Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.5, No.6, 2014

The Development of Contextual Model with Collaborative Strategy in Basic Science Course to Enhance Students' Scientific Literacy

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Abstract
The aim of the research is to develop the model of contextual teaching-learning with collaborative strategy on Basic Science course for non-science student. Moreover, the study was also done to examine the effectiveness of the model in enhancing students' scientific literacy that involves the mastery of concepts, context, process skill and attitudes of students towards science. Mixed methods research (MMR) was used in the study. Preceded by a need analysis, research was continued with the development of contextual models of learning under six themes, such as Human mind and its development, The development of Natural Sciences, Earth in the Universe; The Diversity of Living Things and its spreading; Ecosystems and Human Role , and the Natural Resources and Environment. The overall subjects of the research were 86 accounting students; 20 students involved in trying out the model, 34 students in the control group, and 32 students in the experimental group. The research reveals that through the six themes of contextual teaching-learning along one semester, the implementation of teaching models gave implication to the increasing of scientific literacy of accounting students, in the aspect of mastery of concepts, as well as on the application concept into context, process skill and students' attitudes toward science.
Keywords: contextual teaching-learning; scientific literacy; Basic Science

Background
Basic Sciences (BS) is one of the main compulsory subjects for non-science students in universities, both public and private [1,2]. Coverage of BS course are content, context, process, affective and meta-science. The further meaning is that BS course is dedicated to understanding the science through context encountered in everyday life[3] .Through science, it is also expected to develop personality, thinking skills, scientific attitude, and life ethics. Scientific processes those are used along learning science can develop students' thinking ability[4] . Through learning science, people would recognize the regularities in nature, limitations of science, and understand that the discovery and development of science must be accompanied by scientific ethics. By understanding the scientific ethics, the possibility of crimes that can result from a scientific experiment can be avoided [5]. All the above definition leads to the notion of scientific literacy. Someone who has had scientific literacy means he can understand science and apply it according to the needs of the community[6].
The previous studies[7,8] revealed that the organization of the course has yet to meet the expectations and objectives mentioned above. As a result, the scientific literacy of students is still weak, especially in the aspect of content applications in the context of daily Life, process skill, as well as the attitudes of students towards science. Some of the contributing factors include lack of lecturer to choose the models and strategies of teaching-learning. The lecture and assessments were designed with content based, and forgot about other aspects.
Considering the very strategic purpose of the basic science lectures, such efforts need to be made to provide an alternative model for basic science subject in university so as to produce professional candidates who are able to think rationally, critically and systematically, be professional in solving the problems of life, and demonstrate the good value and attitude. Developing models of basic science lectures on achieving scientific literacy (the ability to master the content, process, application context, and the value of science) is one of the main efforts to make

science education process relevant with the goals. In addition, the assessment should be designed to reflect all aspects of scientific literacy.

Various studies indicate that the lectures were designed by using contexts close to everyday life is one of the potential approach to build scientific literacy of students[9,10,11,12] . Such lectures can build concept mastery, the ability of students to apply the concepts in solving problems in their life, as well as build positive attitudes of students, and can build student interest in science, especially for the non-scientific study[13]. Through this research, a model of contextual lectures with collaborative strategies has developed with the main issues raised: how the contextual model of basic science lectures can build scientific literacy of non science student?

Methods

The method used in this study was a mixed method, which is the process of research that aims to develop and validate educational products. Mixed Methods Research (MMR) is a study designed in accordance with the philosophy of assuming direct inquiry method followed by mixing the collection and analysis of qualitative and quantitative data in the research process[14,15]. The stages in this study consist of: (1) the preliminary stage (needs analysis), (2) the development stage, includes the step of designing/drafting model and trial phase, and (3) the implementation and testing the effectiveness of the model. The research subjects (with purposive random) were 84 accounting students of one of private universities at Bogor, West Java-Indonesia. In the piloting phase, 20 accounting students who had followed the BS were involved, while the implementation phase used 32 students as the experimental class and 32 students as the control class. Teaching and learning in the control class was arranged on using classical approach with group discussion and six themes include.

To learn how the effectiveness of the model enhancing student's scientific literacy, the research was conducted with pre-post test control group design. The model of contextual teaching-learning with collaborative strategy on Basic Science course was implemented in the experimental class, meanwhile the control class was arranged under classical model with group discussion. The instruments used were observation sheets and questionnaires for students (was designed to reveal the students' attitudes toward science), and test to measure the increasing of content knowledge and application of concepts into context, and process skill. Validation of instrument tests performed using Anates program version 4.00, includes index of difficulty, discrimination power, validity, and reliability tests. The test on the rod and the answer choices were revised or discarded if it did not meet the criteria (very low quality).

Result and Discussion

The model of learning was arranged in six themes that reflected the development of all aspects of scientific literacy, on using collaborative strategies, with various methods, and media[16,17,18] . All of methods were foccused on student's self activities. Those six themes include the development of human mind, the development of science, earth and natural science, the diversity of living things and its spread, ecosystem and human role, natural resources and the environment. The model was then implemented in one semester course (16 meetings each in 2 hours).

The model was implemented under the steps adapted from the project "*Chemie im Kontext"* or ChiK[19] with *decision making* step inside[9,10] . The steps includes: *Contact Phase* (initiation and motivation*), Curiosity Phase* (through curious questions*), Elaboration Phase* (exploration, formation, and strengthening concepts)*, Decision Making Phase* (concept related to context)*, Nexus Phase* (using concept into new context)*, and Evaluation Phase* (test and measurement student achievement). The model was also arranged based on three point of views, such as context oriented and authentic problems, self learning and cooperative learning methodologies, and developed basic concept systematically. Observation along the session in both of experimental and control class were done through video-camera.

The implementation of model along the course (1 semester) increases the academic atmosphere. Students did the interactive learning and always with enthusiastically hot discussion. This affect the student literacy on science (Table 1 and Fig.1). The results showed that overall students' understanding of the material of science has been very satisfactory, that resulting in fair criteria.

Table 1. Students' Scientific literacy after the implementation of contextual teaching-learning with Collaborative strategy on Basic Science course

Class	Statistics Parameters	Score		
		Pretest (%)	Postest (%)	N-Gain (%)
Experiment	Number of Student	32	32	
	Students' chievement (Average)	55,6	82,4	60,8
	Standard od Deviation	10,3	10,1	
	Varians	106,7	101	
	Min achievement	36	60	
	Max achievement	80	100	
Control	Number of Student	34	34	
	Students' chievement (Average)	53,4	70	32,6
	Standard od Deviation	10,6	9,2	
	Varians	111,4	84,6	
	Min achievement	36	56	
	Max achievement	76	92	

The pretest results were almost the same in both of groups (in the first and second pretests). This is showed that students in both groups had the same initial understanding of the concepts. The treatment that was done consistently throughout the semester students have built students' scientific literacy. In average, the achievement of scientific literacy was very good category in experimental group and fair in control group, and is significantly different (*Kolmogorov-Smirnov test* on using SPSS 17.0).

Prior to this, student achievement on science concepts has never scored higher than 60 (in average) with a similar type of problems. This can be considered as a success of the model applied, which provides the opportunity for students to learn in collaborative strategy, using the phenomenon in the context of everyday life.

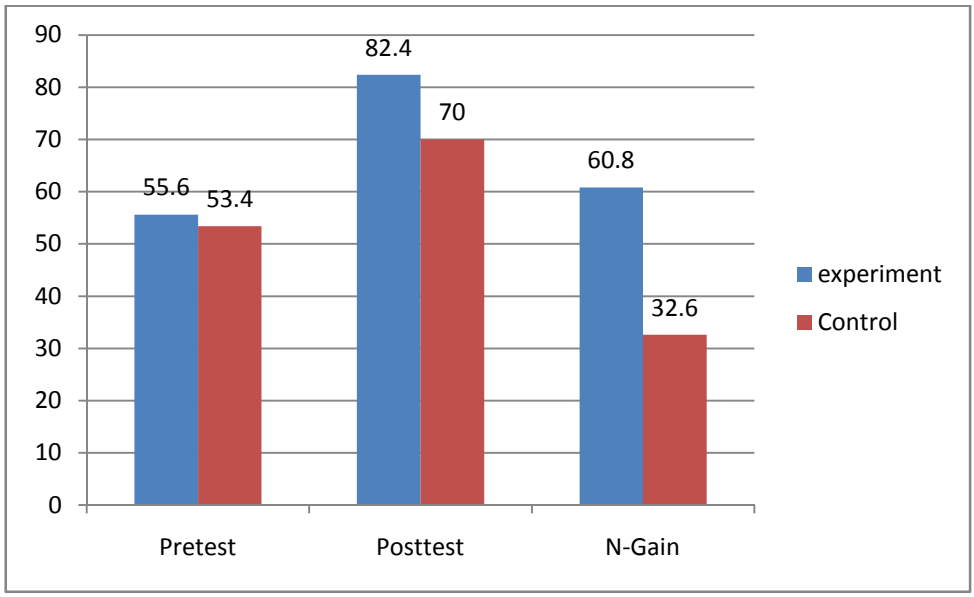

Figure 1. The increasing of Students' scientific literacy in both of experimental and control groups

Students were challenged to solve the given problems related to the life and science itself. Students feel the need to learn science when they need a variety of science concepts and solve the problems. Surprisingly, they learn not just from textbooks, but also from the Internet and other sources. There was even a group of students who went to the botanical institutions for information related to their problems. The interviews revealed their impression of the lecture. They thought they were not studying science, but learning about life. This is the real key to learning science. They learn science as a necessity, not an obligation.

Learning science is closely associated with learning to think[20,21,22] . This can happen especially if the study is designed on the basis of issues. Through science, students can be directed to think to solve the problem, yet, it can also occur otherwise. Thinking can lead students to study science. Lectures by using a model that accommodates a variety of approaches, methods and media, can increase the understanding of science, and also improving critical thinking skills[23,24,25]. This is in line with Holbrook[10] , who stated that "science will easy to understand if it is made sense in student thinking and related to their daily life, interest, and aspiration".

The elaboration of students' literacy into four aspects such as content, context, process and attitude toward science shows a slightly differences result (Figure 2). Although in general, all aspects of scientific literacy showed improvement indicated by the value of N-gain, but the increase of scientific process skill is highest with n-gain 31.4%. Identify of scientific questions, explain scientific phenomena, and use scientific evidence were three aspects learned in this study. Lectures with contextual models and collaborative strategies provide opportunities for students to explore their ability to interact with a variety of learning resources to find answers related questions or issues in the context.

Figure 2. Scientific literacy of students in all of four Aspects: content, context, process skill, and attitude toward science after model implementation

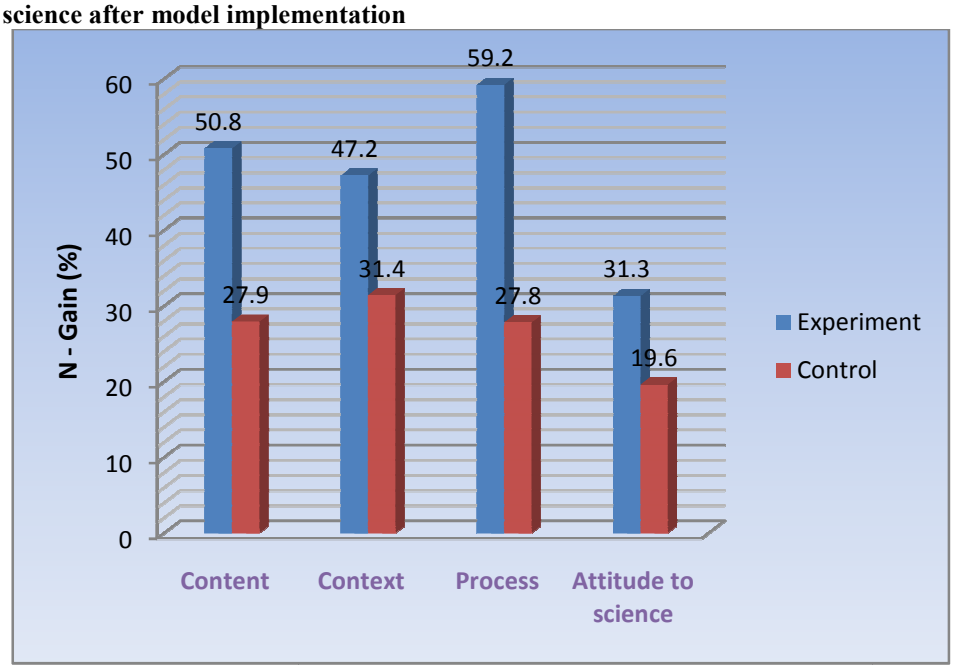

Figure 2. Scientific literacy of students in all of four Aspects: content, context, process skill, and attitude toward science after model implementation

As it is detailed in Figure 3, the increase of all sub-aspects of process skill aspect shows that the teaching-learning process has met the goals. When the students confidence to learn independently, it will be very easy to build all aspects of science process skills. This confidence will be awakened when students feel that studying science was necessary, useful and inspiring. Contextual learning can meet those needs. Packed with collaborative strategies using everyday life contexts, students were challenged to complete a variety of questions that are disclosed in the contact phase. Phase curiosity passed vigorously through various ways; explore a variety of sources, and in-depth discussion. The result of all these processes, students can take a decision on how to resolve the problem with confidence.

Problem solving skill is very powerful in basic process of transformation and causal. Therefore critical thinking skills can be trained involving contextual model with collaborative strategy. This is relevant to the opinion of Gokhale[26] , who argued that the collaborative learning through problem solving, the critical thinking skills and students' interests can be improved. Discussion method, scientific activities and assignments, were able to enhance understanding (*Verstehen*), by motivating the students to understand the variety of symptoms that occur in people's life in the community perspective, culture, and natural environment. Correspondingly, Ennis[27] reveals that critical thinking is reflective and reasonable thinking (reasonable) that is focused on what is believed to be done.

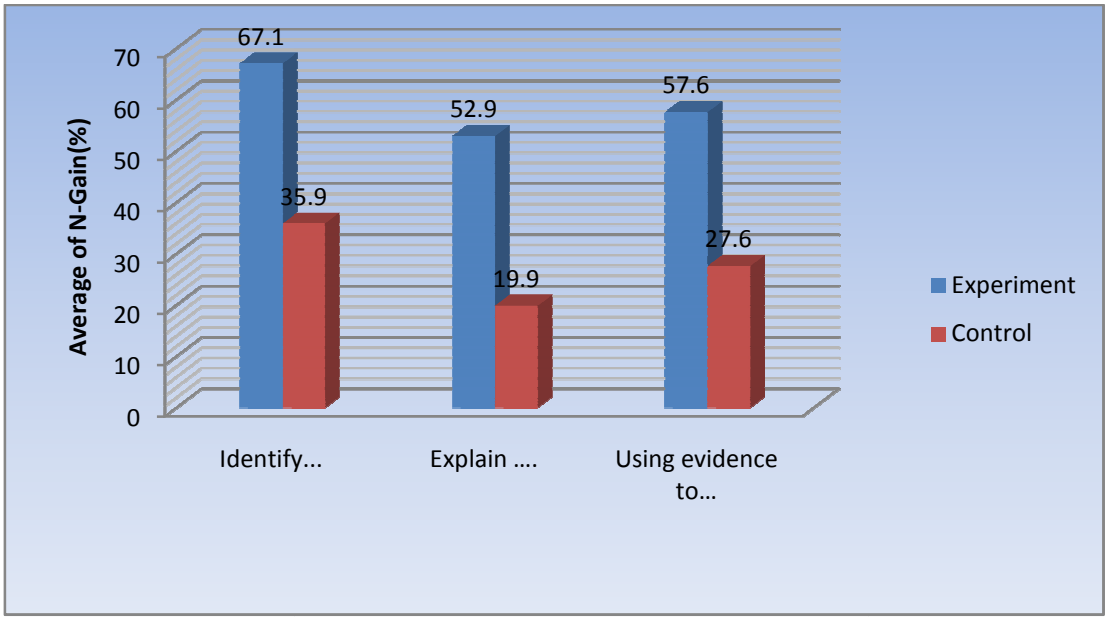

Figure 3. The increasing of Science Process skill of students in three sub-aspects: Identify scientific questions, explain scientific phenomena, and use scientific evidence

As it was mention above, the attitude toward science of students was also increase in line with concepts, context and science process skill. Attitudes toward science have a role as important as other learning outcomes such as knowledge and process skills. In the basic science lectures, development and measurement of scientific attitude is very relevant to be done considering the characteristics of science that the scientific attitude is always put at the forefront. Therefore research on scientific attitude was done with reference to the attitude indicators according to Carin and Sund (1980) such as *curiousity*, *humility*, *scepticism*, *open-mindedness*, *positive approach to failure*, as well *obyectivity*.

Achievements of the scientific attitude are presented in Table 2. In general, it appears that the scientific attitude shown by both the students in the experimental and control groups. The achievement of experimental group was excellent in category, while in the control group were fair categorized. Similarly, it appears that the scientific attitude of students was consistent and maintained the first and second test results. It indicates that the scientific attitude has been implanted in students after attending a half semesters of the lecture and maintained until the next period, with the assumption that the development of this attitude is due to the use of learning models that are implemented.

Table 2. The Final average score of the scientific attitude in both of experimental and control groups along the semester (twice tests)

Subject	n	**Score of scientific attitude**		**Category**
		Mid-half smt	**End-half smt**	
Experimental class	32	80.3	82.0	excellent
Control class	34	61.8	62.1	fair

As it mentioned previous, besides to understand the science and technology and environment, Basic Science lecture aims to instill scientific attitude. Carin & Sund[4] stated that this positive attitude is a nurturing effect of the learning process. The interactive learning process that involves a variety of approaches, methods, and media, with a focus on independent activity of students is a vehicle to build values and positive attitudes. The approach focuses on student activities include contextual teaching and learning, while effective methods such as collaborative discussions, presentations, and case study can be used to support the approach.

Tabel 3. The average score of scientific attitude of every indicators observed efter one semester implementation of the model contextual with collaborative strategy

Subjects	Half smt	Indicators of Scientific attitude (average score)					
		curiousity	*humility*	*scepticism*	*open-mindedness*	*positive approach to failure*	*obyectivity*
Experimental class	**1**	**80**	**84**	**79.8**	**79.6**	**78.8**	**79.6**
	2	**83**	**84.8**	**80**	**82**	**80.4**	**82**
Average score		**81.5**	**84.4**	**79.9**	**80.8**	**79.6**	**80.8**
Control class	**1**	**59**	**59.5**	**62**	**58**	**72***	**60**
	2	**58.6**	**60,3**	**61.8**	**59.8**	**73.5***	**61**
Average score		**58.8**	**59.9**	**61.9**	**58.9**	**71.8***	**60.5**

Maximum score : 100

Table 3 shows the score of scientific attitude in both of two experimental and control class of every indicators. The achievement on all indicators were in excellent cathegories for experimental class, and fair cathegories for control class, except for a positive approach to failure (good categories).

The curiosity of students can be developed in the lecture by giving them the opportunity to ask and find out about everything related to the context that is being or will be discussed. The incorporation of contextual approach to the assignment method and the collaborative strategy is a technique used in the lecture which turned out to be very good to develop this indicator.

Through lecture that is started from showing facts or natural events such as earthquakes in various places, blasting various places by using a powerful bomb, as well as other phenomena, leads students to sharpen a sense of humanity, and to think about solutions that can be done to prevent or minimize the humanitarian disaster. A lecture which brings students to the scientific discussion on how to respond to a news or opinion about a phenomenon will train students to be skeptical, open, and objective.

It has been found from the research results that the score of positive approach to failure indicator reaches an average above 70 (good categories). The interview results reveal an explanation on this. Students generally showed a positive response to the failure. They have had a life principle that failure is the success delayed. This seems they still hold this principle of life since before the lecture, and make it as a base to do the same thing in basic science college.

At the end of the study, the response of students to the course was studied on using questionnaires. It reveals that students responded positively to the course by using a learning model that has been designed. As many as 96 % students said that basic science course is needed, required for the development of science (90% respondents), thinking skills (95% of respondents), as well as personality and positive attitude (90% of respondents). Lectures were also very exhilarated as the material is related to everyday life. Besides, a very attractive method, always involves students in discussions, and uses various interesting media leads the course to be awaited.

Conclusion

Through the study, the contextual model of learning on using collaborative strategies was arranged to enhance students' scientific literacy. The model that was packed in six themes with various methods and media has implemented in the third semester of nonscience student of one of university in West Java Indonesia. The research shows that the students' scientific literacy increased after the model implementation. Designed with the emphasis on student self-learning activities, all of scientific literacy indicators increased such as content, context application, process skill and attitude toward science. It was also found that students responded positively to the course by using a learning model that has been designed. Based on student opinion, Lectures were very exhilarated, very attractive, always involves students in discussions, and uses various interesting media, so it leads the course to be awaited.

Acknowledgement

Many thanks to Pakuan University and Directorate General of Higher Education of Indonesia, for funding the research. Also many thanks to all of staff member that had made a good collaboration for the successful of the project.

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