouds AND a detailed sun |
| Foraging | Number of foraging animals with a maximum of 5 foraging animals/ points | | | | |
| Geography - <i>Mountains</i> - <i>Island aspects</i> | - outer lines with mountains attached to each other - outer line representing an island | - outer lines with mountains separated from each other OR depth 1 with details - outer line representing an island surrounded by water drawn by lines | - two-dimensional mountains separated from each other OR depth 2 with details - outer line surrounded by coloured water OR detailed island line surrounded by water | - a detailed mountain line separated from each other OR depth 3 with details - detailed island line surrounded by fully coloured water OR detailed island line with a detailed shore and surrounded by water | - a detailed mountain line separated from each other with details (e.g. rocks, snow, etc.) - detailed island line with a detailed shore AND surrounded by fully coloured water |
| Relation ecosystem | One big drawing (and not several small ones) containing only trees and plants OR one big drawing containing only animals | One big drawing of only trees containing 1 type of animal OR one big drawing of only animals containing 1 type of tree or plant | One big drawing of only trees containing 2-3 different types of animals OR one big drawing of only animals containing 2 types of trees and/ or plants | One big drawing of only trees containing 4-5 different types of animals OR one big drawing of only animals containing 3 types of trees and/ or plants | One big drawing of only trees containing six types of animal OR one big drawing of only animals containing ≥ 4 types of trees and/ or plants |

* a horizontal line / mountain line on the length of the paper is drawn, so the bottom part shows a substrate and the upper part shows sky ² an invertebrate species that does not have legs can never score ≥ 3 in depth

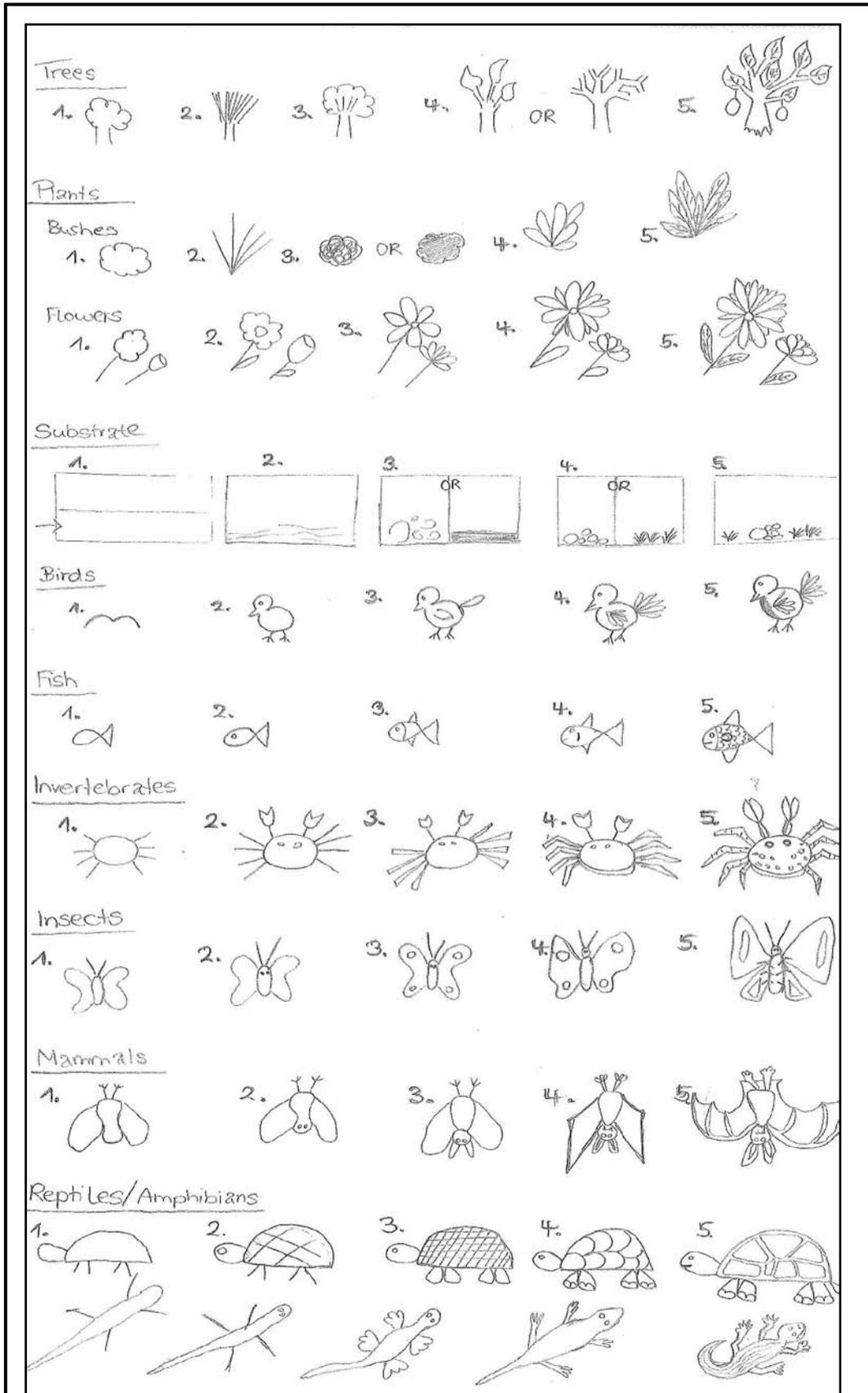


Figure 15. Scoring system 'depth' in drawings version 1: Flora and Fauna; Trees, Plants, Substrate, Birds, Fish, Insects, Invertebrates, Mammals, Reptiles/ Amphibians which is used in addition to the 'Scoring system 'depth' in words version 1'. (S. Wylegalla)

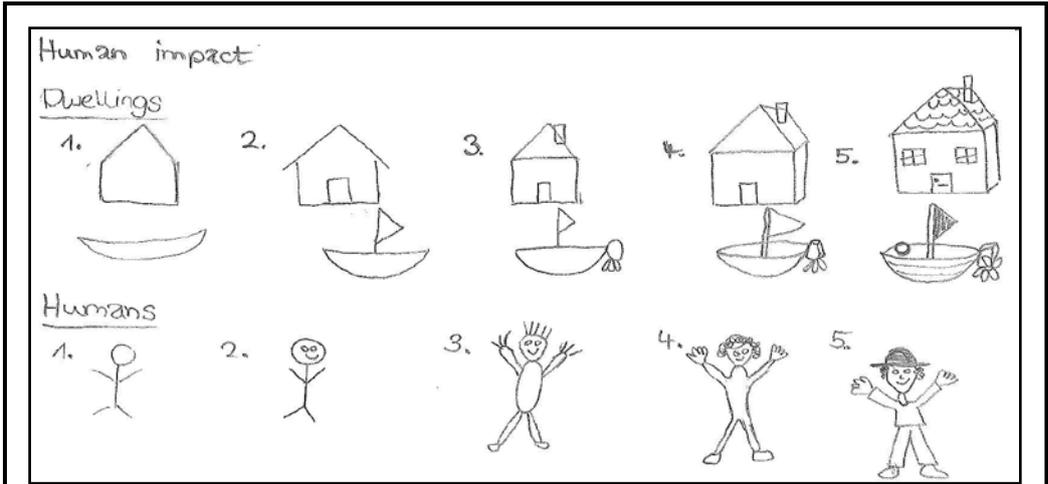
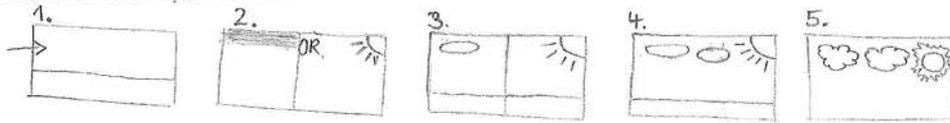


Figure 16. Scoring system 'depth' in drawings version 1: Human Impact; Dwellings, Humans which is used in addition to the 'Scoring system 'depth' in words' version 1. (S. Wylegalla)

Climate and weather

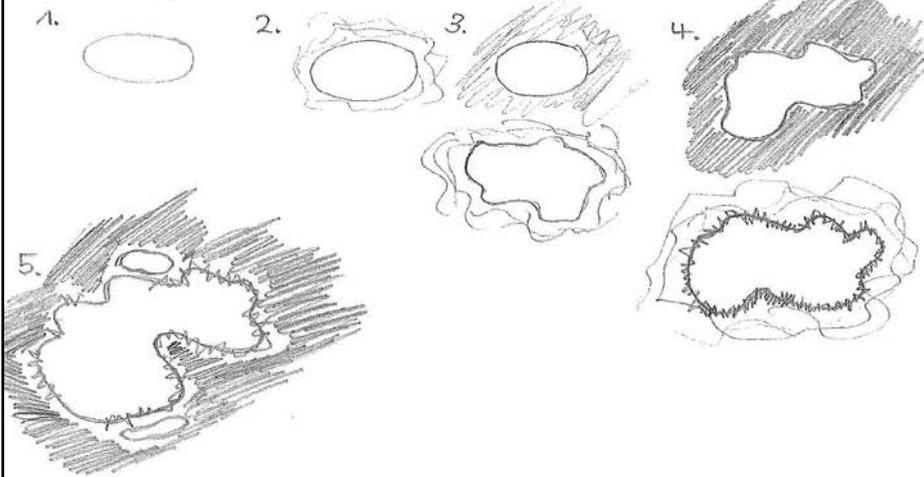


Geography

Mountains



Island aspects



Relation ecosystem

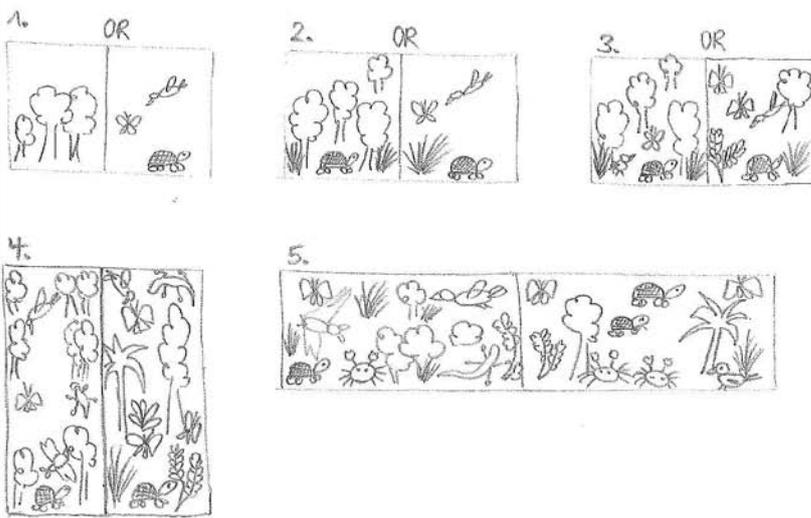


Figure 17. Scoring system 'depth' in drawings version 1: Balanced Ecosystem; Climate and weather, Geography, Relation Ecosystem which is used in addition to the 'Scorina system 'depth' in words' version 1. (S. Wvleqalla)

Appendix IV-b: PMM Scoring system 2

This scoring system is developed with the characteristic that only relevant drawings to the nature trail are counted and scored, so only drawings of themes that are part of the nature trail.

1. Extent:

Every single relevant drawing is counted as well for the pre- and the post-PMM. The extent is the difference in the number of drawings (n).

- A single drawing is recognised when lines are attached to each other; it is counted as one drawing unless it is clearly noticeable that 2 or more different types of drawings are represented
- A relevant drawing is recognised when it clearly represents (for details see Table 8, Figure 18, Figure 19, and Figure 20):
 - A tree⁽¹⁾
 - A plant⁽²⁾
 - A bird⁽³⁾
 - A tortoise⁽⁴⁾
 - A skink/gecko⁽⁵⁾
 - History aspects of human impact⁽⁶⁾
 - Present aspects of human impact⁽⁷⁾
 - A food-chain⁽⁸⁾

⁽¹⁾ A tree is recognised when the drawing contains a tree trunk.

⁽²⁾ A plant is recognised when the drawing contains stalks or leaves attached to each other (exception drawing (a) in Figure 18). When the plant exists of just lines attached to each other, it has to be at least half the size of the nearest tree in the PMM.

⁽³⁾ A bird is recognised when the drawing contains an M or V-shaped line, or exist of a body with a recognisable beak; triangle at the side of the head.

⁽⁴⁾ A tortoise is recognised when the drawing exists of a half-round shape (shell), with marks on it to express the scales, and added head and feet.

⁽⁵⁾ A skink/ gecko is recognised when the drawing exists of a long-shaped body with a recognisable head, tail, and a minimum of two legs.

⁽⁶⁾ History aspects of human impact are recognised when the drawing contains human dwellings (e.g. house, canon), sailors (e.g. boat), deforestation (e.g. fallen tree), killing of animals (e.g. animal lying on its back), or invasive species (e.g. deer, rats, goat, cats, etc.).

⁽⁷⁾ Present aspects of human impact are recognised when the drawing contains a logo of a conservation charity (e.g. MWF, Chester Zoo, Rufford Foundation), fenced areas, or reproduction (e.g. eggs, youngsters, mating animals). The eggs or youngsters have to be with an adult animal except when it is clearly visible that eggs and/ or youngster are drawn (e.g. a solitary bird nest).

⁽⁸⁾ A food-chain is recognised when the drawing exists of 1 foraging animal(s) (e.g. tortoise with a plant in (front of) his mouth, bird with worm in (front of) its beak, skink with insect in (front of) his mouth). Every part of the food-chain is counted as a separate drawing.

- Drawings that have been adapted in the post-PMM are counted again for the post-measuring;
- When PMMs contain text, it is recorded;
- When PMMs contain text, still every single drawing is counted but the text is used to understand the PMM better.

2. Breadth

In this scoring system the concepts are determined before analysing the PMMs by the authors to make sure only the relevant concepts to the nature trail are taken into account. The concepts of the nature trail are discussed and the ones that can be drawn are listed and divided by the main themes Flora and Fauna, Human Impact, and a Balanced Ecosystem.

Every different concept is counted in the pre- and post-PMM and marked as present (1) or absent (0). In this case each participant can get a maximum score of six (6) when all concepts are part of the drawing and a minimum score of zero (0) when none of the concepts are present. All three of the main concepts are

divided into a few different sub concepts which are shown in Table 7. These sub-concepts are part of the nature trail and when these concepts are drawn, relations with the nature trail can be made. It is worth mentioning that *Trees* and *Plants* make one sub-concept (because in the nature trail there is no specific attention for the differences in trees and plants) so when either trees or plants are present in the PMM, the sub-concept *Trees and Plants* is scored as present.

Table 7: Different concepts and sub-concepts of Scoring system 2a and 2b.

| |
|---|
| Flora and Fauna |
| • Birds (different types of birds) |
| • Reptiles (different types of tortoises) |
| • Skinks/ Geckos (different types of skinks/geckos) |
| • Trees and Plants (different types of trees and plants) |
| Human Impact |
| • History Aspects; Dutch & French Period, WWII (different types of history aspects) |
| • Present Aspects: Conservation work of MWF (different types of conservation aspects) |
| Balanced Ecosystem |
| • Food chain or food web (different types of food-chains) |

3. Depth

A five-point scale (very poor to excellent) is used to indicate depth of understanding of every different sub concept for the pre- and post-PMM. A higher score can be gained when more (different) examples are drawn within a concept and/or when detailed examples are drawn. The full scoring system that is used for this dimension is described in Table 8 and in addition drawings are used as examples (to use in addition to Table 8) which are shown in Figure 18, Figure 19, and Figure 20. Because *Trees* is scored separately from *Plants*, the average depth score of both themes relate into the depth score of the sub-concept *Trees and Plants*.

4. Mastery

This dimension takes into account the extent, breadth, and depth, both before and after the visit. All three dimensions will be scored and the total will end in the mastery score.

- Extent:
The maximum scored extent is 144, so five categories are made from 0 to 150 and each category will be scored differently from zero to five. These new scores are created into two new variables; *Mastery Extent Pre* and *Mastery Extent Post*:
 - Extent = 0 → 0
 - Extent = 1 – 30 → 1
 - Extent = 31 – 60 → 2
 - Extent = 61 – 90 → 3
 - Extent = 91 – 120 → 4
 - Extent = 121 – 150 → 5
- Breadth:
First all concepts are scored, where 2 points are divided between their sub-concepts:
 - The concept *Flora and Fauna* is scored with 2 points, divided between *Trees and Plants*, *Tortoises*, *Skinks*, and *Birds*. Every sub-concept is worth 0.5 point in this concept.
 - The concept *Human Impact* is scored with 2 points, divided between *Present* and *History*. Every sub-concept is worth 1 point in this concept.
 - The concept *Balanced Ecosystem* is scored with 2 points, with just *Food-chain*. This sub-concept is worth 2 points in this concept.
 Then the sums of these scored categories are calculated and scored into five categories which relate into the new variables *Mastery Breadth Pre* and *Mastery Breadth Post*.
 - Breadth = 0 → 0

- Breadth = 0.1 – 1.0 → 1
- Breadth = 1.1 – 2.0 → 2
- Breadth = 2.1 – 3.0 → 3
- Breadth = 3.1 – 4.0 → 4
- Breadth = ≥ 4.1 → 5
- Depth:
 The average depth score per concept is calculated (taking into account all scores, also the sub-concepts that scored zero), and scored into five categories which relates into the new variables *Mastery Depth Pre* and *Mastery Breadth Post*:
 - Average depth = 0 → 0
 - Average depth = 0.01 – 1.0 → 1
 - Average depth = 1.01 – 2.0 → 2
 - Average depth = 2.01 – 3.0 → 3
 - Average depth = 3.01 – 4.0 → 4
 - Average depth = ≥ 4.1 → 5

A total mastery score is possible from zero (0) to sixteen (16), where sixteen means that the extent is 121 – 150, all sub concepts are present in the PMM, and all drawings in the (sub) concepts have scored 'excellent' for depth.

Table 8. Scoring system ‘depth’ PMM in words version 2 which is used in addition to the ‘Scoring system ‘depth’ in drawings’ version 2.

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|------------------------|--|---|--|--|---|
| Flora and Fauna | | | | | |
| - Trees | - Drawing(s) that represent 1 type of tree ⁽¹⁾ | - Drawing(s) that represent 2 different types of trees (e.g. lines of branches or detailed branches/ leaves that represent the top of the tree, added fruits) OR Drawing(s) that represents a recognisable endemic tree <i>Palm: segmented tree trunk with palm leaves</i> OR Drawing(s) that represent a type of tree with phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent 3 different types of trees (e.g. lines of branches or detailed branches/ leaves that represent the top of the tree, added fruits) OR Depth 2 with a recognisable endemic tree <i>Palm: segmented tree trunk with palm leaves</i> OR Depth 2 with 1 tree that has phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent 4 different types of trees (e.g. lines of branches or detailed branches/ leaves that represent the top of the tree, added fruits) OR Depth 3 with a recognisable endemic tree <i>Palm: segmented tree trunk with palm leaves</i> OR Depth 3 with 1 tree that has phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent ≥5 different types of trees (e.g. lines of branches or detailed branches/ leaves that represent the top of the tree, added fruits) OR Depth 4 with a recognisable endemic tree <i>Palm: segmented tree trunk with palm leaves</i> OR Depth 4 with 1 tree that has phenology aspects (separated leaves with leaf veins) |
| - Plants | - Drawing(s) that represent 1 type of plant ⁽²⁾ | - Drawing(s) that represent 2 different types of plants (e.g. stripes/ leaves/ branches attached to each other representing a plant) OR Drawing(s) that represent a type of plant with phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent 3 different types of plants (e.g. stripes/ leaves/ branches attached to each other representing a plant) OR Depth 2 with a plant that has phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent 4 different types of plants (e.g. stripes/ leaves/ branches attached to each other representing a plant) OR Depth 3 with a plant that has phenology aspects (separated leaves with leaf veins) | - Drawing(s) that represent ≥5 different types of plants (e.g. stripes/ leaves/ branches attached to each other representing a plant) OR Depth 4 with a plant that has phenology aspects (separated leaves with leaf veins) |

Continuation of Table 9. Scoring system 'depth' PMM in words version 2 which is used in addition to the 'Scoring system 'depth' in drawings' version 2.

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|------------------------|--|--|---|---|--|
| Flora and Fauna | | | | | |
| - Birds | - Drawing(s) that represent 1 type of bird | - Drawing(s) that represent 2 different types of birds (e.g.: an M or a V- shaped line, body existing out of 2 parts, recognisable different shapes of the body, different position of the body (flying or sitting), etc.) OR A drawing that represents a recognisable endemic bird: - <i>Mauritius fody: coloured chest</i> - <i>Olive white eye: ringed eyes</i> - <i>Pink Pigeon: relative big body in proportion to a small head with a slightly bowed beak</i> - <i>Mauritius Kestrel: bowed beak and claws</i> | - Drawing(s) that represent 3 different types of birds (e.g.: an M or a V- shaped line, body existing out of 2 parts, recognisable different shapes of the body, different position of the body (flying or sitting), etc.) OR Depth 2 with a recognisable endemic bird: - <i>Mauritius fody: coloured chest</i> - <i>Olive white eye: ringed eyes</i> - <i>Pink Pigeon: relative big body in proportion to a small head with a slightly bowed beak</i> - <i>Mauritius Kestrel: bowed beak and claws</i> | - Drawing(s) that represent 4 different types of birds (e.g.: an M or a V- shaped line, body existing out of 2 parts, recognisable different shapes of the body, different position of the body (flying or sitting), etc.) OR Depth 3 with a recognisable endemic bird: - <i>Mauritius fody: coloured chest</i> - <i>Olive white eye: ringed eyes</i> - <i>Pink Pigeon: relative big body in proportion to a small head with a slightly bowed beak</i> - <i>Mauritius Kestrel: bowed beak and claws</i> | - Drawing(s) that represent ≥5 different types of birds (e.g.: an M or a V- shaped line, body existing out of 2 parts, recognisable different shapes of the body, different position of the body (flying or sitting), etc.) OR Depth 4 with a recognisable endemic bird: - <i>Mauritius fody: coloured chest</i> - <i>Olive white eye: ringed eyes</i> - <i>Pink Pigeon: relative big body in proportion to a small head with a slightly bowed beak</i> - <i>Mauritius Kestrel: bowed beak and claws</i> |
| - Tortoise | - Drawing(s) that represent 1 type of tortoise | - Drawing(s) that represent 2 types of tortoises (e.g. scales drawn in a different way, different kind of feet/toes, detailed legs, etc.) OR A drawing that represents a recognisable endemic tortoise <i>Giraffe tortoise: long neck attached to the tortoise shell</i> | - Drawing(s) that represent 3 types of tortoises (e.g. scales of a tortoise drawn out of roughly lines, recognisable toes, detailed legs, etc.) OR Depth 2 with a recognisable endemic tortoise <i>Giraffe tortoise: long neck attached to the tortoise shell</i> | - Drawing(s) that represent 4 types of tortoises (e.g. scales of a tortoise drawn out of roughly lines, recognisable toes, detailed legs, etc.) OR Depth 3 with a recognisable endemic tortoise <i>Giraffe tortoise: long neck attached to the tortoise shell</i> | - Drawing(s) that represent ≥5 types of tortoises (e.g. scales of a tortoise drawn out of roughly lines, recognisable toes, detailed legs, etc.) OR Depth 4 with a recognisable endemic tortoise <i>Giraffe tortoise: long neck attached to the tortoise shell</i> |
| - Skink/ gecko | - Drawing(s) that represent 1 type of skink/ gecko | - Drawing(s) that represent 2 types of skinks/ geckos (e.g. different types of toes, detailed legs, tail, skin structure, etc.) | - Drawing(s) that represent 3 types of skinks/ geckos (e.g. different types of toes, detailed legs, tail, skin structure, etc.) | - Drawing(s) that represent 4 types of skinks/ geckos (e.g. different types of toes, detailed legs, tail, skin structure, etc.) | - Drawing(s) that represent ≥5 types of skinks/ geckos (e.g. different types of toes, detailed legs, tail, skin structure, etc.) |

Continuation of Table 10. Scoring system 'depth' PMM in words version 2 which is used in addition to the 'Scoring system 'depth' in drawings' version 2.

| Concept | Depth 1 | Depth 2 | Depth 3 | Depth 4 | Depth 5 |
|---------------------|--|--|---|---|--|
| Human Impact | | | | | |
| History | One drawing of the following aspects: - <i>human dwelling</i> - <i>sailor</i> - <i>deforestation</i> - <i>killing of animals</i> - <i>invasive species (e.g. rats, goat, cats, etc.)</i> | 2 drawings of the same aspect from the following: - <i>human dwelling</i> - <i>sailor</i> - <i>deforestation</i> - <i>killing of animals</i> - <i>invasive species (e.g. rats, goat, cats, etc.)</i> | ≥3 drawings of the same aspect from the following: - <i>human dwelling</i> - <i>sailor</i> - <i>deforestation</i> - <i>killing of animals</i> - <i>invasive species (e.g. rats, goat, cats, etc.)</i> | Two different aspects from the following: - <i>human dwelling</i> - <i>sailor</i> - <i>deforestation</i> - <i>killing of animals</i> - <i>invasive species (e.g. rats, goat, cats, etc.)</i> | ≥3 different aspects from the following: - <i>human dwelling</i> - <i>sailor</i> - <i>deforestation</i> - <i>killing of animals</i> - <i>invasive species (e.g. rats, goat, cats, etc.)</i> OR Depth 4 when each aspect exists of ≥2 drawings |
| Present | One drawing of the following aspects: - <i>logo conservation charity (e.g. MWF, Chester Zoo, Durrell Zoo)</i> - <i>fenced area</i> - <i>reproduction (e.g. eggs, youngsters, mating animals)*</i> | Two drawings of the same aspect from the following: - <i>logo conservation charity (e.g. MWF, Chester Zoo, Durrell Zoo)</i> - <i>fenced area</i> - <i>reproduction (e.g. eggs, youngsters, mating animals)*</i> | ≥3 drawings of the same aspect from the following: - <i>logo conservation charity (e.g. MWF, Chester Zoo, Durrell Zoo)</i> - <i>fenced area</i> - <i>reproduction (e.g. eggs, youngsters, mating animals)*</i> | ≥2 different aspects from the following: - <i>logo conservation charity (e.g. MWF, Chester Zoo, Durrell Zoo)</i> - <i>fenced area</i> - <i>reproduction (e.g. eggs, youngsters, mating animals)*</i> | ≥2 different aspects from the following when each aspect contains ≥2 drawings: - <i>logo conservation charity (e.g. MWF, Chester Zoo, Durrell Zoo)</i> - <i>fenced area</i> - <i>reproduction (e.g. eggs, youngsters, mating animals)*</i> |
| Ecosystem | | | | | |
| Food-chain/web | Two parts of a food-chain (e.g. tortoise eating from leaves) | ≥2 of the same type(s) of animal(s) in a two-part food-chain | Two different two-part food-chains (e.g. tortoise eating from leaves and bird with worm in beak) | ≥3 different types of animals in a different two-part food-chain OR ≥2 different two-part food-chains when all are drawn ≥2 times | ≥3 parts of a food-chain (e.g. kestrel – skink – ant) |

* The eggs or youngsters have to be with an adult animal, except when it is clearly visible that eggs and/ or youngster are drawn (e.g. a solitary bird nest).

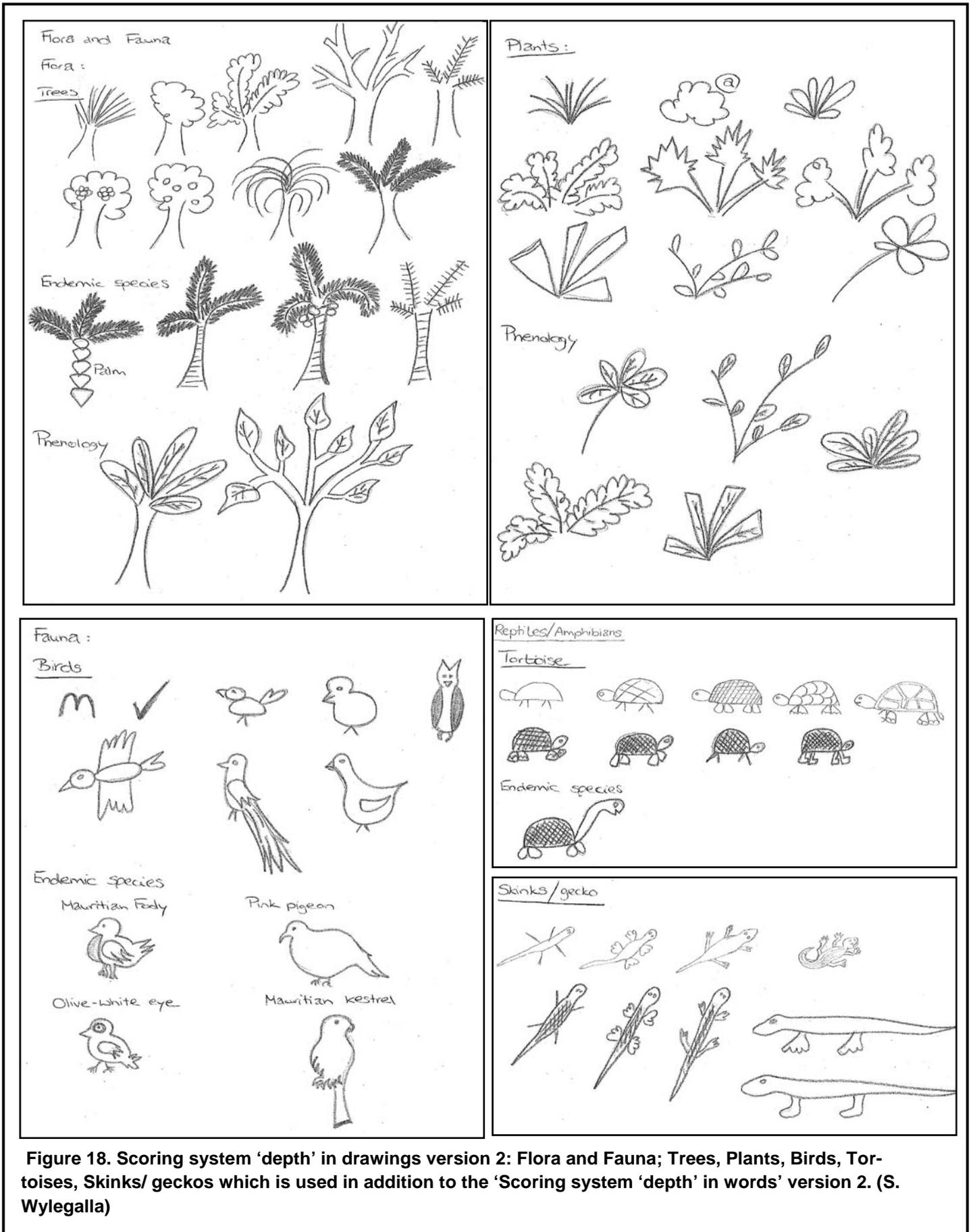


Figure 18. Scoring system 'depth' in drawings version 2: Flora and Fauna; Trees, Plants, Birds, Tortoises, Skinks/ geckos which is used in addition to the 'Scoring system 'depth' in words' version 2. (S. Wylegalla)

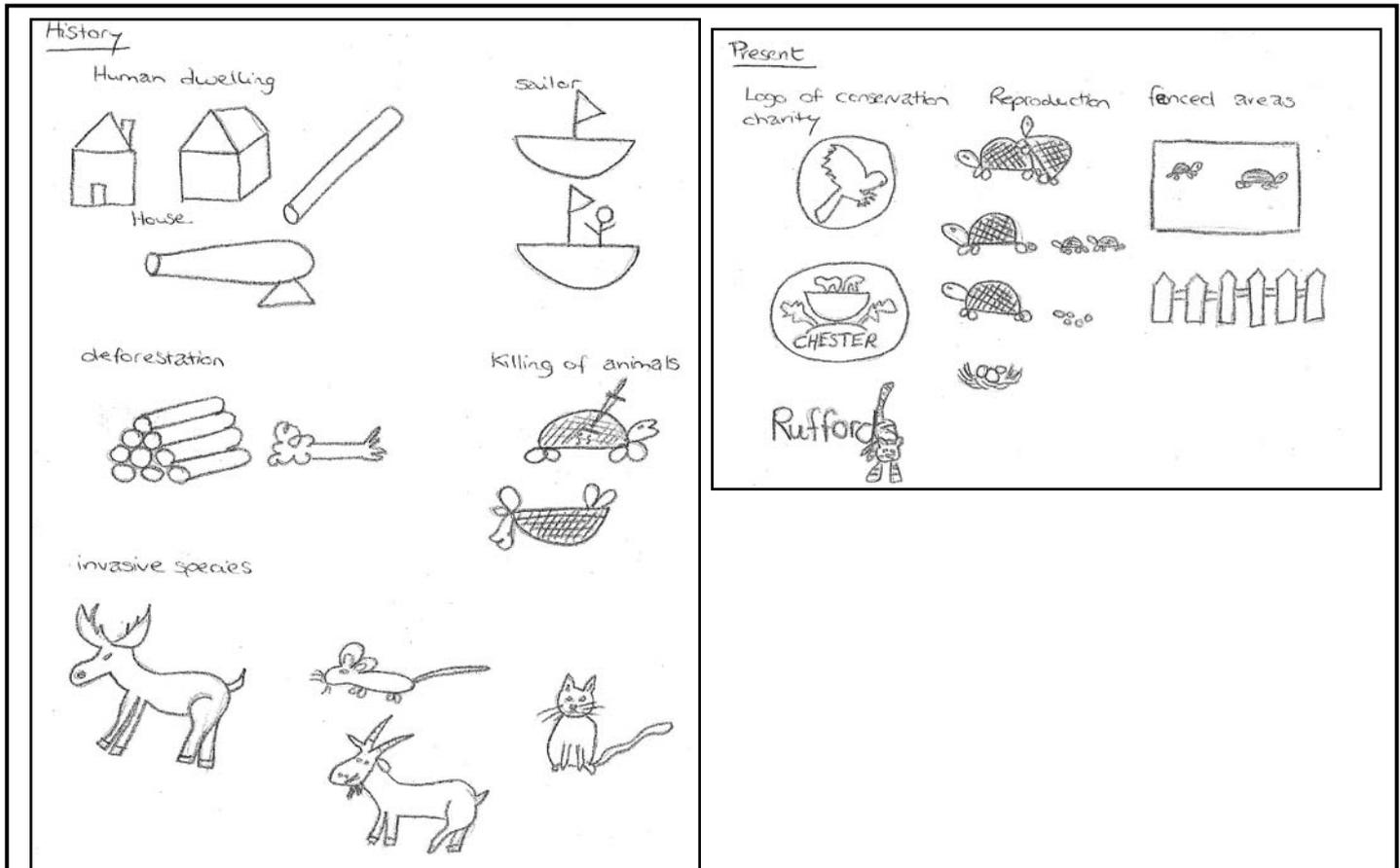


Figure 19. Scoring system 'depth' in drawings version 2: Human Impact; History and Present which is used in addition to the 'Scoring system 'depth' in words' version 2. (S. Wylegalla)

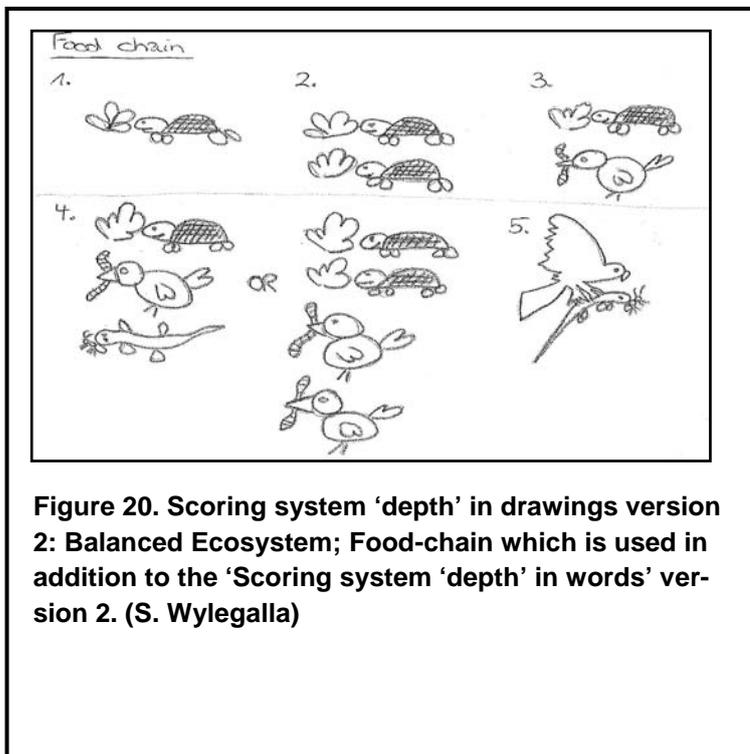


Figure 20. Scoring system 'depth' in drawings version 2: Balanced Ecosystem; Food-chain which is used in addition to the 'Scoring system 'depth' in words' version 2. (S. Wylegalla)