Multimedia Interactive Pedagogies on a CD-Rom for Teaching Primary School Children about the Human Body

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Abstract

Learning about the human body is a very important part of growing up for all boys and girls. To understand the human body is a significant step to understanding oneself and how one responds to one's physical and social environments. Here, the pedagogies used in a CD-Rom on the human body are analysed as appropriate examples for student-teachers preparing for Primary school teaching of children aged 5–12 years. Constructivist principles and Bloom's thinking levels are used as the theoretical bases of the pedagogies that are also integrated with other Primary school Curricula.

Keywords: education, curriculum, teaching, pre-service education, human body, multimedia

Of all the experiences humans have over their lifetime, none is more important than knowing about their body. We live in our bodies for about 80 years, and it has a significant influence on the way we think about ourselves, who we are, and what we would like to become. For many people, their body signifies their self, and is intimately related to how they would like to change it, and thus their sense of self is intrinsically tied to their conception of their body. So, educationally, it is important that young people gain an accurate understanding of their body early.

A CD-Rom on the human body has been designed and developed for some Australian university student-teachers who are intending to be Primary School teachers. This CD-Rom covers the area of Human Relationships Education and examines some appropriate content, objectives, goals, strategies, resources, concepts and skills relevant for future teachers of Grades 1-7 (ages 5 – 12 years). It is presented in ten self-teach modules, and students are required to proceed through these

at their own pace, and respond on computer. Module 3, in particular, deals with the human body and aims to assist student-teachers to understand the 10 systems in the human body, in the context of creating teaching strategies to enhance children's learning about it.

This article analyses the pedagogies in this CD-Rom used in teaching about the human body. The pedagogies are analysed as examples of a Constructivist approach to designing interactive multimedia based on levels of Thinking Skills (Bloom in Frangenheim, 1998).

Defining Multimedia

There is a burgeoning literature on Interactive Multimedia (IMM), but none has been found on appropriate pedagogies for teaching student-teachers about educational strategies for teaching children about their body. The confluence of information technology and education has forced educators to review the nature of teaching and learning. Underwood and Underwood (1990) believe it is logical that we should use the new technologies to encourage the development of cognitive skills needed to process the growing flow of information. So, what is IMM? It may be defined as learner-centred and interactive learning using multimedia. Barker and Tucker (1990: 18) see interactive learning as a process rather than a technology, including 'the creation of an information-rich learning environment involving interactions between: teachers and learners, print-based materials, and new computer-based media including CD-Rom hypermedia optical discs, satellite, and cable'. Multimedia has attained a whole new meaning with the advent of the computer, and now implies 'a collation of disparate media emanating from a single presentation device, typically a computer' (Barker & Tucker, 1990: 20).

Multimedia has been described by Ambron and Hooper (1988: 34) as 'providing the ability to illustrate ideas with visual, audio, text or any combination of media, so users can create new ways of communicating ideas'. The interactivity can be conducted using either a simple navigational tool, which allows students to move through the stored data, or it may require the student to engage in higher-order problem-solving where feedback to the input will indicate the path taken. The term interactive multimedia, then, seems appropriate and accurate. The essential value of interactive multimedia technologies is that they can be used effectively to empower students to take a more proactive role in acquiring, analysing and synthesising information. It is the potential of multimedia to foster this higher level of interactivity that distinguishes it from older technologies such as projectors, radio and television. That is, multimedia is an active form of learning, whereas projectors, radio and television are passive forms.

Interactivity and Constructivism

The focus on interactivity being of special value in facilitating learning, stems from the constructivist view that learners learn best when they are actively constructing their own knowledge based on their own experiences and their own information (Biggs, 1999; Goldman & Torrisi-Steele, 2002; Kindsvatter, Willen & Ishler, 1992; Torrisi & Davis, 2000; Torrisi-Steele & Davis, 2000). The focus on interactivity to maximise the pedagogical potential of multimedia emerges from the adoption of constructivism as the guiding theoretical basis for the design of many multimedia materials, including the example of learning about the human body examined later. The constructivist view of teaching and learning is commonly accepted as a framework for developing appropriate teaching and learning strategies for designing multimedia learning environments in ways which will promote the reshaping of teaching practice towards student-centred learning environments (Goldman & Torrisi-Steele, 2002; Torrisi & Davis, 2000). As Strommen says,

. . . simply thinking up clever ways to use computers in traditional courses [relegates] technology to a secondary, supplemental role that fails to capitalise on its most potent strengths. What is needed is a guiding philosophy that suggests principled changes in the curriculum, and effective uses of technology as part of these changes. We think that this philosophy must be constructivism (Strommen, 1999: 2).

Constructivism theory of learning

Constructivism is a philosophical theory of learning and understanding based on three primary propositions (Savery & Duffy, 1996: 1), namely:

1. *Understanding is in our interactions with the environment.* That is, '...what we understand is a function of the content, the context, the activity of the learner, and perhaps, most importantly, the goals of the learner' (Savery & Duffy, 1996: 1).
2. *Cognitive conflict or puzzlement is the stimulus for learning and determines the organisation and nature of what is learned.* That is, the goal of the learning is ' . . . a primary factor in determining what the learner attends to, what prior experience the learner brings to bear in constructing an understanding, and, basically what understanding is eventually constructed'. (Savery & Duffy, 1996: 1).
3. *Knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings* (Savery & Duffy, 1996: 2). That is, ' . . . concepts that we call knowledge . . . are simply the most viable interpretation of our experiential world' and that 'all views, or all constructions, are not equally viable' (Savery & Duffy, 1996: 2).

The constructivist philosophy, by contrast to the instructivist philosophy, espouses a view of learners as actively constructing knowledge on what they already know and understand, rather than as passive recipients of knowledge (Biggs, 1999). Thus, '... meaning is not imposed or transmitted by direct instruction, but is created by the students' learning activities, [by] their 'approaches to learning ...' (Biggs, 1999: 12). In doing so, learners become part of the learning process at a deeper level, feel actively involved in the process, and take on ownership for their own learning (See Biggs, 1999). The learner, rather than the teacher, then becomes the focus of the learning environment (See Torrisi & Davis, 2000). Thus, the constructivist theory of learning generates a focus on learning to the learner him/herself, students' prior experiences of learning, their perceptions of their learning situation, their approaches to learning and their learning outcomes (See Marton, Hounsell & Entwistle, 1997; Prosser & Trigwell, 1999).

Instructional design characteristics derived from constructivist principles

- Atkins (1993: 259-260) suggests the following instructional design characteristics based on constructivist principles:
- Orientation activities, which 'tune in' the learner and help him/her to attend to new information. These can be text, aural or visual cueing. The aim is to hold new information longer to allow for active engagement.
- Advance organisers or anchoring concepts introduced at the start of material so that the user can make sense of the new information to come.
- Metacognition devices such as advice statements, help facilities, suggestions for more effective engagement and processing of information.
- Learner required to engage with material. Use of frequent decision points and direct involvement in games or simulation with results of decision seen immediately.
- Use of 'compare and contrast' or 'observe and identify' activities. Learner expected to analyse, synthesise, summarise, describe, and solve problems.
- Users invited to explore and discover an environment for themselves, sometimes with guidance. Can be surrogate experience. Variety of information sources available to the user.
- Learner moves back and forth between symbolic representations of phenomena and the real-life referents.
- Learner expected to build up own hypotheses, explanations, definitions, categories, and rules, through study of examples and reflection on own (surrogate) experiences. Dynamic is inductive.
- Provision of micro-worlds and simulations with variables/factors under user control. User expected to test and refine own suggestions of causal relationships. Tools provided.

- Provision of 'safe' learning environments in which mistakes can be made and learning gained from them.

Constructivist principles

In Constructivism, learning is seen to be affected by the context of the learning, and the beliefs and attitudes of the learner (Prosser & Trigwell, 1999: 168). Learners should be given the opportunity to build on the prior knowledge, encouraged to invent their own solutions, and to try out ideas and hypotheses. Savery and Duffy (1996: 3) note that effective instructional design of multimedia interactives (as in other learning situations) may be based on eight constructivist principles, namely:

- Anchor all learning activities to a larger task or problem.
- Support the learner in developing ownership for the overall problem or task.
- Design an authentic task.
- Design the task and learning environment to reflect the complexity of the environment that students should be able to function in at the end of learning.
- Give the learner ownership of the process used to develop a solution.
- Design the learning environment to support and challenge the learner's thinking.
- Encourage testing ideas against alternative views and alternative contexts.
- Provide opportunity for, and support reflection on, both the content learned, and the learning process itself.

In encouraging learners to participate in the interactive experience, interactivities need to be designed to provide experiences that have an appropriate balance between success and difficulty, and between control and discovery (See Seels & Glasgow, 1998; Smith & Ragan, 1999). Success without difficulty does not promote optimal learning, nor does difficulty with little or no success (Csikszentmihalyi, 1990).

Multimedia and the changing role of the teacher

In applying the constructivism theory to the design of multimedia, the principal aim, then, is to engage the learners in the active exploration and construction of their own knowledge (See Goldman & Torrisi-Steele, 2002). Designing tasks that are appropriate to the learner's needs means that the process of *design* of interactive multimedia materials forces a focus onto the characteristics of the learner, rather than onto the teacher's role (See Biggs, 1999; Prosser & Trigwell, 1999). Consideration of the factors that influence how the learner learns best, then becomes of paramount importance.

Interactive multimedia materials, however, lack the dynamics of face-to-face human engagement, during which the teacher can respond to learner-needs 'on the spur of the moment' as the learning situation unfolds. Schon (1983: 50) would probably refer to this as 'reflection-in-action' whereby in the professional teacher's skill, many quality judgements are made instantaneously and are dependent on '... tacit recognition, judgements and skilful performances' which are often difficult to articulate, but result in skilful action or response by the teacher. Thus, in designing educational multimedia, the difficulties that students may encounter, and the importance of constructive feedback needs to be predicted, and the multimedia module designed to cater for these predictions as accurately as possible, as a means of substitution of the teacher and his/her reflection-in-action (See Marton, Hounsell & Entwistle, 1997; Prosser & Trigwell, 1999).

The teacher's role within the multimedia milieu may be seen, then, as a manager of knowledge, a facilitator who provides advice in exploration, a guide, a helper and an assistant (See Marton, Hounsell & Entwistle, 1997; Prosser & Trigwell, 1999). Even in a study of Internet educational usage by High School students around the world, Goldman and Hocking (1999) found that in their sample, nearly all teachers who used the Internet believe its usage motivates students in their learning, and since using it, nearly half the teachers had changed their teaching techniques. In a study of internet connectivity of High School students around the world, Goldman and Hocking (2000) found evidence that there are self-motivated teachers in High schools who are constructing interesting and useful planned activities for students on the Net. For examples of different types of projects see Goldman & Hocking (2001). Further, students as young as Upper Primary (Elementary) School age, about 10 to 11 years, are also proving competent using technology in their learning, and some are becoming competent scriptwriters and educational designers (See Goldman and Krause, 2001, 2003, 2004). Exposure to this CD-Rom content may encourage these student-teachers to consider how technology might be used to more effectively educate children about Human Relationships Education.

Method

This article analyses the pedagogical interactivities designed for a CD-Rom intended for student-teachers, based on Constructivist principles and Bloom's Thinking Levels in teaching about the human body. It also integrates teaching about the human body into other curriculum subjects such as English, Mathematics, Social Studies and Environmental Education, Science, Health, Physical Education and Art and Music.

Pedagogies used in the CD-Rom

This Interactive Multimedia CD-Rom has 10 sections or modules, each with a varying number of sub-modules. The CD-Rom constitutes a self-teach program, and is designed to be followed sequentially. The beginning text of each module explains precisely what is required of the student, and that essential prescribed readings are necessary before undertaking any of the modules. Interactivities have been distributed throughout the text, and some require answers such as yes or no, or other one or two word answers, or fully typed answers. Most of the pedagogies used in the 10 modules incorporate critical thinking strategies (See Bloom in Frangenheim, 1998) such as: deciding, judging, prioritising, justifying, ratifying, assessing, concluding, selecting, choosing, verifying, determining, recommending, and arguing.

Sprinkled throughout the activities are a number of assessable items. The worth of each assessable item is clearly stated for students eg. one mark, half a mark, quarter of a mark, and so on. On completion of all modules the computer has been programmed to provide the student with a printout of his/her total numerical results.

This courseware was designed to be used as a teaching tool to replace lectures and tutorials, and also as a revising tool. The user interface is designed to allow students the choice of progressing linearly, or browsing at will. The module structure presented at the menu level is suggestive of the order in which students might explore modules for maximum understanding. Meta comments such as 'You should have undertaken activity X prior to viewing this module' are provided, where appropriate, throughout the program in order to guide students. In some instances, where it is perceived that a development in the flow of thought is required, the navigation 'locks' students into a sequence of activities. Colour is used consistently throughout the program to provide visual clues as to what is expected of the student in terms of input. For example, all instructions appear in yellow, italic text.

Navigation tools and structure are intentionally kept simple so as to become almost invisible to the user, and not add unnecessary cognitive load by the user either 'becoming lost' in the navigation or by struggling to interpret or locate the appropriate control buttons. Furthermore, the menu page makes explicit the overall structure of the multimedia presentation, and thus assists students to conceptualise 'where they are' in the program. The tool box contains a Help Menu, a Glossary and a Notepad facility. Navigational systems within a computer-assisted program can facilitate the understanding of a student's learning sequence and reduce the problems of poor learning

schema development (Hedberg, Harper & Brown, 1994). The navigational system in this program aimed to do so.

Ten Modules

The ten modules in the CD-Rom constitute a Human Relationships Education course for student-teachers. In order to provide the context for the reader, the ten are listed here.

Module 1 Introduction, Overview and Contexts.

Module 2 Human Relationships Education Curriculum

Module 3 The Human Body's 10 systems

Module 4 Puberty

Module 5 Having Sex

Module 6 Pregnancy and Birth

Module 7 Contraception

Module 8 Sexually Transmitted Infections and Safe Sex practices

Module 9 Child Sexual Abuse

Module 10 The importance of Human Relationships Education for children.

The estimated time taken by average students to complete the ten modules is equivalent to 42 hours, which is the number of face-to face hours during a semester of lecture and tutorial format, namely 14 weeks x 3 hours = 42 hours.

Module 3 consists of 11 sub-modules as shown below with their appropriate Bloom's Critical Thinking verbs identified in brackets. In all questions requiring text answers, a screen box is provided. In other activities, diagrams and graphics are presented, and students need to find the accurate answers from their readings and drag the arrow, using the mouse, to indicate the correct answer. In other activities, students are required to answer set questions for assessment. These are in the form of deciphering graphs, multiple choice, yes/no, true/false, and typing text in specified boxes. A wide variety of interactivities were used throughout the ten modules. However, because of their large number and appropriateness to the pedagogies used, not all could be incorporated in each module.

Aim

This article presents and analyses the pedagogical interactivities on the human body's ten major systems designed for student-teachers to help them teach Primary School children aged 5-12 years (See Goldman & Bradley, 2001).

Module 3 The Human Body's 10 systems

- 3.1 Educational planning
- 3.2 Your Digestive system
- 3.3 Your Respiratory system
- 3.4 Your Muscular system
- 3.5 Your Skin (or Integumentary) system
- 3.6 Your Sexual and Reproductive system
- 3.7 Your Urinary system
- 3.8 Your Nervous system
- 3.9 Your Skeletal system
- 3.10 Your Hormone system
- 3.11 Your Circulatory system

Reading

Read Chapter 1 of the following book and complete all the required exercises in that Chapter. Note particularly the appropriate vocabulary used in the book that children should use also. Goldman, J (1994) *All of Me. Sex Education for Junior Students*, Melbourne; Longman Cheshire.

3.1 Educational planning

It is very important to teach children about the human body: its structure, functions actions, and the appropriate vocabulary for each part. In each of the ten major systems in our body, there is wide a variety of different organs and systems. Children are fascinated by all the different parts and their functions.

Life-size model: A useful and effective strategy to teach about the body is to use a life-size human model with removable organs. Most universities or hospitals use such models and you may be able to borrow one from there. For example, the Faculty of Nursing on this campus has one which is excellent for explaining what, where, when, and how the organs and systems function. One of the advantages of using a human model with removable organs is that students can see the different shapes and sizes of the organs and systems.

Activity (Choosing): Type *another advantage* of using a human model with removable organs. (After the student has typed 10 words, the computer presents the following suggestion.) Suggestion: Students can touch and remove organs, inspect them, compare them, examine their functions and juxtaposition, and become aware of the complexity, relative size, and tight fit of the organs in the body cavity especially when returning organs to their correct position. Children find this fascinating.

Accuracy and honesty: When you teach about the human body you should provide open, honest, and accurate information using accurate vocabulary that will demystify the body. Your teaching should include clear, simple explanations that increase children's knowledge of the body.

Similarities of the systems of humans, birds and insects: Another useful approach is to refer to other animals and insects. That is, in your teaching remind children that all animals, dogs, cats, chickens, cattle, sheep, kangaroos etc, also have very similar systems to humans. Most birds and insects have similar sets also. Children may be encouraged to research these further. Most school libraries and local libraries have books on various bodies.

Vocabulary: Appropriate vocabulary is very important. Use accurate terms, then re-use them in your English language classes as in Spelling. The chapter in the book *Sex Education* you have just read, uses only appropriate sexual and other vocabulary. If unsure of appropriate vocabulary re-read that text. Here are some examples: use stomach not tummy; penis not dick; testicles not balls; breasts not boobs; vagina not fanny; poo or feces not shit, and anus not arse. Always use correct vocabulary and encourage children to use those words and feel comfortable with them.

The 10 major systems in the human body

Let us see how much you remember from your reading about your body.

- **Assessable Activity #3a** (*Determining*) What is the following definition of? These are the internal parts of the human body and have a variety of shapes and sizes and functions. (Your typed answers must be spelled accurately to gain its mark.) (answer = organ, quarter of a mark).
- **Assessable Activity #3b** (*Determining*) What is the following definition of? The group of organs that work together (or function) to keep your body working well. (answer = system, quarter of a mark).

Text: Our human body is a remarkably complex computer. Even today there is still such a lot we do not know about its workings. However when teaching School students, the human body can be easily simplified by saying there are 10 major systems in our bodies.

- **Assessable Activity #3c** (*Determining*) Type the names of as many of the 10 major systems of the body as you can, and their function, in the following table

Answer for column 1= Digestive, Respiratory, Muscular, Skin/Integumentary Sexual and Reproductive, Urinary, Nervous, Skeletal, Hormone and Circulatory (quarter of a mark each.)

Now let us look at each of the 10 major systems.

3.2 Your Digestive System

Here is a diagram of the Digestive system. (Computer shows a clear, colorful graphic of the Digestive system with empty name lines.)

- **Assessable Activity#3d** (*Determining*) Type the *names* of the organs in the appropriate places, and their *functions* beside each one (quarter of a mark each).

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their digestive system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of healthy food for their digestive system, their body and their lives.

Activity: (*Determining, concluding*) In what other areas of the curriculum could you *integrate* the Digestive system with. Design a mini web to show that. (Graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 4-7, design a Crossword using Digestive System vocabulary.

Activity: (*Deciding, choosing*) What *Maths* activity could students integrate here? (After the student has typed 10 words/Returned, the computer throws up the following suggestion.) Grade 7 children could examine the food triangle, estimate the total kilojoules in the food they will probably consume today, and identify the proportions of each food in each of the levels in the triangle. Discuss if this is their usual eating pattern. Arrive at a generalisation about their eating.

Activity: (*Deciding, choosing*) What *Music or Art* activity could students integrate here? (After the student has typed 10 words, the computer presents the following suggestion.) Grade 5 children research in their library, or on the Web, songs and paintings about healthy food, learn the song, or analyse the painting, then present it to their class.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure healthier food is sold at the Tuck Shop? Specify the Grade it would be appropriate to. (After the student has typed minimum of 10 words/Returned, the computer presents the following suggestion.) Grade 6 children could use the food triangle as a basis for research on what their tuckshop sells, and what items are the most popular foods, and how healthy food could be encouraged, talk to the Principal about their results, then present the findings to a School Assembly.

Activity: (*Justifying, rating*) What could you as teacher do to be a *role model* for children in caring for your digestion, eating and food? (After the student has typed minimum of 10 words/Returned, the computer presents the following suggestion.) Ensure that the food you eat at school, especially when on Playground Duty, and children can observe you, follows the principles of healthy eating that you have addressed in the classroom.

Activity: (*Deciding*) Type a list of 8 correct *digestive vocabulary* words useful for students to understand, learn and know their meanings. (After the student has typed 8 words, the computer presents 8 vocabulary words.)

3.3 Your Respiratory System

Here is a diagram of the Respiratory system. (Graphic here of Respiratory system with empty name lines.)

- **Assessable Activity #3e** (*Determining*) Type the *names* of the organs in the appropriate places, and their *functions* beside each one, quarter of a mark

Activity: (*Deciding, judging, recommending*) Type a *strategy* you could use to teach children about their respiratory system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type an *activity* for children to *understand* the importance of fresh, clean air for their respiratory system, their body and their lives.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the Respiratory systems with. Design a mini web. (Graphic of a simplified web here with spaces for students to complete)

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here? (After the student has typed 10 words or Returned, the computer presents the following suggestion.) Grades 1-3, read a Big Book to children about clean air and how important it is.

Activity: (*Deciding, choosing*) What *Maths* activity could students integrate here? (After the student has typed minimum of 10 words/Returned, the computer presents up the following suggestion.) Grades 6-7, in groups, research the volume of air each person usually breathes in and out, estimate your daily intake and expiration. Research the volume required by pets e.g., your dog, cat and bird. Make a histogram of all this data. Present the information to your class, then pin it on the class wall for one week.

Activity: (*Deciding, choosing*) What *Music* activity could students integrate here? (After the student has typed minimum of 10 words/ Returned, the computer presents up the following suggestion.) Grades 1-3, teacher finds a song about healthy bodies and fresh air and teaches it to the class.

Activity: (*Justifying, rating*) What could you as teacher do to be a *role model* for children in caring for your respiratory system? (After the student has typed 10 words/Returned, the computer throws up the following suggestion.) Ensure that you do not smoke in the school or its environs, so children do not observe you flouting the principles of clean respiratory systems that you addressed in class.

Activity: (*Deciding*) Type a list of 5 correct *respiratory vocabulary* words useful for students to understand, learn and know their meanings. (After the student has typed 5 words, the computer presents 5 vocabulary words.)

3.4 Your Muscular System

Here is a diagram of the muscular system. (Graphic here of Digestive system with empty name lines).

Activity: (*Determining*) Type the *names* of these muscles in the appropriate

places, and their *functions* beside each one. Note that the penis in a male is *not* a muscle, but the Uterus in the woman *is* a muscle.

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their muscular system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of muscles for their body and their lives.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the muscular systems with. Design a mini web. (Graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here? (After the student has typed 10 words/ Returned, the computer presents the following suggestion.) Grades 6 and 7, write a Haiku poem about what role muscles play in your body when you walk and then run.

Activity: (*Deciding, choosing*) What *Music* activity could students integrate here? (After the student has typed 10 words or Returned, the computer throws up the following suggestion.) Grades 4–7, create a story/song about marathon runners and what their muscles are doing during those 2 hours.

Activity: (*Deciding, choosing*) What *Physical Education* activity could students integrate here? (After the student has typed 10 words/Returned, the computer throws up the following suggestion.) Grades 4–7, teach children how to stretch muscles before a run, then stretch when cooling down after a run.

Activity: (*Deciding, choosing*) What *activity or research* could you get your class to undertake to ensure they develop further their understanding of muscles? Specify the Grade it would be appropriate to.

Activity: (*Justifying, rating*) What could you as teacher do to be a *role model* for children about caring for your muscles? (hint: exercise)

Activity: (*Deciding*) Type a list of 10 correct *muscular vocabulary* words useful for students to understand, learn, and know their meanings, and include Uterus, as it is referred to later in these modules.

3.5 Your Skin System

The skin system is the name of the covering of your body. It is also called the Integumentary system. (Graphic here of skin system with empty name lines.)

Activity: (*Determining*) On this graphic, type the *names* of two *other* natural coverings of parts of our bodies. Type their *functions* beside each one.

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their skin system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of caring for their skin?

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the skin system with. Design a mini web. (hint; coverings of animals, birds, reptiles etc.) (Graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 3-7, design an activity from two paragraphs you have chosen from an informative book on skin and body coverings for humans and animals.

Activity: (*Deciding, choosing*) What *Environmental Studies* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 1-7, compare the coverings of humans with those of animals, birds and reptiles. Arrive at a generalisation about the coverings of bodies.

Activity: (*Deciding, choosing*) What *Health* activity could you get your class to undertake to ensure they understand skin problems such as acne and pimples? Specify the Grade it would be appropriate to. (After the student has typed 10 words/Returned, the computer presents the following suggestion.)

Activity: (*Judging, recommending*) Which *community resource person* could you invite to class to help students care for their skin? (After the student has typed 10 words, the computer presents the following suggestion.) Grades 1-7, invite a guest Speaker from the Australian Skin Cancer Council to talk about the 'Slip, Slop, Slap' Campaign (Slip on a shirt, Slop on sunscreen, Slap on a hat).

Activity: (*Justifying, rating*) What could you do as teacher to be a *role model* for children about caring for their skin? (hint; a hat, sunscreen)

Activity: (*Deciding*) Type a list of 10 correct *vocabulary* words associated with skin, caring for skin, acne, or skin cancer, useful for students to understand, learn and know their meanings. (After the student has typed 10 words, the computer presents 10 vocabulary words.)

3.6 Your Sexual and Reproductive System

The man's sexual and reproductive system. Here is a diagram of the man's sexual and reproductive system. (Graphic here of male sexual system with empty name lines)

- **Assessable Activity #3f** (*Determining*) Type the *names* of the organs in the appropriate places, and their *functions* beside each one (quarter of a mark each).

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about the male sexual or reproductive system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of caring for the male sexual system (hint; keep your penis clean, do not hurt it.)

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the sexual systems with. Design a mini web. (hint; animals, birds, mammals, marsupials etc) A graphic of a simplified web here with spaces for students to complete.

Activity: (*Deciding, choosing*) What *Social Studies* activity on *World Population* could students integrate here? (After the student has typed 10

words or Return, the computer throws up the following suggestion.) Grades 5-7, following lessons on making babies and contraception, research the current world population, how it is increasing, and how and what contraception could be used to curb it.

Activity: (*Deciding, judging, recommending*) Which *community resource person* could you invite into class to help children understand the male sexual system? (hint; condoms, sexual health) (After the student has typed 10 words/Return, the computer presents the following suggestion.) A guest nurse talks about sexual health, STI's (Sexually Transmitted infections), condoms and other contraception

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure they develop a greater understanding of the male sexual system? Specify the Grade it would be appropriate to. (After the student has typed 10 words, the computer presents the following suggestion.) Grades 5-7, in groups, each person writes a question about something they do not understand and puts it into a Question Box. Teacher offers the Question Box to every group to answer another question they pull from the box.

Activity: (*Deciding*) Type in a list of 10 correct *sexual vocabulary* words about the male sexual system useful for students to understand learn and know their meanings. (After the student has typed 10 words, the computer throws up 10 vocabulary words.)

The woman's sexual and reproductive system Here is a diagram of the woman's sexual or reproductive system. (Graphic here of woman's sexual system with empty name lines.)

- **Assessable Activity #3g** (*Determining*) Type the *names* of the organs in the appropriate places, and their *functions* beside each one (quarter of a mark).

Activity: (*Deciding, judging, recommending*) Type in your suggestion of a *strategy* that you could use to teach children about the female sexual or reproductive system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type in how you could get children to *understand* the importance of caring for the female sexual system. (hint; keep your sexual organs clean, do not hurt them.)

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the sexual systems with. Design a mini web. (hint animals, birds, mammals, marsupials) Graphic of a simplified web here with empty spaces for students to complete.

Activity: (*Deciding, choosing*) What *Social Studies* activity on *World Population* could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 5-7, link to the male sexual system earlier.

Activity: (*Deciding, choosing*) Which *community resource person* could you invite to help children understand the female sexual system? (hint; Nurse, doctor)

Activity: (*Deciding, choosing*) What *Health* activity could students integrate

here? (hint; diaphragm) (After the student has typed 10 words, the computer presents the following suggestion.) Grades 5-7, link to the male sexual system earlier.

Activity: (*Deciding, choosing*) What other *Health* activity could students integrate here? (hint; sexual health) Grades 5-7, link to the male sexual system earlier.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure they develop a greater understanding of the female sexual system? Specify the Grade it would be appropriate to. (After the student has typed 10 words, the computer presents the following suggestion.) Grades 5-7, link to the male sexual system earlier.

Activity: (*Deciding*) Type in a list of 10 correct *sexual vocabulary* words about the female sexual system useful for students to understand, learn and know their meanings. (After the student has typed 10 words/Returned, the computer presents 10 vocabulary words.)

3.7 Your Urinary System

Here is a diagram of the Urinary systems of both a man and woman. (Graphic here of Urinary system with empty name lines.)

Activity: (*Determining*) Type in the *names* of the organs in the appropriate places, and their *functions* beside each one.

Activity: (*Deciding, judging, recommending*) Type in your suggestion of a *strategy* that you could use to teach children about their urinary system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type in how you could get children to *understand* the importance of 8 glasses of clean water daily for their urinary system.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the Urinary systems with. Design a mini web (hint; animals, birds etc). (Graphic of a simplified web here with spaces for students to complete)

Activity: (*Deciding, choosing*) What *Science* activity could students integrate here (After the student has typed 10 words/Returned, the computer throws up the following suggestion.) Grades 6-7, as part of the 'Water Wise Campaign' do the experiments on the health of the waterways near your school.

Activity: (*Deciding, choosing*) What *Health* activity could students integrate here? Grades 5-7, survey the children in your grade to see how much water they usually drink each day. Compare the data with what they should be drinking. Graph the results on computer, and present the information to a School Assembly.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to examine the *quality of water* in your community that birds and animals drink? Specify the Grade it would be appropriate to. (After the student has typed 10 words/Returned, the computer presents the following suggestion.)

Activity: (*Judging, recommending*) What *community resource* could your

class *visit* to help students understand more about their water in their community? (After the student has typed 10 words, the computer presents the following suggestion.)

Grades 4-7, integrate with Social and Environment Education on the water cycle, collection, storage and distribution. Visit your local dam/water storage and have a talk from the City Council workers on water as a precious resource.

Activity: (*Deciding*) Type in a list of 5 correct *urinary vocabulary* words useful for students to understand, learn and know their meanings. (After the student has typed 5 words, the computer presents 5 vocabulary words.)

3.8 Your Nervous System

Here is a diagram of the Nervous system. (Graphic here of nervous system with empty name lines.)

- **Assessable Activity #3h** (*Determining*) Type in the *names* of the organs in the appropriate places, and draw arrows to show directions of nerve messages beside each one (quarter of a mark each).

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their nervous system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of their nervous system for their body and their lives.

Activity: (*Judging*) Can you think of an *analogy* which would be useful to apply when teaching about the nervous system?

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the nervous systems with. Design a mini web (hint; Science). Graphic of a simplified web here with spaces for students to complete.

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 3-7, create a fictional short story about a neural message that was supposed to go in a certain direction, but took the wrong turning, and what happened next.

Activity: (*Deciding, choosing*) What *Music* activity could students integrate here (After the student has typed 10 words, the computer presents the following suggestion.) Grades 4-7, in groups create a series of sounds, or a tune, that describes your Nervous System from when you were asleep, then waking, then at school, then at play, then back to sleep at night.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure a greater understanding of their nervous system? Specify the Grade it would be appropriate to. (After the student has typed 10 words, the computer presents the following suggestion.) In groups, research the Nervous System in the library or on the Net. Present your findings to your class.

Activity: (*Deciding*) Type a list of 3 correct *nervous vocabulary* words useful

for students to understand learn and know their meanings. (After the student has typed 3 words, the computer presents 3 vocabulary words.)

3.9 Your Skeletal System

Here is a diagram of your skeletal system. (Graphic here of skeletal system with empty name lines.)

- **Assessable Activity #3h** (*Determining*) Type in the *names* of the major bones in the appropriate places, and their *functions* beside each one (quarter of a mark).

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their skeletal system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of healthy bones for their skeletal system, their body and their lives.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the Skeletal systems with. Design a mini web. (Graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What *English language* activity could students integrate here. (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 4-7, write a piece of fiction called 'I am a Knee Bone' from the bone's point of view, as it grows from a baby, to a child, to an adult, and then dies.

Activity: (*Deciding, choosing*) What *Physical Education* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Research and write a report on what your bones are linked to in the human body, how they move, what happens if they break. Present your report to your school Assembly.

Activity: (*Deciding, choosing*) What *Music or Art* activity could students integrate here. (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Teacher finds a song about bones, and gets children to make a wire and clay, or papier mache model of the human skeleton.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure a greater understanding of their skeletal system? Specify the Grade it would be appropriate to. (After the student has typed 10 words/Returned, the computer throws up the following suggestion.) Grades 4-7, research what foods and other nutrients are good for you to encourage healthy bones (e.g., Calcium and weight-bearing exercises). Put your findings on your class section of your school's web site.

Activity: (*Deciding, choosing*) What *resource* could you obtain from a university or teaching hospital which children would love to touch and explore? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) A plastic model of the human body with removable organs.

Activity: (*Deciding*) Type a list of 10 correct *skeletal vocabulary* words useful for students to understand learn and know their meanings. (After the

student has typed 10 words, the computer presents 10 vocabulary words.)

3.10 Your Hormone System

Here is a diagram of the Hormone system. (Graphic here of hormone system with empty name lines.)

Activity: (*Determining*) Type in the *names* of the glands in the appropriate places, and their *functions* beside each one.

Activity: (*Deciding, judging, recommending*) Type in your suggestion of a **strategy** that you could use to teach children about their glands and hormone system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type in how you could get children to *understand* the importance of hormones for their body and their lives.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the Hormone system with. Design a mini web. (A graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What two research questions could you pose for your class to undertake to ensure a greater understanding of their hormone system? Specify the Grade it would be appropriate to. (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 6-7, 'What are hormones?', 'How do hormones work in the human body?'

Activity: (*Deciding*) Type in a list of 5 correct *hormone vocabulary* words useful for students to understand, learn and know their meanings. (After the student has typed 5 words/Returned, the computer presents 5 vocabulary words.)

3.11 Your Circulatory System

Here is a diagram of the Circulatory system. (Graphic here of circulatory system with empty name lines.)

- **Assessable Activity #3i** (*Determining*) Type in the *name* of the very important organ and two others parts in the appropriate places, and their *functions* beside each one (quarter of a mark each).

Activity: (*Deciding, judging, recommending*) Type your suggestion of a *strategy* that you could use to teach children about their circulatory system? Specify the Grade it would be appropriate to.

Activity: (*Determining, concluding*) Type how you could get children to *understand* the importance of healthy blood for their circulatory system, their body and their lives.

Activity: (*Determining, concluding*) What other areas of the curriculum could you *integrate* the circulatory systems with. Design a mini web. (hint; animals, birds etc) (Graphic of a simplified web here with spaces for students to complete.)

Activity: (*Deciding, choosing*) What *Environmental Education* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 6-7, compare the role of rivers in a land to that of the human circulation system. What are the similarities, and the differences?

Activity: (*Deciding, choosing*) What *Physical Education* activity could students integrate here? (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 3-7, show children how to measure their heart beat as their pulse rate. Measure prior to exercise, then measure after exercise. Graph the two figures. Repeat the exercise over a week to see if any changes have occurred.

Activity: (*Deciding, choosing*) What *Art* activity could students integrate here. (After the student has typed 10 words/Returned, the computer presents the following suggestion.) Grades 3-7 draw a life-size human body, and its circulation system. Hang it on the classroom wall.

Activity: (*Deciding, choosing*) What *research* could you get your class to undertake to ensure greater understanding of their circulatory system? Specify the Grade it would be appropriate to. (After the student has typed 10 words, the computer presents the following suggestion.) Using the library and/or Web, research the answer to the following question, 'Why is the heart so important for humans, animals, birds and insects?'

Activity: (*Deciding*) Type a list of 5 correct *circulation vocabulary* words useful for students to understand, learn and know their meanings.(After the student has typed 5 words/Returned, the computer presents 5 vocabulary words.)

Congratulations you have now completed Module 3 of the CD-Rom on Human Relationships Education. It is a good time to stop and have a break and appreciate just how important all the systems in your body are. Why don't you go and drink two glasses of clean, pure water to help your kidneys, have a brisk walk, and decide to eat healthy food to help your body work well.

Discussion

The design of each of these interactivities were based on two pedagogies; higher level thinking skills (Bloom in Frangenheim, 1998) predominantly Evaluation and Synthesis where students are encouraged to undertake Deep Learning (See Biggs, 1999), and Constructivist theory where the learner is provided with a variety of learning aimed at engendering a greater understanding based on students' prior knowledge. Table 1 shows the application of Constructivist principles to these Human Body sub-modules.

In Table 1, each of the eight Constructivist principles applicable to each of the 11 sub-modules is addressed. For example, in the first principle to anchor all learning activities to a larger task or problem, all sub-modules are anchored in the larger problem of the understanding and caring for our bodies. Applying Constructivist principles of facilitating links to prior knowledge, interactions were structured to encourage student-teachers to examine preconceptions about their body. Feedback containing further educational suggestions was pro-

vided as students undertook or completed interactions. This feedback was framed in such a way as to encourage student-teachers to compare their preconceptions with the appropriate information provided. Student-teachers were thus encouraged to test their ideas against these. This further exemplifies constructivist notions of interaction design. Thus, student-teachers are provided with an authentic environment (their classroom), in which concepts are applied to situations they are likely to experience (teaching their class).

Of the eight Constructivist principles, the one that was not specifically addressed in Module 3 was 'Provide opportunity for, and support reflection on, both the content earned and the learning process itself'. These 11 sub-modules were embedded within the broader ten modules, and in the design, reflection was included at varying appropriate stages within the modules, frequently following the completion of a coherent conceptualisation, pedagogical task or problem-solving activity. In each of the examples above, this Constructivist principle may not appear evident, however, it was present later in the final modules where students were asked to write their reflections on their learning process and their learning progress. Because of the difficulty in computer-marked assessment for Social Science subjects such as this one, of essay-type responses, many reflections were included to assist learners' micro-, macro- and meta-cognitive processes, rather than for assessment.

Conclusion

Multimedia has enormous potential for enhancing the learning of adults and children, particularly when dealing with the human body. The confidential non-threatening environment offered by multimedia is a great advantage especially in terms of encouraging active participation and reflection. Here, a module designed as one part of the Human Relationships Education subject in a CD-ROM for Bachelor of Education students at an Australian university, was examined in terms of both higher level thinking skills and the principles of a Constructivist approach. Enhanced interactivity of the learner, on an individual basis, with the knowledge and/or the experiential, means that what is being learned is aimed to be more relevant to the learner, and therefore more likely to be authentic and of greater importance for the learner. That is, the learner will be changed in some way/s for having had the experience of learning (Biggs, 1999). Grant and Vansledright (2001: 75-76) note that the promise of constructivist views includes shifting control for learning to the learner, enhancing motivation, increasing expectations of what students can learn, and building interdisciplinary connections.

Thus, it seems that the application of the eight constructivist principles has wide scope for its application of enhancing learning and providing pedagogical variety. This approach, to address such characteristics, encompasses the underlying principles used by the educational scriptwriter and the educational designer here. No doubt, there are other pedagogies that could be employed in teaching about the human body. However, the variety chosen here has a three-fold aim: to enhance student-teachers' learning about it, to demystify any misconceptions they have, and to enhance their understanding of a variety of appropriate strategies including curriculum integration, for use in the Primary School classroom. Biggs (1999: 2) says 'there is no single all-purpose best method of teaching. Teaching is individual'. This characteristic may be said to apply also to this module on the CD-ROM where pedagogical variety and integration are common, addressing students-teachers' variety of learning styles. The Constructivist theoretical approach, when used in conjunction with multimedia, may be summed up, as Grant and Vansledright (2001: 158) note, to '... open up wonderful worlds to learners'. Such worlds are increasingly being experienced by all university students, and any other learners, to make learning more enjoyable and relevant.

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Appendix

Table 1: Application of the 8 constructivist principles to interactivities on the human body on CD-Rom.

Constructivist principles and their applications
1. Anchor all learning activities to a larger task or problem. <ul style="list-style-type: none"> • Anchored in the problem of understanding the human body generally. • Purpose clear to learner by being anchored in research findings on the human body. • Anchored to metacognitive understanding • Relevant to the larger task of learning about Human Relationships curriculum and its application • Anchored in concept of teachers as professionals; helping to address misconceptions. • Anchored in values, particularly respect, care and empathy for all children and their bodies. • Anchored in scientifically proven research. • Anchored in understanding concepts and their importance in identifying and understanding the human body. • Relevant to informing understanding of students' metacognitive processes. • Learner to make conceptual links. • Learner to experience making links. • Learner progresses easier if s/he is fully committed to the task. • Gain appropriate understandings of ignorance about the human body in the classroom/school.
2. Support the learner in developing ownership for the overall problem or task <ul style="list-style-type: none"> • Active participative skills in the learning to encourage ownership of learning. • Learner develops enhanced professional understanding. • Learner gains marks for enhanced participation. • Interact with new knowledge for student-teachers to understand and teach. • Instructional goals relate to knowledge of the human body as essential for teachers to understand. • Learner progresses more easily if s/he is fully committed to the task. • Developing ownership of multimedia learning. • Develop professionally through the opportunity to encourage individual multimedia learning. • Experiencing an awareness of goals of respect, care and empathy for the needs of children. • Learner to make conceptual links between societal health problems and those in the classroom. • Learner as an active participant in addressing health problems.
3. Design an authentic task. <ul style="list-style-type: none"> • Conceptually addressed in 'bite-sized pieces'. • Relevant to the lives of the student-teachers' future experiences in Primary schools. • Professionally relevant for users. • Health is significant in the lives of all Primary School children. • Teachers becoming more professionally aware and active in protecting children, and helping to prevent body abuse. • A meaningful problem is addressed • Tasks relevant to conceptual understanding and development. • Tasks relevant for student-teachers' portfolio of teaching strategies. • Tasks relevant to Human Relationships Curriculum.

- Tasks relevant to children's lives, thus influencing their ability to learn, and teachers' achievements in teaching them.
- Tasks relevant to today's and tomorrow's authentic personal and social problems.
- Learner uses higher order Thinking Skills

4. Design the task and learning environment to reflect the complexity of the environment that students should be able to function in at the end of learning

- Importance of positive human relationships for everyone on the globe
- Complexity of human interactions.
- Support the learner (student-teacher) working in a complex environment of the modern Primary school.
- Importance of context and complexity of the role of the school teachers and curriculum design.
- Complexity of classroom structures and processes for schools.
- Complexity of curriculum pedagogical tasks for school teachers
- Relevant to the day-to-day lives of the learners.
- Inter-relationship of all educational environments on the globe.
- Simplifies the complexity of the human body and looking after it, into manageable cognitive 'portions'.

5. Give the learner ownership of the process used to develop a solution.

- Student-teacher progresses at own rate.
- Student-teacher uses own bookmarks according to their own 'stop-start' learning pattern.
- Learner suggests solutions to problems.
- Learner tries examples and tests own understanding prior to doing assessable questions.
- Learner makes judgements about the problem-solving process.

6. Design the learning environment to support and challenge the learner's thinking

- Problem-based learning
- Zone of proximal development; students write their answer even if unsure of answer.
- Support the learner in becoming an effective thinker using higher order Thinking Skills, eg justifying, verifying, arguing.
- Learner undertakes task, then compares it with the given answer.
- Learner is immersed in thinking about concepts, conceptualisations, and knowledge of the human body, its health and wider implications.

7. Encourage testing ideas against alternative views and alternative contexts

- Ideas are discussed and understandings enhanced.
- Student compares own responses to the suggested answer.

8. Provide opportunity for and support reflection on both the content learned and the learning process itself.

- In a later sub-module, students were asked to reflect on their learning progress.
- Students discover the advantages and disadvantages of this pedagogy, for themselves as learners and for their future students. Source: (Savery & Duffy 1996: 3)