

# Development of Learning Achievements of Bachelor Degree Students in Basic Scientific Research Method Course Using Inquiry Approach

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## Abstract

The purpose of this research was to develop learning achievement in basic scientific research method course using scientific inquiry approach. The participants were 47 third year students in Bachelor degree from Faculty of Science, Department of Biology and Zoology, Kasetsart University, The research instrument consisted of lesson plans, Basic Scientific Research Method (BSRM) Test, Attitude Tests, Social Dimensional Diagram, learning log and informal interview note. Quantitative data were analyzed by frequencies, percentage and mean. Content analysis was used to analyze the qualitative data. The results indicated that after using inquiry approach students had better learning in three aspects as follows: 1) Most of students had more understanding on basic scientific research method; 2) Students had good attitude toward basic scientific research method course by using scientific inquiry, and 3) Students had more social dimensional than before teaching.

**Keywords:** Learning achievements, Inquiry approach, Basic Scientific Research Method Course

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**Introduction:**

Biology is a branch of science in relation to study living organisms and how to understand nature of such living organisms. It is necessary to utilize scientific inquiry related to an explanation or prediction about phenomena by using experimentation, giving reasons or imagination. According to National Education Act B.E. 2542 and Second Additional Revised Act B.E. 2545 mention that "To authorize Educational Institutes and Governmental Agencies in relation to educational management, learning management with emphasis on learners by promoting thinking process, ability in learning, inquiring knowledge, problem solving and had creative thinking to construct the new knowledge, on the activity that based on real experience, evaluate students by considering from development of students and using various methods of evaluation that related to learners and authentic assessment (Office of National Education Committee (ONEC), 2002).

Therefore, management of learning science according to educational reform is necessary for the learners who had to understand content knowledge, skill and good attitude. So the teachers should give opportunity to inquire knowledge like working of scientist. They also expected their learners could learn science with emphasis on linking knowledge with process skill and have ability to construct own knowledge by using inquiry and using various ways to solve the problems. Inquiry is a term used to describe both teaching and doing science. In term of teaching, inquiry is a particular method of teaching. It is an approach to teaching and learning which is based on sound and established concepts, and is directed toward achievement in content areas as well as toward development of rational powers (Bibens, 2001). In order to prepare for learners who would be important population of the nation and be Scientific literacy (Office of Technique and Education Standard, 2008) by conforming with learning management with emphasis on inquiry-based instruction which was a model of learning to be used in science learning management (Institute for Promoting Teaching Science and Technology (IPST), 2545) which students could understand scientific concept and got more knowledge about scientific terms. The students also had analytical

thinking, good attitude to learn science, familiar with process of scientists', understand how scientists discovery scientific knowledge and apply scientific knowledge to social and people (National Research Council (NRC), 2000).

Department of Zoology, Faculty of Science, Kasetsart University as in one's capacity as is an organ responsible for education related to produce scientists in Biology Branch and Zoology Branch, had realized the importance of graduates production with high quality equipped with knowledge and experience including good attitude to basic scientific research methods in biology onto Thai society. Thus, there were several courses in connection with basic scientific research methods, i.e. basic scientific research methods in biology and basic scientific research methods in zoology. From the experience as researcher, it was found that students did not understand in how to determine the research problem or research topic, research hypothesis, research planning and design, data collection, data analysis and research conclusion etc. This results affected to students could not write research outline as well as had bad attitude to research process in science and how to write research outline was rather very difficult for them and they did not know how to begin.

Therefore, researcher as a instructor for the course is interested in developing learning achievement of bachelor degree in the topic of basic scientific research methods which was a topic of the course in basic scientific research methods in biology and basic scientific research in zoology which were main important topics of two courses by having learning management with emphasis on inquiry-based instruction. The result from this study would be a basic data for educational institutes and universities in learning management that promotes learning achievement by learning management with emphasis on scientific inquiry.

### **Research Objective:**

The researcher aimed to develop bachelor degree students' learning achievement in Basic scientific research method course by using scientific inquiry.

**Research Methodology:**

With the lens of an interpretive perspective, the research design of this study portrayed both quantitative and qualitative data for developing bachelor degree students' learning achievement in Basic scientific research method course using scientific inquiry.

**Research Participants:**

Participants of this research were 47 Bachelor degree students in Biology and Zoology who enrolled Basic Scientific Research Method in Biology Course and Basic Scientific Research Method in Zoology Course in second semester of academic year 2012. Thirty three of them were male and fourteen of them were female.

**Research Instruments:**

The researchers developed instruments for the course which consisted of 11 lesson plans in basic scientific research method which based on scientific inquiry. All lesson plans took time for 15 weeks in a total of 45 hours using scientific inquiry. The management activities are in the following steps 1) Engagement was that instructors attract interest of students in topics what they would instruct 2) Exploration was that instructors allowed students to engage in the activity for discovering knowledge as step in examining of ideology, seeking answers, taking action and creating meaning, by social interaction undergoing learning with one heart and one mind 3) Explanation and creating conclusion were that instructors stimulate students to jointly creating the meaning of data from surveying and seeking, training in thinking analysis and synthesis with discussion and data exchanging, discussion of data results and jointly creating conclusion 4) Elaboration was that students can link up knowledge and experience in different contest 5) Evaluation was that instructors test their understanding and experience. In addition, the researchers had supplemental activities in learning management as follows 1) Data analysis in statistic, planning, experimentation and using computer programs 2) Scope of research in various branches 3) Writing the report of research result and 4) Preparation of original manuscript for publication in technical journal.

The researchers also used Basic Scientific Research Method (BSRM) test as research instruments for data collection. It consisted of opened-ended questions which researchers created themselves for 13 items by dividing into 2 sections i.e. section 1: basic data of answer for 2 items and section 2: understanding relating basic scientific research method for 11 items which were examined the validity of test forms, substance, language, suitability and conforming of questions and answers from 3 experts. Then, they were brought to be tested with similarity groups and test forms were brought to be revised again before using.

In addition, the researchers collected the data relating students' attitude in basic scientific research methods emphasized on scientific inquiry. In attitude test which consisted of 5 scales form with value estimate for 10 items which had 5 selectors, namely the most agreement, much, medium, small, the smallest. The characteristics of content had both positive and negative statements which researchers examined the content validity from 3 experts. Then, it was brought to test with similarity groups and finding reliability of the whole test form by using alpha coefficient before using with the participants. The researchers also used social dimensional diagram, journal log and informal interview log to examine learning management emphasized on scientific inquiry.

### **Data Collection:**

The researchers collected data by letting students worked on BSRM test and attitude test including allowing students to write 3 of their friends' name who would work together in the paper given by researcher for making social dimensional diagram of the classroom before learning. After that, the researchers taught according to 11 developed lesson plans emphasized on scientific inquiry with a total of 45 hours. In each period, the researchers also let students wrote journal log in order to reflect their ideas after finished activities in each times. In addition, researchers examined the answers in activity papers, students' artifact, informal-interview for additional data, evaluated students' presentation, gave student opportunity to discuss the point that students still misunderstood, negotiated their ideas about their works and make a conclusion received from activities. After finished all lesson

plans, researchers let students do BSRM test and attitude test concerning learning on basic scientific research methods which were the same in the beginning. Finally, the researchers let students to write 3 friends' name who wanted to work in the paper which researchers distribute for making social dimension of classroom again.

### **Data Analysis:**

After collecting data, researchers analyzed BSRM test before and after finished learning activities by classifying answer and categorized students' answer into 6 groups i.e. 1) Sound Understanding (SU) group 2) Partially Understanding (PU) group 3) Partially Understanding with Specific Misconception (PU&MU) group 4) Specific Misconception (SM) group 5) No Understanding (NU) group and 6) No Answer (NA) group. From there, numbers of students were counted. In each answer group, frequency and percentage were calculated in each group. In case of measuring attitude test about scientific inquiry in Basic Scientific Research methods before and after in learning management, researchers set the scale in giving grades of positive statement in selectors: the most agreeing = 5 points, much agreeing = 4 points, moderate agreeing = 3 points, small agreeing = 2 points, and the smallest agreeing = 1 point. For the content that is negative, points were given in reverse, and basic statistic values of attitude scores to learning management were calculated and then analyzed the data by calculating frequency values, mean and standard deviation of each question.

For social dimension, researchers compared the distribution of student groups before and after finished learning activities in order to consider social dimension skills. In addition, researchers used journal log, informal interview to analyze students' behavior, problems, obstacles and guidelines in solving the problem of learning management.

### **Research Results and Discussion:**

Researchers would like to propose research results into 3 sections as follows:

#### **1. Students' Understanding of on Basic Scientific Research Methods**

Researchers concluded knowledge and understanding of students on basic scientific research before and after learning management emphasized on scientific inquiry in table 1.

**Table 1** Frequency and percentage of students' answer in Basic Scientific Research Methods before and after finished learning management

(n=47)

Topics	Time	Frequency (percentage)					
		SU	PU	PU&MU	SM	NU	NA
Principle and basic scientific research methods	Pre	1 (2.38)	0 (0)	1 (2.38)	5 (11.90)	18 (42.85)	17 (40.47)
	Post	0 (0)	0 (0)	3 (6.52)	13 (28.26)	30 (65.21)	0 (0)
Writing and presenting the research proposal	Pre	0 (0)	1 (2.38)	3 (7.14)	10 (23.08)	11 (26.19)	17 (40.47)
	Post	0(0)	0(0)	6 (13.04)	28 (60.86)	12 (26.08)	0(0)
Searching information	Pre	2 (4.76)	2 (4.76)	1 (2.38)	16 (38.09)	9 (21.42)	12 (28.57)
	Post	2 (4.34)	0(0)	15 (32.60)	19 (41.30)	9 (19.56)	1 (2.17)
Using EndNote program for reference	Pre	1 (2.38)	1 (2.38)	3 (7.14)	6 (14.28)	5 (11.90)	26 (61.90)
	Post	1 (2.17)	7 (15.21)	10(21.73)	14 (30.43)	13 (28.26)	1 (2.17)
Principle of experimental design and data analysis	Pre	2 (4.76)	0(0)	1 (2.38)	4 (9.52)	3 (7.14)	32 (76.19)
	Post	0(0)	1 (2.17)	12 (26.08)	18 (39.13)	14 (30.43)	1(2.17)
Scope of research work in various discipline	Pre	2 (4.76)	2 (4.76)	6 (14.28)	12 (28.57)	3 (7.14)	17 (40.47)
	Post	1 (2.17)	2 (4.34)	33 (71.73)	4 (8.69)	4 (8.69)	2 (4.34)
Writing research results report and preparation of original manuscript for publication in academic journal	Pre	0(0)	1 (2.38)	1 (2.38)	2 (4.76)	5 (11.90)	33 (78.57)
	Post	0(0)	0(0)	5 (10.86)	22 (47.82)	13 (28.26)	6 (13.04)
Using and maintenance of basic equipment	Pre	3 (7.14)	0(0)	3 (7.14)	4 (9.52)	5 (11.90)	27 (64.28)
	Post	0(0)	4 (8.69)	15 (32.60)	16 (34.78)	9 (19.56)	2 (4.34)
Codes of conduct of researchers	Pre	1 (2.38)	1 (2.38)	2 (4.76)	6 (14.28)	6 (14.28)	27 (64.28)
	Post	0(0)	2 (4.34)	14 (30.43)	15 (32.60)	15 (32.60)	0(0)
Codes of conduct in use of experimental animal	Pre	1 (2.38)	0(0)	3 (7.14)	4 (9.52)	6 (14.28)	28 (66.66)
	Post	0(0)	3 (6.52)	8 (17.39)	21 (45.65)	14 (30.43)	0(0)
Safety standard in the laboratory	Pre	0(0)	2 (4.76)	2 (4.76)	6 (14.28)	4 (9.52)	28 (66.66)
	Post	2 (4.34)	9 (19.56)	13 (28.26)	13 (28.26)	9 (19.56)	0(0)

**Notice:** Pre means that before learning management and Post means after learning management

SU, Sound understanding; PU, Partially understanding; PU&MU, Partially understanding with specific misconception; SM, Specific misconception; NU, No understanding; NA, No answer.

From Table 1, it was found that before learning management most of students did not answer the question in topic, writing and presenting the research proposal, using EndNote program for reference, principle of experimental design and data analysis, scope of research work in various discipline, writing research results report and preparation of original manuscript for publication in academic journal, using and maintenance of basic equipment, codes of conduct of researchers, codes of conduct in use of experimental animal and safety standard in the laboratory by calculating in percentage: 40.47, 61.90, 76.19, 40.47, 78.57, 64.28, 64.28, 66.66 and 66.66 respectively.

In case of the topic on principle and basic scientific research methods, most of students (42.85%) did not understand. In the topic on data findings, most of students (38.09%) had specific misconception but after finished learning management, most of students had specific misconception in the topic on writing and presenting research outline, data searching, use of EndNote program for reference, principle of experimental design, analysis of data from statistics, and use of computer program in data analysis, writing research result report and preparation of original manuscript for publication in academic journal, use and maintenance of basic equipment, code of conduct of researchers, code of conduct in use of experimental animal and safety standard in the laboratory. Most of students were calculated in percentage: 60.86, 41.30, 30.43, 39.13, 47.82, 34.78, 32.60, 45.65 and 28.26 respectively. For topic on principle and basic scientific research methods, most of students (65.21%) did not understand. Most of students also held partially understanding and specific misconception in the topic of research scope in various discipline and safety standard in the laboratory in 71.73% and 28.26%, respectively.

## **2. Attitude toward Learning Management Regarding Basic Scientific Research Methods Emphasized on Inquiry Approach**

Researchers concluded about students' attitude regarding learning management on basic scientific research methods emphasized on scientific inquiry from attitude test before and after finished learning activities as Table 2.



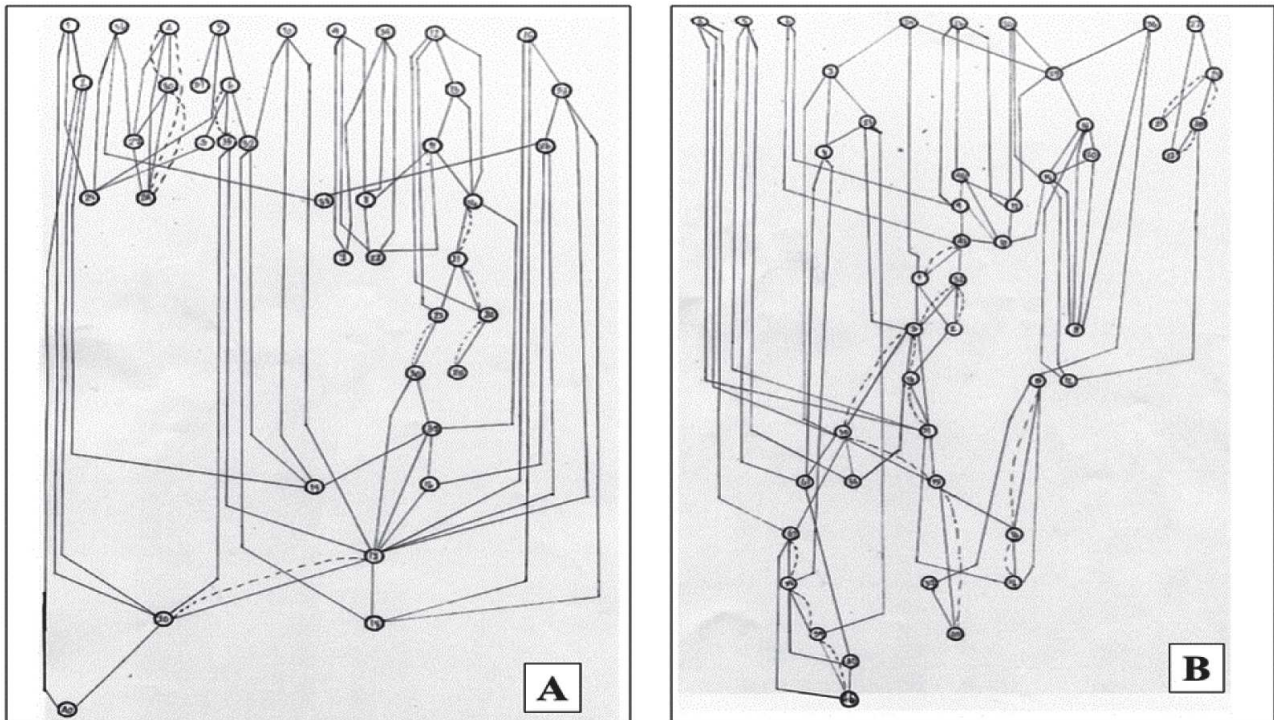
**Table 2** Comparison of averaged scores (X), students' attitude toward learning management emphasized scientific inquiry

Period of test	X	SD	Attitude level		
			High	Moderate	low
Pre-test	3.84	0.50	✓		
Post-test	3.87	0.46	✓		

From table 2, it showed that after finished learning activities, students had averaged scores for opinions of students to learning management emphasized on scientific inquiry equal to 3.87 points which were higher than before learning management with averaged scores equal to 3.84 points. After learning management, opinions of students which had the highest averaged values for the first three orders, as follows: students did not agree that they did not receive knowledge from learning management. After finished learning activities, students did not agree that learning management in courses for basic scientific research methods was not useful to students and they did not also agree that they did not like learning respecting basic scientific research methods which was not useful to students and students did not agree that students did not like learning regarding basic scientific research methods.

### 3. Social dimension

Researchers summarized students' social dimension the course on basic scientific research methods before and after finished learning activities as Figure 1.



**Figure 1:** Students' social dimension in the course on basic scientific research methods before (A) and after (B) finished learning activities

From Figure 1, it was found that after finished learning management in social dimension of students (B). There was an increase of more HUB before learning management by having 9 HUB while social dimension before learning of students (A) had only 4 HUB. In considering node located at the topmost rank of the plan, it was found that social dimension after learning had smaller number. In case of class order of social dimension showed, it was the dispersal of each students in the rule of hierarchic, class number of node in social after learning (B) which indicated that selection of grouping in the classroom had more dispersal than social before learning (A).

## Discussion

From the study, students' knowledge and understanding regarding on basic scientific research methods, it was found that most of students had less experience in learning process of scientific research. They lacked of behavior in searching for knowledge, not dare to

express their own opinion, like to be good listeners. Therefore, an importance of learning process in the course on basic scientific research methods in biology and the course on basic scientific research methods in zoology, students must participate in activities, particularly joint discussion which was found that students will be interested during learning all the time. In addition, students should jointly negotiate idea each other. It would happen that there were mobilizations of thought and occurrence of topping up the idea and should emphasize an increase of learning experience. Therefore, after instructor taught the principle of each topic and it should have jointly discussion to find out the correct conclusion. Then students were designated in each topic to do the research. From there, all designated data are brought back for jointly discussion once again which instructor would know that students had the knowledge, right understanding or not. If they do not understand rightly, students would be adjusted correctly. In essence, inquiry strongly suggests that the learner is his own teacher, with the teacher acting as "a guide on the side." Therefore when inquiry is conceptualized as a teaching approach, the teacher's role is to engage students in student-directed inquires about scientific phenomena, refine their critical and scientific thinking skills and help them learn to work collaboratively with peers as they engage in science investigation (Luft, 2001). In order to facilitate inquiry, teachers need to learn many new ideas about students, learning, curriculum, pedagogy and assessment (Wilson and Berne, 1999)

For topics submitted as outlines in research work by students, it is found that they were fully successful since topics had diversified in many disciplines and questioning including discussion that cause students dare to think, occurrence of topping up an idea in constructive suggestion and knowing to accept other people comments. Therefore, from this study it was found that learning management by scientific inquiry was considered to be suitable to learning management of the course on basic scientific research methods in biology and the course on basic scientific research methods in zoology which were in line with Kunhasuwan (2003) and IPST (2002) which found that scientific inquiry could be well promoted learning science to learners.

### Recommendations

From research results, researchers suggested that instructors should adjust content in courses to be compact so that students had more time to discuss and more studied materials or searching knowledge by themselves. For the further researches, researchers should divide students in biology and zoology because of the curriculum are quite differences which may be helpful in developing curriculum in the future.

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