CONCEPT MAPPING, VEE HEURISTICS AND THE LEARNING PROCESS: TOWARDS A META-LEARNING EXPERIENCE

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Abstract. For too many years, teachers have prepared lesson plans according to their own preferred way of learning whilst ignoring the fact that all children process incoming information differently and in this way, many children are left behind. If one wants to be successful one must understand how one learns and then make sense of it so as to make one's mental mechanisms work most efficiently for him/her. This paper will describe that when Vee Heuristic and Concept Maps are placed within a context of an understanding of different learning patterns, the learning process develops from a metacognitive level to a meta-learning experience thereby equipping the learner with a life-long learning skill.

1   Introduction and Background information

Education is of highest priority to every nation around the world. Education can be defined as "the organised, systematic effort to foster learning, to establish the conditions, and to provide the activities through which learning can occur" (Bruner, J. 1971:35). Furthermore, Wilson argues that "to be interested in education is to view him (the child) primarily as a learner" (Wilson, J. 1975:44). However, for too many years, teachers have prepared lesson plans according to their own preferred way of learning whilst ignoring the fact that all children process incoming information differently. Similarly, Novak argues that teachers tend to "focus on teaching activities and tend to ignore learning activities. They center attention on how to teach a given topic, rather than on what is required for a learner to learn the topic. This stems, in part, from teachers' limited knowledge of the learning process" Novak, 1998:120). In this way, many children are left behind or build an image of themselves as non-learners. Yet, everyone can learn!

But when and how does learning occur? What do we mean by the word 'learning'? 'Learning' is one of those words everyone uses, and seems to understand, but would be hard pressed to define. Learning is a complex process involving different mental processes. We have all experienced it, we usually know it when we see it and we tend to accept its crucial function in life. Understandings of learning have advanced significantly in the past few decades and increasing attention has been given to 'higher order' processes of understanding. Consequently, the term 'metacognition' (awareness of thinking processes/thinking about thinking) has become the latest buzz word in educational settings. Indeed learning is an integral part of our being and as such, it cannot be overlooked. If one wants to be successful one must understand how one learns and then make sense of it so as to make one's mental mechanisms work most efficiently for him/her. This is the primary reason why educational research is nowadays focusing on meta-learning (learning about learning). "*Meta-learning covers a much wider range of issues than metacognition, including goals, feelings, social relations and context of learning*" (Watkins, 2001:1). Meta-learning is to make sense of one's own experience of learning and in this way the learners would be equipped with a life-long learning skill.

This research made use of Vee Heuristics and Concept Mapping as effective metacognitive tools (Novak, 1984,1998; Cañas et al, 2004, 2006) and so as to provide a metacognitive understanding to our learners and to the teacher, this research made use of the Learning Connections Inventory (LCI) which is an instrument developed by Johnston and Dainton to profile an individual's learning patterns. The theoretical basis for the LCI is the Interactive Learning Model, which posits that learning processes occur through the interaction of three mental processes: Cognition (I think), Affectation (I feel) and Conation (I act). Each of these components is taken into consideration and through their interaction; learning patterns are formed and each pattern is distinguished by a number of features. A few characteristics are listed below:

Sequence	learners prefer order and consistency. They like to follow step-by-step directions, and time to plan, organize and complete tasks.
Precise	learners who thrive on detailed and accurate information. They take copious notes and seek specific answers.
Technical Reasoning	learners who like to work alone on hands-on projects. They enjoy figuring out how something works and enjoy doing tasks which is relevant to their lives.
Confluence	learners who have a strong desire for creativity and innovation. They are not afraid of risks or failure and prefer to be unique or unconventional approaches.

Table 1: different characteristics typical in different learning patterns (Johnston, 2005)

The Let Me Learn Process® is truly an advanced learning system since unlike other learning styles it doesn't place the learner into one single quadrant but reveals that the patterns are ***all*** used by ***all*** learners but to

varying degrees. A learner's LCI reveals the learner's profile by determining the strengths of his/her preferences and avoidances scored as "avoid", "use as needed" and the "use first". Therefore, some learners lead with one or two patterns, some avoid certain patterns, some are able to use a number of patterns on an as-needed basis and still others exhibit strong preferences for a number of patterns.

	How I think	How I do things	How I feel	What I might say
Sequential Process	▪ I organize information ▪ I mentally analyze data ▪ I break tasks down into steps	▪ I make lists ▪ I organize ▪ I plan first, then act	▪ I thrive on consistency and dependability ▪ I need things to be tidy and organized	▪ Could I see an example? ▪ I need more time to double-check my work ▪ Could we review those directions?
Precise Process	▪ I research information ▪ I ask lots of questions ▪ I always want to know more	▪ I challenge statements and ideas that I doubt ▪ I prove I am right	▪ I thrive on knowledge ▪ I feel good when I am correct	▪ I need more information ▪ Let me write up the answer to that ▪ Did you know that….
Technical Process	▪ I seek concrete relevance – what does this mean in the real world? ▪ I only want as much information as I need	▪ I get my hands on ▪ I tinker ▪ I solve the problem ▪ I do	▪ I enjoy knowing how things work ▪ I need real world relevance ▪ I do not need to share my knowledge	▪ I can do it myself ▪ Let me show you how… ▪ How will I ever use this in the real world? ▪ I could use a little space…
Confluent Process	▪ I read between the lines ▪ I think outside the box ▪ I brainstorm ▪ I make obscure connections	▪ I take risks ▪ I am not afraid to fail ▪ I talk about things – a lot ▪ I might start things and not finish them	▪ I enjoy energy ▪ I feel comfortable with failure ▪ I feel frustrated by people who are not open to new ideas	▪ What do you mean, "that's the way we've always done it"?! ▪ The rules don't apply to me ▪ I have an idea…….

Table 2: These patterns represent how the learner sees the world, takes in stimuli, integrates the stimuli and formulates a response to it.
(Johnston, 2005)

2 Methodology

This paper will describe that when Vee Heuristics and Concept Mapping are placed within a context of an understanding of different learning patterns, the learning process develops from a metacognitive level to a meta-learning experience.

In this research I used Vee Heuristics and Concept Mapping in a primary classroom so as to improve on meaningful learning of a specific environmental issue related to biodiversity. Since the Vee Heuristic presented in Novak & Gowin (1984) was too complex to tackle with six to seven year old, I opted to adapt the wordings as presented in Ahoranta's adapted version of Åhlberg's improved Vee Heuristics which have withstood theoretical and empirical testing from 1993 to 2006 and have been applied to Environmental Education in Finland for several years (Åhlberg in Cañas et al 2004; Åhlberg & Ahoranta, 2002; Åhlberg & Ahoranta in Cañas et al 2004).

Furthermore, a semi-structured interview was carried out with a number of selected different types of learners so as to find out the details of the children's knowledge and maybe even misconceptions of the environmental issue in discussion through a Concept Map constructed **before** the learning project and how this knowledge was developed to construct new meaningful knowledge in a second Concept Map constructed **after** the learning project. Finally, the different learners' learning patterns were taken into consideration as to how or whether they contributed to diverse structures of knowledge.

3 Data Analysis

I shall now present, analyze and discuss in detail this process with two learners having different learning profiles. This is only just a very small part of a larger research results published as a Masters in Education Theses for the University of Malta.

3.1   Nina: Her LCI score was Sequence 23; Precision 22; Technical 23; Confluence 19 (7-17= Avoid; 18-24=Use as Needed; 25-35=Use First).

The LCI score of Nina represents a 'bridge learner' (Johnston, 2005) since she avoids no learning patterns nor does she make use of any at a Use First Level. This means that this learner enjoys learning through many ways, through listening and interacting with others and she feels comfortable using all of the learning patterns. She finds it easy to adapt to different situations and so she can blend in and help make things happen as a contributing member in a group. This kind of learner weighs things in the balance before she acts and the following Vee further confirms how Bridge learners process incoming information.
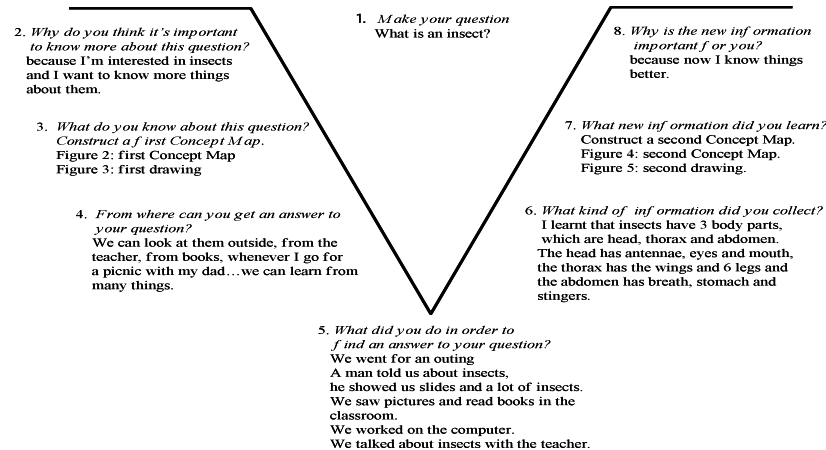

Figure 1: Nina's Vee Heuristic

   From this Vee Heuristic one can easily note that Nina is able to learn in various different situations. The first reply shows her interest since she's a kind of learner who is interested in many things that surround her and that she's interested in expanding her prior knowledge. In reply no.4 we have a very clear picture of how Nina would like to learn and this substantiates her LCI score since she mentions various ways both inside and outside the classroom setting. Her learning patterns are further reinforced in reply no.5 where one can note the emphasis she puts on learning through interacting and listening to other people since she mentioned both the teacher present in the classroom context and a man present in an outside the classroom context. The reply in No.6 is quite detailed, very confident and straight forward revealing how much she felt good with the new knowledge learnt. It is worth noting that Nina found the information useful because now she knows "*things better*" suggesting this learner's motivation and willingness to improve on what she already knows.
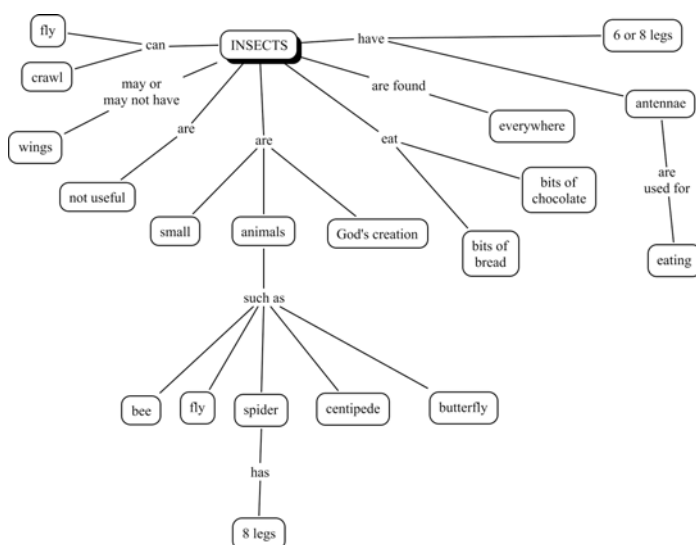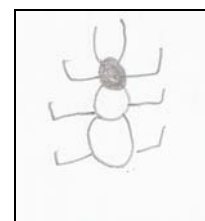

Figure 3: Nina's first drawing before the learning project

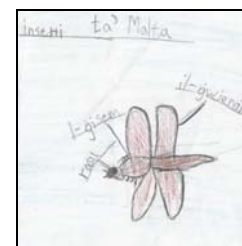Figure 5: Nina's second drawing after the learning project.

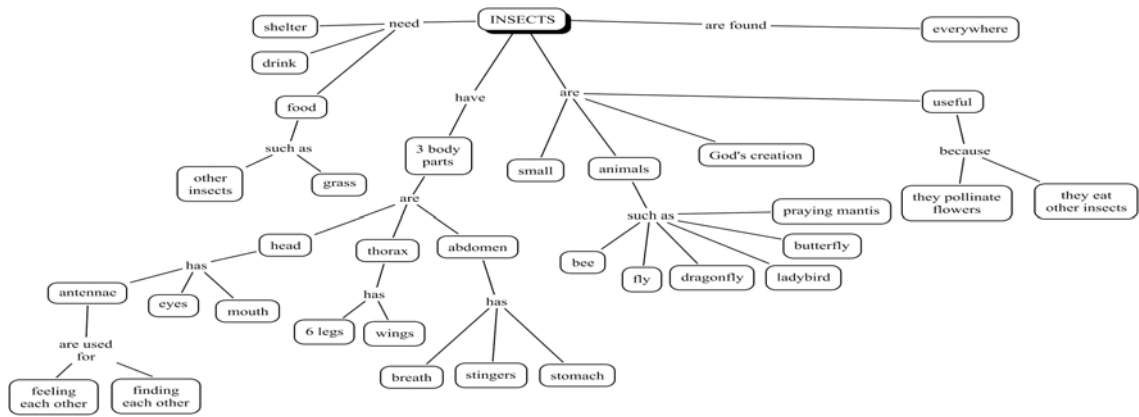Figure 2: Nina's first Concept Map before the learning project.

Figure 4: Nina's second Concept Map after the learning project.

When comparing the two Concept Maps presented in Figures 3 and 4, one can observe that learning has taken place due to the increase in the number of concepts and propositions. From the first Concept Map one can note a good number of correct concepts and this is substantiated in her first drawing in Figure 5. From Nina's first drawing one can also remark on the three visible body parts, however this is not represented in the first Concept Map. This could be because this concept was caught by Nina's observational skills since she learns in different situations but it was never externalised or developed. In the second Concept Map, however, one can observe how well Nina refined her knowledge about insects by correcting all her previous misconceptions while extending other good concepts. If we take a closer look at the second drawing, we can note how well refined it is even with regards to the proportion of the size of the three parts of the body. One can see that while in the first drawing each part of the body held a pair of legs, the second drawing depicts the legs coming out from the thorax.

3.2   Anna: Her LCI score was Sequence 23; Precision 27; Technical 20; Confluence 15 (7-17= Avoid; 18-24=Use as Needed; 25-35=Use First).

Anna is a dynamic learner (Johnston, 2005) who scores high in Precise therefore she feels the need to be accurate and correct when answering questions and she attends to details. She prefers to express herself in words but she needs complete and thorough explanations. She avoids Confluence so she would rather NOT make mistakes than having to learn from them, besides she's more cautious in how she's going to answer questions and she does not like to take risks. There are only certain aspects that she uses from her Sequential and Technical patterns since her scale score of these patterns falls in the Use As Needed.
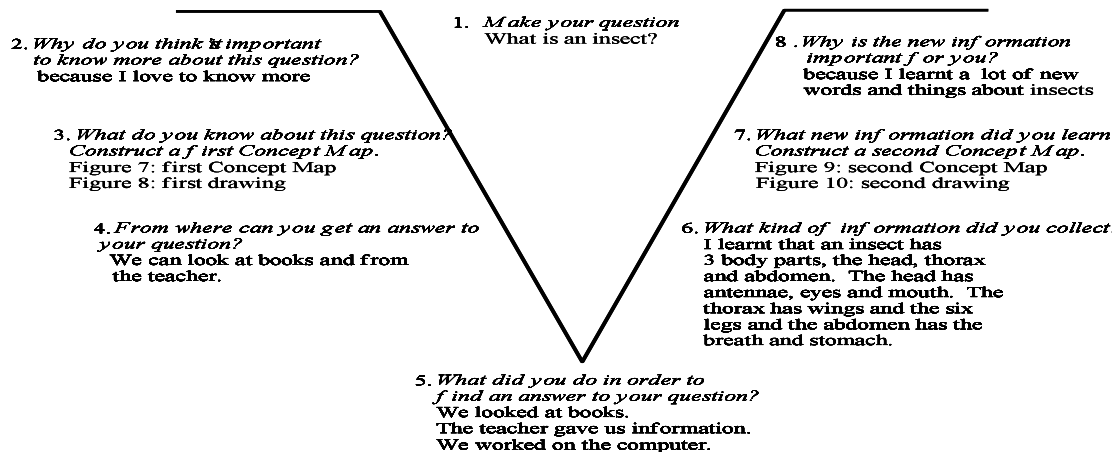

Figure 5: Anna's Vee Heuristic

This Vee Heuristic once again reveals this learner's preferred way of processing incoming information. In reply No.2, from the use of the phrase "*I love to know more*" one can see that this girl enjoys learning and developing her knowledge. Scoring high in Precise means that one wants to get more and more information and is motivated by lots of details. In reply No. 4 the learner sheds light upon how and from where she prefers to get the necessary information. She didn't mention observation, imagination or going out from the class to have hands-on learning but instead she mentioned "*from the books and from the teacher*".

This is substantiated in reply No. 5 where one can note that the primary sources of her learning were actually the books and the teacher. In fact, during the interview this was her instant reply and only when I prompted "*anything else?*", did she mention the computer. Once again the answer to question No. 6 has a lot of exact details and in reply No. 8 one can become aware why this new information was important for this learner, "*because I learnt a lot of new words*". Here again we see how important words are for this learner.
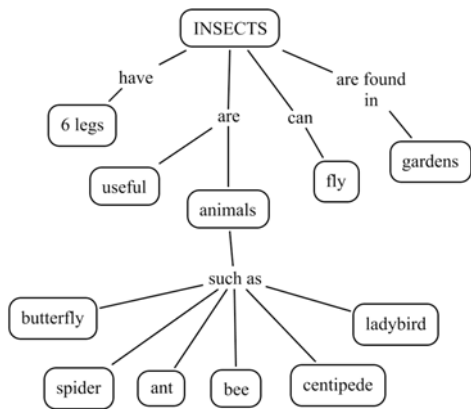

Figure 7: Anna's first Concept Map before the learning project.

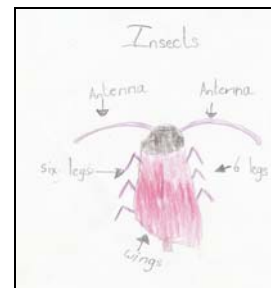Figure 8: Anna's first drawing before the learning project

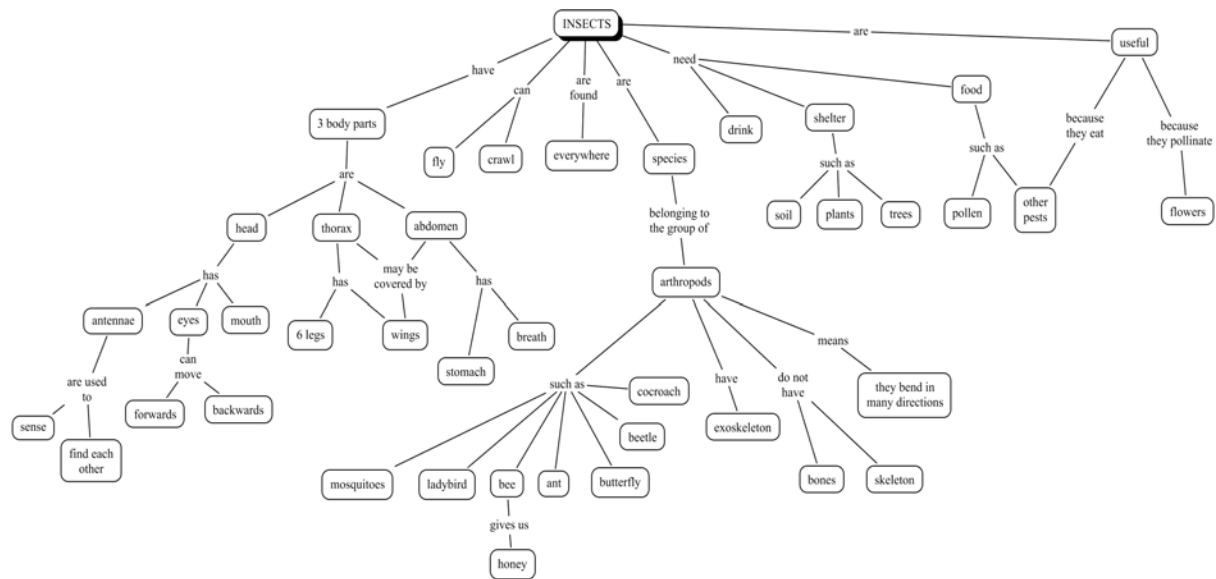Figure 10: Anna's second drawing after the learning project

Figure 9: Anna's second Concept Map after the learning project

When we take a look at the two Concept Maps presented in Figures 7 and 9, we can note an impressive increase in concepts and propositions and this implies that learning has taken place. Even here, this learner was able to delete the misconceptions and expand her concepts. In the first concept map (Figure 7) one can observe that there are almost no misconceptions except for the concepts that a spider and a centipede are insects. If we refer back to this learner's learning patterns we can understand that her high score in Precision keeps this learner from taking risks, she has to take time to think and she prefers not answering than risking to answer incorrectly. This is why her first Concept Map, though limited, contains a lot of good concepts. These learning characteristics were also exhibited during the interview. It is also worth remarking that she was the only learner in this study to know exactly how many legs an insect has and she stated that she knew this "*because I saw a picture in a book and I counted how many legs it has*". She was also the only one to be convinced that insects are useful but at this stage she was unable or in this case, uncertain how to explain it.

If we closely observe her second Concept Map (Figure 9), we find out that it's amazing how this girl was able to go into details. I am referring to the details such as *"the eyes can move forwards and backwards"* or that *"the thorax and abdomen may be covered by the wings"*. She not only increased the number in concepts and propositions but she also extended by giving reasons or examples. It is worth noting the correct use of detailed words such as *"pests"*, *"arthropods"*, *"exoskeleton"* and *"species"* and these are further proof of what a learner who scores high in Precision enjoys learning most. When constructing the second Concept Map, this girl needed prompting to carry on; she needed reassurance that what she was doing was correct. When she was first asked to draw an insect she was quite reluctant, stating *"but I don't know how to draw"*, she drew the insect only after feeling safe on listening to what I had to tell her, hence *"don't worry, you can draw it how you like, it's just going to help us learn something more about insects"*. The second drawing carried out after the project was done with more confidence and labelled very well with distinct parts of the body whilst also having number 6 written in numerical form on one side and in letter form on the other.

4   Discussion

The data collected in this research reveals that each learner processes and responds to incoming information in various distinctive ways. Nonetheless all of the learners were able to construct new knowledge when presented with a learning programme which suited their preferred way of learning and when being actively involved in their own learning. This is where I found the Let Me Learn Process most valuable since it revealed how each learner prefers to learn and how and why she/he responds to incoming information in the way they do.

4.1   Vee Heuristics

Very often learning starts off with a question and actually the `focus question` is placed at the top centre of the Vee since questions *"are what drive the inquiry that leads eventually to new knowledge"* (Novak, 1998:85). Eliciting a focus question from the

Figure 11: A question box

children proved to be more challenging than I had anticipated. I found out that by already the age of six, children are very often conditioned to become passive learners and so are not trained to reflect and question critically. *"In many ways, the reason for this anomaly lies in the nature of both society and the primary classroom"* (Johnston, 1996a:33) There are various reasons why children find it difficult to raise questions and this is analyzed and discussed in detail in my complete research.

Figure 13: Display of question words.

Figure 12: *Here, questions are OK, we turn them into lessons.*

However, I can say that the key to developing the skill of raising questions is to create an atmosphere in the classroom where the children feel safe in practicing this skill. Actually, I had to do several various activities (figures 11, 12 & 13) revolving around this notion before I could elicit a focus question. Similarly Cañas & Novak (2006) argue that *"one of the difficulties that seem to be pervasive is the lack of a (good) focus question that focuses the construction of the Concept Map"* (Cañas & Novak, 2006:494). Through this research I found out that this is the product of the prevailing transmission model which many schools still advocate where children are told to "sit down and be quiet".

Focus questions lead the learner to trigger off a process of reflection and so are a key step in the whole process since the teacher has to stop and consider the children's questions. Many teachers tend to ignore young children's questions or else they are very disposed to provide a quick answer thus inhibiting the learner from going through a process of higher order thinking skills, problem-solving and decision making skills. Also, research shows that teachers tend to become more didactic and switch on the transmission mode, the less they know about a subject (Frost, 1997).

The left hand side of the Vee is the thinking part of the whole process, where one is encouraged to stop and reflect upon what one already knows about the focus question. It also reveals one's relation to the question and why he/she wants to know more about this question and therefore, emotions are here highlighted. Many teachers have the syllabus and they have to deliver it and very rarely do they stop to consider how the child feels about what he/she is learning. Very often, teachers tend to take for granted that children come to class all prepared and ready to take in the information we present to them. This is a very important factor to consider since it will directly affect learning. Too often teachers get subsumed in their daily fast routine of lessons where the content becomes more important than the process so missing out on other major elements occurring in the learning
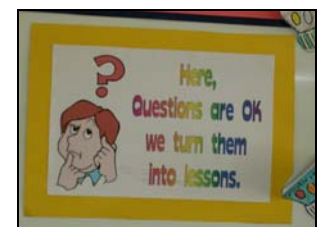
process. As Novak argues "*the complex interaction that takes place between stored information about knowledge, feelings and actions is very important in education*" (Novak, 1998:25). A lesson might be very well prepared but it is done so according to the teacher's own knowledge and experiences and many times it ignores the learner's prior knowledge and experiences and in this way learning becomes superficial.

This side of the Vee is also very effective in capturing how the learner plans to learn. From the data collected we can observe the diverse ways in which learners plan to learn, there are those who plan to ask the teacher or by referring to books or through hands-on experience or even through imagination, observation and in their daily lives. So this part of the Vee helps the teacher to plan a learning programme which suits the different learners' preferred way of learning thus increasing relevance and motivation.

The right hand side of the Vee focuses on our action, what we did so as to develop our knowledge and what new knowledge was constructed. Novak (1998) reveals that the shape of a Vee was chosen above other shapes because one can clearly distinguish that both thinking and doing are implicated in the process of learning. The learners presented in this study reveal that while certain learners learnt well in a classroom setting, others preferred an outside the classroom setting. This side of the Vee also sheds light upon why the new knowledge constructed was important for the learner. It was very clear that all learners in this study presented different feelings, while some were happy to be able to learn new words, new information (like Anna) others were happy because they could comfortably and visually communicate what they had learned (like Nina).

4.2   Concept Maps

From the Vees presented in figures 1 and 7 in their simplest form possible, one can easily note that within the whole process there is the construction of a first Concept Map prior the whole process and the construction of a second Concept Map at the end of the whole process. From the comparison of these two Concept Maps, both the teacher and the learner can observe how their knowledge was constructed and developed. This is yet another key step in this whole process since it responds to Cañas & Novak (2006) concept map-centered environment proposition where "*the concept map evolves from an intial `assessment` of what students know about the topic being studied to a knowledge model reflecting the students' progress*" (Cañas & Novak, 2006:501). The data analysis presented evidences that through Concept Mapping, misconceptions were detected and altered while missing gaps of information were included and this is an ongoing process as learning continues, revealing that learning is continuous and never ending.

The cognitive structures represented in this way makes it relatively easy to follow the development of new knowledge and the specific changes in the learners' knowledge structure since Concept Maps give a specific picture of what the child has in her/his head (Kinchin, Hay & Adams, 2000, Cañas et al, 2004, 2006). The first Concept Map is very important since it exposes what the learner has in his/her head about the issue under study and in this way the teacher can pin-point any misconceptions or missing information so as to build his/her instruction accordingly. According to Vygotsky this is where learning occurs and he terms this as the Zone of Proximal Development (ZDP). Ample research has shown that new meaningful knowledge does not occur in a vacuum (Bruer, 1993; Johnston, 1998; Novak, 1998) and so prior knowledge has to be taken into consideration if we expect meaningful learning to take place. Through the data analysis I could observe that Concept Mapping helped those learners, who tend to answer quickly without reflecting, to organize more their thoughts since when they were revisiting their first Concept Map, they could visually see where the concepts were missing or where relationships were not appropriate and therefore they inserted the necessary information or relationships and in this way retention will automatically follow (Kinchin, Hay & Adams, 2000).

4.3   The Let Me Learn Process

My prior knowledge of the Let Me Learn Process was crucial in this whole process since it facilitated my understanding of how learners will apply their thinking processes presented on both sides of the Vee in order to learn more effectively since it revealed how both, the student and the teacher, made their learning mechanisms work most efficiently for them. With an awareness of the diverse children's learning patterns I could make this whole process make more sense to the learners and so I was in a much better position to negotiate meanings and experiences in a way which was meaningful for the learners. With such awareness teachers and students may form partnerships based upon the knowledge of each other's ways of processing incoming information and they are able to create an atmosphere in which they have the opportunity to formulate specific techniques and strategies for developing learning that makes sense to them (Johnston & Johnston, 1997).

5   Conclusion

By going through the whole process of the Vee Heuristic, it is very unlikely to disregard relevant key concepts or information, moreover, ideas are, in this way, more organized. In this way, teachers are made to stop and consider what the learner's question is, what the learner's prior knowledge and feelings are about the issue in question. The teacher is also made to reflect on the learner's preferred way of learning so as to adjust to the learner's needs in order to be able to learn meaningfully. Moreover, this whole process is negotiated with the teacher, therefore it cannot be ignored by the teacher while empowering the learner to become an active agent in his/her own learning process. This teacher/learner negotiation lead to what Novak calls 'emotional sensitivity', that is, during this process the teacher can perceive what the emotional status of the learner is whilst also becoming aware of her/his own emotional status and this has a direct affect on learning.

This paper revealed that through merging metacognitive tools and learning processes one would be actually steering the learners unto a meta-learning educational journey since the learners are empowered to develop a better understanding of how they learn and guide them to construct strategies for their future learning in any domain. In this way children will really become agents of their own learning because:
1.   The process of the Vee Heuristic lends itself beautifully for reflection and action.
2.   Concept Maps offer a visual picture of what the learners have in their heads.
3.   Let Me Learn advanced system is value added due to the lexicon used with intention and by revealing how each learner processes incoming information.

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