USING ICT TO ENHANCE STUDENT UNDERSTANDING OF CLASSIFICATION

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Abstract

It is common for 13-year-old students in Victoria, Australia to learn how to classify animals and plants using the Linnaean system and dichotomous keys. This is usually done with text based research on the major groups of animals and plants and a few simple exercises with various objects to explain the underlying concept of classification. In this paper we describe our attempt to achieve similar goals using three computer software programs to build dichotomous keys and represent the data: Inspiration, MS PowerPoint, and MicroWorlds. Student work is included to illustrate what can be achieved by students of various abilities with these information and communication technologies.

Introduction

In this paper we would like to describe an attempt to enhance student understanding of the concept of classification using various computer programs. We start by describing the school setting and the class of students who have been involved. The teaching and learning environment is one characterised by constructivist philosophy and the manner in which this impacts on the task is then explored. The students' tasks are then explained in the context of a unit of study focussed on the scientific application of classification to the five kingdoms of living things. We conclude this paper by reflecting on the outcomes of the teaching and learning experience and what it has taught us, as teachers.

The Setting

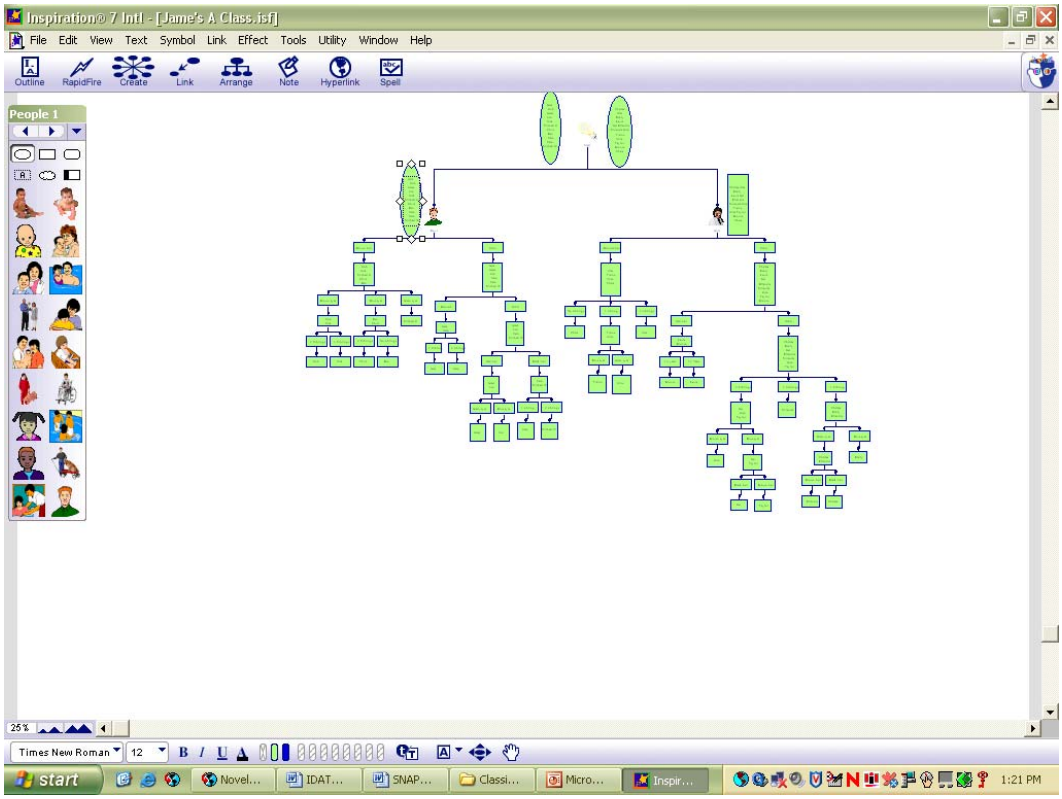
Woodleigh School is a small coeducational independent school approximately 50 kilometres south of Melbourne set on the rural/urban fringe. The population of the school is mainly Anglo-Celtic with some students of post World War II European immigrant

descent (Greek, Italian, Dutch, and German) drawn mainly from the Mornington Peninsula. The School has an Early Education Centre for 3 and 4 year old students, a Junior School for 5 to 12 year old students (Preparatory Year to Year 6) and a Senior School for 12 to 18 year old students (Years 7 to 12).

This particular class are a mixed ability group of Year 7 students (12 to 13 years old) studying classification as part of their general science course. As can be expected from a mixed ability class (Simpson, 2001) the many intelligences of Howard Gardner are all represented and the students display a range of learning styles and learning abilities. That is, we are able to identify students with visual, auditory and kinaesthetic learning preferences, logical-mathematical, linguistic, spatial, musical, naturalistic, bodily-kinaesthetic, intra-personal and inter-personal intelligence preferences, students who have learning abilities and learning disabilities or difficulties as well as those who have prior experience of classifying objects and cognitive structures related to this concept and prior experience with information and communication technologies and confidence in using them. We have twenty-five very individual children.

The students commenced their study of classification by completing a series of activities which were prepared for them. First they were required to sort wrapped sweets into various groupings, producing at least three different outcomes. The students' various groupings were collected on the white board and discussed. A discussion of objective characteristics and subjective characteristics ensued. Second, the students were given a range of natural and artificial objects. These included feathers, cones from plants, leaves, shells, rocks, buttons, and plastic animals. The students were again required to arrange the objects into at least three different groupings. The results were again collected on the whiteboard and discussed.

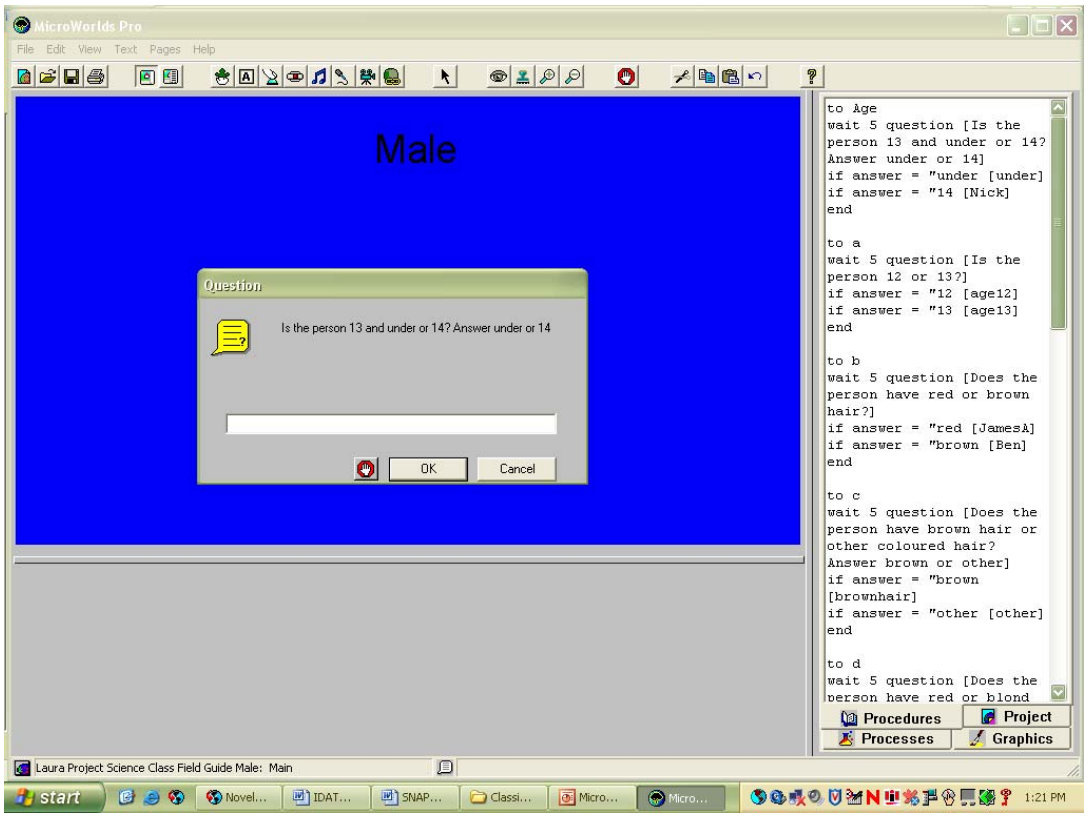
Having introduced the idea of sorting objects into groups, the next step was to introduce the concept of dichotomous keys. The students were required to collect information from each of the students in the class including things like height, eye colour, hair colour and siblings and use this information to complete a dichotomous key of the class (using pencil and paper, although some students chose to use Inspiration to represent their work).



There is a link to the file that James created at http://www.woodleigh.vic.edu.au/idater/index.htm. You will need a copy of Inspiration[1] to view the actual file.

One very computer literate student decided to arrange this information with MicroWorlds.

[1] Inspiration can be downloaded for a free evaluation from http://www.inspiration.com/home.cfm



Hyperlink to Laura's work - http://www.woodleigh.vic.edu.au/idater/LaurasMWClass.htm

The students were then required to use this information into a field guide of their class (the data collected while completing the key was used to build student descriptions and then represented as a field guide in MS publisher using digital photographs of each child taken by the teacher – Gary Simpson). The publisher document has not been linked to this paper in order to protect the privacy of the students in this class.

Following these activities the students were required to represent the Animal and Plant kingdoms in dichotomous keys using either Inspiration, PowerPoint or MicroWorlds. This task is the central point of this paper and presented in greater detail below. To complete the unit of study students were required to complete a short project on Carl Linnaeus to gain an historical perspective of the major scientific concept of classification and the technique of dichotomous keys. They were also required to explore the classification systems of the Karam of Papua New Guinea and the Yolgnu of Arnhem Land to gain a cultural perspective of these concepts.

Appendix 1 contains a description of the unit of work that the students received.

Constructivism

My teaching uses constructivism as a philosophical referent for my pedagogy. Therefore, I have included a short description of its core influence here. Ernest (1995) claims that constructivism originated with Jean Piaget, was anticipated by Giambattista Vico and is most fully explicated by Ernst von Glasersfeld (1995). Vico is credited, by von Glasersfeld (1990), with recognising the basic tenet of constructivism. Vico wrote, "The human mind can know only what the human mind has made" (Vico, 1858). The mathematician and psychologist von Glasersfeld, working with the theories of Vico and Piaget was among the first to describe the way that human beings construct knowledge. To von Glasersfeld there are two basic characteristics of constructivism:

a) Knowledge is not passively received but built up by the cognising subject.
b) The function of cognition is adaptive and serves the organisation of the experiential world, not the discovery of ontological reality.

(von Glasersfeld, 1995, p. 18)

To apply von Glasersfeld's construction of Constructivism to the classroom it has been found, through reading, that Constructivists tend to agree on four characteristics:
- all conceptual knowledge is constructed,
- there exist cognitive structures that are activated in the process of construction,
- cognitive structures are under development but can be transformed through purposive activity or from environmental or social pressure, and
- acknowledgement of constructivism as a cognitive position leads to the adoption of a constructivist methodology by the teacher to inform the teachers pedagogical practice.

Critical constructivists, such as Peter Taylor (1998) add the concern of valuing. That is developing an ethic of care within the relationship between student and teacher and an ability to value knowledge claims which requires an acknowledgement that one knowledge claim may be more appropriate in a particular setting. Von Glasersfled's construction of constructivism is founded in relativism, so this valuing tends to require a neo-relativist approach (Simpson, 2004) for critical constructivists.

To me, this means that all students in my classrooms are capable of cognitive processes that will allow them to gain knowledge and understanding. That is, they have the ability to succeed. When I considered the implications for my own teaching of these general characteristics of constructivism, I coined six key pedagogical principles for guiding my practice:

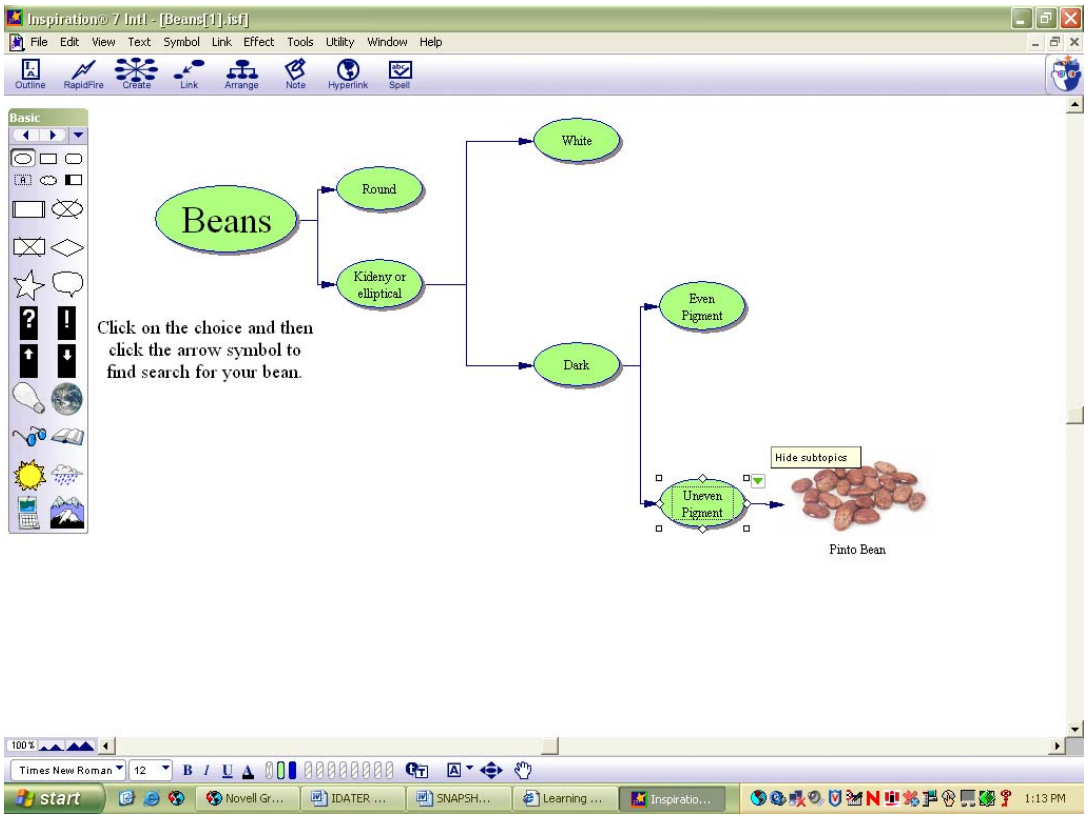
- measurement of students' prior knowledge and understanding, especially to diagnose existing misconceptions - or non-viable constructions,
- intervention by the teacher to mediate the learning of students with purposive activity,
- establish social situations in which students can make sense of experiences in terms of what is already known,
- provide opportunities for students to represent their knowledge in a variety of ways that is matched by a variety of assessment techniques, including posing situations where students are caused to take action based on their knowledge and understanding,
- constantly monitor student activity to recognise signs of difficulty, disengagement and depth of understanding, and
- report student learning in a way that recognises the student as a unique individual.

These principles guide this unit of study. The tasks at the centre of this paper are designed to provide opportunities for the students to represent their knowledge and understanding of classification, which they should have gained by completing the earlier activities which were used to measure the students' prior knowledge and understanding of the concepts and ensure that all students had the required information to be successful.

The Tasks

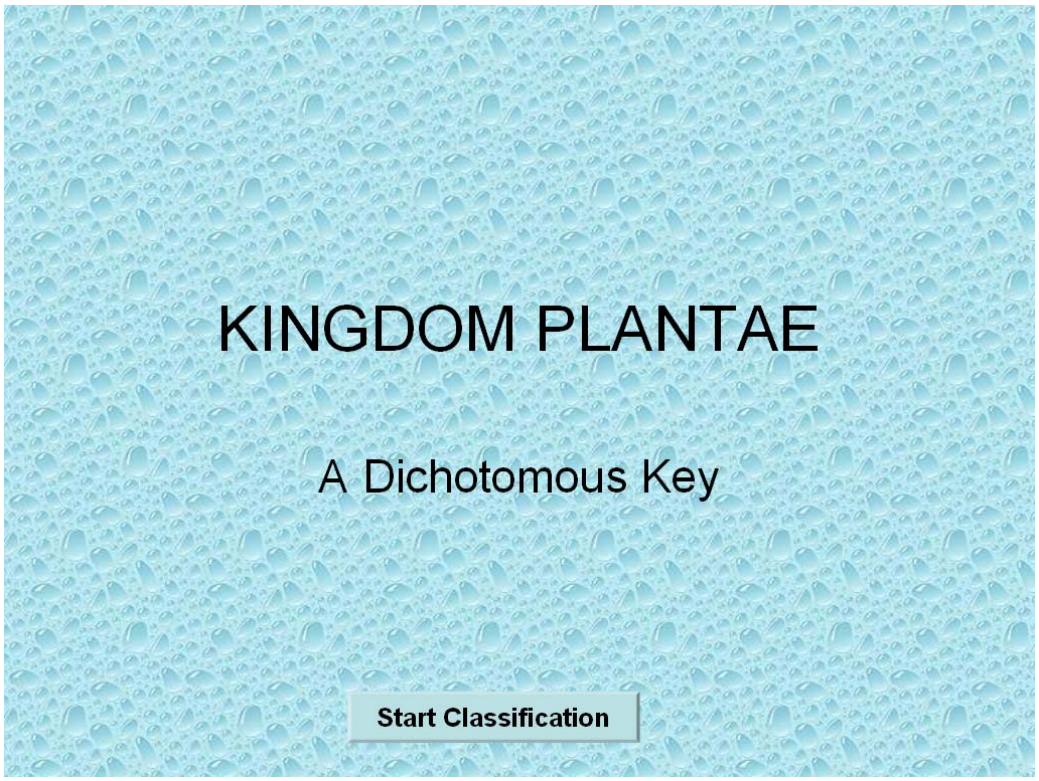
Having completed the preliminary activities which allowed me to both assess prior knowledge and ensure that the basic concepts required of the tasks had been experienced, the students were required to complete two dichotomous keys - one for the Plant Kingdom and one for the Animal Kingdom. As the students displayed a broad range of computer skill and experience a number of programs were offered to them. The simplest way to represent the information was in Inspiration. This program allowed students to arrange the data on the screen in front of them, as one would when concept

mapping on paper, and insert all the relevant information about the various major groupings of animals and plants. Mark Chapple had created a key to beans using Inspiration which was available to the students via the school intranet as an example of how to complete a key using this program.



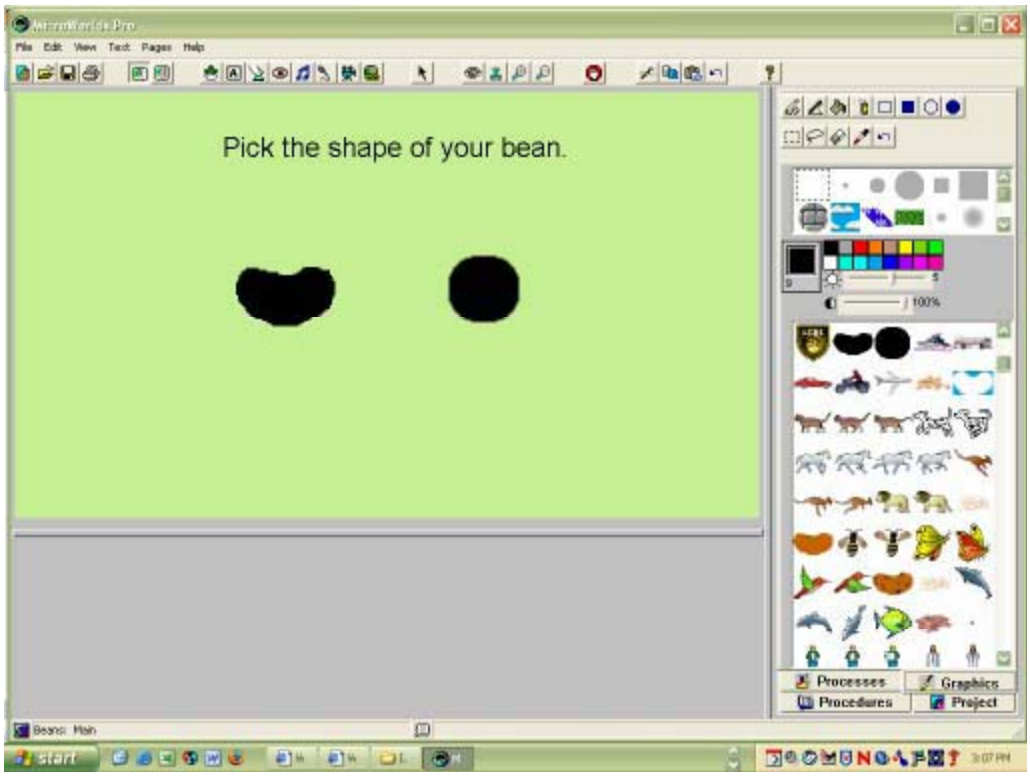
Page containing Mark's files - http://www.woodleigh.vic.edu.au/idater/index.htm

Students who were more comfortable with the computers were encouraged to use MS PowerPoint to make a more interactive key. Using the hyperlink capacity of this program students were able to pose a question, offer two solutions and link each solution to the next appropriate page of the slide show, eventually displaying the information required. Gary Simpson had created an example of a plant key using PowerPoint. It was deliberately incomplete and contained logic errors so that students would not directly copy it, but could improve on it.



Page containing Gary's file - http://www.woodleigh.vic.edu.au/idater/index.htm

The more able students were encouraged to use MicroWorlds. MicroWorlds is a collection of tools in the form of simple programming language which encourages students to explore concepts and show what they have learnt, how they have investigated a concept and sought for deeper understanding. Many teachers will be aware of the LOGO language of which MicroWorlds is a later evolutionary stage. Mark Chapple had created an example of how this program could be used to create a key for beans, which was made available on the school's intranet.



Page containing Mark's sample beans file -
http://www.woodleigh.vic.edu.au/idater/beans.htm

The information required to complete these two tasks was readily available in the students' text books (Lofts and Evergreen, 2000). Students needed to read, analyse and select the appropriate information to prepare questions for their keys and descriptions of the major groups of plants and animals.

Reflections

This was a highly successful teaching innovation. The students spent 8 x 80-minute sessions collecting the data for a class key and guide and preparing dichotomous keys for Animal and Plant Kingdoms. The students were highly motivated, spending their time productively discussing the biological concepts and sharing their knowledge of the various programs. We believe that by integrating ICT into the performance of these tasks that the student outcomes have been enhanced. The students have been required to carefully select information and images to construct a representation of their knowledge. While this is possible using paper and pencil techniques, we believe that by using ICT the students have been able to produce finished products of a higher standard more

efficiently and are able to share these with a wider audience than their immediate peers. While not directly measured, essentially as it was an afterthought, we believe that the students have been able to retain their knowledge and understanding of these concepts, more so than our previous experience would suggest. The proof of the effectiveness of this activity has been in the student outcomes.

Nick is a student who has partial deafness and various diagnosed learning difficulties who usually struggles to complete the tasks set in this class. However, it must be said that he works hard to try to complete all activities. In this case he managed to finish a key of Animals using Inspiration. It doesn't contain all the required information, but for a student who has struggled to complete tasks all year, this is by far his best effort and one of which he was very proud.

Page containing Nick's file - http://www.woodleigh.vic.edu.au/idater/index.htm

Tom is a very able student who generally finishes all tasks, but not always fully or to the best of his ability. In this case he managed to complete a paper based class key, a paper based class field guide (because he realised that the photographs would make the file too large for him to store in his network folder – a realisation he could have shared with the rest of us!) and then completed keys for both Kingdoms – Animals in Inspiration and Plants in PowerPoint. He was able to demonstrate a clear understanding of dichotomous keys and their use for grouping like objects.

Page containing Tom's files - http://www.woodleigh.vic.edu.au/idater/index.htm

Chelsea and Alex are friends who regularly work together. One is more able than the other when completing Science based work, while the other is more competent with computers (interestingly she is also more competent with mathematically based activities). They both completed the Animal and Plant keys, but worked together to share their various skills.

Page containing Chelsea and Alex's files - http://www.woodleigh.vic.edu.au/idater/index.htm . There are three files in all – two from Chelsea and one from Alex.

Laura and James are both highly motivated and highly competent Science students with excellent computer skills. Laura chose to extend herself by producing a class key in MicroWorlds as mentioned above. She then used the skills she had developed to prepare keys of Animals and Plants which displayed her growth of knowledge with both the software and the biological concepts.

Page containing Laura's class files -
http://www.woodleigh.vic.edu.au/idater/LaurasMWkey.htm

James also chose to extend himself. He prepared a fabulous class key in Inspiration (above) and then worked with MS PowerPoint to produce a key of the Animal Kingdom which links 30 slides together to present a particularly intricate and detailed key of the major groups of animals.

Page containing Jame's files - http://www.woodleigh.vic.edu.au/idater/index.htm

We learnt that, as for all successful innovations with students, one is able to measure individual success. This is not always success against a predetermined outcome or goal or a class mean, but success for each individual in the sense of personal growth in skills and knowledge. Our students all started from different places and all ended up in different places, but they have successfully constructed dichotomous keys and grouped like objects. Their class test results suggest that the students have also successfully reconstructed their cognitive structures in relation to classifying living things and the use of dichotomous keys. They were asked to classify objects and develop keys for objects which they mostly did very well. They were also asked questions about plants and animals and how they are classified and again mostly did very well. As one would expect the stronger and more confident the student the better their results, but all students were able to show growth in their knowledge and understanding of the classification of living things. They have also had rich experiences of information and communication technologies, using Inspiration, PowerPoint, and /or MicroWorlds, search engines to seek appropriate images for their keys and attaching files to e-mail to send their completed tasks to me for assessment. To add to this ICT rich environment the students have used the school intranet to view each others work. This experience has reinforced both their understanding of the biology and ICT.

References

Ernest, P. (1995) The one and the many, in Steffe, L. and Gale, J. (Eds.), *Constructivism in education,* New Jersey, Lawrence Erlbaum

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Simpson, G. B. (2004), 'Critical Constructivism, Neo-Relativism, and the Place of Values in Science Education', Science Education Review, V3 n1 pp23 - 28

Taylor, P.C. (1998) Constructivism: Value Added, in Fraser, B. & Tobin, K. (Eds.) *The International Handbook of Science Education*, Dordrecht, Kluwer Academic

Vico, G. (1858) *De antiquissima Italorum sapientia*, Naples, Stampera de Classici Latini.

von Glasersfeld, E. (1990) *An Exposition of Constructivism: Why some like it Radical, Constructivist Views on the teaching and learning of mathematics*, Chicago, National Council of Teachers of Mathematics

von Glasersfeld, E. (1995) *Radical Constructivism: A way of Knowing and Learning*, London, The Falmer Press

Mark Chapple is currently an onsite educational technology specialist working at the Woodleigh School. Mark also maintains an independent consultancy practice, working with teachers and schools as they strive to improve student outcomes using learning technologies. In previous positions within the IT industry, Mark worked closely with schools and teachers to assist them integrate technology within classrooms. Over the past ten years he has presented nationally at conferences and held workshops on issues such as planning for technology, developing collaborative learning environments and using technology within the classroom**.**

Gary Simpson is currently Coordinator of Independent Learning and Homestead Coordinator at the Woodleigh School, having worked extensively at incorporating ICT in the Science curriculum at his previous school**.** He is a NCISA Scholar

completing his PhD on the application of constructivist epistemologies to the teaching and learning of middle school science, at the Key Learning Centre for Mathematics and Science Education at Curtin University, contributing Editor to Science Education Review, coordinating author of Heinemann Science Links Books 3 & 4 and a regular contributor to various publications.

APPENDIX 1 YEAR 7 CLASSIFICATION UNIT

Rationale

This unit of work requires the student to carry out tasks to investigate the manner in which objects can be grouped together to fulfil a social function. The investigation of other cultural groups and the historical development of the Linnean System will be complimented with practical investigations and applications of this theoretical knowledge. The conceptual setting is one of open ended but directed tasks. It is intended that an understanding of the theoretical setting of the classification of living things will occur through vicarious and tacit experiences. Students will be encouraged to hypothesise and draw their own conclusions.

Objectives

These objectives are based upon the Curriculum and Standards Framework for Science Curriculum foci for levels 1, 3, 4 and 5 for the sub-strand Biodiversity, change and continuity.

Knowledge - This unit aims for students to achieve the following:

- to be able to distinguish between living, non-living and dead things.
- to be able to classify living things in a variety of ways.
- to develop an appreciation of the historical development of Western taxonomical systems.
- to develop an appreciation of selected indigenous taxonomical systems.
- to be able to investigate the similarity and diversity of characteristics within and between groups of living things
- to be able to identify features of living things that determine their classification into major groups.

Skill - This unit aims for students to develop the following skills:

- to report on practical investigations in a structured, logical manner.
- to be able to make biological drawings.

- to be able to dissect plant specimens.
- to be able to use a light microscope.
- to present data in a variety of forms: as graphs, tables, charts; with words both written and spoken and through 2 and 3 dimensional representations.
- to conduct independent research using magazines, books, CD-ROM and the World Wide Web.
- to develop higher level abstract thinking to deal with scientific theories concerning the manner in which organisms are ordered.

TASK ONE - PRACTICAL EXPERIMENTS LOG BOOK
DUE DATE: Monday 2 August 2004

You are to keep reports of all the experiments that you do during this unit. You must write an aim, a list of apparatus, a method, display your results and observations and include a discussion and conclusion. Students are to work in groups of 2 or 3. But each student must keep a logbook. The experiments that you will need to complete are:

1. Classifying Objects (Lollies)
2. Classifying Objects (Various) - The Sequel
3. Living, Non-living or Dead (p149)
4. Making a Class Key (p150)
5. Making a Class Field Guide (p151)

Practical Experiment No. 1 - Classifying Objects (Lollies)

1. Collect a box of objects.
2. Sort the objects into groups. Record the groups of objects and the reasons why you sorted them in that way on a piece of paper.
3. Repeat step 2 above at least twice more. You will have at least three different systems for grouping the objects recorded in your observations/results.
4. Choose the groups best sorting of the objects and present this on an A3 sheet of paper, explaining how you sorted the objects.
5. You may eat them when you finish.

Practical Experiment No. 2 - Classifying Objects (Various) - The Sequel

1. Collect a box of objects.
2. Sort the objects into groups. Record the groups of objects and the reasons why you sorted them in that way on a piece of paper.
3. Repeat step 2 above at least twice more.
4. Choose the groups best sorting of the objects and present this on an A3 sheet of paper, explaining how you sorted the objects.

CRITERIA FOR ASSESSMENT

1. Completion of five tasks. (10 marks)
2. All tasks completed correctly - that is correct method for presentation of the experiment, all results and observations included and conclusions make sense. (15 marks)
3. Work neatly and clearly presented. (5 marks)

TOTAL MARKS **(30 MARKS)**

TASK TWO – CLASSIFYING ANIMALS

DUE DATE: Wednesday 11 August 2004

Using the information presented on pages 152 – 161 of your text book you are to prepare a dichotomous key of the major animal groups – vertebrates (including the three groups of mammals) and invertebrates. All the information you require is in the text book. The key is to be produced using the computer and needs to operate in an interactive manner.

You need to make sure that your key uses the information about each of the groups of animals as the basis of the questions and includes:

- Birds
- Mammals
- Amphibians
- Reptiles
- Arthropods
- Molluscs
- Echinoderms
- Worms
- Cnidarians
- Porifera

You may use Inspiration to create your key, but this will not be interactive, it is possible to use a Web Page to achieve the interactive nature of this task, it is possible to use MS Excel and MS Access and MicroWorlds may offer a simple programming solution. We will work through the solutions to making an interactive key in class.

CRITERIA FOR ASSESSMENT

1.	Completion of a working key.	(10 marks)
2.	Key contains all the information required.	(15 marks)
3.	Key presented in a neat, logical manner.	(5 marks)

TOTAL MARKS **(30 MARKS)**

TASK THREE - CLASSIFYING PLANTS

DUE DATE: Wednesday 25 August 2004

Using the information presented on pages 164 & 165 of your text book you are to prepare a dichotomous key of the major plant groups. All the information you require is in the text book. The key is to be produced using the computer and needs to operate in an interactive manner.

You need to make sure that your key uses the information about each of the groups of plants as the basis of the questions and includes:

- Bryophytes
- Mosses
- Liverworts
- Tracheophytes
- Gymnosperms
- Angiosperms
- Pteridophytes

You may use Inspiration to create your key, but this will not be interactive, it is possible to use a Web Page to achieve the interactive nature of this task, it is possible to use MS Excel and MS Access and MicroWorlds may offer a simple programming solution. We will work through the solutions to creating an interactive key in class.

CRITERIA FOR ASSESSMENT

1.	Completion of a working key.	(10 marks)
2.	Key contains all the information required.	(15 marks)
3.	Key presented in a neat, logical manner.	(5 marks)

TOTAL MARKS **(30 MARKS)**

TASK FOUR - DICHOTOMOUS KEYS

DUE DATE: Thursday 12 August 2004

This task is to be completed by each student in their exercise books.

1. What is meant by the term classification? (pp 148 & 149 may assist)

2. There are eight things that all living things have in common. What are they?
   (p 149 may help).

3. When we classify things we make charts like family trees or dichotomous keys.
   a) Make a chart of your family for about three or four generations.
   b) What is a dichotomous key? How does it work? (see p150)
   c) Try to turn your family tree into a dichotomous key. What difficulties did you have? How did you overcome those difficulties?

4. Carolus Linnaeus developed a system for classifying living things that is named after him: The Linnean System. (p148 will help – but you'll need more, Ask Jeeves turned up a treasure trove including http://www.ucmp.berkeley.edu/history/linnaeus.html, but the library is sure to have books with information on this famous scientists as well.)
   a) Write a short history of Linnaeus.
   b) Explain how his classification system worked.

5. There are five Kingdoms of Living Things. We have looked closely at animals and plants. What are the other three kingdoms? Describe the sorts of organisms that are in the other three kingdoms.

CRITERIA FOR ASSESSMENT

1.	All questions attempted.	(5 marks)
2.	Family Tree Dichotomous Key - neat and complete	(5 marks)
3.	Carolus Linnaeus - neat and complete	(5 marks)
4.	Five Kingdoms – questions answered correctly	(5 marks)
5.	References	(5 marks)
Total Marks		**(25 marks)**

TASK FIVE - DIFFERENT CULTURES DIFFERENT CLASSIFICATIONS

DUE DATE: Thursday 26 August 2004

Students may work in small groups to collect and discuss the following information. But each student is to submit the work in their exercise books.

Common to most cultures is the need to explain the natural world. To find order and system in the natural world makes human beings more comfortable in their own lives. Classification of living things and non-living things is an attempt to impose a system that gives order to the natural world. It is usually done in such a way as to be sensible to the cultural group and therefore makes little sense to another cultural group.

Karam Culture - Papua New Guinea

The Karam people of Papua New Guinea live in the rainforests and have an extensive, richly detailed knowledge of the natural world and a well-developed classification system. As part of this system they have a group called yakt. The yakt include birds and bats, but not cassowaries. The cassowary holds a place of special significance within Karam culture and has a special relationship with humans. Because it walks on two legs it is seen as a stage between being human and what happens after death – so they are treated as sacred and their various body parts are used for special, powerful objects. The cassowary is also quite a dangerous animal, capable of killing a young person or frail adult. The websites below are included to help, there are others – but this topic is hard to search for.

1. Collect some information about what birds might live in the rainforests of Papua New Guinea. Describe their features. (http://www.hbw.com/ibc/, http://www.gspeak.com.au/kirrama/newgui.html)
2. Collect some information about what bats might live in the rainforests of Papua New Guinea. Describe their features. (http://www.amonline.net.au/mammals/bats/index.htm)
3. Collect some information about the Cassowary. Describe its features. What role might it have in Karam culture? (http://www.zoo.org.au/education/factsheets/cassowary.PDF, http://www.wettropics.gov.au/pa/pa_casso.html)
4. Why are birds and bats classified together by the Karam? Why is the cassowary not included?
5. Would you classify these animals in the same way? Why/Why not?

Yolngu Culture - Arnhem Land

The aboriginal people of north east Arnhem Land (the Yolngu) have a rich and detailed knowledge of the plants and animals of their environment. They

classify plants and animals very differently to us - the *balanda* (essentially meaning non-Yolngu people). Many plants have a number of different names and can be found in their classification system in a number of places. One such plant is the Cycad. It has fronds like a palm-tree and fleshy fruit. It is found in coastal eucalypt forests around most of Australia. The Yolngu have a name for the fruit of the cycad and the bread that is made from that fruit. They have special ceremonies and dances about the use of the fruit and they know that the fruit must be prepared in a special way to remove the chemicals that the fruit contains that could harm them. The cycad has at least four different names for the Yolngu. Other plants and animals are the same. One name for the fruit, one name for the bark, one name for the leaves, one name for the root or one name for the eggs, one name for the flesh, one name for the bones and teeth. The names reflect the use of the part of the organism (a word we use to describe all living things). The website below is included to help, there are others – but this topic is hard to search for.

Prepare a chart for a Yolngu classification system. It must include the cycad, a eucalypt, a yam, a goanna, a wallaby and a barramundi. You will need to do the following:

a) Find out what parts of the different animals and plants are used by aboriginal people and for what purpose. (http://www.abc.net.au/message/radio/awaye/stories/s123780.htm)
b) Make up a name for each part of the organism – if you can find out the real name, you could use that.
c) Present your classification system on an A3 sheet of paper, illustrating the chart with appropriate diagrams and pictures and including a key of what the names mean. (You may chose to use Inspiration for this.)
d) Write a short explanation of how your "Yolngu" classification system works.

It is not possible to use the real Yolngu system because it is far too complex and requires a detailed knowledge of Yolngu cultural and spiritual life. Many of the paintings, stories and ceremonial dances told to explain the system have never been explained to *balanda*.

CRITERIA FOR ASSESSMENT

1.	All questions attempted.	(5 marks)
2.	All questions answered fully and completely	(10 marks)
3.	Yolgnu Classification Chart presented neatly with all the required information included.	(10 marks)
4.	References listed	(5 marks)
Total Marks		**(30 marks)**

Assessment

For the students assessment is criteria referenced. The teacher should stress that there are a number of clearly defined requirements of the student for each activity. The students should receive copies of the criteria for assessment at the same time as they receive the task. Written tests and practical tests could also be used by the teacher to assess the degree to which the learning outcomes have been achieved.

Diagnostic Tests

To be used prior to the teaching of the unit and following the completion of the unit.

1. Concept Plan

Have each student brainstorm words under the heading "Living and Non-Living Things". After about 5 minutes ask the students to map all of their words on a piece of A3 blank paper. These maps should be retained by the teacher for comparison with the concept plans produced at the completion of the unit of work.

2. Test (Written, Audio or Graphical)

The same test will be applied prior to and following the completion of the unit of work. The teacher will hold the pre-test papers for comparison with the post-test papers to evaluate how effective this curriculum package has been.

a) Explain in your own words the difference between living and non-living things.
b) All living things have six things that they share in common. What are they?
c) Sort the following list of animals and plants into groups.
Elephant, Whale, Dolphin, Seal, Tuna, Shark, Giraffe, Human, Gorilla, Chimpanzee, Koala, Echidna, Platypus, Kangaroo, Tiger Snake, Frilled Neck Lizard, Cow, Sheep, Anaconda, Oak Tree, Pine Tree, Tree Fern,

Gum Tree, Bottlebrush, Protea, Grass Tree, Rose, Daisy, Petunia, Orchid, Couch Grass.

d) Explain why you chose the groups you did in question three.

e) Using the following collection of objects prepare two keys that sort the objects differently.
Red Ball, Blue Triangle, Yellow Square, Green Cube, Blue Square, Red Cube, Yellow Triangle, Green Ball, Yellow Ball, Green Triangle, Blue Ball, Red Square, Green Square, Yellow Cube, Blue Cube, Red Triangle.

f) Why is it possible to sort the objects differently?

The ten questions produced above test each of the knowledge and some of the skill objectives of the unit, they offer students to exhibit knowledge that they can recall (questions 1 & 2) and knowledge that they understand (questions 3 - 6). To cater for students with learning disabilities an audio tape of the questions with colour charts for questions 3 and 5 will be available. These students will be able to answer orally if they desire.

Learning Outcomes

For the teacher, the CSF requires evidence of the learning outcomes being achieved to be collected. Assessment is then based upon how well the students have achieved the Learning Outcomes. The table below should assist with this requirement.

LEARNING OUTCOME	**EVIDENCE FOR ACHIEVEMENT**
Distinguish between living and non-living things	* this knowledge is at the core of the whole unit and should be established by the pre-test and very earlier classroom activities.
Classify living things in a variety of ways	* tasks 1, 4 and 5 and the test require students to consider how living things can be classified.

Investigate the similarity and diversity of characteristics within and between groups of living things	* All five tasks require the students to display this learning outcome and it features on the test.
Suggest why some species have become extinct.	* Tasks 2 and 3 require this learning outcome to be addressed and the test will discover if it has been achieved.
Identify current endangered species and examine strategies to conserve them.	* Tasks 2 and 3 require this learning outcome to be addressed and the test will discover if it has been achieved.
Identify features of living things that determine their classification into major groups.	* Tasks 4 and 5 require this learning outcome to be addressed and the test will discover if it has been achieved at a basic level.