LINKAGE BETWEEN SCIENCE, TECHNOLOGY AND CREATIVITY IN NEW TAIWAN'S NATIONAL CURRICULUM

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At present, the people in Taiwan are again paying attention to the curriculum reform for grades 1-9. The newly revised national curriculum, were put into effect in 2001, emphasizes curricular coherence and integration as well as more school-based development and management. The idea regarding the study of technology education should focus on the nurture of the basic competencies for a positive life for primary students in Taiwan. There are seven learning areas in the new national curriculum. Technology education is expected to unify with science, and is also renamed as " science and living technology " at the primary and junior high school levels. This study is to articulate the species of 2001 national curriculum of technology education regarding creativity at Taiwan's primary and junior high school levels.

SIGNIFICANCE OF THE STUDY

In 1993, the Ministry of Education proposed a new curriculum standard for primary schools to prepare students to be futuristic, internationalized, integrated, life-oriented, humanized and flexible citizens in the 21st century (Ministry of Education, 1993). In 2001, the people in Taiwan again paid attention to the curriculum reform for grades 1-9. The newly revised national curriculum emphasized curricular coherence and integration as well as more school-based development and management (Ministry of Education, 2001). All this indicates that Taiwan has been and continues to be involved in fundamental and significant educational reform.

Creativity is a gift exclusive to human beings, by which progress in society, politics, economics, culture, education and technology can prevail. In a time of fluctuation and uncertainty, success made in the past is not a guarantee to the future, only the "innovators" will triumph (Ray & Myers, 1986). Facing the global change of economy and the knowledge-based economy era to come, in search of excellence, innovation, and elevation of quality is the direction for all walks of life. Education is, as a matter of fact, the supreme form of art. Students would be more motivated provided with creative teaching, consequently, the results of teaching would be more satisfying and would therefore increase more interested students. The crux of successful teachings lies in the performance of creativity (Chen, 2002).

PURPOSE OF THE STUDY

In order to conduct this study, the following purposes were analysed:

(1) To explore technology education development in Taiwan primary and junior high school levels.
(2) To explore technology education curriculum in Taiwan primary and junior high school levels.
(3) To explore the rationale and implementation of the cultivation of creativity in Taiwan.
(4) To offer a creativity lesson plan of technology education in Taiwan.
(5) To propose some suggestions for the concerned and involved administrators in Taiwan.

TECHNOLOGY EDUCATION DEVELOPMENT IN TAIWAN

In Taiwan, before 2001 all curriculum standards were regulated by the central government. All levels of instruction followed these curriculum standards. Teachers can only make choices on instructional methods and supplementary materials. Primary schools in Taiwan are divided into three levels: low (1st and 2nd grades), middle (3rd and 4th grades), and high (5th and 6th grades). Students' age is between six and twelve years old. At present, the new 2002 national curriculum syllabi were established. There are seven learning areas in the national curriculum: languages, mathematics, science and living technology, arts and the humanities, social studies, health and physical education, and comprehensive activities. Also there are six learning topics which are suggested to integrate and connect the above seven learning areas: gender, environmental protection, computer science, home economics, human rights, and career development. The learning sessions are divided into area learning sessions and flexible learning sessions. The flexible learning sessions can be arranged according to the school-based development. Technology education in Taiwan is a new area that is called "Living Technology". Before the new 2002 national curriculum, technology education was usually integrated with fine arts and no technology was taught. Now technology education in Taiwan is expected to unify with science at the primary and secondary school levels. Also technology education of low level at primary schools in Taiwan is called "Life" that is integrated with social studies, science and arts and the humanities. Taiwan's teachers also can make choices on instructional methods and supplementary materials. By the way, the teachers need to match and design the courses according to both school-based development and students' interest for their teaching.

TECHNOLOGY EDUCATION CURRICULUM IN TAIWAN

Technology Education Objectives

The new 2002 national curriculum syllabi set up five main goals as follows: the humanism, the integrated abilities, the democratic education, the lifelong learning, and international and local perspectives of culture. In response to the curriculum reform, the present primary curriculum syllabi emphasized curricular coherence and integration as well as more school-based development and more student-experienced. Therefore the Ministry of Education described ten basic learning abilities as follows: the individual potential, the creation and appreciation, the communication, the career planning, the concerning society, the international perspective, the organization, the technology, the exploration and research, and the problem-solving. Under the new 2002 curriculum syllabi, the goals of science and living technology (SLT) learning area is to assist students: (1) to cultivate the enthusiasm and the interest of exploring science and to have a habit of active learning, (2) to learn the basic knowledge and the exploring ways of science and technology, and to be able to apply them to the daily lives, (3) to cultivate the attitudes of protecting environment, treasuring resources, and respecting life, (4) to cultivate the abilities of communicating, cooperating, and treating people harmoniously, (5) to cultivate the potentials of independent thinking, problem-solving, and the creativity, and (6) to explore and observe the relationship between human beings and technology (Ministry of Education, 2001).

Technology Education Content

Science and living technology (SLT) course in Taiwan include eight indicators of learning abilities and the total of 233 statements of attainment. Primary and junior high living technology course includes four indicators of learning abilities and the 45 statements of attainment as follows:

(1) indicator of the skills of process-- includes 5 sub-indicators such as observation, comparison and classification, organization and connection, induction and inference, and communication that has the total of 24 statements of attainment.

(2) indicator of the knowledge of technology-- includes 3 sub-indicators such as knowledge level, know the technological products to be used frequently, and know the technology to be seen frequently that has the total of 6 statements of attainment.

(3) indicator of the development of technology-- includes 2 sub-indicators such as essence of technology, and technology and society that has the total of 5 statements of attainment.

(4) indicator of the knowledge and skills of thinking-- includes 3 sub-indicators such as creative thinking, problem-solving, and critical thinking that has the total of 10 statements of attainment.

The Rationale and Implementation of the Cultivation of Creativity

To adapt to the globalize knowledge-based economy with innovation as its core value, the government has been promoting creativity as the main national development strategy. The Report of Education Reform of the R.O.C announced by the Education Reform Councils in 1996 proposed "innovation with versatility and energy" as the direction for modern education. Creativity and innovation have been the main issues in programs such as the National Promotion Project of Technology, The Developmental Program of Knowledge-based Economy, The Program of Manpower Development of the New Era, and the 6th National Technology Conference. In addition, strategies and plans for creative education were also revealed in the Grade 1-9 Curriculum Guidelines. In 2002, the White Paper on Creative Education was promulgated by the Ministry of Education in the hope to integrate related strategies and to promote the overall creative education. The White Paper on Creative Education of the Ministry of Education (2002) has defined 10 basic principles in promoting creative teachings:

(1) The principle of omnipresence: the essence of creative teaching should be taking balance in the skills of perception, knowledge, and skill; in the creativity between science and social studies; in giving equal emphasis to results and process under the assessing standards of creativity.

(2) The principle of construction: establish an environment and ecology that would enjoy the culture of creativity.

(3) The principle of ecology: building a culture and society that is friendly to the development of creativity.

(4) The principle of incorporation: in order to exert the best use of pedagogic resources, strategies regarding to creativity should be incorporated with related policies.

(5) The principle of connection: creative teaching policies and measures of each phase should be inter-connected.

(6) The principle of authorization: giving authorization to the grass roots, respecting and encouraging initiative from the basic units.

(7) The principle of motivation: motivating creative leanings in students, creative teachings in teachers, and creative management in schools.

(8) The principle of affinity: constructing a cultural mechanism through which creative knowledge can be converged, transmitted, and shared.

(9) The principle of experience: creative teaching should provide the learners with enjoyment of creating personal experience.

(10) The principle of integration: the creative programs and materials should be integrated with teachings of every subject and with life.

Creativity Example of Technology Education in Taiwan (Wei, 2002)

Theme: transportation technology—The Car da bomb

Level: 3rd to 6th grades at primary school and adult

Introduction of challenge. Group reports (the security installation of car): 30 minutes

Demonstration: 10 minutes

Testing and discussion: 30 minutes

Design and create: 70 minutes

Evaluation and feedback: 30 minutes

Activity introduction: Utilizing materials such as wheels, axes, and straws to design a mobile car combined with the safety concept of smash-proof transportation.

Main concepts:
(1) The utilization of transportation technology.
(2) Knowing the constitution of car and create a mobile one.
(3) Naming the security installations of car and body protection.
(4) Designing a car with security installation (e.g. a bumper or air bag) to protect the lime-preserved duck egg (as human body).
Materials: plastic lids, a pair of disposable chopsticks, 8 straws (bendable), 50 cm of electrical tape, a lime-preserved duck egg.
Tools: 1 scissors, 1 knife.
Main teaching process:
(1) Create a mobile car using plastic lids (as wheels), a pair of disposable chopsticks, straws, electrical tape.
(2) Make a security installation to protect the lime-preserved duck egg with the remaining straws and electrical tape.
(3) Test the car with a sloped wood board and see if it moves smoothly.
(4) Place the car and the protected lime-preserved duck egg on a 30-degree board. Slide them down together and hit the wall to test the security of car and egg.
(5) Conduct a further test placing the car and the protected lime-preserved duck egg on a 45-degree board. Slide them down together and hit the wall to test the security of car and egg.
Procedure of activity:

(1)　The teacher states the challenge.

(2)　Group the students into 5~7 per group. Make sure the group understands the challenge.

(3)　Each group brainstorms creative problem-solving strategies.

(4)　Group members discuss the feasibility of each strategy and decide the best resolution.

(5)　Conduct the testing. Go back to Step 3 if the testing result is disappointing.

(6)　Finish the problem-solving process. Display the production and making evaluation.

Items for evaluation:

(1)　Problem-solving design and process of production:

Discussion—participation. 25%

Creation process—dedication. 20%

Evaluation—the fullness of completion. 40%

The creativity and aesthetics of installation design. 15%

(2)　Questionnaires on paper:

Please state briefly the process of your designing and making The Car da bomb.

What are the data collected that are contributory to your problem-solving process?

What materials, tools have you used during the activity process to create The Car da bomb? What techniques have you learned?

What methods have you applied to strengthen the structure of The Car da bomb?

What are the related structural elements concerning The Car da bomb? What is the major element among them?

What crucial concepts have you acquired through the process of activity?

Science:

Math:

Technology:

Others:

Please present your problem-solving scheme that you have developed regarding The Car da bomb.

Do you enjoy the activity?

SUGGESTIONS FOR THE FUTURE

Some suggestions for Taiwan's educational authorities can be drawn from the above conclusions as follows:

(1) The course content of "Living Technology" in Taiwan can be added the following categories: technology and life, information and communication, construction and manufacturing, and energy and transportation.

(2) Design abilities and problem-solving skills are important elements of those which Taiwan's primary and junior high students desperately need.

(3) Taiwan normal universities should provide a graduate level training course for living technology. Furthermore, it should be a required course for all primary and junior high teachers.

(4) At the primary and junior high level, living technology is only a small part of national curriculum in Taiwan. The best solution is to establish a national examination for Taiwan's administrators and parents to emphasize the instruction of "Living Technology ".

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