

FACT VERSUS FICTION?  
THE SOCIO-ECONOMIC BENEFITS TO BE FOUND IN TEACHING CRITICAL  
THINKING SKILLS ON NUCLEAR WASTE ISSUES IN PUBLIC SCHOOLS

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ABSTRACT

The safe storage of radioactive wastes has been the topic of much heated debate. Many of the concerns raised demonstrate that the public is poorly informed about nuclear matters, bewildered by conflicting testimony and lacking the intellectual skills required to discriminate between statements of fact versus opinion or motive. Recently, the National Council for the Social Studies (NCSS) adopted a set of guidelines intended to encourage a stronger emphasis on urgent science-related social issues in the classroom and to provide for social studies teachers, rational and structure for the presentation of these issues. In this way, the NCSS is moving to meet the needs of the community for greater technological awareness. NCSS believes students need instruction and strategies for evaluating science-related material intelligently. As a case study in point, the topic "Nuclear Waste: A Science Related Social Issue of Urgent Concern" was brought before a recent NCSS national meeting. This paper discusses strategies for dealing with nuclear waste issues in the classroom and the potential socio-economic benefits to be found in dispelling myths surrounding nuclear issues.

BACKGROUND

It is inescapable to even the most casual observer that the nuclear industry in this country has suffered a series of alarming setbacks. Headlines, such as those in the January 22nd, New York Times, tell of a "a week-long train of disasters putting the nuclear power industry through its darkest days since the accident at Three Mile Island." Editorialists write that the events at the Rockford Illinois Byron plant, Marble Hill plant in Indiana and the Zimmer plant in Ohio stem from deep seated, generic problems ranging from overregulation and high inflation to poor management and shortsighted enthusiasm (1).

Not the least of these deep seated problems is a general public distrust of the nuclear technology. High on the list of public concerns are questions relating to the safety of nuclear waste. Nealey and Rankin (2) note that far and away, the public wishes to learn more and receive more information about nuclear waste management. Without an answer to these concerns and a rebuilding of public confidence in nuclear technology, it is highly likely that the nuclear industry will continue to travel that very rocky road typified by the events of recent months.

TOWARDS BUILDING PUBLIC UNDERSTANDING  
AND TRUST OF NUCLEAR TECHNOLOGY

Two pervasive attitudes seem to exist within the nuclear community with regard to the problem of public mistrust of technology. These points of view can be described, for better or worse, as:

- A. Ignorance is bliss! The public is unqualified or unable to grasp the complexity of the technological issues. Therefore, treat the problem by "selling an image" through a media campaign of radio, TV and newspaper ads.
- B. Public service information programs designed to educate and inform the public. Starting at a grass roots level, attempt to build a constituency with greater awareness.

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Advocates of either approach have a logic to back up their position. Those taking the "ignorance is bliss" attitude might cite numerous studies on the relationship of nuclear knowledge to nuclear attitudes and conclude that differences in knowledge about the issues have little bearing on nuclear attitudes. Studies by Bultena, et al (3) tend to support this view, whereas those by Rankin and Nealey (2,4) call this into question. Congress has recently found political merit in supporting efforts to increase science literacy through public schools. Legislation such as H.R.1310, the Emergency Mathematics and Science Education Act (5) or S.1285, Education for Economic Security Act (6) generally are intended to promote a higher standard of public scientific and technology literacy. A few organizations in support of the effort to educate and inform have created classroom materials such as "Nuclear Power, An Energy Unit" (7) for "students with scientific background" or "Understanding Radioactive Waste" (8) for high school science classes.

Danfelter (9), although a proponent of public service information programs, has pointed out that flaws exist in the present educational strategies aimed largely at increasing scientific literacy. The approach is unlikely to have any immediate, substantial impact on the problem of public perception of nuclear technology since the efforts are almost exclusively directed at science teachers and those few students with the ability to join the technological elite. Furthermore, neither science nor math teachers are equipped to deal with the controversies surrounding nuclear technology. Their teaching role involves the technology itself. Public attitude changes are unlikely to occur rapidly if we are to rely on a policy which educates only the few capable of mastering the scientific literacy needed simply to ask the right questions.

However, it is also important to note that in considering the subject of nuclear knowledge and how the general public obtains this information, serious oversights have occurred. For example, in measuring the subject of nuclear knowledge and attitudes in a survey of Washington state residents, Nealey and Rankin (4) consider four sources of information about nuclear technology:

1. news media
2. government agencies
3. utility companies
4. environmental groups

Conspicuously lacking from this list are "public schools, colleges and universities." Has the "teacher" been replaced as a source of knowledge in our society by the "news media"?

The National Council for the Social Studies (NCSS) acting on the recommendations of its Science and Society Committee has recently adopted guidelines intended to encourage a stronger emphasis on urgent controversial science-related social issues. As an outgrowth of this policy, the teacher has the potential, if put to practice, to gain recognition as an authority and source of information on controversies arising from science-related issues such as nuclear technology. NCSS believes students need instruction and strategies for evaluating science-related material intelligently for the express purpose of providing:

"A starting point for a wider dialogue on the nature, scope, goals and methods of teaching about science-related social issues within the social education of children and youth" and

"A starting point for an ever wider dialogue throughout the community on these science-related issues, with the eventual goal of reaching some consensus about basic human needs and values which form the foundation for decision-making about such issues" (10).

However, the question remains how can these goals be realized for the betterment of the community?

#### TEACHING CRITICAL THINKING SKILLS ON NUCLEAR TECHNOLOGY AS A CONTROVERSIAL SCIENCE-RELATED SOCIAL ISSUE

Although the NCSS guidelines go a long way toward providing a format within which a social studies teacher could address nuclear technology as a science-related social issue, the document does little to prepare a public school teacher for that day in the classroom. Danfelter (9) has pointed out the critical lack of educational material suitable for a social studies teacher with little or no technical training. It is no wonder social studies teachers have had little inclination to write lesson plans dealing with the controversy surrounding nuclear issues.

In an attempt to address this deficiency, Anderson (11) and Anderson, Brookins and Danfelter (12) conducted two experiments in teaching strategies for nuclear issues. Two workshops for teachers were held based on using "primary source documentary material" to discuss, "Nuclear Waste, A Controversial Science-Related Social Issue of Urgent Concern."

A critical assumption made in preparing for the workshop was that the objective of the session would be the broader civic goal of teaching how to "discriminate between statements of fact and statements of opinion or motive." Controversial claims made by anti-nuclear activists (13) about the safety of nuclear waste disposal were examined in the light of scientific findings reported by Trabalka, et al (14). With these controversial claims in mind, a simple model for classroom instruction of any science-related social issue was developed. The

model consisted of the four following tasks:

1. Construct the issues surrounding the controversy.
2. Develop a knowledge base for problem solving and decision making.
3. Form generalizations.
4. Verification and hypothesis testing.

In this context, the primary question posed was not "is radioactive waste storage safe?" Rather, the question became "is there the possibility for distortion of nuclear waste safety related issues and what critical thinking skills are needed to discern fact from fiction in this matter?" Put forth in this light, it was felt that teachers at the public school level would feel much more at ease with the subject matter and less likely to inject any of their own preconceived bias.

The development of a knowledge base for problem solving and decision making regarding nuclear waste issues was essential to the workshop. The material has to be simple enough for teachers and students with little or no scientific training to understand, yet broad enough to provide the basics for a technical understanding of the issues involved. The concept of primary source documentation was adopted because it is commonly used in social studies curriculum and it is well suited to rapidly getting salient points across. Using a "you are there" approach Anderson, et al (11,12) took the audience via a slide presentation for a first hand look at the Waste Isolation Pilot Plant (WIPP) of southeastern New Mexico.

The slides used in the presentation came about from first hand observations made by Anderson in conjunction with sponsored research from Sandia National Laboratories (15) and personal trips to the site during construction. Supplemental background information on radioactive waste was provided by Westinghouse WIPP Operations. In a straightforward, unbiased manner, the material provided answers to the following questions.

1. What are the types of nuclear waste?
2. How are nuclear wastes presently stored?
3. How are nuclear wastes transported?
4. Where are the suitable areas in the United States for nuclear waste disposal?
5. Why is the bedded salt of southeast New Mexico such a good medium for disposal?
6. What does the WIPP underground site look like?
7. How long will radioactive waste exist and how long has the salt formation existed.
8. What safety features will exist at the WIPP on its completion?

#### PRIMARY SOURCE MATERIAL AND MINICASE STUDIES CONCERNING NUCLEAR TECHNOLOGY

The notion of incorporating primary source materials in these presentations also came about as an outgrowth of the highly successful Procter and Gamble "Perspectives Workshop" (16), a program of P&G's educational Services Department. The aim of the Perspectives Workshop is to provide educators with

material that could be useful in helping students and teachers relate to a technology which otherwise would be removed from their range of experience. Controversy surrounding the WIPP operation and nuclear waste management is simply one of a number of minicase studies which could be addressed through primary source documentation.

#### RESULTS AND DISCUSSION

A detailed discussion of the success and implications of these workshops has been published previously in ANS news (17). However, the results of surveys taken of teacher participants before and after the workshops have yet to be discussed.

Although our sample is admittedly small (of the approximately 55 participants in the two workshops, we complete the survey) and could not be considered scientific, it nevertheless represents a cross-section of views held by public school teachers from across the state of New Mexico as well as a number of teachers from other states. Those surveyed indicated they were predominately neutral to hostile toward nuclear waste disposal plans prior to the workshop. Furthermore, the most common source of information about nuclear waste issues has been either newspapers or television. Only a few indicated they had received information from other sources such as government agencies or environmental groups.

The results of the post workshop survey were most encouraging. Of those responding, 79% responded with a more positive view of nuclear waste management and the safety of nuclear waste disposal technology, at least in as much as it related to the WIPP site. Even more significant, 91% indicated that the material presented and the subject matter discussed could and should be used in their classrooms. The obvious conclusion most of the teachers apparently gathered from the workshop was that indeed, there is an enormous potential for distortion of nuclear waste issues and that this could be brought out in the classroom. Direct questions regarding other attitudes they might have regarding nuclear technology were avoided so as not to introduce bias of the workshop leaders into the controversy being examined. Nonetheless, the results appear to stand in sharp contrast to those of Bultena et al (3) in that an increased knowledge of the WIPP project did foster a decidedly more positive project attitude.

#### CONCLUSIONS

The extent to which benefits can be derived from bringing nuclear technology into the public school classroom have yet to be demonstrated on any kind of national scale. Hence, it is impossible to fully determine the impact of this approach. However, there is a clear indication on the part of NCSS and public school teachers of a willingness to address these controversial science-related issues in the classroom as well as a strong desire to have suitable educational material which would help them to discern fact from fiction. The primary source document approach appears to be one promising method of fulfilling this goal.

Although it is far from clear whether this thrust to educate and inform would have significant impact on the broader public in a short time frame, it is interesting to speculate on the potential impact of a well informed student bringing facts and not fiction into a family conversation. And judging from recent events, it's an avenue the nuclear community cannot afford to ignore.

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