

The Course Program Development of Invertebrate Zoology- Inquiry Laboratory Based (PPZI-BIL)

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Abstract: *This study aimed to develop the course program of Zoology Invertebrate- Inquiry Based. This study belonging to mixed methods research with the embedded design, that was embedded experimental model, that can be defined as qualitative data taped on the quantitative data, and in this case, the quantitative data as the dominant one. The subject of this study were students of the Pasundan University (UNPAS) as amount as 52 people (one class), by using purposive sampling. Result of this study indicated that the characteristics of PPZI-BIL such as : the course centered on students that oriented to the cooperative learning and a same age tutor, the students focused to be a scientist who expected can find any new concept independently, the lecturer acted as facilitator and motivator. The component of PPZI-BIL consisted of introducing, submission of critical questions, proving through experiment, and elaborating the practical work result. The application of this program was also influential toward the increasing of students' mastery concept. The result of this test indicated the occurrence of increasing on students' conceptual. The result indicated the significant increase for every this lectures program's concept ($Ng \geq 0,49$). Besides that, the application of this program was very influential toward the increasing of student's scientific attitude. The result caused students have a positive scientific attitude and developing this program independently. Furthermore, there a positive relation between scientific attitude and the student's mastery concept, by the correlation coefficient in medium category ($r=0,54$).*

Keyword: Course Program, Intervertebrate Zoology-Laboratory Inquiry Based (PPZI-BIL), Concept mastery, student's scientific attitude.

1. Introduction

Biology is the one of fundamental knowledge and be a basis for developing of another knowledge, Intervertebrate Zoology science was the one of them. This science, specifically explained the ins and outs about the vertebrates. This kind animal occupied in almost of every mullet in the earth, begin from boiled water that originate from the Hydrothermal hole of the deep sea until the stone and frozen-Antarctic soil (Campbell et al. 2008). Based on this geography condition, Indonesian located in between of two oceans and two continents, so it was reaching about a sea organism, and the vertebrates were the one of it.

The spreading of this animal was a wide, it required of Indonesian people, especially students to study the life of this animal, the aims are to make easy in identifying, see the relationship of genetic, and the its benefit for human life. The reality, according to Rusyana (2011) based on the study result in Ciamis Regency, West Java in 2009, most biology teacher candidates have a low capability in classify of animal based on the existence of similarity and dissimilarity of characters (about 24, 5%) and genetic relationship (about 25 %). The lowing of all teacher candidate's capabilities in classifying and deciding of genetic relationship, along with the lowing of capability for thinking critically, became an important academic study to be held by the related lecturers in the Institute of Education Service (LPTK).

The another finding that related to this lecture, namely (a) the lowing of concept mastery and critical capability of students in some of this courses, that comprised three phylas

(Aschelminthes, Annelida, and Molusca) (Putra et al., 2014).

(b) This study during this was disposed to the lectures-centered, so the students' understanding of this material were less maximum (Suwondi et al, 2013) (3) the study system of this course during this have done by giving the reference books and told the material to the students directly (Tibrani and Madang, 2012). The study system like that caused the students who only active to listen without joint to participate and interact, it can also cause the limitation in study activity and student's capability in mastery the concept as its competency standard. (4) the lack of students scientific attitude in this lecture, and proving throughout the students analysis scale result, that declared if they have an unconfidence scientific attitude toward them finding resulted in observing of invertebrate's body structure, besides that the student have no any positive attitude toward the failure (Putra and Redjeki, 2013).

Based on this field finding that referenced base on the observation result and the experimental result of some experts, concluded that this course study has still far from what expecting, so that the development of this lectures program- inquiry laboratory based to be needed to do and indicated can be solve of all those problems.

2. Research Methode

This study was a mixed method research with embedded design that is: "*Embedded Experimental Model*" (Creswell and Clark, 2007:7). This model can defined as the qualitative data that taped on quantitative data, and in this case the quantitative data as the dominant data. The notation used was a QUAN (qual). The model implementation here can be seen from figure 1.

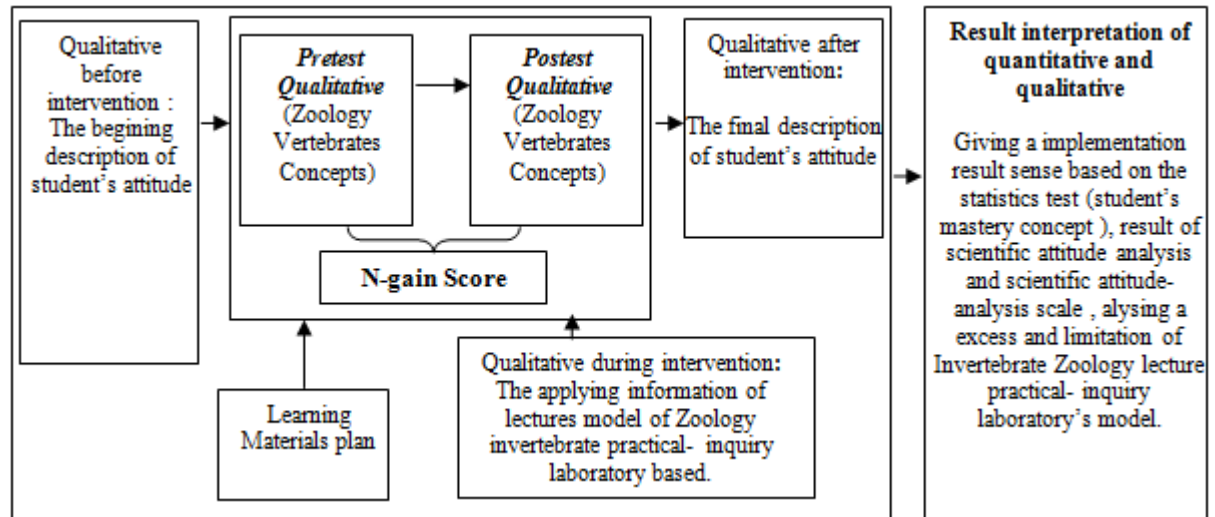


Figure 1: Embedded Experimental model

Before the implementation of this lecture program, the students gave by the scientific attitude scale. After implementation done, the students giving back a scientific attitude scale, that has purpose to know the existence of student's scientific attitude chancing toward invertebrate zoology practical. This activity (intervention) formed application of PPZI-BIL completed by a giving a pretest and posttest to measure the mastery of invertebrate concept and observing the scientific attitude of students. The next step was held the interpretation of both quantitative and qualitative result data in order to give an implementation result sense based on the statistical test (student's mastery concept). The result of this scientif attitude-observation analysis and analysis toward the scientific attitude, along with the excess and the limitation of invertebrate zoology-practical lecture based on laboratory inquiry.

Based on this method as the explanation above, the steps to hold this research divided into 3 main parts, such as (a) preparation step in typed of field study and literature study, the model plan, and limited test, (b) implementation step of the developing model, and (c) interpretation step to giving a sense toward the main test.

This research took place in Biology Education Course Program of the private university in Bandung city, west Java province, about one semester among the September until January 2013, by the population of all third semester's students, academic years 2013/2014 that decided to be 3 classes by total about 163 persons. Those students had firstly followed the general biology course and general biology practical amount of 3 SKS (two SKS for theory and on SKS for practical). The population's characteristics of this research were the students who have a homogeneous capability, it means that all students had fulfilled the regulation for entering passed to this university, so the progress of every student can be seen obviously. The sample of this reseach amounted to 52 persons (one class (B) used the *purposive sampling*, the basic reason to choose this class, that also in step with the using of this sampling kind because it was a discussion result with this course lecturer, and was also the lecturer for general biology course previously, concluded that class B's Students averagely have high motivation rates and the capability than two another

classes (class A and C), besides that the total of students in this class were abit (52 persons) than total of students in two another classes (class A: 56 students and class C: 55 students). The less of students's total caused to efectivity of the study, and also to dividing of group member that caused the total of students was not too much, so to be easy to see the students activity during of lecture. The reason to use one class in this research, because this research was only aim to see, how far the efectivity of this planned program that was a invertebrate zoology lecture program-inquiri laboratory based (PPZI-BIL), becace of that, in this study was only to used one class by comparing between N-Gain posttest value with N-Gen Pretest.

The applying program in this course, was also consisted by 3 SKS (2 SKS of thory and 1 SKS of Practical). The practical carried out after the students have gotten any per-phylum theory (the course carried out per-set or structure) and it to be held, out of the lecture schedule. The reseach variable that measured, including to (1) the students scientific attitude that referenced from 6 indicators (Carim & Sund, 1997) that included : Being Curious in understanding the surrounding nature, give a priority to any facts, dare to approve the differences, cooperative, and be a positive toward the failure (2) the mastering of students concept that compiled by 5 main consepts (phylum), such as *Aschelminthes*, *Annelida*, *Mollusca*, *Arthropoda*, and *Echinodermata's Phylum*.

This reseach consisted by two main components, namely : the component related to the program and the component realted to the program evaluation. The component that related to the program consisted by two syllabus, SAP, and the students work sheet (LKM), the content of LKM itself consisted by material's resume, practical guide, list of questions and working instruction). All components firstly judging by the expert and had been trial. The related component with this program evaluation itself consisted by observation sheets of scientific attitude, and the critical thinking skill, the mastery concept test, the critical thinking skill test, scienctific scale attitude, and motivation scale. That all components were also firstly judging by the experts and had to be tried.

3. Result and Discussion

a. Result

1) Design of PPZI-BIL

Invertebrate Zoology Practical work designed to developing and increasing the scientific attitude and student's concept mastery. Based on a preface study (literature study and field study), so, it held the program planning of practical work. The main activity in this lecture that will observe, namely: Aschelminthes Phylum, Annelida, Mollusca, Arthropoda, and Echinodermata. The Preface planning of this laboratory inquiry program (practical work procedure), has any stages such as:

- a) **Introduction** : explaining of Invertebrate philosophy and the work way, that they will do.
- b) **Question's submission**: appearing the critical question (problems) that submit by the students related to phylums as the research object.
- c) **Verification**: The implementing of PPZI-BIL, that carried out per-package or structured (theory + practical work for one phylum and this application will be executed out of lecture schedule.
- d) **Elaboration** : elaborating the finding result (practical work), related to the theory/exist concept.

The lecture begun by delivering a philosophy or material preface of this course by the lecturer. In this stage, the lecture giving a basic concept about the characteristics of phylum and the basic distributing class. The giving of this preface course, have purpose to gave the beginning knowledge to the students. That delivering material finished by the distributing of student work sheet (LKM), every group got any LKM containing different task. Every groups that have gotten any LKM, should be discussed and divide the task, because the instruction that have given in LKM may allow them to arrange the tools, materials, and delivering the critical question as the observed species. The main key of this stage was a delivering the critical question related to observed species. The delivering question of each group should take time to find any continuation question, so the students' capability to thinking critically will be improved.

The critical questions that have accomodated, must be answered by the verification trough the practical work. The students will be choose the tools and material they were needing to prove or answering the delivering questions. The ussing tools were also referenced to the species availability, by meaning if the species as a living organism or preservation, so the students can be chose the laboratory equipment, such as discenting set, while the group that did not get any species, they have only got any explanation in video type, so they used any computer as the tool to show the video and also the material used, it must be appropriate to the species printed on the LKM. In the reality, were not all answer of delivering questions can be proved by the practical work, so in making out these matters, it was ordered to carry out the literature study (book and journal), although directly asking to the expert in this field. Because of that, the implementation of this program carried out per-package or structured, it means the theory adds by practical work for one phylum and the work continued out of the lecture schedule.

The last stage of this program was an elaboration, that has purpose to check the validity of the getting results during the practical work. If they found any contradiction between the result of the work with the exist concept based on the literature study result, so it may can be additional or continuation study toward this concept, so the capability of the students as the discoverer who were not released form the inquiry activity, can they felt. This activity that will make them to be a scientists based on the experience in the laboratory, will be affected to the developing of the scientific attitude and the mastery of this program's concept. All stage series above will be closed with the arranging the complete report that contained morphology data, anatomy, physiology, the disadvantage, advantage and the relation of the species toward the other organism.

The practical work program plan that had been made, for the next will be validated by the expert to get the input and the most proper for the betterment of the program plan. The validator has skill in this zoology study. The learning evaluation, educational psychology and critical thinking skill. Generally, the expert agreed the model draft of the lecture within the instruments. After the betterment carried out based on the suggestion from the expert, so the stages of the study this course can be seen from Table 1.

Table 1: The Practical Work Procedure of Invertebrate Zoology- Inquiry Based.

NO	Lecturer activities	Students Activities
1	Introduction The lecturer suggested the students sit in their groups (every group have been gained the LKM that consisted of the name of the species that they will discuss) The lecturer explained the preface about the phylum that will discussing. The lecturer gave the task for students to carry out the practical work as the guidance in the LKM.	The students carried out the asking – answering toward the explanation of the lecturer about the phylum that will learned. The students started to carry out the stages in this practical work- inquiry based, as the topics and the guidance that consisted in the LKM.
2	Delivering Questions The lecturer instructed to students to make critical question related to discussing species (in the LKM), so that the living organism of that species can be analyzed.	Students make a critical question related to the discussing species (consisted in LKM)
3	Validation The lecture instructed the students to answer the critical questions that they made, by proving through the practical work- inquiry based.	The students carried out the practical work- inquiry based (to answer the arranged questions)
4	Elaboration The lecture ordered the students to elaborating them finding based on the exist theory/concept.	Students finishing the task or elaborating the their finding result, based on the exist concept or theory, by referenced to the journal, books and expert in this Invertebrate field.

This research used three kinds of instrument, such as scientific attitude instrument scale, scientific attitude observation sheet instrument, and mastery concept test instrument. The trial of scientific attitude instrument scale

consist of 25 points and the test of mastery concept consisted of 80 points, the point that had been tired, firstly revised and the next it used at the time of pretest and posttest the application of this PPZI-BIL.

(2). The limited trial of PPZI-BIL

The practical work model plan that had been validated and revising, as the suggestion of experts, tested on 25 students in the one of private university that located in Bandung City, West Java Province, fifth semester at academic years 2013/2014 and four students in the one of private university in Bandung City, West Java province, fifth semester and seventh semester, at academic years 2013/2014.

b. Implementing Stage of PPZI-BIL

The Implementing stage of this this research was used the *one group pretest-posttest design*, that in this implementing, involved one class of students that have been joining this Invertebrate Zoology course. The implementation stage of this research consisted of (a) analysis of scientific attitude during the implementation of the program, (b) the developing analysis of this program mastery concept during the implementation, (c) the analysis of student's scientific attitude before and after implementation of the program.

(1) the analysis of scientific attitude during the implementation of PPZI-BIL.

The analysis of the scientific attitude during the implementation of this program carried out to get any information about the student's scientific attitude during this implementation. The getting data during the implementation have taken by using the observation sheets, and carried out by the practical assistance and the lecture in every subject explanation or every phylum (every meeting). The valuation toward the student's attitude carried out by giving check the attitude that doing by students as the deciding indicators..

Based on the summary of observation results about student's scientific attitude during the lecture of PPZI-BIL, explained that 70% of the students have any positive scientific attitude and developing it by self. The higher average total found on the closing activity (100%), this matter believed that firstly, both lecture and the assistance explained to the students to make a working paper completely as the deciding systematics, submitting the paper on time, using the valid references, making and answering the critical questions, so that the students be motivated to do this. The lowest average total found in this main activity (89, 64%, this matter caused by the existence of some obstacles in implementing this program, for example, there were some students who shy to ask what things they have not understood yet.

(2) The developing analysis of Zoology Invertebrate mastery concept during the implementing of program.

Student's mastery concept in type of pretest average value, posttest and N-gain. Have gotten from the mastery concept test, and the result was an average of student's pretest about 37, 52 and the average of student's posttest amount 74, 88. This matter indicated that, generally there were an increasing of students.

(3) Result analysis of student's scientific attitude before and after implementation of PPZI-BIL

The analysis of student's scientific attitude before the implementation carried out

To know the beginning condition of students' scientific attitude. Based on the descriptive analysis of the student's attitude, can be explained that generally, the students have had any good scientific attitude, however, there are some indicators that have not maximum yet, namely: the fact give priority to evidence (the statement number 8. (46.15%) and 9 (26.93%)) have a skeptical attitude (statement number 12 (50%)), and have a positive attitude toward the failure (statement number 21 (38,46)).

This attitude analysis, after the implementation to be done to know the final condition of student's scientific attitude. At the beginning description of the attitude, found some weakness and after the implementing of this program, those problems can be solved maximumly. Based on the final description analysis of student's scientific attitude, can be explained that generally, the students have had any good scientific attitude, the highest average indicator chronologically were : indicator can be develop the curious, tolerant to the difference, can be be work together, give a priority to the facts, have a sceptical attitude, be a positive toward the failure.

c. Interpretation Stage of PPZI-BIL

Interpretation stage of this program, before and after the implementing have experienced the increasing significantly. This program gave an opportunity for students to find by them self about concepts related to this Invertebrate Zoology lecture. The qualitative analysis data, during the implementation of a program carried out by two stages, such as through the observation sheet and scale. The observation result indicated, that students developed the scientific attitude during the practical work took place. The indicator of this attitude that improved in every meeting, were indicators of (a) time discipline, (b) focus toward the lecturer explanation, (c) discussing in each group, (d) active during the lecture process, (e) able to asking, without afraid to be wrong, and (g) able to used the appropriate references. While the other indicators, such as: (a) prepare the practical work's equipments, (b) bring the practical work's materials, (c) elaborate the continuation finding result. (d) make a report, (e) joint to reflection activity (quiz), and (f) have an honest attitude in answering questions, as the existing innate in students' self, so the result was positive.

The effect of this program's implementing, toward the students scientific result, can be seen from the student's scientific attitude scale, before and after the implementation of this program. The changing attitude of the student was positively disposed. The students have had any high confidence toward them getting results, was not easy to be believed in a thing, before it proved scientifically, and will be find any validity, if what was then found, did not appropriate to the theory/ exist concept.

4. Discussion

The data analysis above, can be a foundation, if this program can improve the student's scientific attitude and concept

mastery. The result analysis of scientific attitude that selected through the scientific attitude scale, produced the indicator sequences of scientific attitude that developing dominantly, such as: able to work cooperatively (87, 13%), have a skeptical attitude (85,04%), tolerant with the differences (80,69%), developing the curious (79,84%), have a positive attitude toward the goal (72,13%) and give a priority to evidences (71,43%). Widjajanti et al (2011), explained that, the student activity in the laboratory was very effective to be practiced the process skill, developing of the scientific attitude, and improving the comprehension about this science. Because of that, the attitude needed to be built since early, in order they will be a good self and have a quality in the future.

The scientific attitude is an attitude of someone during the research/experiment process, that was an inclination and preparation in giving a response. This attitude was also an inclination of somebody to act in solving a problem. This attitude cannot formed automatically, without any learning activity. This activity was not only can be implemented in the class, but also in laboratory through practical work. The lecture by using the practical work like this was an important thing in developing the student's scientific attitude (Putra and Redjeki, 2013). This attitude has an important role in developing the this qualification. Every student who has this qualification, indirectly have had the interest to them surrounding nature, avoid the generation based on the phenomenon and do not believe with dogmatic conviction (Anagun and Yasar. 2009)

The application of this program had influenced significantly toward the concept mastery, the result explained that the N-gain amount 0,6 and included to medium category. This matter indicated that generally, there were an increasing of student's concept mastery.

The students said had achieved the concept, if they can answer the delivering questions by the lecturer or educator by right. So that, the educator must be paid attention the students beginning knowledge, before they taught the concept, neither the new concept, nor the old one that had been known. The purpose was, to limiting the deviation or of the concept that they knew. Siptawati (2009) also stated that the educator who ignore the process and only orientating to the product, will disposed to make the students remember in the short term, so it's causing the mastery of the concept to be low.

The mastery of concept influenced by the psychological factors, such as intelligence, the attention, interest, talent, ripeness motivation and the tiredness (Santroock 2010). Beside that, the concept mastery can also influence by the learning strategy. This appropriate factor can make that concept can be clung in the student's mind. The learning that engaging the students in the direct field experience, can stimulate the thinking skill, can combine some learning strategies and including kind fields (cognitive, affective and psychomotor) were very need in mastery of learning concept and the one exact way is practical learning based (Putra, Dec., 2014).

5. Conclusion and Suggestion

a. Conclusion

Based on the result of literature study, validation from some experts, experiment (small scale and more extensive scale), so it specifically concludes that:

- 1). PPZI-BIL's characteristics: The study centered to a student, that oriented on the cooperative learning and same age level's tutor, students may focus to be a scientist who expected can find any concept autonomously, the lecturer act as a facilitator and motivator. This component consists of a preface, submission of critical questions, realization throughout the practical work and elaboration of work result.
- 2). PPZI-BIL's application was very influential toward the student's concept mastering escalation, this can be seen from the test's result of mastering concepts. The result showed that happened a significant increasing in every this concept.
- 3). PPZI-BIL's application was very influential toward the increasing of student's scientific attitude, this matter can be seen from the scientific attitude a and result of the student's attitude scale in before and after the applying of PPZI-BIL.
- 4). PPZI-BIL' excess, can be stimulated the students to study independently and make them to be a scientist by giving an opportunity to them to find any concept, through the practical work. The lack of this program were: need the time, complete facilities (room, equipmnets, and materials) and need the student's characteristic who independent, have a curious sense toward the science and have a high motivation in finding the knowledge, neither in class, nor out of class.

b. Suggestion

This study may could be applied by the lecturer who taught this subject, especially Invertebrate Zoology. PPZI-BIL can also used to measure the thinking skill of students, and some other skills.

References

- [1] Anagun, S.S. dan Yasar, S. (2009). Reliability and Validity Studies of The Science and Technology Course Scientific Attitude Scale. *Journal of Turkish Science Education*, 6 (2), 43-45.
- [2] Campbell, N.A. dkk. (2008). *Biologi*. Edisi Kedelapan. Jilid 2. Jakarta: Erlangga.
- [3] Creswell, J.W. dan Clark, V.L.P. (2007). *Designing and Conducting: Mixed Methods Research*. Sage Publications, Inc.
- [4] Damanik, D.P. dan Nurdin, B. (2013). Analisis Kemampuan Berpikir Kritis dan Sikap Ilmiah pada Pembelajaran Fisika Menggunakan Model Pembelajaran *Inquiry Training* (IT) dan *Direct Instruction* (DI). *Jurnal Online Pendidikan Fisika*. 2 (1).
- [5] Putra, R. A., Sudargo, F., Redjeki, S., dan Adianto. (2014). The Analysis of Concepts Mastery and Critical Thinking Skills on Invertebrate Zoologi Course. *International Journal of Science and Research (IJSR)*. 3 (3).

- [6] Putra, R. A. dan Sri Redjeki. (2013). Analisis Sikap Ilmiah Mahasiswa terhadap Perkuliahan Sistematika Invertebrata Berbasis Inkuiri Laboratorium. Prosiding: Seminar Nasional “Arah Pendidikan MIPA Masa Depan; Antara Harapan dan Kenyataan”, FKIP Universitas Mataram. Mataram.
- [7] Rusyana, A. dan Rustaman, N.Y. (2011). Pengembangan Program Perkuliahan Zoologi Invertebrata (P3ZI) Berbasis Keterampilan Berpikir Kritis. *BIOEDUKASI*, 4 (2).
- [8] Santrock, J.W. 2010. *Psikologi Pendidikan Edisi Kedua*. Jakarta: Kencana.
- [9] Siptawati, N.L.P. (2009). *Pengaruh Model Siklus PAS (Pratyaksa-Anumana Sabda) terhadap Sikap Ilmiah dan Penguasaan Konsep Sains Siswa Kelas VIII di SMP Negeri 2 Tabanan Tahun Pelajaran 2008/2009*. Tesis (tidak diterbitkan). UNDIKSHA Singaraja.
- [10] Suwondo, Febrita, E., dan Suryana, A. (2013). Analisis aktivitas dan sikap ilmiah mahasiswa dengan model pengajaran langsung berbasis inkuiri pada mata kuliah sistematika invertebrata. *Jurnal Biologis*. 10 (1).
- [11] Tibrani, M.M. dan Madang, K. (2012). Aktivitas Belajar dan Gain Mahasiswa pada Perkuliahan Zoologi Avertebrata setelah Penerapan Variasi Tahap Metode SQ3R. *Prosiding Seminar Nasional Penelitian, Pendidikan, dan Penerapan MIPA*, Fakultas MIPA, Universitas Negeri Yogyakarta, 2 Juni 2012.

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