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AUTHOR	Gilbert, Steven W.
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ABSTRACT

This paper presents three reasons why teachers should understand and actively use models and model building to frame science. First, science model building and testing is the heart of scientific enterprise, and understanding of the process is crucial for developing scientific literacy. Second, models are a familiar framework through which to understand and explain knowledge from the constructivist perspective. Third, the process required for developing models corresponds to the processes of active learning in science. A rationale for models based on science and science education is briefly introduced. The impact of a model building theme in an elementary science methods courses on the knowledge and attitudes of prospective science teachers is also discussed. (Contains 19 references.) (CCM)

The Model as a Vehicle for Understanding the Nature and Processes of Science

by

Steven W. Gilbert

THE MODEL AS A VEHICLE FOR UNDERSTANDING THE NATURE AND PROCESSES OF SCIENCE

Steven W. Gilbert, Indiana University Kokomo

Traditionally, science has been identified with the construction of symbolic models, especially mathematical models, but also theories (Bross, 1953). Analogical and metaphorical models have also historically played a crucial role in scientific work and are responsible for creative efforts, not only in science but in many fields (Black, 1962; Dreistadt, 1968). In fact, one only has to review any scientific journal to realize that models do not just play an important role in science--they are, in fact, at the heart of the scientific enterprise.

Despite their importance, Van Driel (1998), in a study of a limited sample of seven teachers, found few attempts by teachers to address the nature of models and practice of modeling as such in science. This paper presents three reasons why teachers should understand and actively use models and model building to frame science. First, since model building and testing is the heart of the scientific enterprise, an understanding of the process is crucial for developing science literacy. Second, models are a familiar framework through which to understand and explain knowledge from a constructivist perspective. Third, the processes required for developing models corresponds to processes of active learning in science.

This paper will briefly introduce a rationale for models based science and science education. It will then discuss the impact of a model building theme in an elementary science methods course on the knowledge and attitudes of prospective teachers of science.

Models and Science

A model is a representation of selected elements of one system, a target, by corresponding elements in a second system, the model. Usually, the model is more familiar to the learner than the target (Black, 1962). Various authors have categorized models differently, depending upon their purposes, but most include, in one form or another, mathematical models, representations, analogues (and metaphors, in language), simulations, procedures and conceptual/theoretical models (Gilbert, 1991). Some authors do not consider direct records of events, such as photographs, to be models (Van Driel, 1998) while other writers, such as Lunetta and Hofstein (1981) include them. Given that photographs are representations in another medium, and that they do not completely describe their targets but only certain perceptually salient features of them, I do not consider their exclusion to be justified.

By definition, a model can never be a complete representation of a target, or it would in fact be the target. Stevens and Collins (1980) observe that multiple models of varying sophistication may represent a single target, depending upon the builder's purposes. For example, the water cycle may be understood semantically, schematically, by physical models or through mathematics. They propose that learning is largely a process of refining models to make them correspond better with the real world. Models are refined by adding, replacing, deleting, generalizing and differentiating their parts so they correspond better to their targets. The criteria used to accept models varies according to the tenets of the field of study. In science, the test used to accept or reject a model is its perceived predictive validity (Bross, 1953).

While most people, when visualizing models, might think of dolls, toy airplanes or other constructs with perceptual similarities to their targets, models, in fact, do not need to look at all like their targets. Mathematical equations, arithmetic problems, and computer codes representing values and relationships look nothing like their targets, yet are considered to be models because their nodes and relationships correspond to nodes and relationships in their targets.

All of the essential characteristics describing scientific knowledge can also be applied to describe models. Rubba and Andersen (1978) created their six subscales in their Nature of Science Knowledge Scale on the assumptions that scientific knowledge is (1) amoral, neither good nor bad by itself (although its uses could be good or bad); (2) developed creatively; (3) developmental, constantly open to change; (4) parsimonious, in that the simplest of otherwise equal explanations is considered correct; (5) testable, not relying on metaphysical explanations; and (6) unified across traditional disciplines. Scientific models display these characteristics.

For example, the goodness of a scientific model depends upon its "fit" to its target, not on notions of moral goodness or badness (Black, 1962). The development of a speculative (hypothetical) model may be highly creative, combining perceptions (data) and evaluations in new and interesting ways. Some models that are now accepted by scientists, such as theories of global catastrophe, began as highly speculative models on the fringes of science. Of course the ultimate test of the scientific model is our ability to predict from it (Bross, 1953), so the creativity of science ultimately has to withstand tests not required of artistic creativity.

As mentioned earlier, models cannot be completely accurate representations of their targets, thus there are no complete models of any phenomenon (Johnson-Laird, 1983). Scientific models are always tentative, open to change and development. Models are parsimonious by nature, because the utility of a model depends upon our ability to simplify it (Johansen, 1980). Models are testable by nature, since they are human constructs, and tests are required to determine the fit of any model to its target. Finally, and perhaps most important, model building is a process that cuts across fields and the content of the targets. The same basic processes of construction and evaluation of models are used in chemistry, biology, physics and the earth sciences. The grand unifying model of the world ultimately sought by scientists, at least before constructivism cast doubt on our ability ever to find such a model, is not limited by artificial boundaries and must withstand the same evaluative processes regardless of the fields in which its components originate.

The theoretical paradigm of science as model building appears to have potential for conveying the important idea that science is more than the accumulation of facts (more properly the goal of exploration) and, at the same time, that it is not a search for ultimate explanation. Models are recognized as human constructs. They are artificial, like knowledge itself. The game of science, as McCain and Segal (1969) have pointed out, is the production of theories, concepts and other relational structures (all models) that hold up under scrutiny by the rest of the scientific community. Such constructs are discrete and sometimes have little meaning in and of themselves. When linked to other conceptual/ theoretical models, they are the sum of that which is considered scientific knowledge.

Mental Models and Constructivist Teaching

I do not suggest that model building is a useful way to describe science to prospective teachers just because model building is a good definition of scientific work. Certainly science can be described as model building because it explains and unifies the dimensions of science that might otherwise be presented as discrete processes and outcomes. A second and equally important reason for framing science as a process of model building is that this is a parsimonious way to convey to new teachers constructivist ideas about the way people know, think and learn.

Much of our current learning theory centers on the constructivist notion that human perceptions are fragmented and, therefore, reality must be constructed (von Glasersfeld, 1985). According to this argument, observation isolates elements of experience, not elements of an objective world. Since any science is determined by what the scientist sees, the way he observes, and the way he conceptually processes his experiences, science is necessarily subjective in nature.

Constructivism is based on the Darwinian idea that adaptation means only that the organism has found one way to survive and procreate within the limits of its environment (von Glasersfeld, 1985). Organisms do not evolve (or retain) ways of seeing and knowing that do not benefit them or which are beyond their genetic capabilities to evolve. Just as our observations of other animals may lead us to believe them unable to perceive or understand as we do, so our own perceptions and understanding may be very limited, an assumption that is supported by the previously unknown world that has been revealed as we extend our perceptual abilities with machines.

We understand our world only insofar as we perceive events and attribute meaning to them. Our perceptions are communicated to others by various means so that many people may agree on the general meaning of any particular event. Knowledge beyond that possessed by any one individual is a body of relationships and ideas individuals share, although the precise meaning of any one event may vary widely among individuals. Objectivity is achieved when the concepts, relationships, and operations seem viable both in the individual and group model. Individual models are constructed both from the individual's experience and the models of others communicated to the individual.

The question of whether or not objective reality really exists and is knowable has been the subject of debate (Osborne, 1996; Staver, 1998). Staver (1998) is careful to remind us that constructivism is a theory of knowing, not being. For practical purposes, most theorists, including Staver, choose to accept the idea that an external world exists and can be operated upon, even if we can never be sure that we are aware of its true nature. What is important is the understanding that our perceptions of existence are the products of internal representations and mental models (Johnson-Laird, 1983) rather than incoming stimuli alone. All perceptions, whatever their source, are filtered through the brain and given meaning by the generative processes occurring there (Osborne and Wittrock,1983). Learning is not just additive. The quality as well as the quantity of the resulting mental model is changing continually (Osborne and Wittrock, 1983; Shuell, 1990). Creativity results from mental processes that link models in novel ways. Humans, and perhaps some other animals, are able to produce imaginary models (Johnson-Laird, 1983).

Propositions, images, and mental models are three mental representations associated with thinking in humans: (Johnson-Laird, 1983). A *proposition* is a mental representation consisting of a string of symbols. They are most commonly experienced as words in a sentence, spoken or unspoken. For example, the assertion "cats have fur" is a proposition consisting of three symbols (words) corresponding to understood objects or relationships. Mathematic formulae are also considered to be propositions.

Propositions have little meaning by themselves, rather they must be interpreted in a larger framework. That framework is the *mental model*, a complex mental representation with nodes, attributes, and relationships corresponding to received from the perceived world (Johnson-Laird, 1983). When propositions are well integrated into this model, they have or acquire meaning, but propositions may also be stored without being integrated into the individual's mental model and may later be recalled and articulated without evident understanding. New propositions are generated by interactions in the mental model.

The third type of mental representation is the *image*. The image is a perceptual correlate of a mental model from a particular perspective (Johnson-Laird, 1983). Imagine an apple and certain perceptual features come to mind. The image is incomplete: it only represents certain attributes of the complete model. If the model is viewed from a different perspective, the image of the apple changes. Images created from our perceptions may be integrated into one or more appropriate mental models and stored as records of events.

Mental models are numerous and probably hierarchical. They may range in size and generality from your world view, with its many organizing propositions and images, to models as specific as your models of various kinds of apples. Miller (1979) argues that the process of creating an image from written text is both constructive and selective. First, a viewer constructs a general model from a set of attributes he or she perceives, then selects from among existing models that have the selected attributes. The meaning of the image is thus interpreted in relation to existing models.

Recent research demonstrates that the elements of our mental operations are neurons and configurations of synaptic connection strengths (Staver, 1998). In relating new research findings to the proposition that learning is a process of model building, it is important to remember that models need not take the same form as their targets. A complex mathematical model does not materially or spatially resemble its target. Similarly, the word "cat" is a symbolic model of the real thing, but bears no material relationship to the real thing. In fact, it can be argued that the word "cat" is a model of our mental model of the target animal. The encoding of our perceptions, or translations of our perceptions, is thus a model building process.

Model building and the Teacher of Science

Constructivism is identified by Dana, Campbell and Lunetta (1997) as one of the most important theoretical bases for the reform of science teacher education. Even critics of constructivist epistemology such as Osborne (1996) recognize its positive implications for science teaching, for example, its recognition of the influence of prior knowledge, of the need for active exploration, individual and group sense making, and consideration of alternative conceptions.

My goal in representing science and learning as model building, and knowledge as a conceptual model, is to effectively convey the general ideas of constructivism to prospective teachers, many of whom have a realist perspective, without threatening their world view. Because the concept of a model is a familiar construct to most prospective teachers, it should be an efficient theme for bridging the gap between the traditional realist philosophy and the newer, less popularly accepted, constructivist philosophy.

In addition to constructivist thinking, Dana, Campbell & Lunetta (1997) also suggest that reflection is an important theoretical basis for reform. They propose that teachers should be challenged to teach for meaningful understanding and that learners should be constructors of their own learning. However teachers should also challenge learners, even at the earliest grades, to think not only about what they are learning but how they are learning it (Novak and Gowin, 1984). Achieving this goal goes beyond using analogies and models while teaching science concepts. Model building should serve as a filter for teachers to determine both the content and processes of their science curriculum and should be a framework through which their students can understand science as an individual and social process for constructing a consistent, predictive knowledge structure.

Models as a Theme for Preparing Teachers of Science: A Study

The small elementary science program in which this preliminary research was conducted graduates 60–70 new teachers each year. These prospective teachers are generalists, completing only 12 credits of content study in earth, biological, environmental and physical sciences. The program is located on a small branch campus of a large Midwestern university. All students are commuters and the majority of candidates are older, nontraditional students.

The elementary science methods course is a three credit offering. It is organized into three parts: an introduction phase of approximately nine weeks followed by a short, two week, peer teaching phase, which leads to a practicum phase of approximately three weeks, during which students team teach in area classrooms. There is, thus, only a limited time during which students must be introduced to discovery and inquiry learning and related practices. About one-third of the way through the course, students form teams. Practicums are planned, developed and then taught by these small groups. Each group completes a portfolio and oral presentation of their practicum. The science methods practicum is thematically integrated with the social studies practicum.

During the 1997–98 academic year, the fundamental theme of models based science was introduced on the first day of the single fall and spring elementary science courses, and reinforced regularly during the activities of the introductory phase. This was accomplished by (a) an introductory session relating models and construction of knowledge; (b) readings specifically addressing the theme; (c) and regular framing of inquiry learning as a process of model building.

At the end of each course, following the practicum, students were asked to anonymously respond on a written instrument to three items. They were not aware beforehand that they would be given this assessment, so the responses are assumed to represent meaningful propositions rather than propositions memorized for recitation. The items were:

1. Throughout the semester, science (not science teaching) was described as a process of model building. Please explain why science as a process was described this way.
2. Did the concept and theme of models and model building in any way strengthen or change your concept of knowledge and the nature of science? How?
3. In your best assessment, did the concept of science and learning as a process of model

building impact the way you chose to teach science in your practicum, or will teach science in the future? How?

Overall, 58 students responded.

Results of the Study

The results of using the concepts of models and model building to describe science and science teaching has been largely encouraging. It was clear from the diversity of responses that students interpreted the importance of this idea in relation to their own prior understandings and willingness to entertain novel ideas. Almost, all, however, related the concepts in a positive way to the importance of active, hands on learning in childhood science. The idea of building or constructing knowledge was particularly apparent in many of the responses, as shown by the response of one student that "Model building is a way to describe science because we build on each lesson. We begin simple and build up and in the process [construct] more difficult concepts."

This was expected. Questioning early in the course shows that students generally understand that models are constructed entities, but they may not understand that knowledge is constructed as well. In the response just cited, model building is related to teaching rather than to the more general goal of understanding science. From a conceptual development standpoint, the idea expressed also demonstrates awareness of the hierarchical nature of the conceptual models built during science instruction.

The idea of a mental model is expressed by the student who stated "Model building is a thought process that requires the learner to process information and then create understanding by mentally creating a model that consists of facts, terms and concepts surrounding the subject at hand."

This response is interesting in that it is related generally to knowledge rather than science. The response shows awareness of the fundamental concept of individually constructed knowledge and the mental model each student builds. It relates the elements of thought (facts, terms and concepts) to a larger structure. The term "create" relates to active building and also relates to the proposition that science (and learning in general) is a creative activity.

A number of students were able to relate the concept of model building effectively to an understanding of the nature of science, as discussed earlier in this paper. For example, the tentative nature of knowledge is clearly explained in the context of models by the student who wrote: "There are different pieces to the model and we do not have them all yet. Each piece of new evidence in science connects with some other piece of evidence. We will never complete the model."

Several other students address the idea that scientific knowledge is testable and developmental in nature. One wrote, "All theories can be tested. Just because the test seems to prove the hypothesis to be correct does not mean it is scientific truth. Models are ideas we think are true. They are only models, subject to change." Another stated that "the theories of science are building blocks in which more extensive research and experimentation can be done. The theories and laws are represented as models for scientists to go by until another law or theory can better describe it."

One of the potential benefits to be realized from integrating models into our explanation of science is that some prospective teachers, at least, are able to go further and relate the idea to knowledge in general, as shown earlier. The two students following also generalize from model building in science to knowledge in general. One writes, "I feel that it is not just science that is made up of models. Everything that we do we have created some sort of model for. I feel that in science it is more common to think of things in the form of a model." The other student asserts that "people of all ages possess individual models of life and life's events, objects, and students/ people build or change their models throughout life."

In a number of cases, the responses of the students show they did not clearly delineate the concept of science as model building from the idea of using models to teach science. A number of respondents felt they better understood the reason for using hands on, active learning when it was framed in the context of model building. One student felt that "it is important for children to understand *how* things work and this is best done with model building. This way, facts are not just presented, but also displayed in a manner that enables students to actively learn."

Some students appeared to relate the concept of model building primarily to the development of the inquiry activities and the learning cycles they were required to construct and use in their practicums. When asked if the concept and theme of models and model building in any way strengthened or changed her concept of knowledge and the nature of science, a student replied: "*It did*, but it kind of takes the fun out of things. I know there must be a method or rationale behind things -- especially learning cycles -- but sometimes it is nice to do things that are interesting without all the research-based justifications."

In the end, however, she acknowledges that there may be considerations other than fun. Asked if the concept of science and learning as a process of model building impacted the way she chose to teach science in her practicum, or is likely to teach science in the future, she responds: "Yes, because it was required, at first, but then I did see the value of well reasoned and planned science. It allows for more student discovery."

Not all students fully understood or accepted the idea of mental model building, at least overtly. A number accepted the idea that science consists of building and testing models, but did not relate this to the more general idea that knowledge itself is a model. Others focused on the idea of model building as a teaching approach rather than a process of science. Even in these cases, it was clear that the model paradigm provided justification for hands on active learning.

In both semesters, almost all students indicated that the concept had influenced their ideas of what science is about and would probably influence the way they taught science. Some students appeared to grasp the idea that model building applies to the construction of knowledge in general, not just to science. For example, one student wrote that "everyone has different concepts and thoughts. You have to take that into consideration. Using models can help build concepts and understanding." This response was echoed by a second student, who wrote: "The concept of models and model building was confusing at first, but now it makes sense. Life, in general, is about referring to our own notion of models."

The potential impact of this approach on the teaching of science was apparent in a number of responses. One student responded that "my goals of teaching science have been altered by wanting to use many demonstrations, using a hands on approach and using discovery learning in my classroom," while a second said: "I realized that models are a must with science. They strengthen the ideas and concepts and help the ideas stay with a student."

Summary

The result of this work over two semesters has been very satisfying, even as the results are difficult to define precisely. If the responses of prospective teachers on these questionnaires are a valid indication of their beliefs and intentions, then it appears that the models based approach is an effective way to develop their mental models in relation to their (a) knowledge of science as inquiry; (b) understanding of the nature of scientific knowledge, and knowledge across fields; and (c) ability and willingness to apply constructivist approaches to teaching.

Work over the two semesters covered by this assessment appears to support the hypothesis that students can relate the concept of models to a more general concept of knowledge. In addition, model building, used as a framework for describing science, appears to strengthen the resolve of prospective elementary teachers to use active learning with students and provides them with an acceptable rationale, in their minds, for doing so. As might be expected, not all students embraced the more abstract implications of the models based theory of knowledge. However, almost all respondents on the assessments articulated a justification for active learning by referring to models on some level. In addition, the responses of prospective teachers leave little doubt that framing science (and learning in general) as model building promotes acceptance of the idea that knowledge is constructed rather than merely learned or discovered. Finally, this approach promotes the acceptance of certain defining attributes of scientific knowledge: that it is tentative, testable, creative, and so forth.

This project was undertaken to assess a potential remedy for a concern that only presenting the conception of science as a process of active inquiry to prospective teachers does not adequately or efficiently describe the results of these processes, the nature of science or the properties of human knowledge that must be understood to fully understand science. The results reported here indicate that the introduction of science as model building holds promise as a way to relate constructivism, as an epistemology and an approach to science teaching, to the goals, processes and outcomes of science.

References

Black, M. (1962). *Models and metaphors*. Ithaca, NY: Cornell University Press.

Bross, I. D. (1953). *Design for decision*. New York, NY: The Macmillan Company.

Dana, T. M., Campbell, L. M. & Lunetta, V. N. (1997). Theoretical bases for the reform of science teacher education. *The Elementary School Journal*, 97(4), 419–432.

Dreistadt, R. (1968). An analysis of the use of analogies and metaphors in science. The *Journal of Psychology*, 68, 97–116.

Gilbert, S. W. (1991). Model building and a definition of science. *Journal of Research in Science Teaching*, 28(1), 73–79.

Johansen, G. (1980). *Analogue models in the laboratory exercise: One method for teaching to think*. Paper presented at the National Association for Research in Science Teaching 1980 annual meeting.

Johnson-Laird, P. N. (1983). *Mental models*. Cambridge, MA: Harvard University Press.

Lunetta, V. & Hofstein, A. (1981). Simulations in science education. *Science Education*, 65, 243–252.

McCain, G. & Segal, E. M. (1969). *The game of science*. Belmont, CA: Brooks/Cole Publishing Company.

Miller, G. A. (1979). Images and models, similes and metaphors. In Ortony, A. (Ed.), *Metaphor and thought* (pp. 202–250). New York, NY: Cambridge University Press.

Novak, J. D. & Gowin, D. B. (1984). *Learning how to learn*. New York, NY: Cambridge University Press.

Osborne, J. F. (1996). Beyond constructivism. *Science Education*, 80(1), 53–52.

Obsorne, R. J. & Wittrock, M. C. (1983). Learning science: A generative process. *Science Education*, 67(4), 489–508.

Rubba, P. A. & Andersen, H. O. (1978). Development of an instrument to assess secondary school students' understanding of the nature of scientific knowledge. *Science Education*, 62(4), 449–458.

Shuell, T. J. (1990). Phases of meaningful learning. *Review of Educational Research*, 60(4), 531–547.

Staver, J. R. (1998). Constructivism: Sound theory of explicating the practice of science and science teaching. *Journal of Research in Science Teaching*, 35(5), 501–520.

Stevens, A. & Collins, A. (1980). Multiple conceptual models of a complex system. In Snow, N., Federico, P-A., & Montague, W. (Eds.). *Aptitude, learning and instruction* (vol. 2). Hillsdale, NJ: Lawrence Earlbaum Associates, Inc.

Van Driel, J. H. (1998). *Teachers' knowledge about the nature of models and modeling in science*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego CA.

von Glasersfeld, E. (1985). Reconstructing the concept of knowledge. *Archives de Psychologie*, 53, 91–101.

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