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Goals of Science Education in the Tertiary Level: Assessment of the College of Science Faculty, University of Eastern Philippines

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Abstract

The study determined the knowledge of the College of Science faculty on the goals of science education, the importance of each goal as perceived by the faculty, how often each goal is used and operationalized for teaching/learning purposes. The results revealed that teachers' level of knowledge on the science goals and objectives was minimal. The faculty perceived scientific knowledge and methods very important and used it frequently in teaching. They used lecture for students to acquire scientific knowledge and laboratory activities to develop scientific methods. They did not know how to operationalize societal issues, personal needs, and career awareness when teaching their subject matter. The problems that prevent them from pursuing the goals were lack of instructional materials, lack of interest and negative attitude of students, lack of facilities, and knowledge in handling laboratory apparatus. Teachers do not utilize strategies that can facilitate the students' construction of meaning and ideas.

Keywords: Goals; science; education; tertiary faculty; constructivism

1.0 INTRODUCTION

Science educators have established consensus on the goals of school science in the Philippines. Using some criteria, the goals have been identified by the Department of Education, Culture and Sports as follows: science education should develop fundamental understandings of natural systems; develop understanding of, and ability to use the methods of scientific investigation; prepare citizens to make responsible decisions concerning science-related issues; contribute to an understanding and fulfillment of personal need, thus contributing to personal development; and inform students about careers in the sciences (Ibe, 1997).

Accordingly, a college faculty particularly in the College of Science must know not only the national goals of science education but the most effective methods and techniques which can best accomplish them. He/she should set the objectives in teaching along with the nation's goals in science education as well as stimulate each student to make the maximum use of his capacities and potentialities. The faculty should use the best methods and techniques that would enable students to achieve maximum growth and development.

As described by Marinas (ibe.unesco.org), a teacher must be multiskilled to teach all science disciplines. But that is not the reality (Mendoza, 1998). Even teachers in science high schools find difficulty in teaching the integrated way (Reyes, 1998). Similarly, based on the results of the students' evaluation of the faculty performance every semester in the University of Eastern Philippines it was found out that majority of the faculty including those from the College of Science used lecture as a method of teaching, that is, teaching in a "teacher-telling" approach to learning rather than a student-centered learning approach.

Along this line, the author conducted a survey to gather information about what the College of Science faculty think are the goals of science education in the tertiary level. This was an assessment of the goals of science education as perceived by the College of Science faculty, University of Eastern Philippines.

The College of Science is one of the degree granting academic units of the University of Eastern Philippines, a state university in the Eastern Visayas region of the country. It was established as an academic unit by the UEP Board of Reagents on June 5, 1996 through Resolution No. 49, series of 1996. It started its operation effective first semester, school year 1996-1997, in recognition of the need to establish a center of excellence in the basic sciences. The college offers six baccalaureate degree programs namely: BS in Biology, BS major in Chemistry, BS Environmental Studies, BS Information Technology, BS Marine Biology and BS Mathematics. It offers general education courses in the sciences and mathematics and is one of the university colleges in the University of Eastern Philippines.

The objectives of this study were as follows: (1) establish profile of the College of Science faculty in terms of department, educational qualification, sex, age, length of teaching experience and subjects taught; (2) determine the level of knowledge of the faculty on the science goals and objectives; (3) find out how often each goal was used by the faculty in teaching; (4) determine the importance of each goal as perceived by the faculty; (5) find out how they operationalize the goals for teaching/learning purposes, and (6) identify the common problems encountered by the faculty that prevents them from pursuing each goal when teaching.

2.0 THEORETICAL FRAMEWORK\

This study was anchored on constructivism. Constructivism is in essence a philosophical epistemological theory (synonymous to empiricism), which is in contrast to another theory, that of realism. Realism points out that the physical laws exist autonomously in nature, the work of scientists being to find/discover them. On the other hand, followers of constructivism suggest that what we consider as science is but the scientists' constructions that are subject to subjectivity and fallibility. The existence of such a dichotomy, at least as far the status of scientific laws and concepts is concerned, is now being questioned. Realism and empiricism must be considered as two extremes in a continuum. It is certain that in its early years (certainly until the beginnings of the twentieth century), science was closer to empiricism, but as time went past, it approached more closely the outlook of realism (Tsaparlis, 2001).

Constructivism refers to a philosophical view about the nature of reality and perception. As a theory, it is often reduced to the mantra-like slogan that "students construct their own knowledge" (Cobb, 1994).

On the other hand, constructivism is a model intended to describe learning. It says that learning is always an active process of making sense out of an experience and that this process is much influenced by prior knowledge (Cobern, 1995).

In the constructivist paradigm, the teacher's role is not to lecture or to provide structured activities that guide students, step by step, to mastery of some teacher-imposed goal. Instead, teachers in a constructivist classroom are called to function as facilitators who coach learners as they blaze their own paths towards personally meaningful goals (Alesandreni & Larson, 2002)

The constructivist teacher considers the various ways in which his/her students may view certain idea. He/she encourages them to accommodate these ideas into their mathematical network. Then he/she helps them (re)structure these ideas and views through a constructive process called reflection, until he/she is assured of the adequacy and strength of the students' constructions. The teacher assesses the validity of the students' constructs and ensures that these are suited to the mathematics instruction (Limjap, 1999).

According to Limjap (1996) this theory does not promote a specific teaching methodology. Instead, it suggests strategies that can facilitate the students' construction of meaning and ideas.

In this connection, a science faculty should employ the most effective methods and techniques which can best accomplish the national goals of science education as well as stimulate students to construct their own knowledge and make the maximum use of their capacities and potentialities to enable them to achieve maximum growth and development.

Thus the author conducted a survey to determine the level of knowledge of science faculty on the science goals and objectives; how often each goal is used in teaching; determine the importance of each goal as perceived by the faculty; and find out how they operationalize the goals for teaching/learning purposes hence, this study.

3.0 METHODOLOGY

The respondents of the study were faculty members of the College of Science. Out of forty faculty members who were given survey questionnaire only fifteen teachers answered and returned it.

The questionnaire consists of both open-ended and closed-ended questions with three parts. Part I was on the profile of respondents which included the name (optional), age, sex, highest educational attainment, length of teaching experience, subjects taught, and the college department to which the faculty belongs. Part II was open ended questions on the goals and objectives of science education. Part III gathered information about the respondents' frequency of using the different goals in teaching and their perception on the importance of each goal. Each goal was rated in a scale of three according to the respondents' frequency of using, with 3–always, 2–sometimes and 1–never, and their perception on the importance of each goal with 3–very important, 2–important and 1–not important.

Open-ended questions on how the respondents operationalized the goals for teaching and learning purposes and the common problems they encountered which prevented them from pursuing the goals were also included. The instrument was tried-out to science and mathematics faculty in the College of Education, University of Eastern Philippines. Items which were not clear were identified and improved. The questionnaire yielded the data needed.

The revised questionnaire was distributed to the faculty members of the College of Science. The researcher had difficulty retrieving the questionnaire for several reasons. One faculty member would tell that she misplaced it. Another faculty would reason out that she left it at home. Still another faculty would mention another reason. A second questionnaire was given to faculty member who misplaced the first one but still the faculty reasoned out that she is busy and cannot attend to it. Only fifteen of the forty College of Science faculty members answered and returned the questionnaire.

Data on the profile of the College of Science faculty members in terms of highest educational attainment, sex, age, length of teaching experience, subjects taught, and department were collated using frequency counts. Mode was used to describe these items.

To come up with the proper categories of the responses a rubric was used in the qualitative analysis of the goals and objectives written by the respondents. The answers were evaluated based on the goals and objectives of science education in the instructional material of (Ibe, 1997). The rubric was created to categorized the answers with 4–proficient, 3–adequate, 2–minimal, 1–inadequate, and 0–none at all. Table 1 shows the rubric used for evaluating the goals and objectives written by the respondents.

Table 1 Rubric for evaluating goals/objectives

	Category	Description
4	Proficient	Knows all the goals/objectives of science education. Wrote exactly all the goals/objectives of science education.
3	Adequate	Knows the goals/objectives of science education but not all. Wrote some goals/objectives of science education.
2	Minimal	Knows a little about the goals/objectives of science education. Wrote ambiguous, incomplete, and insufficient goal/objective.
1	Inadequate	Wrote something but not correct.
0	Knows nothing	Knows nothing. Wrote nothing/none at all.

The respondents' frequency of using the different goals in teaching and their perception on the importance of each goal were collated using frequency counts. Ordinal scale was used to describe these items.

The answers to questions on how the respondents operationalize the goals for teaching and learning purposes, as well as the common problems they encounter which prevent them from pursuing the goals were identified. The measure of central tendency used to describe these data was mode.

■4.0 RESULT AND DISCUSSION

The results of the study provided valuable information and practical suggestions to people involved in science and mathematics teaching in the tertiary level. It gave the teachers a chance to reflect on their respective goals in the light of the contemporary scene in science education. Likewise, the results provided the faculty of the UEP College of Science some directions in their work as science and mathematics educators in a state university.

4.1 Profile of Respondents

The profile of the respondents by department: four respondents from each of these departments: Biological Sciences, Physical Sciences, and Information Technology (IT); two from the Department of Mathematics, and one from the Department of Environmental Studies (ES).

The highest educational attainment of the respondents was as follows: five were Bachelor's degree holder, seven were graduates of Master's degree, and three were Ph.D. degree holders.

The profile of the respondents by sex: five male and ten female. The profile of the respondents by age: six respondents were between 20-29 years of age, two faculty members were between 30-39 years old, four were between 40-49 years of age, and three respondents were between 50-59 years old.

The profile of the respondents by length of teaching experience: eight were below 10 years of teaching, three had 10-19 years teaching experience, three were between 20-29 years of teaching, and one respondent had been teaching for more than 30 years.

In terms of subjects taught, ten were teaching science subjects, one was teaching mathematics, and four were teaching computer subjects. There were two respondents from the Department of Mathematics but only one faculty was handling mathematics subjects since the other faculty was physics major. The following table shows the profile of the respondents

Table 2 Profile of respondents

Department	Biological	Physical	IT	Math	ES
	4	4	4	2	1
Educational qualification	BS	Masters'	PhD		
	5	7	3		
Sex	Male		Female		
	5		10		
Age	20-29	30-39	40-49	50-59	
	6	2	4	3	
Years of teaching experience	below 10	10-19	20-29	30 & above	
	8	3	3	1	
Subjects taught	Science	Math	Information Technology		
	10	1	4		

4.2 Goals and Objectives of Science Education

The following were some of the answers written by the respondents to question 1: What in your opinion should science/mathematics education strive to accomplish? (Please write general statement(s).

- That both teacher and students should have a favorable attitude towards science and mathematics education.
- To continue doing analysis of the curriculum especially on the areas of its weaknesses, coverage of lessons and effectiveness.
- To develop the high-level professions that will provide leadership for the nation, advance knowledge through research, and apply their new knowledge for improving the quality of human life.
- Scientifically literate citizens
- Quality education, competent graduates

The following were some of the answers written by the respondents to the question 2: What should science/math subjects in college try to attain? (Please write specific statement(s).)

- To produce graduates with high regard to teaching competence.
- Students with an understanding of how science has influenced the daily life of man
- To implement the interdisciplinary research and extension in the Biological Sciences relevant to the efficient management and utilization of the local natural resources.
- Expertise in the subject so that they could apply it in field of work once they graduate
- To enhance students thinking ability

The goals written by three respondents were categorized as adequate, six answers were minimal, and four answers were inadequate. Two faculty members did not answer. The mode is 2 or minimal. The faculty members wrote ambiguous, incomplete, and insufficient goal.

The objectives written by five respondents were categorized as adequate, seven answers were minimal, and two were inadequate. One faculty member had not written any objective. The mode is 2 or minimal. The faculty members also wrote ambiguous, incomplete, and insufficient objectives.

Table 3 shows the goals and objectives written by the respondents.

Table 3 Respondents' goals and objectives of science education

Respondent	Goals	Objectives
1	2	2
2	2	3
3	3	2
4	2	2
5	1	1
6	3	3
7	3	3
8	2	3
9	1	2
10	2	2
11	0	1
12	1	2
13	1	3
14	2	2
15	0	0

Legend: Goals/Objectives
4 – Proficient **3** – Adequate **2** – Minimal **1** – Inadequate
0 – None at all

It was observed that the faculty members could not distinguish goal from objective. Table 4 shows the order of respondents' frequency in using the different goals in teaching.

Table 4 Frequency in using the goals in teaching

Goals	Rank	Always	Sometimes	Never
Scientific knowledge	1	15		
Scientific methods	2	14	1	
Societal issues	5	6	8	1
Personal needs	4	7	7	1
Career awareness	3	11	4	

Scientific knowledge ranked first, scientific methods was second, career awareness ranked third, personal needs was fourth, and societal issues was last. This means that all the respondents always used scientific knowledge as their goal in teaching. Fourteen respondents always used scientific methods as goal and one respondent sometimes used it. Eleven respondents used career awareness always and four sometimes used it as goal. Seven respondents always used personal needs, seven used it sometimes, and one respondent never used it as goal in teaching. Societal issues ranked last among the five goals. Six respondents used it always, eight used it sometimes and one respondent never used it as goal in teaching.

Table 5 Respondents' perception on the importance of each goal in teaching

Goals	Rank	Very Important	Important	Not Important
Scientific knowledge	1	13	2	
Scientific methods	1	13	2	
Societal issues	2	9	6	
Personal needs	4	7	8	
Career awareness	3	9	5	1

Table 5 shows the order of importance of each goal as perceived by the respondents. Scientific knowledge and methods both ranked first; societal issues were second, career awareness was third and personal needs ranked fourth.

The thirteen respondents' perceived scientific knowledge and methods as very important goal in teaching while two considered it important. Nine out fifteen respondents perceived societal issues as very important goal and six considered it important. Career awareness was perceived very important goal in teaching by nine respondents while five and one respondent perceived it important and not important goal respectively. Personal needs were perceived by seven of the fifteen respondents as very important while eight respondents considered it as important goal in teaching.

Table 6 Method used to operationalize the goals

Goal	Method
Scientific knowledge	Lecture
Scientific methods	Laboratory activities
Societal issues	No answer
Personal needs	No answer
Career awareness	No answer

Table 6 shows the method by which the respondents' operationalize each goal for teaching and learning purposes. These methods were the mode for each goal. The faculty members used lecture to help students acquire scientific knowledge, and laboratory activities for students to develop scientific methods. There were no answers for the other goals. This means that the respondents did not know how to operationalize societal issues, personal needs, and career awareness when teaching their subjects.

Table 7 Common problems encountered by faculty

Goal	Problems encountered
Scientific Knowledge	Lack of instructional materials Lack of interest and negative attitude of students
Scientific Methods	Lack of facilities Lack of knowledge of faculty in hands on of apparatus
Societal Issues	No answer
Personal Needs	No answer
Career Awareness	No answer

Table 7 shows the common problems encountered by the faculty members that prevent them from pursuing the goal on scientific knowledge were lack of instructional materials, lack of interest and negative attitude of students. For scientific methods, the common problems encountered by the faculty members were lack of facilities and knowledge in handling laboratory apparatus. The respondents had no answers for societal issues, personal needs, and career awareness.

5.0 CONCLUSION

The teachers' level of knowledge on the science goals and objectives is minimal. They are not clear about the goals and objectives of science education.

The faculty perceived scientific knowledge and methods very important and used it frequently. Consequently they employ lecture method and laboratory activities in teaching. The common problems encountered by the faculty that prevent them from pursuing the goals were lack of instructional materials, lack of interest and negative attitude of students, lack of facilities, and knowledge in handling laboratory apparatus.

They do not know how to operationalize societal issues, personal needs, and career awareness when teaching their subject matter. These teachers do not utilize strategies that can facilitate the students' construction of meaning and ideas.

The following recommendations were suggested: Faculty members should be given in-service training on the goals and objectives of science education as well as pedagogy which can best achieve these goals and objectives in the classrooms. In-service training in using laboratory apparatus as well as budget for laboratory facilities and books should be given priority by the school administration. Sustained support from the administration is essential.

Finally, there is a need for faculty to look at science education from the constructivist perspective. In the constructivist standpoint, learning is an active process and not a stimulus-response phenomenon. It results from exploration and discovery. Students learn concepts while exploring their application. The teacher acts as model and guide in the classroom. Teaching activities must be conducted in manners that allow students to construct conceptual structures of science through reflection and abstraction.

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