

***The Research of Instructional Objectives of Science Education in Taiwan:
An Experience of Biology Teaching in Junior High School***

Chia-Jung Hsu, National Yunlin University of Science and Technology, Taiwan
Wen-Shan Chang, National Yunlin University of Science and Technology, Taiwan

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Abstract

The rapid changes bring with the tide of globalization. To promote national development in upcoming knowledge economy and information technology, cultivation of talent becomes an important issue. School education must also be amended and adjusted. In daily life, the relationship of public and technology products is closer and thus the cultivation of scientific literacy is much more important. Therefore, researcher focus on science education in this study. In the traditional school education, teaching emphasis on knowledge learning. Teachers usually use direct instruction as the main teaching method, and students tend to mastery learning to get high scores in pencil-and-paper test. To adapt modern social life, Grade 1-9 Curriculum Guidelines especially shows that students obtain the knowledge and ability by scientific inquiry and experience of life. However, field instructor didn't own this kind of learning process this day. To help instructors produce more profitable instructional events, researcher investigates instruction design of nature science in this study. First, the study used document analysis to discover acceptable instructional objectives of nature science. Then researcher conducted focus group of a group of field instructors to analysis the instructional objectives. The result is to discover instructional objectives that reach the curriculum goal of Grade 1-9 Curriculum Guidelines and 12-year Basic Education, and meet the instructor's demand. Researcher expect this study could serve as a sample for science education related area.

Keywords: Instructional Objective, Science Education, Biology Teaching.

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Introduction

The rapid changes bring with the tide of globalization. To promote national development in upcoming knowledge economy and information technology, cultivation of talent becomes an important issue. In daily life, the relationship of public and technology products is closer and thus the cultivation of scientific literacy is much more important. The key issue is to enhance the scientific literacy of all people, and that is starting from taking root in scientific development. Elementary and junior high schools play an important role in the promotion of science education (Guo, 2012). In regard to the development of science education on elementary and junior high schools, there is Grade 1-9 Curriculum Guidelines and 12-year Basic Education in Taiwan. According to Grade 1-9 Curriculum Guidelines, the main goal of science education is to enhance the scientific literacy of all people. For adapting to the modern social life, learning of students should be based on scientific inquiry activities combined with experience of life to get related knowledge and ability (Ministry of education, 2003). Chang et al. (2011) indicate that the cultivation of ideal people is indeed of coordination of teacher's instruction, curriculum objectives and educational goals.

Education is effective by teacher's instructions, and there is an excellent instruction only by good instructional design. The purpose of instructional design is to bring up an educational blueprint, to make learner reach expected change of learning performance, and to create the best combination of instructional strategies, instructional method and designing instructional materials. Generally speaking, there are different models in Instructional Design, exist for different instructional purpose; however, the process is summarized in 5 phase, called as ADDIE model.

To detect if the instructional outcome is effective, definition of instructional objectives is an essential factor. Researcher conduct the first stage of instructional design, to find out learner's characteristics and define the instructional objectives clearly. Because the researcher majors in Biology and has been a teacher in junior high school, choosing biology-teaching instruction as research topics.

The teacher faces all kinds of the on-site difficulties; as a curriculum developer, an instructor and the researcher at the same time, it will be helpful to integrate the practice with the theory and to enhance the effect on biology curriculum.

According to the situation above, there is 3 purposes in this research.

- 1.To analyze the competence indicators of Grade 1-9 Curriculum Guidelines and the core competence of 12-year Basic Education in the field of the natural science education in Taiwan.
- 2.To explore the theory of instruction in the field of the natural science education.
- 3.To develop a questionnaire of instructional objectives for biology teaching in the field of the natural science education in Taiwan.

Reviews

According to research framework, there is divided into 3 parts, knowledge of biology, theory of instruction, and educational policy.

The questionnaire of instructional objectives is based on this framework. (Fig 1.)

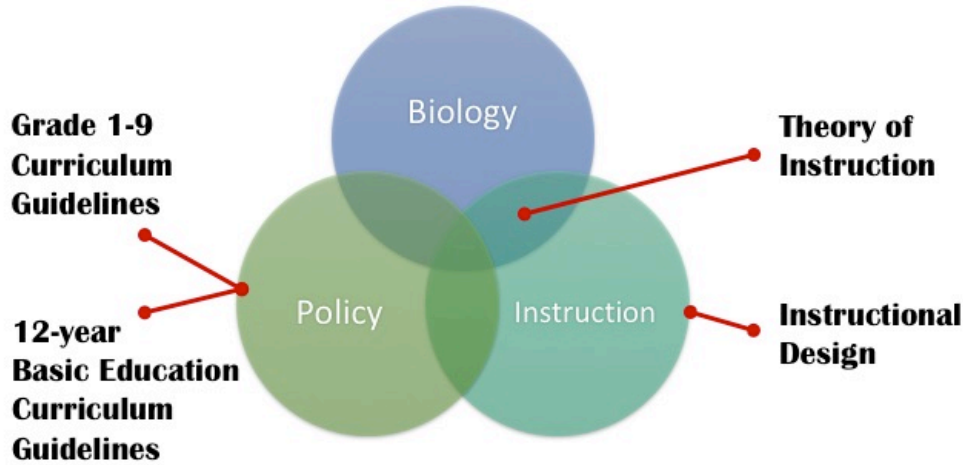


Fig 1. The framework of the questionnaire.

2.1 Instructional Design

Instructional design is based on learning theory, and to bring up an educational blueprint for specific people. The instructors organize learners, teaching content, teaching method, instructional objectives, and evaluation into an instruction. To make learner reach expected change of learning performance, as same as to reach the learning objectives, is the purpose of instructional design (Chang et al., 2011).

There is usually divided into 5 phase in Instructional Design, called as ADDIE model, A represent Analysis, D represent Design, D represent Development, I represent Implementation and E represent Evaluation. At first, to find out the learner's general characteristics and define instructional objectives clearly; on second stage, to learn about the ability that the learners are provided with, and to forecast specific entry competencies; selecting media and materials is next stage, and to design the teaching plan, included with the teaching activities which are appropriate for learners reaching the instructional goals effectively; then, to implement the plan in classroom; at last, we can make sure whether the instruction is successful to reaching the goals by evaluation.

Instructional design is a race that teachers conceive of the teaching plan, and there is systematic and reflective in instructional design (Wang, 2016). Poor design will waste time and resources, and also make instruction ineffective. To detect if the instructional outcome is effective, definition of instructional objectives is an essential factor. Thus, researcher conduct the research of instructional objectives, as same as first stages of instructional design, for biology teaching in the field of the natural science education in Taiwan.

2.2 Knowledge of Biology

“Biology” is the science dealing with living organisms, a term coined by J.B. Lamarck in 1802. From ecology to molecular biology, the science of biology studies them all. Biology is the science of life, including the structure, function, growth, origin, evolution and distribution of living organisms. (<https://www.livescience.com/44549-what-is-biology.html>, Retrieved April 2, 2014)

There are generally considered to be at least nine fields of biology, consisting of Biochemistry, Botany, Cellular biology, Ecology, Evolutionary biology, Genetics, Molecular biology, Physiology and Zoology.

2.3 Curriculum Guidelines in the field of the natural science education in Taiwan

Ministry of education (2003) announces a policy, Grade 1-9 Curriculum Guidelines, which says that the life should be taken as the center of curriculum objectives, also arranged the development of abilities about the learner in groups. To reach the goal, instructional design should take students as the principal thing, and curriculum has to be based on experience of life, for cultivating the basic competence of all people.

As a result of knowledge economy and information technology, there is a shift in the social culture and life recently. Getting information becomes easier, but it makes instructions much more difficult, especially the school education. As an instructor, we have to try an innovative method, accept the changing surroundings, and overcome the challenge these schools must meet at last.

According to the curriculum goals of 12-year Basic Education in Taiwan (Ministry of education, 2016), Grade 1-9 Curriculum Guidelines being assistant to, teaching activities would be based on scientific inquiry mainly in the field of the natural science education. By scientific inquiry activities integrated with experience of life, student would get related knowledge and ability, especially the competence of critical thinking, practice and problem-solving. We esteem it to be vital that students are active, and their motivation should be triggered availably.

About implementation of new curriculum, it takes scientific inquiry and learners as the center. Integrated with scientific knowledge and experience of personal life, we expect that learners feel helpful solving problems in life.

2.4 Theory of instruction in the field of the natural science education

There are 8 theories in science education for elementary and junior high school student (Chen et al., 2011), including constructivist instruction, inquiry-oriented instruction, problem-solving instruction, science-technology-society movement, teaching science as argument, teaching strategy such as Predict-Observe-Explain (POE), Outdoor Teaching Strategies, and Games for the Science Curriculum.

Besides rational and logic thinking personally, it should be paid attention to external factors of social, culture and ecology. It also attaches importance to interactive abilities with people, society and nature.

On aggregate, for students, we believe that the most important thing is to put into practice what has been learned, as same as the cultivation of critical thinking and creativity.

Methodology

During the study of instructional objective on biology teaching, there are research methods of questionnaires design, document analysis, focus group, and questionnaires survey. (Fig 2.)



Fig 2. Research design.

The researcher integrates instructional objectives of science education into a questionnaire, based on Grade 1-9 Curriculum Guidelines, 12-year Basic Education Curriculum Guidelines, and the theory of instruction in the field of the natural science education.

Focus on that students know what to learn, the establishment of curriculum is reality-based. It is significant about the strategy of solving-problem, using knowledge in practice, making good use of evidence, encouraging learners to think and discover, the cultivation of creativity, and interactive abilities with people, society and nature.

The researcher uses the questionnaire combined open-ended and close-ended questions, and applying the Likert scale to measure the importance of instructional objectives. There are 3 parts in the questionnaire, including foreword, information of research participants and main content. In third part of the questionnaire, there is description of instructional objectives. By scale, the research participants can point out the importance of each one.

After developing a questionnaire of instructional objectives for biology teaching, the researcher invites 6 teachers who have taught biology in junior high school being group members. By discussing with each other, the research participants put forward some revise of the questionnaire, on rearranging the sequence of problems and making the description concrete.

Then, the researcher conducting a pre-test, and the most important purpose of the pre-test is statistical analysis, including item analysis and reliability of the questionnaire. If Cronbach α value is more than 0.7, the reliability of the questionnaire is acceptable, showing that there is internal consistency.

The main aim of item analysis is discrimination testing, running descriptive statistics, the independent t test and the correlation. From descriptive statistics, there are averages and the standardized difference. The average which is more than 3.5 shows the fitness to the instructional objectives, and the standardized difference is under 1, which means the consistency of the participants (Tsai, 2006).

If there is a difference in statistical significance, it means that the instructional objective is important in science education for junior high school student. Otherwise, if it is not, the instructional objective should be corrected or deleted, shows that it is not appropriate to the questionnaire. At last, carrying out the questionnaires, it will be the basement of the future research in science education.

Results

About the study, there are 2 results, including a questionnaire of instructional objectives for biology teaching in the field of the natural science education in Taiwan, and the pre-test of the questionnaire.

About implementation of instruction, curriculum guidelines on 12-year Basic Education attaches importance to scientific inquiry, activation of students, and the knowledge combined with daily life experience. In addition to learning of basic knowledge, it is also important to cultivate the competence of thinking, practicing and problem-solving.

In science education, the researcher generalizes 6 parts of instructional objectives for biology teaching from Document Analysis. There is inquiry ability, problem-solving, rational thinking, innovation-creating, caring-attitude, and interpersonal interaction respectively. The result of Document Analysis is the questionnaire, composed with 6 parts and 49 questions. (Fig 3.)

Instructional Objectives	Q	1	2	3	4	5
Inquiry ability	49					
Problem-solving						
Rational thinking						
Innovation-creating						
Caring-attitude						
Interpersonal interaction						

Fig 3. First edition of the questionnaire.

After Focus Group, the questionnaire is revised to 5 parts and 32 questions. (Fig 4.)

Instructional Objectives	Q	1	2	3	4	5
Inquiry ability	32					
Problem-solving						
Rational thinking						
Innovation-creating						
Caring-attitude						

Fig 4. Second edition of the questionnaire.

Then, the researcher conducting a pre-test, getting 31 sheets of the questionnaire. Getting Cronbach α value is 0.808, which is more than 0.7, shows that the reliability of the questionnaire is acceptable. From descriptive statistics, we got averages and the standardized difference. The average of each question is more than 3.5, and the standardized difference is also under 1. (Fig 5.)

Question	N	Average	Standardized Difference
32	31	max 3.74	max 0.37
		min 4.83	min 0.85

Fig 5. The result of pre-test of the questionnaire.

We know that the fitness to the instructional objectives of biology teaching for junior high school student, and the consistency of the participants. In the end, the questionnaire is available, and it will be applied to the research of instructional design for the future.

Conclusion 結論與討論

Cultivation of scientific literacy and attitude is related to superior science education on elementary and junior school closely. In order to that learners get excellent learning experience of science, being interested in science, showing the scientific literacy, the instruction of science education must be revised. Thus, the teaching effect on biology curriculum also be raised.

About biology teaching for junior high school students, we know that the instructional objectives can be divided into 5 parts, and there are 32 questions in the questionnaire. From the results, it says that the questionnaire is acceptable, and will apply to the research of instructional design for the future.

For the future, the researcher will release questionnaires to confirm the reliability, and it will be applied in teaching activities in practice. The questionnaire turns into a tool for the detection of teaching effect, and researcher expects that it is helpful for instructors actually.

Instructional design is professionalism of teachers, assistant to implementation of teaching activities. In the process of design, it can increase the understanding of knowledge of the subject and teaching, concentrating on coherence and logic between activities, to support instructors growing up in many aspects. There is an excellent instruction only by good instructional design. Thus, the teachers should keep growing on instructional design, and it should be taken more seriously about teacher education and development of professionalism.

The researcher studies on instruction of biology for junior high school students in Taiwan. It brings out positive assistance for development of teacher's professionalism to clarify the instructional objectives and contents.

The most important thing is that it is worthy for advance and application of science education.

References

- Chang, Te-jui. Chen, Hsiao-lan. Chen, Li-hua. Hsieh, Pao-mei. Huang, Hsiu-shuang. Li, Chun-fang. Li, Tsung-wei. Tsai, Ke-jung. Wang, Hsiu-ling. (2011). *Principles of Instruction* (7th ed.). Taipei: Shih-tai-shu-yuan.
- Chen, Li-wen. Chin, Chih-chin. Hsu, Liang-jung. Huang, Hong-po. Lin, Su-hua. Wang, Ying-feng. Wu, Ying-tien. Yu, Shu-mei. (2011). *Teaching Methods and Materials in the field of the nature and living technology*. Taipei: Wu-Nan Book Inc.
- Guo, Chorng-Jee. (2012). Advances, difficulties and challenges in science education research. *Chinese Physics Education*, 13(1), 1-10.
- Mary Bagley. (2014). What is Biology, *Live Science*, April 2.
<https://www.livescience.com/44549-what-is-biology.html>
- Ministry of education. (2003). *Grade 1-9 Curriculum Guidelines in the field of the nature and living technology in Taiwan*. Taipei: Ministry of education.
- Ministry of education. (2015). *Draft of 12-year Basic Education Guidelines in the field of the natural science in Taiwan*. Taipei: Ministry of education.
- Tsai, J. T. (2006). The identification of the components for an outdoor education curriculum in Taiwan. *Unpublished Doctoral Dissertation*, Indiana University, USA.
- Wang, Chin-Kuo. (2016). Expectation of attaching importance to instructional design. *Taiwan Educational Review Monthly*, 5(2), 71-75.

Contact email: wbustlf@gmail.com