Science Team Term Project

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Lamothe, Shannon N

Takamura, Nicole A

What is Science?

Our Opinions

We feel Science is an approach to studying various functions and phenomena in the world. We normally associate the word "Science" with things like research, the Scientific Method, chemicals, formulas, deductive reasoning, experimentation, etc. The *Merriam-Webster Dictionary* defines science as, "knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method," (2004).

Within the discipline of Science, there are many sub-disciplines, which emphasize a particular focus in Science. These sub-disciplines include, Astronomy, Chemistry, Health, Geology, Physical Science, Physics, Biology, and so on. These sub-disciplines can be broken up even further. For example, according to the Division of Biological Sciences at the University of Georgia, Biochemistry, Molecular Biology, Plant Biology, Cellular Biology, Entomology, Genetics, Marine Biology, Microbiology, and Ecology, are sub divisions of Biology (2004).

Science also includes discoveries and inventions and is always evolving and changing with new discoveries and inventions. This is a unique characteristic to the discipline of Science. There are always reports of new discoveries that happen on the brink of scientific research which have the potential of changing the lives of people. Take medical research in Genetics and the strides that we have made towards curing diseases because of it. Contrast these dynamic changes to a discipline like Language Arts for example; basic components of the study of language normally include things like reading, writing and speaking (oral language). There have been no major discoveries in the field of Language Arts, which have added to or changed the nature of the discipline.

Another thing, that distinguishes Science from other disciplines, is its deductive nature. Deductive reasoning plays a significant role in Science because it is the process by which many problems are found, experiments created and carried out, and evaluations for the next steps are made. We associate this type of reasoning with being able to justify conclusions because it gives a clear and definable path to how the problem was solved.

Science also lends itself to discovery learning more than other disciplines. Through experimentation a student can come up with a solution to a problem or question without needing to look it up in a book or other resource. Compare this to a discipline like History

where all the knowledge base in the field relies on things that have already happened and therefore are not open to being discovered.

Gaining Expertise

What is Expertise?

When considering a person's expertise, one must realize that there is a difference between being an expert and having expertise (Moursund, 2004). Expertise works on a continuum which goes from "a very low level to a very high level" (Moursund, 2004, p.27) and a person can be at any level within this continuum. In a classroom the teacher would likely be considered the expert and the students would be at varying levels of expertise, but not at the expert level. A high level of expertise can be described as, "high knowledge and skill that is efficiently applied to solving the problems and accomplishing the tasks of domain," (Moursund, 2004, pp. 27– 28). In our case we would be looking at the discipline of Science at the Elementary (K- five) level.

Gaining in Expertise

Each child will come to the classroom with varying levels of expertise in the discipline of Science. Our goal is to increase their level of expertise as much as possible and in concurrence with the state and national standards for Science Education (see the "What are the Standards" section for more specific information).

At first, students will be working on developing or expanding on a working knowledge base in Science. For example, children in Kindergarten will most likely be working on developing an initial knowledge base, while older grades will expand on the knowledge collected from previous years. This knowledge base may include such things as, vocabulary used in Science, general terminology, facts that one may acquire through experimentation or research, etc. Expertise is also gained through the student's ability to work through and execute scientific investigation using the scientific method. Being able to problem solve is also an important aspect of gaining expertise. When one is able to increase the rate and accuracy of finding a solution then one increases the ability to solve more difficult problems in Science. Communication of what was learned and how solutions were found is also imperative towards gaining expertise. The more able students are to clearly and effectively communicate their ideas and findings to others, the more expertise they have gained.

Gaining of expertise in Science, like any other area of study, is approachable through practicing and carrying out a number of tasks in that area, which exercise the skills needed within the discipline. The more practice you have, the more expertise you are likely to gain.

Gaining expertise is also about knowing where you stand. Thus, it becomes important to know what you know and do not know. Understanding this about yourself as a teacher as well as about your students will help you to gage the level of expertise at current and give you an idea of how much progress you would like to take place.

What are the Standards?

Oregon State Standards

The following are the general standards and Common Curricular Goals for Oregon in the area of Science. The discipline has been divided up into sub-disciplines, which we have labeled accordingly. All information was taken from the Oregon Department of Education Website at http://www.ode.state.or.us/teachlearn/standards/newspaper/details/pg2A9Ascience.doc.

1. Physical Science: Understand structures and properties of matter and changes that occur in the physical world.
    a. Matter: Understand structure and properties of matter. Understand chemical and physical changes.
    b. Force: Understand fundamental forces, their forms, and their effects on motion.
    c. Energy: Understand energy, its transformations, and interactions with matter.
2. Life Science: Understand structure, functions, and interactions of living organisms and the environment.
    a. Organisms: Understand the characteristics, structure, and functions of organisms.
    b. Heredity: Understand the transmission of traits in living things.
    c. Diversity/Interdependence: Understand the relationships among living things and between living things and their environments.
3. Earth and Space Science: Understand physical properties of the Earth, how those properties change, and the Earth's relationship to other celestial bodies.
    a. The Dynamic Earth: Understand the properties and limited availability of the materials which make up the Earth. Understand changes occurring within the lithosphere, hydrosphere, and atmosphere of the Earth.
    b. The Earth in Space: Understand the Earth's place in the solar system and the universe.
    c. The Universe: Describe natural objects, events, and processes outside the Earth, both past and present.
4. Scientific Inquiry: Use interrelated processes to pose questions and investigate the physical and living world.
    a. Forming the Question/Hypothesis: Formulate and express scientific questions or hypotheses to be investigated.
    b. Designing the Investigation: Design safe and ethical scientific investigations to address questions or hypotheses.
    c. Collecting and Presenting Data: Conduct procedures to collect, organize, and display scientific data.
    d. Analyzing an Interpreting Results: Analyze scientific information to develop and present conclusions.

National Standards

The following are the National Content Standards of Science Education. They are separated by the disciplines within Science as well as by levels (which are separated into to groups: K-4 and 5-8). All of the following information was taken from the National Science Education Standards Website at http://books.nap.edu/html/nses/6a.html.

1. Science as Inquiry
    a. Level K-4: Abilities necessary to do science inquiry. Understanding about scientific inquiry.
    b. Level 5-8: Abilities necessary to do science inquiry. Understanding about scientific inquiry.
2. Physical Science
    a. Level K-4: Properties of objects and material. Position and motion of objects. Light, heat, electricity, and magnetism.
    b. Level 5-8: Properties and changes of properties in matter. Motions and Forces. Transfer of energy.
3. Life Science
    a. Level K-4: Characteristics of organisms. Life cycles of organisms. Organisms and environments.
    b. Level 5-8: Structure and function in living systems. Reproduction and heredity. Regulation and behavior. Population and ecosystems. Diversity and adaptations of organisms.
4. Earth and Space Science
    a. Level K-4: Properties of Erath materials. Objects in the sky. Changes in Earth and sky.
    b. Level 5-8: Structure of the Earth system. Earth history. Earth in the solar system.
5. Science and Technology
    a. Level K-4: Abilities of technological design. Understandings about Science and technology. Abilities to distinguish between natural objects and objects made by humans.
    b. Level 5-8: Abilities of technological design. Understandings about Science and technology.
6. Science in Personal and Social Perspectives
    a. Level K-4: Personal health. Characteristics and changes in populations. Types of resources. Changes in environments. Science and technology in local challenges.
    b. Level 5-8: Personal health. Population, resources, and environments. Natural hazards. Risks and benefits. Science and technology in society.

7. History and Nature of Science
    a. Level K-4: Science as a human endeavor.
    b. Level 5-8: Science as a human endeavor. Nature of Science. History of Science.

ICT and Science

Current Model of Teaching Science

From our experience in being in various classrooms around the Eugene area, as well as our own experience as students, the current model of science instruction seems to incorporate the study of Science much less than other core subjects (such as Language Arts and Mathematics). Schools in the local area include a time for Science for half a year and the other is focused on Social Studies. This tight budgeting of time leads to a lack of Science curriculum instruction throughout the duration of the year. Thus, children have much less experience and exposure towards developing skills in areas like scientific inquiry/investigation, scientific method, problem solving and basic science knowledge.

Many school districts have themed supplies that correspond to a specific unit of study within Science. These "Science kits," as they are called, can be checked out by teachers from the district office and used in their classroom to teach a specific unit in Science. Typically each kits is taught for a period of six weeks then returned for another. For example, a teacher doing an instructional unit on geology, could get a rock kit which may include, various examples of the different types of rocks, and supplies that could help to examine the rocks, such as magnifying glasses, microscopes, etc. This kit may also include written unit instructions and resources for the teacher, such as lesson plans, worksheets, quizzes, etc.

Information and communication technology (ICT) does not play a significant role in Science education. If you look at the above section of standards, there is no clear expectation for the integration of ICT into the discipline of Science. In our personal classroom experience, we have not seen any use or attempts to incorporate ICT with Science education. Teachers simply conduct minimal experiments, which utilize textbooks, science magazines and science kits to teach concepts within Science. They do not use or rely on ICT as a resource for teaching and learning concepts of Science.

Where We Think Science Instruction Should Go

We definitely feel that there needs to be an integration of ICT into Science education. This integration needs to take place throughout the curriculum, instruction given by the teacher and assessment. We also feel that Science needs to be given a more equal level of priority as other core disciplines, such as Language Arts and Mathematics. Within Science, problem solving is a very important component of study. Problem solving itself is a skill that is useful in all disciplines, which is why we think there should be more time dedicated towards its instruction.

There is also information which supports the increase of student attitudes towards using ICT in education. One study we looked at compared the use and non-use of technology in classrooms. The results found that in general student attitudes were more positive when using technology (Shaha, et al., 2002)

Science and technology are inexorably linked. It is because of science that we have technology and it is because of the advancements in technology that we now make these new leaps in science. For example, new technologies have allowed forensic pathologists to conduct DNA testing. Without these advances in technology we would not be where we are today. One can see that science and technology are linked together. Because of these new advancements in science and technology the world we live in is changing dramatically and at a higher rate than ever before. Therefore, it is imperative that students learn about science and technology and how they interact with each other in order to be able to be successful functioning citizens of our society.

More specifically students need to be taught the value of ICT as a learning tool. This can be done through the daily and frequent use of the ICT when teaching Science. For example, instead of just using a textbook as a resource, students should go on to the web to gather information about what they are learning. Teachers should teach short lessons on using the web for research to ensure that students know what to do. Students should learn about appropriate uses of the Web, how to enter search questions (Boolean logic), using various web browsers, as well as how to recognize a reliable source or site. Another great way to integrated ICT in Science education is through the use of instructional software. There are numerous pieces of software available that offer interactive ways for students to engage in learning the concepts of Science. For example, the software "Operation Frog" is a computer simulation of frog dissection. It is a great way for students to learn about the functions of an animal and how their body works without having to actually dissect a real frog. Most software also gives students immediate feedback, which is something that all students can benefit from because they are able to adapt or correct themselves immediately instead of retroactively.

ICT is a great tool for assessment. Computers offer many advantages for testing that are not always available through paper and pencil testing. For example, computers are capable of giving immediate feedback; letting the student know whether the answer is correct and often indicating where the correct information can be found. Computerized assessments can also be more dynamic. For example, a test could include a video clip that the student could watch and answer questions about. Standardized testing is also becoming computerized in Oregon through the use of TESA (Technology Enhanced Student Assessment). This innovative way of state-wide testing offers a faster way of scoring because answers are submitted in electronic form. Computers and other like devices (i.e. Palms) offer text to speech and speech to text capabilities, which are very valuable features when accommodating students who have special needs.

ICT also offers great abilities for authentic assessment. Through the use of simulation software, students have access to real-life situations, settings and contexts, which they may not otherwise be exposed to in school. Simulations give students practice in problem-solving, which is something that they encounter daily. "Simulations provide tools from modeling dynamic data ... They allow students to explore 'what if' questions and to analyze the behavior of simple and complex systems" (Woosley, 1997, p. 386). For example, the software called *Science Seekers: Endangered Species* poses a problem of the decline in otter population. Students are presented with a video scenario of the problem and given five possible reasons for the population decline. They are expected to

work to resolve the problem and are also given various resources, such as multimedia conversation with a professional from the field (Snyder, 2004).

ISTE NETS

According to the National Education Technology Standards (NETS) for students from International Society for Technology in Education (ISTE) there are six basic categories for standards of technology. All the following information was taken from ISTE's Website at http://cnets.iste.org/students/s_stands.html. These six are

1. Basic operations and concepts
2. Social, ethical, and human issues
3. Technology and productivity tools
4. Technology and communication tools
5. Technology research tools
6. Technology problem-solving and decision-making tools

The above standards go in order from a lower order thinking to higher order thinking. Our goal with technology should be working towards the higher numbers on this scale. ISTE also designates specific performance indicators, which address each of these standards. (Each performance indicator corresponds to a NETS standard and is denoted by the numbers in the parenthesis).

Prior to the completion of grade two, students should have met all of the following performance indicators. All the following information was taken from ISTE's Website at http://cnets.iste.org/students/s_profile-k2.html.

1. Use input devices (e.g., mouse, keyboard, remote control) and output devices (e.g., monitor, printer) to successfully operate computers, VCRs, audiotapes, and other technologies. (1)
2. Use a variety of media and technology resources for directed and independent learning activities. (1, 3)
3. Communicate about technology using developmentally appropriate and accurate terminology. (1)
4. Use developmentally appropriate multimedia resources (e.g., interactive books, educational software, elementary multimedia encyclopedias) to support learning. (1)
5. Work cooperatively and collaboratively with peers, family members, and others when using technology in the classroom. (2)
6. Demonstrate positive social and ethical behaviors when using technology. (2)
7. Practice responsible use of technology systems and software. (2)
8. Create developmentally appropriate multimedia products with support from teachers, family members, or student partners. (3)

9. Use technology resources (e.g., puzzles, logical thinking programs, writing tools, digital cameras, drawing tools) for problem solving, communication, and illustration of thoughts, ideas, and stories. (3, 4, 5, 6)
10. Gather information and communicate with others using telecommunications, with support from teachers, family members, or student partners. (4)

Prior to the completion of grade five, students should have met all of the following performance indicators. All the following information was taken from ISTE's Website at http://cnets.iste.org/students/s_profile-35.html.

1. Use keyboards and other common input and output devices (including adaptive devices when necessary) efficiently and effectively. (1)
2. Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide. (1, 2)
3. Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use. (2)
4. Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum. (3)
5. Use technology tools (e.g., multimedia authoring, presentation, Web tools, digital cameras, scanners) for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom. (3, 4)
6. Use telecommunications efficiently to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests. (4)
7. Use telecommunications and online resources (e.g., e-mail, online discussions, Web environments) to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom. (4, 5)
8. Use technology resources (e.g., calculators, data collection probes, videos, educational software) for problem solving, self-directed learning, and extended learning activities. (5, 6)
9. Determine which technology is useful and select the appropriate tool(s) and technology resources to address a variety of tasks and problems. (5, 6)
10. Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources. (6)

Conclusion

The best way we found to incorporate ICT with Science education is by using interactive software programs and using the Internet as a resource to gain new information. We would use these in the classroom for students to do work independently or as a whole class activity.

References

Division of biological sciences. (2004). retrieved Nov. 22, 2004, from http://www.biosci.uga.edu/.

This site is provided by the University of Georgia's Division of Biological Sciences. The page provides a break down of the various sub-discipline within Science.

Merriam-Webster, Incorporated, (2004). retrieved Nov. 22, 2004, from Merriam-Webster Online Dictionary Web site: http://www.m-w.com/cgi-bin/dictionary?book= Dictionary&va=Science.

An online form of the Merriam-Webster Dictionary. The linked provided here displays the results for a search of the term "science".

Moursund, D.G. (2004). *Introduction to information and communication technology in education.* Retrieved Oct. 10, 2004 from http://darkwing.uoregon.edu/~moursund/ Intro %20ICT/index.htm

This book discusses the ideas of and uses for ICT in education. The text is mainly introductory discussing the basics of ICT and making general points towards the integration of ICT in the classroom in such areas as content, teaching, learning, assessment, and students with special needs.

Oregon state standards. (2004). retrieved Nov. 22, 2004, from Oregon Department of Education Web site:http://www.ode.state.or.us/teachlearn/standards/newspaper/ details/ pg2A9Ascience.doc.

This is a Word Document download of the Oregon State Standards in Science.

Performance indicators for technology- literate students. (2004). retrieved Nov. 21, 2004, from National Educational Technology Standards for Students Web site: http://cnets.iste.org/students/s_profile-k2.html.

These are the technology standards for students within the discipline of Science.

Science content standards. (2004). retrieved Nov. 20, 2004, from National Science Education Standards Web site: http://books.nap.edu/html/nses/6a.html.

Site describes the National Science Standards for students.

Shaha, S. H., et al. (2002). Preparing tomorrow's teachers to use technology: learning and. *Journal of Instructional Psychology*, *29*(3), 121-139.

This is a research study that looked at various forms of instruction (multimedia, Internet, and non-technology) to determine the effects upon student attitudes towards technology.

Snyder, T. (2004). Science seekers. retrieved Nov. 23, 2004, from Scholastic Web site: http://www.tomsnyder.com/products/product.asp?SKU=SSKSSK&Subject=Science.

This is a product overview of a piece of interactive software called Science Seekers, which include sample videos from the program.

Woolsey, K., & Bellamy, R. (1997). Science education and technology: opportunities to enhance student learning.. *Elementary School Journal*, *97*(4), 385-400.

This article describes opinions about using technology to enhance Science education.