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**Shaping Scientific Attitude of Biology Education Students Through Research-Based Teaching**

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**Abstract.** Scientific attitude is need of today's society for peaceful and meaningful living of every person in a multicultural world. A case study was conducted at the Faculty of Teacher Training and Education, University of Riau, Pekanbaru in order to describe the scientific attitude that shaped by research-based teaching (RBT). Eighteen students of English for Biology bilingual program were selected from 88 regular students as a subject of the study. RBT designed consists of 9 steps: 1) field observations, 2) developing research proposals, 3) research proposal seminar, 4) field data collecting, 5) data analyzing & illustrating, 6) writing research papers, 7) preparing power point slides, 8) creating a scientific poster, 9) seminar & poster session. Data were collected by using check list observation instruments during 14 weeks (course sessions), then analyzed by using descriptive-quantitative method. The results showed that RBT were able to shape critical-mindedness, suspended judgment, respect for evidence, honesty, objectivity, and questioning attitude as well as tolerance of uncertainty. These attitudes which shaped were varies according to every steps of learning activities. It’s seems that the preparation of scientific posters and research seminar quite good in shaping the critical-mindedness, suspended judgment, respect for evidence, honesty, objectivity, and questioning attitude, as well as tolerance of uncertainty. In conclusion, the application of research-based teaching through the English for Biology courses could shape the students scientific attitudes. However, the consistency of the appearance of a scientific attitude in every stage of Biology-based RBT learning process need more intensive and critical assessment.

**INTRODUCTION**

Scientific attitude is need of today's society for peaceful and meaningful living of every person in a multicultural world [1, 2]. One of instructional goals in Indonesian university is to develop student’s potential to become a graduates who mastered the science and/or technology to meet the national interests and increase the nation's competitiveness. Mastery of science and technology should be based on the steadiness of the scientific attitude of students as prospective educators and young scientists so that science and technology generated or controlled can be beneficial for the nation's progress, civilization and welfare of mankind.

Biology Education Study Program, the Faculty of teacher Training and Education (FKIP), Universitas Riau as part of a national higher education aims to produce biological science educators who have faith, taqwa, noble, intelligent, professional and competitive. Graduates of this course are expected to have qualified as candidates for secondary school biology teachers, researchers and laboratory managers of biology education. To obtain a graduate with that profile, then teaching biology should be shaped and foster scientific attitudes of prospective biology teachers.

But present reality shows that scientific attitude of students of biology education FKIP Universitas Riau tend to weaken [3]. These indications are easily observed during the process of academic interaction (lectures, laboratory work, seminars) as well as the assignment of lecturers products. In fact, the demand for graduate biology teacher candidates who mastered 21st century skills increasingly urgent with the implementation of 2013 curriculum which
emphasizes the scientific approach with a focus on the students. Exposure like a learning experience as a researcher or scientist to biology student teachers during their undergraduate education followed in FKIP expected to grow and strengthen their scientific attitude. Biology teacher with adequate scientific attitude will easily provide exemplary to learners through the learning of biology with scientific approach as demanded by 2013 curriculum. Therefore, Biology research-based teaching (RBT) approach become crucial within the framework of strengthening the scientific attitude biology teacher candidates.

RBT has been widely recognized [4] and accepted by more colleges [5, 6]. It is teaching through meaningful and real hands-on experiences in research. Students have a role as researchers and ask complex questions, search for answers by doing research, and report about their research journey [7]. This innovative teaching approach is based on the philosophy of constructivism that includes four aspects: learning that build student understanding, learning by developing prior knowledge, learning is a process of social interaction and meaningful learning is achieved through real experience [8]. Research-based teaching blends authentic learning, problem-solving, cooperative learning, and contextual inquiry discovery approach that is guided by the philosophy of constructivism [9]. In implementation, students are trained to be able to solve the problem with research which is based on the fact that they have encountered [10]. RBT provides an opportunity for students to find information, develop hypotheses, collect data, analyze data, and make conclusions based on compiled data. Students trained to apply the scientific method, draw up a report and present it in public [11].

Scientific attitude as mind’s habits which guide predisposition to act and think in particular way when facing scenario of problem solving [12]. Kozlov & Nay [13] labeled the “attitudes” components as the “cognitive”, "intent" and "action". The component of cognitive reflects student's understanding of the manner in which attitudes appear themselves in scientist professional behavior. The component of intent reflects the student's tendency to show agreement or disagreement of behaviors which determine an attitude. The action component reflects the extent to which the student actually shows in the science classroom.

Studies of the effect of different approaches in the learning of science on the scientific attitude had much already done [1, 14-16] showed that there are significant differences in the level of scientific attitude among pre-service teachers. Another study by Kazempour [17] revealed that the science experiences shaped post pre-service teachers altered consequently their attitude. A recent study conducted by [2] confirms that academic achievement is positively correlated significantly with scientific attitude. Meanwhile, the steps in each process of learning approaches which affect the growth of the scientific attitude has not received much attention. Stages of the process depends on the type of learning approach chosen. Behavior that reflects the scientific attitude at every stage of the learning process is also determined by the object being studied and the learning situation or context.

The aim of this paper is to share our research experiences in shaping scientific attitude of biology education students through Research-Based Teaching in the real learning situation. In particular, we are interested in describing of which scientific attitude that most shaped by research-based teaching and what learning activities that shaped those scientific attitude.

**METHODS**

The research-based teaching was used in Advance Course of English for Biology II (KPK 1102/2 credits) in the even semester of 2013 at the Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Riau. The sample of this case study were 18 students of international standard of Mathematics and Science Teacher Education Program which selected from 88 regular students.

The Course schedule was designed for 14 weeks classroom meeting. The subject were grouped into six teams (3 students per team) has been involved in collaborative learning during one semester.

Research-based teaching design which was applied in this study consists of the following steps: 1) introduction course design, (2) field observations, (3) developing research proposals, (4) research proposal seminar, (5) field data collecting, (6) data analyzing & illustrating, (7) writing research papers, (8) preparing power point slides, 9) creating a scientific poster, (10) seminar & poster session (Table 1).

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Research process/Students Activities</th>
<th>Learning Situation</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Introduction Course Design</td>
<td>Inside Classroom</td>
</tr>
<tr>
<td>2</td>
<td>Field observations</td>
<td>Outside Classroom</td>
</tr>
<tr>
<td>3, 4</td>
<td>Developing Research Proposal</td>
<td>Inside Classroom</td>
</tr>
<tr>
<td>5, 6</td>
<td>Research proposal seminar</td>
<td>Inside Classroom</td>
</tr>
</tbody>
</table>

TABLE 1. Weekly learning Design of research-based teaching.
The present study focuses on the action component of scientific attitude which the student actually perform in the science classroom [13]. There are nine scientific attitudes in action that will be identified: 1) critical-mindedness, 2) suspended judgment (restraint), 3) respect for evidence (reliance on fact), 4) honesty, 5) objectivity, 6) willingness to change opinions, 7) open-mindedness, 8) questioning attitude, and 9) tolerance of uncertainty [12]. Direct observation approach was performed by using check list observation instrument. Data were analyzed by using descriptive-quantitative method.

RESULTS AND DISCUSSION

Development of scientific attitudes as long as fourteen weeks of learning activities were presented in the figures 1 (week 2-14). Field observation activity were able to shape the attitude of respect for evidence, honesty, objectivity, and tolerance of uncertainty (Week 2).

FIGURE 1. Percentage of student’s scientific attitudes that were shaped by every step learning activities through research-based teaching in English for Biology at the Faculty of Teacher Training and Education, Universitas Riau, Pekanbaru 2013/2014.
Developing research proposal were able to shape the attitude of respect for evidence, honesty, objectivity, and questioning attitude (Week 3, 4). Research proposal seminar activity were able to shape the attitude of respect for evidence, honesty, objectivity, and tolerance of uncertainty (Week 5, 6). Field data collecting and data analyzing & illustrating were able to shape the attitude of suspended judgement, respect for evidence, honesty, objectivity, questioning attitude and tolerance of uncertainty (Week 7 dan 8). Writing research article (Week 9, 10), preparing power point slides (Week 11, 12) and creating a scientific poster (Week 13) were able to shape the respect for evidence, honesty, objectivity as well as questioning attitude and tolerance of uncertainty. Seminar & poster session (Week 14) as the end course session were able to shape much more scientific attitudes, i.e. critical-mindedness, suspended judgement, respect for evidence, honesty, objectivity, questioning attitude and tolerance of uncertainty.

It’s seems that the results are also consistent with previous reports that research project is a good way to shape the scientific attitude of the students [18-20]. Research in science education involves various attitudes which is formed through experiential learning in the classroom in a broad sense [21]. Doing research also inculcate a scientific way of thinking that allows students to experience the authentic activity of the work of scientists, including research designing, interpreting unexpected outputs and confidence [22].

The research project represents human creative achievement with materials and ideas and results in an experience of self-fulfillment [23, 24]. The results show that in the earlier step of learning activities, scientific attitude of students is less critical in the observations, open-mindedness and questioning attitude. The possible reasons for these attitudes might be because students in the second semester are not yet accustomed to make a field observation. The first experience in lecturing activities with RBT approach probably caused anxiety in showing that attitudes. In the next steps, the attitude of suspended attitude judgment, willingness to change opinions, and questioning attitude began to appear. This indicates that students gradually begin to adjust to the RBT learning approach so that the psychological burden of learning began to decrease. Weaknesses observed during the research-based learning process in this study are mostly students unfamiliar with the application of scientific methods in research activities. In high school, they are less accustomed to conducting scientific research as a form of learning.

The advantage of research-based teaching design is it can trigger the learning motivation because they are challenged by a variety of research activities, so that the learning environment from each lecture session has been very enjoyable.

Implementation of research-based learning design of this course is already succeed to change the orientation of Teacher-centered Learning to Student-centered learning. This support the view of Widayanti et al. [11] that research based teaching is one approach of student-centered learning, making students become more competent in science and research, skilled to identify problems and solve them properly, independent, critical and creative. It provide opportunities for generate a new idea and innovation as well as the professional ethics. Weidong et al. [6] also confirmed that in RBT, students absorb knowledge by exploration, so in the implementation, they are no longer passive in accepting science, but they could participate to explore research topics. Students' learning activities are very dynamic, joyful and excited (video clip recording will be presented in an oral presentation). This is mainly due to the students interaction directly with biological objects through research approaches like a researcher in a real situation. The learning atmosphere of English for Biology II was evaluated very conducive by Gusti Herdiah [17]. This was seen from the indicators of relationship between students, orientation tasks, and collaborative work among them in completing the project.

CONCLUSION

The findings show that research-based teaching through the English for Biology courses were able to shape the students scientific attitude in particularly critical-mindedness, suspended judgement, respect for evidence, honesty, objectivity, and questioning attitude as well as tolerance of uncertainty. These scientific attitude which shaped were varies according to every steps of learning activities. Preparation of scientific posters and research seminar provides the best contribution to the shaping of the scientific attitude of critical-mindedness, suspended judgment, respect for evidence, honesty, objectivity, and questioning attitude, as well as tolerance of uncertainty. However, the consistency of the appearance of a scientific attitude in every stage of Biology-based RBT learning process need more intensive and critical assessment.
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