Ethical Issues in Technology Education in Taiwan

Kuen-Yi Lin

Introduction

A significant trend in technology education has shown internationally widespread acceptance with the increasing needs of developing students' technological literacy on both the elementary and secondary level from manual training to basic competency. Therefore, more and more countries have developed their national technology standards in order to enhance students' technological literacy.

Standards of Technology Education in Taiwan

As standards have developed in technology education around the world, including countries such as the United States, the United Kingdom, Australia, New Zealand, and others, Taiwan is no exception. The standards of technology education in Taiwan can be divided into two different areas: (1) basic competency in developing standards of technology education for elementary and junior high schools (like Australia), and (2) developing standards of technology education in senior high schools (like the United States). No matter which area of standards is adopted, the major purpose of standards in technology education is to develop students' basic technological literacy on different educational levels. Therefore, the standards of technology education in Taiwan can be described as follows:

1. The elementary and junior high level

With the trends of educational reform, Taiwan has made many changes at the elementary and junior high levels. For the purpose of coherence and integration, a so-called "nine-year joint curriculum" was created. There are two major categories of competency indicators in technology education in the nine-year joint curriculum, which includes both "Technological Development" and "Design and Making of Products."

(1) Technological Development

The three levels of competency indicators in the nine-year joint curriculum are shown in Table 1.

(2) Design and Making of Products

There are two different levels of competency indicators in the nine-year joint curriculum as shown in Table 2.

2. The senior high school level

The recent reform in technology education at the senior high school level does not follow the trend of developing competency indicators in the nine-year joint curriculum. The reforms follow the form of content standards like that of the United States. The new temporary standards in technology education can be divided into two parts:

(1) Standards of the core course in technology education

In order to make sure that senior high students can possess the same basic competency, the Department of Education decided to formulate the common core curricula for senior high schools, including high schools and vocational-technical schools. Technology education was, therefore, also an important subject in the formulation of the common core curricula, and its standards are listed in Table 3.

(2) Standards of advanced and optional courses in technology education

In addition to the standards of core courses in technology education as mentioned previously, there are six additional standards of advanced and optional courses in technology education:

• Communication Technology,
• Construction Technology,
• Manufacturing Technology,
• Transportation Technology,
• Energy and Power Technology,
• Technology and Engineering.

Level	Grades	Category	Competency Indicators
1	3 & 4	The Nature of Technology	1. To understand the importance of technology in daily life. 2. To know the characteristics of technology.
		Technology	1. To feel the mutual relationships between personal life and Society and technology. 2. To know the products in common use in our daily life.
2	5 & 6	The Nature of Technology	1. To know the classification of technology. 2. To understand machines and tools, materials, and energy.
		The Evolution of Technology	1. To know the technology in the era of agriculture. 2. To know the technology in the era of industry. 3. To know the technology in the era of information. 4. To know the internal and overseas invention and innovation in technology.
		Technology and Society	To understand the traffic and leisure facilities in common use in the community.
3	7-9	The Nature of Technology	1. To understand the relationship of science, technology, and society. 2. To understand the relationship of science and technology. 3. To understand the relationship of science, technology, and engineering.
		The Evolution of Technology	1. To understand the development of technology in Taiwan through the technological products in daily life. 2. To understand the trends of technological development. 3. To have their own viewpoints about the development of technology.
		Technology and Society	1. To understand different kinds of technological industry. 2. To know the mutual relationship between the development of industry and technology. 3. To know related occupations in technology. 4. To know educational and training approaches in technology. 5. To realize the relationship between personal development in life and technology.

Source: Department of Elementary Education, (n. d.).

Table 1. Competency Indicators in Technological Development

Ethical Issues in Technology Education

Over the past several years there has been a considerable amount of professional pressure, and numerous position papers expressing a need for technological ethics in technology education. As a society experiences the trends of globalization and advanced technology, there is an increasing need to discover what people in the technological society should understand regarding new issues of technological ethics. For example, ethics and ethical decision making have become increasingly important as technology has permeated the workplace (Hill & Womble, 1997). In other words, to keep pace with change in society, new ethics have been suggested to help advance technological literacy by highlighting the relationships among humans, the environment, and technology (DeVore, 1980, 1991).

Reed, Hughes, Presley and Stephens (2004) mentioned that "a great deal of the technology education literature regarding ethics stress the need for teachers to include the social context inherent in science and technology studies (STS)" (p.171). In addition to the topic of STS, environment pollution, labor issues, nonrenewable energy sources, medical care for the aged population, and technological control of the

Level	Grades	Competency Indicators
1	5 & 6	1. To utilize thinking, brainstorming, and concept mapping in developing creativity and expressing a person's ideas in changing products. 2. To use many different ways of thinking, especially about function and shape in changing things. 3. To know and design the basic shape. 4. To understand the process of making prototypes.
2	7-9	1. To read both illustrations and manuals of technological products. 2. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas. 3. To understand usable resources and analytic jobs in designing. 4. To design the procedure of solving problems. 5. To simulate the process of mass production. 6. To execute, test, and adjust a product during the process of making it or at the end of making it.

Source: Department of Elementary Education, (n. d.).

Table 2. Competency Indicators in Design and Making of Products

environment have been mentioned as content foci for ethics in technology education (Hill & Dewey, 2001; Hendricks, 1996). Reed and colleagues (2004) were curious about how many ethical topics were addressed in technology education textbooks. They used the 20 areas in the ITEA Standards for Technological Literacy for textbook vendors to identify in which of the categories their curriculum materials teach about ethics. Seventeen of the 20 areas mentioned some ethical issues.

This study focused on the junior high level, and for it a questionnaire was developed employing the same 17 competency indicators in Technology Education that were used in the Reed, Hughes, Presley, and Stephens (2004) study. In order to understand the technology teachers' viewpoints about ethical issues, technology teachers were selected as the participants instead of textbook vendors. In sum, this study attempted to clarify some of the issues facing technology education in Taiwan and then to compare the results of this research with findings in the United States.

Purposes of the study

Specifically the study sought the following:

1. To explore the ethical issues in technology education in Taiwan through a survey of technology teachers in junior high schools.

2. To distinguish the differences regarding ethical issues in technology education between Taiwan and the United States.

3. To generalize the major ethical issues in technology education and offer some suggestions to Taiwanese technology teachers and others teaching ethics in technology education.

Methodology

In order to achieve the purposes of this study, a questionnaire survey was employed. The participants, instruments and procedure are explained next.

Participants

Since the junior high technology teachers understand their students better than others, the major participants of this study were junior high technology teachers. However, the time for the "Living Technology" curriculum in junior high schools in Taiwan was sometimes utilized in teaching Natural Science curriculum. For that reason, the researcher selected junior high technology teachers according to their actual teaching situations. The participants were not randomly selected from a population. A total of 50 junior high technology teachers were invited to participate in this study in order to analyze ethical issues in technology education in Taiwan.

Category	Sub/category	Content Standards
The Nature of Technology	The Meaning of Technology	1. To explore the nature and meaning of technology, and its relationships with life, society, and culture. 2. To discuss the problems of ethics, morals, and laws in technology.
	The Evolution of Technology	To explore the evolution and development of technology.
	The System of Technology	To explore the system, method, management, evaluation, and impact of technology.
Technology, Science, Environment	The Utilization of Resources	To discuss the situation of utilizing resources in the and development of technology.
	Technology and Science	1. To explore the relationship and differences between science and technology. 2. To solve technological problems by using scientific principles, technological knowledge, and engineering concepts.
	The Impact of Technology in the Environment	To discuss the problems of environmental change and pollution through technology, and to build the conception of environmental protection.
Technological World	The Scope of Technology	To understand the scope and classification of technology.
	The Outline of Technology	1. To understand the mass media, applications, services and their relationships with life in communication technology. 2. To understand the materials, methods, process, and their relationships with life and environment in construction technology. 3. To understand the materials, methods, products, and their relationships with life in manufacturing technology. 4. To understand carrying machines, logistics, systematic planning, and their relationships with life in transportation technology. 5. To understand the categories, development, application, the setting of power supply, and their relationships with life in energy. 6. To understand the situation, trends, influences of bio-related technology (such as medical treatment and agriculture) and other emerging technologies.
Creative Design and Making of Products	The Meaning, Method, and Procedure of Technology	To become aware of problems and think about the methods and steps in the daily life; furthermore, to generate many solutions and choose the best solution in order to achieve the purpose of innovation.
Creative Design and Making of Products	The Planning and Making of the Design of Products	1. To utilize written words, diagrams, engineering drawings, computer drawings, or other methods to express creativity and ideas clearly, and to arrange the process of complete production. 2. To display creativity, ideas, and design in making real objects.

Source: Department of Secondary Education, (n. d.).

Table 3. Standards in Technology Education in the Formulation of the Common Core Curricula

Instrument

The major instrument used in this study was called "The Importance of Ethical Issues in Technology Education Questionnaire." It contained two main parts: "Personal Data" and "Ethical Issues in Technology Education." The personal data included gender of teacher, school name, and major teaching grade. The ethical issues in technology education component included the 17 competency indicators in the nine-year joint curriculum. Participating technology teachers were asked to rate the importance of competency indicators in combination with ethical concerns by using the same 5-point scale ranging from "very important" to "very unimportant."

The creation of the questionnaire emphasized reliability and validity. The reliability of the questionnaire is demonstrated in Table 4. It indicates that each part and the whole of questionnaire was greater than .80. The content validity of the questionnaire was determined by one professor and two technology teachers who specialize in technology education. The instrument was designed particularly for this study.

Table 4. The reliability of the questionnaire

Questionnaire	Cronbach
Part 1: Technological Development	.8449
Part 2: Design and Making	.8370
Whole	.9101

Procedure

The researcher reached every participant through e-mail with a cover letter and an electronic questionnaire. Follow-up e-mail was sent to non respondents at 7- to 10- day intervals. These approaches were used to acquire the highest possible participation in the study. Forty of the 50 junior high technology teachers returned their surveys, resulting in an 80 percent return rate. Because the participants were invited by the researcher, any generalization beyond the persons who participated in the study should be made with caution. Information collected from the respondents' completed questionnaires were coded and analyzed using SPSS.

Results and Discussion

The Analysis of Participants' Data

There were 40 junior high technology teachers involved in this study. Among them, 25 are male teachers, and 15 are female (see Table 5). Twenty-four technology teachers lived in the north of Taiwan, 7 lived in the middle of Taiwan, and 9 lived in the south of Taiwan (Table 5). Furthermore, 14 technology teachers taught the seventh grade, 14 technology teachers taught eighth grade, and 12 technology teachers taught the ninth grade. There is no doubt that the selection of technology teachers contains different characteristics for the purpose of avoiding possible error.

Ethical Issues in Technology Education in Taiwan

The first research question focused on how junior high technology teachers view the importance of various competency indicators of ethics. The results of this analysis are shown in Table 6.

1. *Nine important ethical issues are generated in technological development*

According to the results of analysis, nine important ethical issues ($M >$ or $= 4.0$) in technological development are "to realize the trend of technological development ($M = 4.39$, $SD = .82$)," "to understand the development of technology in Taiwan through the technological products in daily life ($M = 4.38$, $SD = .68$)," "to understand the relationship of science and technology ($M = 4.34$, $SD = .75$)," "to realize the relationship between personal development in life with technology ($M = 4.21$, $SD = .74$)," "to realize the related occupation in technology ($M = 4.18$, $SD = .73$)," "to understand the relationship of science, technology and engineering ($M = 4.11$, $SD = .73$)," "to show their own viewpoints about the development of technology ($M = 4.11$, $SD = .99$)," "to understand the relationship of science, technology and society

Table 5. Participants' data

	Gender		Location			Teaching Grade		
	Male	Female	North	Middle	South	7	8	9
N	25	15	24	7	9	14	14	12

Items	M	SD	Rank
Part 1: Technological Development			
1. To understand the relationship of science, technology, and society.	4.05	.80	8
2. To understand the relationship of science and technology.	4.34	.75	3
3. To understand the relationship of science, technology, and engineering.	4.11	.73	6
4. To understand the development of technology in Taiwan through the technological products in daily life.	4.38	.68	2
5. To know about trends in technological development.	4.39	.82	1
6. To share their own viewpoints about the development of technology.	4.11	.99	6
7. To know about different kinds of technological industries.	3.89	.80	10
8. To understand the mutual relationship between the development of industry and technology.	4.00	.70	9
9. To know about related occupations in technology.	4.18	.73	5
10. To understand educational and training approaches in technology.	3.87	.99	11
11. To realize the relationship between personal development in life and technology.	4.21	.74	4
Part 2: Design and Making			
1. To read both illustrations and manuals of technological products.	4.21	.96	3
2. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas.	4.45	.76	1
3. To understand usable resources and analytic jobs in designing products.	4.21	.78	3
4. To design the procedure of solving problems.	4.45	.76	1
5. To simulate the process of mass production.	3.45	.95	6
6. To execute, test, and adjust a product during the process of making it or at the end of making it.	4.05	.98	5

Table 6. The Analysis of Ethical Issues in Technology Education

(M = 4.05, SD = .80)," and "to realize the mutual relationship between the development of industry and technology (M = 4.00, SD = .70)." Therefore, there are nine important ethical issues in technological development according to technology teachers' opinions in Taiwan. In other words, if technology teachers want to teach ethical issues in technology education, they can plan either learning content or activities when they are teaching about technological development in a course on technology education.

2. Five important ethical issues are generated in design and making of products

In contrast, according to the results of analysis, the most important ethical issues (M > or = 4.0) in design and making are "to use the language, images, written words, pictures, drawings, and real items to express creativities and ideas (M = 4.45, SD = .76)," "to design the procedure of solving problems (M = 4.45, SD = .76)," "to understand usable resources and analytic jobs in designing products (M = 4.21, SD = .78)," "to read the

illustration of combination and manual of technological products (M = 4.21, SD = .96)," and "to execute, test, and adjust a product during the process of making it or at the end of making it (M = 4.05, SD = .98)."

In light of that, there are five important ethical issues in the design and making of a product, according to technology teachers in Taiwan. Therefore, if technology teachers want to teach ethical issues in technology education, they can also incorporate such content or activities when they are teaching about product design and the making of products within technology education.

3. The most important issue suggested in this study corresponds with the literature

According to the results shown in Table 6, one of the most important issues was "to design the procedure of solving problems (M = 4.45, SD = .76)" in the standards of technology education in the nine-year joint curriculum in Taiwan. However, Hill and Womble (1997) mentioned that ethics and

Content Standards in United States	Competency Indicators in Taiwan													
	1. To understand the relationship of science, technology, and society	2. To understand the relationship between science and technology	3. To understand the relationship of science, technology, and engineering	4. To understand the development of technology in Taiwan through the technological products in daily life	5. To know about trends in technological development	6. To share their own viewpoints about the development of technology	7. To understand the mutual relationships between the development of industry and technology	8. To realize the related occupation in technology	9. To understand the relationship between personal development in life and technology	10. To read both illustrations and manuals of technological products	11. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas	12. To understand usable resources and analytic jobs in designing products	13. To design the procedure of solving problems	14. To execute the test and adjust of product during the process of making it or at the end of making it
1. Characteristic and scope of technology														
2. Core concepts of technology										+	+	+	+	+
3. Relationships among technologies and connections between technology and other fields	+	+	+				+							
4. Cultural, social, economic, and political effects of technology									+					
5. The effects of technology on the environment														
6. The role of society in the development and use of technology				o	o	o								
7. The influence of technology on history														
8. Design											+	+	+	
9. Problem Solving										+	+	+	+	
10. The impacts of products and systems						o					+			
11. Medical							+							
12. Agricultural and biotechnology							+							
13. Energy and transportation							+							
14. Information and communication							+							
15. Transportation							+							
16. Manufacturing							+							
17. Construction							+							

NOTE: + high relationship, o low relationship.

Table 7. The Comparison of Ethical Issues in Technology Education

ethical decision making have become increasingly important as technology has permeated the workplace. Junior high technology teachers in Taiwan had the same viewpoints, and how to teach ethical decision making in the procedure of problem solving should be emphasized.

4. The most insignificant issues might be hard to incorporate with ethics

According to the results shown in Table 6, the most unimportant issue was "to simulate the process of mass production ($M = 3.45$, $SD = .95$)" in the standards of technology education in the nine-year joint curriculum in Taiwan. The main reason for this result might be that it is difficult to incorporate ethical considerations into the process of mass production.

5. There were no significant differences in the views of technology teachers with different backgrounds

Beyond the descriptive analysis of the questionnaire, a t-test and ANOVA also were used in comparing the differences in the

views of technology teachers with different backgrounds. The factors of gender, teaching grade, and teaching area were insignificant in terms of technology teachers' views about the importance of incorporating competency indicators for ethics in technology education in Taiwan.

6. Similarities and Differences between Taiwan and the United States

The results in Taiwan (Table 6) can be compared to those seen in the United States (Reed et al., 2004). As the matrix results in Table 7 show, the lack of inclusion of ethical issues related to the "Characteristic and scope of technology," "The effects of technology on the environment," and "The influence of technology on history" should be addressed in the future.

Conclusions

According to the previous analysis and discussion, the following conclusions can be stated:

1. *Nine ethical issues in technological development and five ethical issues in design and making of products can be the focal point for ethics in technology education in Taiwan.*

2. *There are no significant differences concerning the inclusion of ethical issues in technology education between Taiwan and the United States.*

According to the results of this study, technology teachers do recognize that ethical issues are important in technological development and the design and making of products. The result of this study can be a beginning point for developing effective approaches for the teaching and learning of ethical issues in technology education. Success in this venture will result in students being much more savvy about the ethical dimensions of modern technology; they will also be able to operate more effectively as both workers and citizens in the future.

Dr. Kuen-Yi Lin is a researcher in the Center for Teaching Development at the National United University in Taiwan. He has been working as a research scholar in the Department of Design and Industry at San Francisco State University.

References

Department of Elementary Education (n. d.). *Nine-year joint curriculum*. Retrieved on December 1, 2004, from http://www.edu.tw/EDU_WEB/Web/EJE/index.htm/

Department of Secondary Education (n. d.). *The formulation of the common core curricula of senior high schools, comprehensive high schools and vocational-technical schools*. Retrieved on December 1, 2004, from http://www.edu.tw/EDU_WEB/Web/HIGH-SCHOOL/index.htm/

DeVore, P. W. (1980). *Technology: An introduction*. Worcester, MA: Davis Publications, Inc.

DeVore, P. W. (1991). Technological literacy: The evolving paradigm. In M. J. Dyrenfurth & M. R. Kozak (Eds.), *Technological literacy* (pp. 251-279). Peoria, IL: Glencoe/McGraw-Hill.

Hendricks, J. L. (1996). Technology-social and interpersonal interaction. In R. L. Custer & A. E. Wiens (Eds.), *Technology and the quality of life* (pp. 321-344). Peoria, IL: Glencoe/McGraw-Hill.

Hill, R. B., & Dewey, G. (2001). Moral and ethical issues related to appropriate technology. In R. C. Wicklein (Ed.), *Appropriate technology for sustainable living* (pp. 78-91). Peoria, IL: Glencoe/McGraw-Hill.

Hill, R. B., & Womble, M. N. (1997). Teaching work ethic: Evaluation of a 10-day unit of instruction on work ethic, work attitudes, and employability skills. *The Journal of Education Opportunity, 16*(1), 57-79.

Reed, P. A., Hughes, A., Susan, P., & Stephens, D. I. (2004). The status of ethics in technology education. In R. B. Hill (Eds.), *Ethics for citizenship in a technological world* (pp. 163-186). Peoria, IL: Glencoe/McGraw-Hill.