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ABSTRACT

The Certification and Accreditation in Science Education (CASE) Network has done a commendable job in their development of Draft Standards for Science Teacher Preparation (CASE and Network 1998). This paper is a response to the repeated requests of the CASE Network for feedback about the Standards. It focuses on the presentation of the standards rather than the standards themselves. The discussion primarily addresses the nature of the structure and presentation of the CASE Standards and suggests that the flexibility of electronic publishing can be exploited to overcome problems associated with the ordered presentation of the standards used in the current draft. (Author/CCM)

Rethinking the Presentation of the Case Standards for Science Teacher Preparation

by

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RETHINKING THE PRESENTATION OF THE CASE STANDARDS FOR SCIENCE TEACHER PREPARATION[1]

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The Certification and Accreditation in Science Education (CASE) Network has done a commendable job in their development of Draft Standards for Science Teacher Preparation (CASE and Network 1998). The information on these pages is a response to the repeated requests of the CASE Network for feedback about those Standards and focuses on the presentation of the standards rather than the standards themselves. This paper primarily addresses the nature of the structure and presentation of the CASE Standards and suggests that the flexibility of electronic publishing be exploited to overcome problems associated with the ordered presentation of the standards used in the current draft.

Rationale for a Non-linear Presentation:

While the Standards are generally well-written, there are concerns about their presentation. In their current form, the Standards are numbered 1 through 10, with Content being

[1] This feedback was written with much input from doctoral students in Jim Gallagher's Special Topics in Science Education: Current Reform in Science Education course at Michigan State University. The original version was written in the Spring of 1998.

Standard #1. While it is not directly stated that the order of the Standards is a rank order, it is problematic that Content is placed well ahead of Pedagogy (Standard #5). We believe that understanding content and understanding pedagogy are roughly equal in importance, and that these two standards are the most important.

These two standards stand above the others -- pedagogy and content. Good pedagogy is impossible in the absence of deep knowledge of the subject to be taught. Similarly, strong content knowledge is of little value to teachers if it exists without understandings of how to help their students come to understand that knowledge. In order to be a good science teacher, it is necessary to have firmly established operational understandings in both pedagogy and science content. It is necessary to have pedagogical content knowledge (Shulman 1987). The other eight standards are included in the tight embrace of pedagogy and content. One cannot be successfully exercised without successful exercise of the other. Indeed, "How you teach is what you teach." (Human Rights 1998?)

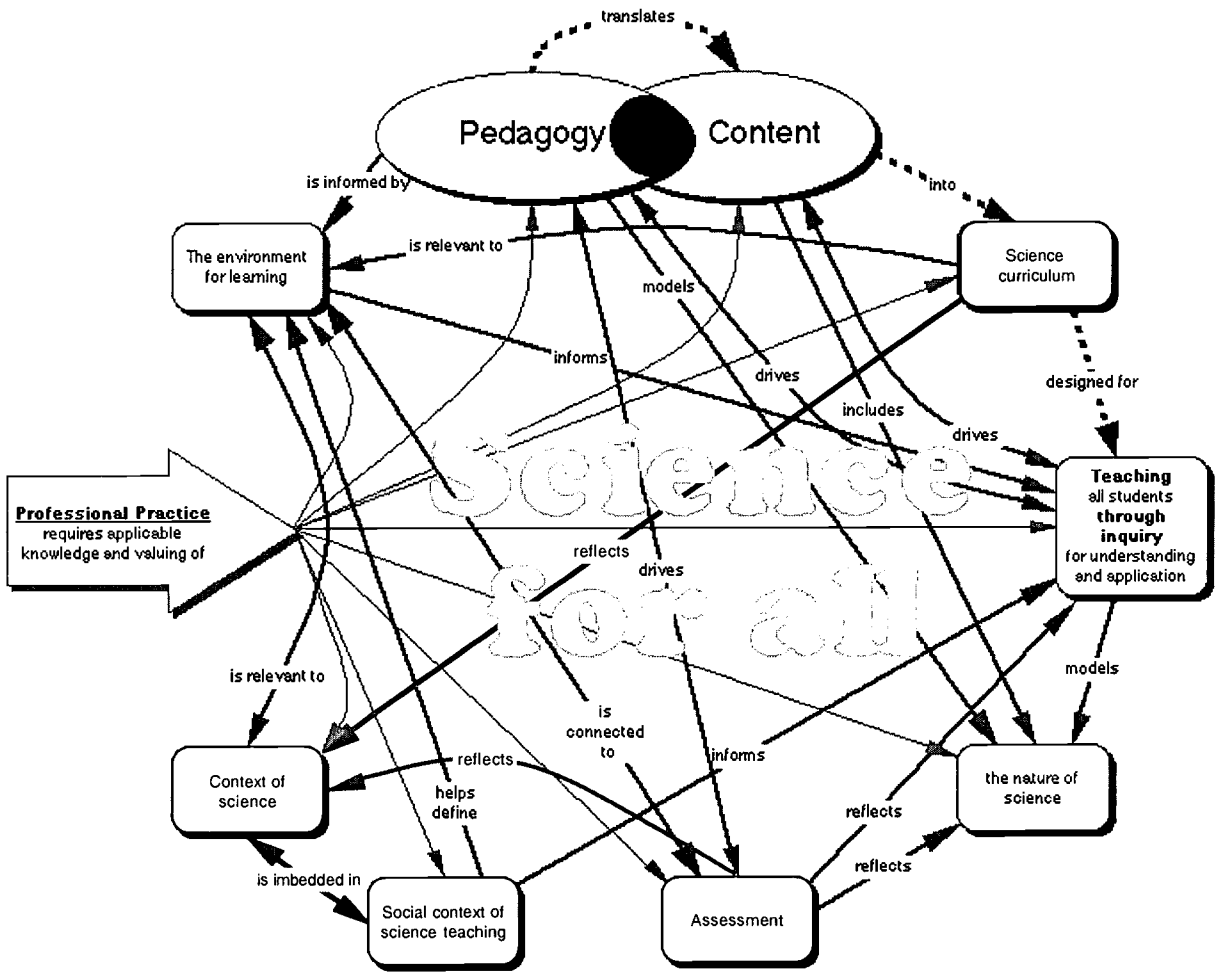
As the Standards cannot be ranked in importance from 1 to 10, the publication of this document is well suited to electronic media - CD ROM and the World Wide Web. The electronic format allows a genuine cross-linking among standards that is lost when text is bound in printed pages. The schematic below shows some, though certainly not all, of the important linkages among the standards. Thus far, the Standards have been disseminated electronically and other

information related to the Standards are available primarily in electronic format. Some electronic sources for information related to the Standards are shown in Table 1.

Table 1: Electronic Sources Related to the NSTA Standards for Science Teacher Preparation

Title & Description	URL
NSTA Draft Standards for Science Teacher Preparation	http://www.iuk.edu/faculty/sgilbert/nstastand.htm
Introduction to the newest version of the Draft Standards and the request for feedback	http://www.iuk.edu/faculty/sgilbert/draftstand.htm
Bill Baird's editorial in Volume 2, Issue #3 of the Electronic Journal of Science Education – A Progress report on the Certification and Accreditation in Science Education (CASE) performance standards for science teachers	http://unr.edu/homepage/jcannon/ejse/baird.html

Figure 1: Map of NSTA Standards for Science Teacher Education



Electronic publication offers a way around the problem of placing one Standard above another. Using hot-linked schematic representations of the relationships among Standards, the rank order implied by page order in a printed and bound document can be eliminated. Figure 1 shows such a representation, although obviously not hot linked from the printed page. In the

electronic version of this diagram[2], each of the ten standards are hyperlinked to their descriptions. In the electronic representation of the diagram, color is used and is another clear advantage of electronic publishing. The following description references colors used in the diagram in this form. The description and diagram would be made far more complex if other methods besides coloring were used to discuss and describe the diagram. It is therefore recommended that the reader access the electronic version of Figure 1 at http://www.msu.edu/~haasdona.

A more conceptual introduction

In addition to reformatting the structure of the CASE Standards presentation, the Standards for Science Teacher Presentation lack significant introductory and connective text to bring the discrete Standards into a coherent vision for science teacher preparation. There is some introductory text included with the November, 1998 draft of the Standards, however, this introduction is largely logistical in nature and the presentation would benefit from text that ties the individual standards together into a single, coherent document. The Introduction and Map of the Standards above are an attempt to tie the Standards together into a more coherent vision.

[2] This can be found online at: <http://www.msu.edu/~haasdona/NSTA_AETS.htm>. Text on this page by Don Duggan-Haas and Jim Gallagher. Graphics and web design for this page by Don Duggan-Haas with helpful feedback from Jim Gallagher and fellow students in TE 991A, Special Topics in Science Education: Current Reform in Science Education, in the Spring of 1998.

Again, the CASE Network is to be commended for their excellent work in development of The Standards for Science Teacher Preparation.

Introduction to the Standards

The NSTA/AETS Standards for Science Teacher Preparation are described by ten broad categories. It is necessary that new science teachers gain applicable knowledge and appreciation of each of the ten aspects of science teaching. Without competency in, and subscription to these NSTA/AETS Standards new teachers will not successfully teach all students for understanding and application utilizing a broad vision of science. These three ideas, teaching all students science; for understanding and application; utilizing a broad vision of science; plus one more key idea; that teaching less content allows for better understanding and more meaningful application are the heart and soul of the current reform efforts in science education reflected in the National Science Education Standards and Project 2061. (AAAS 1989; AAAS 1993; NRC 1996)

Science for All

Again, one of the several premises of the National Science Education Standards and Project 2061 is encapsulated in the phrase Science for All. This is a demanding goal. Many changes are needed in the education of science teachers if this goal is to be achieved, requiring

increased sophistication in attitudes, professional knowledge, and skills in both teaching and interpersonal interactions.

Only a portion of science teachers have developed the knowledge, skills, and attitudes that are compatible with the goal of Science for All. Further, many science educators have little experience in helping prospective and practicing science teachers increase their capability of teaching all students science.

In order for science educators to be able to help science teachers develop the capabilities for teaching science for all, several actions are needed:

- Efforts need to be expanded to foster attitudes among scientists, science educators, and science teachers that scientific literacy is achievable for a broad spectrum of the population.
- Scientists, science educators, and science teachers should work diligently to develop interpersonal skills that will help to engage all students in learning science.
- Science educators and science teachers should work together to develop the professional knowledge and skills needed to foster scientific literacy among all students.
- Where research is needed to fill gaps in our knowledge about teaching science effectively to all students, science educators, psychologists, sociologists, scientists, and science teachers should join forces to design, conduct, and disseminate findings from their research.

- Relevant research should continue to be analyzed and recommendations from it made available to colleagues across the nation.

Science for All must become more than simply a slogan. It is essential that science educators lead others in the science education community in giving substance and positive action to this goal. The development of the NSTA/AETS Standards for Science Teacher Preparation is a step toward meeting these challenging goals.

Connections Among Standards

The diagram maps each of the ten standards, showing important connections among the standards. Each of the ten Standards, the brown text in the blue background, is linked to the appropriate web page (when accessed through the web[3]). The arrows included obviously do not represent every possible connection, but ones that we believe are most important.

The red arrows all flow from the standard for professional practice. Professional practice requires applicable knowledge and valuing of the information conveyed in each of the other nine standards. The purple dashed arrows should be read in sequence beginning with pedagogy: "Pedagogy translates content into science curriculum designed for teaching all students through

[3] Again, a central point of this paper is that electronic publication should be taken advantage of for the publication of the NSTA Standards for Science Teacher Preparation. One of the advantages of publishing electronic is the cost free use of color. This description refers to colors used in the diagram available from the authors website.

inquiry for application and understanding." Thus, there are linear paths through and around this non-linear structure.

The dark gray arrows are important connections between individual standards other than professional practice. The authors make no claims that the links shown here is exhaustive or even necessarily the most important linkages. The point is to foster an understanding that each of the individual standards is dependent upon or influenced by other standards.

The links within the diagram are analogous to supports within a structure. The removal of any one of the standards makes the structure too weak to support science for all. In order for science teacher preparation programs to be effective, they must effectively address and assess each Standard. New science teachers should enter their classrooms with the understandings associated with each of the ten standards and with an understanding of the connections among these standards.

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