



50th ANNIVERSARY
FACULTY OF EDUCATION | KKU



APEC-ICER

2018

13th APEC-KHON KAEN INTERNATIONAL SYMPOSIUM
"BRIDGE 12 YEARS OF APEC LESSON STUDY TO INSIDE HIGH QUALITY CURRICULUM FOR DIGITAL ECONOMIES"

11th INTERNATIONAL CONFERENCE ON EDUCATIONAL RESEARCH
"INNOVATIONS FOR CAPACITY BUILDING AND NETWORKING"

SEPTEMBER 8-11, 2018

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**CONFERENCE
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Rationale and Topical Areas

Rationale

People everywhere inescapably face the challenges of our rapidly globalizing world. Our ways of life, world views, even our most cherished academic paradigms, are being challenged. The need and opportunity for our education systems is clear: we must rise to this historical occasion, not only to adapt to but to play a central role in the transition toward a sustainable future based on transdisciplinary innovation.

These innovation themes cut across the conference's eleven topical areas. Thus, in addition to the sharing of the latest advances in education research and practice in each area, the conference's goal is to facilitate new thinking via each theme separately and in combination. We expect this transdisciplinary exchange of knowledge will result in the emergence of new strands of thought linking all topical areas, and encouraging development of new, more synergistic modes of education research and practice.

Topical Areas:

- Teacher Education and Professional Development
- Curriculum and Instruction, Learning in Classroom Context
- Education Measurement and Evaluation
- Languages, Cultures and Social Contexts
- Educational Management: Planning, Policy Implementation and Assessment
- Mathematics and Science Education
- Educational Psychology and Special Education
- Technology and Innovation
- Education for Sustainable Development
- Physical Education
- Art Education and Art Exhibition

Message from the Host: Faculty of Education, Khon Kaen University

Dear Colleagues,

On behalf of Khon Kaen University, the host of the International Conference on Educational Research (ICER) 2018, I take great pride in welcoming you to *Isaan*, a land rich in history, culture and traditions.



This is the 11th Annual Conference which coincides with the 50th Anniversary Celebration of the founding of Faculty of Education, KKU. This year the ICER conference's theme is ***innovations for capacity building and networking***.

The goals of the conference are to give international educators the opportunity to share ideas and form networks while working together toward achieving the aim of the conference' theme. It is anticipated that the exchange of ideas and research findings will contribute greatly to future generations.

During the ICER 2018 event, the APEC-Khon Kaen International Symposium 2018 with its theme "*Bridge 12 years of APEC Lesson Study to InMside High Quality Curriculum for Digital Economies*" is also held at KKU starting from September 8 to September 11, 2018. The meeting is aimed at discussing the lesson learned from 12 years of implementing lesson study and way forward to inclusive mathematics for sustainability in digital economy. Nonetheless, the two events will share the plenary sessions during the first two days of APEC symposium. This is providing a great opportunity to extend the network of educators and researchers in order to learn and share about the future education.

In closing, I would like to express my gratitude to our co-host institutions, the guest speakers and the organizing committees for their efforts. I also would like to thank all delegations and participants who come from afar to join this event.

Associate Professor Maitree Inprasitha, Ph.D.
Dean, Faculty of Education
Director, Institute for Research and Development in Teaching Profession for ASEAN
Director, Center for Research in Mathematics Education
Khon Kaen University
Thailand

Message from Co-host



The Faculty of Education and Human Development is young faculty that aspires to contribute in meaningful ways to education development in the Asia Pacific Region. It is an integral part of The Education University of Hong Kong - a multidisciplinary education focussed institution with a strong research emphasis. The University has a growing international reputation for excellence in preparing globally aware professional educators, providing culturally enriched educational experiences, and producing research of distinction. Central to the University's values is a commitment to developing international and regional networks that will facilitate the integration of intercultural and global dimensions into its teaching, learning, and research.

At EdUHK we particularly value collaborative research with international partners. We seek to understand better the contexts that influence people in the Asia Pacific region and to identify ways of improving social outcomes for all. We see international partnerships as important opportunities for enhancing the impact of our research.

EdUHK is proud to join with Khon Kaen University to co-host the 2018 International Conference on Educational Research.

Professor Allan Walker
Joseph Lau Chair Professor of International Educational Leadership
Dean, Faculty of Education and Human Development
The Education University of Hong Kong
HONG KONG SAR
People's Republic of China

Message from Co-host

It is an honor for the College of Education of Mindanao State University-Iligan Institute of Technology (MSU-IIT) to continually co-host the International Conference on Educational Research (ICER) in partnership with the Faculty of Education, Khon Kaen University, Thailand. This eleventh annual conference on September 8-9, 2018 with the theme: “Innovations for Capacity Building and Networking” is a very significant occasion to bring to the fore the achievements in the various academic disciplines, share best teaching-learning practices across the globe and increase collaborative linkages of educational institutions through more creative ways.



In our current situation, there are new discoveries that contribute to the evolution of knowledge. This propels innovative ways of doing things. The changes that are happening can best be understood when disseminated in an appropriate assembly such as the ICER. It is a venue where educators and researchers can engage in a dynamic exchange of ideas and experiences in the fields. New learning from this gathering can further promote excellent educational practice.

I wish all the delegates a meaningful encounter of new friends and associates among the participating universities and learning institutions. May they forge stronger collaboration in many areas of academic endeavors so that they can deliver the best and effective services that are responsive to the needs of the learners.

Once again, let me congratulate the Faculty of Education of Khon Kaen University for the commitment to the goals of the ICER. To the organizers and resource persons, thank you for sharing your expertise. To the participants, may the ICER 2018 spark greater enthusiasm for productivity, progress and sustainable life for everyone.

Associate Professor Josefina M. Tabudlong, Ph.D.
Dean, College of Education
Mindanao State University-Iligan Institute of Technology
Mindanao, Philippines

Message from Co-host



Welcome to the International Conference on Educational Research (ICER) 2018: Innovation for Capacity Building and Networking which will be held during September 8 – 11, 2018 in Faculty of Education Khon Kaen University.

The 11th annual conference alongside with the 50th anniversary of the establishment of the establishment of Faculty of Education Khon Kaen University has specific aims to give international educators the opportunity to share ideas and form networks while working together on challenging education for future change. This is in line with the main goal of education in as the fundamental human right. Moreover, hopefully through this conference stable networks between educators, universities, and stakeholders will be formed. In return, it can also ensure the implementation of sustainable education in each country now and after.

However, as a co host of the International Conference on Educational Research (ICER) 2018, the success of this conference depends ultimately to all of us who have supported our members of university to join the conference. Especially, we deliver our greatest appreciation for Khon Khaen University in organizing the technical program; the Program Committee for their thorough and timely reviewing of the papers, and all committee who have helped us to for all participants. Furthermore, recognition should also go to the Local Organizing Committee members who have all worked extremely hard for the details of important aspects of the conference programs and seminar. Truly, thank you to the partners who jointly organize this great and extraordinary event.

Last but not least, thank you to all participants of ICER 2018 who have shared idea and insight also with the good cooperation for supporting the education quality. I firmly believe by this conference, we can create foundation of life through education and take part in realizing sustainable development goals (SDGs) especially for quality education. Thus, we expect to get technical insight and tremendous opportunities for formal and informal networking which will be useful for every aspect of life.

Sujarwanto
Dean, Education Faculty
Universitas Negeri Surabaya
Indonesia

Message from Co-host



The Central University of Technology (CUT) is extremely proud to be associated with Khon Kaen University, not only as a MoU partner, but also by participating in co-hosting the *International Conference on Educational Research (ICER) 2018: Innovations for Capacity Building and Networking*. CUT also congratulates Khon Kaen University on the institution's 50th anniversary celebration- indeed a mammoth milestone achieved through a life long commitment to quality teacher education and becoming a leading, international faculty of education.

As a global south partner to ICER 2018, CUT pledges its support in solidifying its current engagements with Khon Kaen University and forging vibrant relations and collaborative interactions with the other partners partaking in ICER 2018. CUT further commends Professor Maitree Inprasitha and the local ICER Organising Committee members for their leadership demonstrated in coordinating activities, confined to the successful operationalisation of this milestone event.

I'm hopeful that the ICER 2018 gathering will be blessed with fruitful engagements which could provide a platform for research collaboration, international partnerships and networking opportunities amongst participants. CUT is indeed geared in learning good practices from partner institutions across the Asian context.

Professor Nosisi Nellie Feza
Dean, Faculty of Humanities,
Central University of Technology,
South Africa

Message from Co-host



I would like to sincerely congratulate Khon Kaen University for organizing ICER 2018. Especially, it is a great pleasure for KNUE to co-host ICER this year.

I myself have had many chances of visiting Khon Kaen APEC for Lesson Study Group and have participated in ICER since its early years. Every time I visit Khon Kaen, I am highly impressed with academic enthusiasm of the College of Education, Khon Kaen University under the leadership of Associate Professor Maitree Inprasitha. Moreover, I have been certainly able to find their advancement of academic capabilities in ICER.

Through continuous collaborative activities in ICER, KNUE and Khon Kaen University are expected to establish more close relationships. I am looking forward to more exchanges of students and faculty members between KNUE and Khon Kaen University.

I would like to appreciate your kind invitation to KNUE as a co-host of ICER 2018. KNUE will do its role so as to contribute to development of ICER.

Once again, I congratulate all of you for opening ICER 2018 successfully.

Professor Lew Hee-chan
President, Korea National University of Education
South Korea

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Effectiveness of Inquiry Learning Model in Photosynthesis and Respiration Material To Increase of Science Process Skills for Biology Education Students

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Abstract

This study aimed to measure the effectiveness of inquiry-based learning model on photosynthesis and respiration materials in terms of the completeness of scientific process skills and to describe students' responses to the application of the model. This study began with developing a learning device using inquiry-based learning model on photosynthesis and respiration materials. The learning device was tested on students majoring Biology Education to train their scientific process skills covering formulating research problems, proposing hypotheses, defining variables, constructing and conducting experiments, analyzing data and drawing conclusion. This study used three methods namely observation, test, and questionnaire. Observation was used to assess the implementation of inquiry-based learning model while test was employed to look at the students' scientific process skills. The result of the test was considered effective if there were more than 50% of students passed the learning who had score more than 65. At last, questionnaire was used to gather students' responses regarding the implementation of inquiry-based learning model. The obtained data were analyzed using descriptive quantitative approach. Results showed that the scores of students' scientific process skills for photosynthesis and respiration materials depicted 93.5 and 86.9 respectively, of which all students passed the course. The best score for photosynthesis material was in conducting experiment (100), then followed by proposing hypotheses (98.75) and presenting data (96.75). Meanwhile, the best score for respiration material was in proposing hypotheses (97.37), then followed by conducting experiment (98.37) and formulating research problems (96.71). Overall students' responses were positive in which 96.15% of them were attracted to use inquiry-based

Keywords: inquiry-based learning model, photosynthesis, respiration, scientific process skills

INTRODUCTION

Plant Physiology course is a compulsory subject for students to enable taking many other elective courses such as phytohormone and nutrient science. Mastering the concept of physiology and scientific process skills remains essential in order to apply the concept on other disciplines. The mastery of such materials is important when students proceed their final study producing undergraduate thesis or called *skripsi*. In other sides, students might experience about critical thinking to troubleshoot various existing problems nearby their living environment.

Based on the conducted teaching and learning process in Plant Physiology course, students' learning attainments regarding photosynthesis and respiration materials were very low. For instance, their average classroom score was only 62.32 for photosynthesis material and 51 for respiration material. They also showed low ability in understanding various process skills. In short, such phenomena indicated that students had difficulties in learning.

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They had not been able to formulate problems, identify variables, devise experimental design, analyze data, and draw conclusion. Since they have not been skillful in identifying variables, they might

face troubles in formulating research problems. Henceforth, the right learning model and strategy is important to address the above multifaceted issues. Here, the researchers propose inquiry-based learning model as to cope with the ways to overcome the issues.

Schwarz (2009) and Alameddine (2016) define *inquiry* as an instructional approach that involves students in conducting scientific investigations focusing on creating, evaluating, and revising scientific models that can be applied to understand and predict nature. It is also a learning strategy that invites students to solve problems through experimental activities by the aim that students can build their own understanding of scientific process starting from formulating research problems, conducting experiments to obtain data, and drawing conclusions. Further, students are expected to get a meaningful learning process and able to improve their process skills (Alberta, 2004; Thoron and Myers, 2011; Ogan-Bekiroğlu and Arslan, 2014). Whereas, Alfieri, Brooks, Aldrich, and Tenenbaum (2011) conducted a quantitative study using a meta-analysis method to compare *inquiry* using direct instruction or *inquiry* without instruction, of which the result showed that inquiry learning model made students improve their learning outcomes. Pedaste *et al.*, (2015) and Sriarunrasme *et al.*, (2015) concluded that inquiry-based learning model can improve scientific process skills that include identifying problems, formulating research problems and hypotheses, planning and carrying out experiments, collecting and analyzing data, presenting results, and drawing conclusions.

That is, this study is conducted to measure the effectiveness of inquiry-based learning model on photosynthesis and respiration materials in terms of the mastery of scientific process skills, including formulating research problems and hypotheses, identifying variables, devising experimental designs, analyzing data, and drawing conclusion. This study also describes students' responses to the application of inquiry-based learning model.

DESIGN

This study used inquiry-based learning model on photosynthesis and respiration materials. The learning devices used covered handouts, student's worksheet, and lesson plan. The implementation of the learning devices was carried out in the Laboratory of Physiology, Biology Department, Mathematics and Science Faculty, Universitas Negeri Surabaya. The learning devices were implemented to students majoring Biology Education who programmed Plant Physiology course. In this study, students were trained in scientific process skills.

The data were obtained through three different methods. First, observation was employed to look at the implementation of inquiry-based learning model by assessing the implementation of the teaching and learning process. Second, test was to reveal the students' scientific process skills after the inquiry-based learning model implemented by the lecturer. In this case, the lecturer referred to one of the researcher boards. Scientific process skills were considered effective if the percentage of students who could achieve the learning completeness was more than 65 with more than 50% of students passed the test. Third, questionnaire was used to find out the students' responses to the teaching and learning process using the inquiry-based learning model. The questionnaire was given to the students after the learning process done. Learning devices were considered effective if the percentage of positive responses given by students was more than 71%. The obtained data were analyze using descriptive quantitative approach.

FINDINGS

A. Results

The study results covered the outcomes of students' scientific process skills, the completeness of learning process, and students' responses toward the implementation of inquiry-based learning model.

1. Students' Scientific Process Skills

Table 1. Students' scientific process skills on photosynthesis material

Student's Number	Scientific Process Skills							Total Scores
	FP	H	V	E	CD	AD	C	
1	3	4	4	4	4	4	4	27
2	4	4	4	4	4	4	3	27
3	3	4	4	4	4	4	4	27
4	3	4	3	4	4	3	3	24
5	3	3	4	4	4	4	3	25
6	4	4	4	4	4	4	3	27
7	3	3	4	4	4	3	4	25
8	4	4	4	4	3	3	4	26
9	4	4	4	4	4	4	4	28
10	4	4	4	4	4	4	3	27
11	3	4	4	4	4	4	4	27
12	3	4	4	4	4	3	4	26
13	4	4	4	4	4	4	4	28
14	3	4	4	4	4	4	4	27
15	4	4	4	4	4	4	4	28
16	4	4	4	4	4	4	4	28
17	3	4	4	4	4	3	3	25
18	4	4	3	4	4	4	3	26
19	3	4	4	4	3	2	4	24
20	3	4	4	4	3	3	4	25
21	3	4	4	4	4	4	4	27
22	3	4	4	4	4	4	3	26
23	3	4	4	4	4	4	4	27
24	3	4	3	4	4	4	4	26
25	3	4	3	4	4	4	4	26
26	4	4	4	4	4	3	4	27
27	4	4	4	4	4	3	4	27
28	4	4	4	4	4	2	4	26
29	3	4	3	4	4	4	4	26
30	4	4	4	4	4	4	3	27
31	4	4	3	4	4	3	4	26
32	4	4	3	4	3	3	4	25
33	4	4	4	4	4	4	3	27
34	3	4	4	4	4	2	4	25
35	3	4	4	4	3	4	3	25
36	4	4	4	4	4	3	4	27
37	3	4	3	4	4	2	4	24
38	3	4	3	4	4	3	4	25
Average	3.45	3.95	3.76	4	3.87	3.47	3.71	26.21

Points								
Average Scores	86	98.75	94	100	96.75	86.75	92.75	93.57

Notes:

- FP : Formulating research problems
H : Proposing hypotheses
V : Determining variables
E : Planning and conducting experiment
CD : Collecting and presenting data
AD : Analyzing data
C : Drawing conclusion

Table 1 shows that the students majoring Biology Education gained an average point of 3.74 with average score of 93.57, which were categorized as very good and effective (scores ranging from 86 to 100 were 100% very good). The best score of students' scientific process skills was in conducting experiments, then followed by formulating hypotheses and presenting data. Meanwhile, the lowest score was in formulating research problems. In addition, the scientific process skills on respiration material can be seen in table 2.

Table 2. Students' scientific process skills on respiration material

Student's Number	Scientific Process Skills							Total Scores
	FP	H	V	E	CD	AD	C	
1	4	4	3	4	3	2	2	22
2	4	4	2	4	4	3	4	25
3	4	4	3	4	3	2	3	23
4	4	4	3	4	3	2	3	23
5	4	4	3	4	4	3	4	26
6	4	4	4	4	4	3	4	27
7	4	4	3	4	3	2	3	23
8	4	4	4	4	3	3	3	25
9	4	4	3	4	4	4	4	27
10	4	4	4	4	4	4	4	28
11	4	4	4	3	3	4	3	25
12	4	4	3	3	3	2	3	22
13	4	4	3	4	4	4	3	26
14	4	4	2	4	3	2	4	23
15	4	4	3	4	3	4	4	26
16	4	4	2	4	3	3	4	24
17	4	4	3	4	3	3	4	25
18	4	4	2	4	4	4	4	26
19	4	4	3	4	3	2	3	23
20	4	4	3	4	4	2	4	25
21	4	4	4	4	4	4	3	27
22	3	4	4	4	4	3	4	26
23	4	4	3	3	3	3	3	23
24	4	4	3	4	4	3	3	25
25	3	4	2	4	3	2	3	21
26	4	4	2	4	4	3	4	25
27	4	4	3	3	3	3	4	24
28	3	3	2	4	4	3	3	22

29	4	4	3	4	4	3	4	26
30	4	4	3	4	4	3	4	26
31	3	3	2	4	4	2	4	22
32	4	4	2	4	3	4	4	25
33	4	4	4	4	3	3	2	24
34	4	3	2	4	3	2	4	22
35	4	4	4	4	3	2	3	24
36	4	4	3	4	3	2	4	24
37	3	4	2	4	3	1	3	20
38	4	3	4	4	3	3	4	25
Average Points	3.87	3.89	2.95	3.89	3.42	2.82	3.50	24.34
Average Scores	96.71	97.37	73.68	97.37	85.53	70.39	87.50	86.9

Table 2 showed that the students majoring on Biology Education gained an average point of 3.47 with the average score of 86.9, which were categorized as very good and effective (scores ranging from 70.39 to 97.37 were in a very good category). The best score of the students' scientific process skills was in formulating hypotheses, then followed by conducting experiments and formulating research problems. However, the lowest score was found in presenting data. In short, students showed better scientific process skills on photosynthesis material rather than the respiration ones.

2. The Implementation of Teaching and Learning Process

Using observation method, Table 3 shows the implementation of teaching and learning process on photosynthesis and respiration materials.

Table 3. The teaching and learning process on photosynthesis and respiration

Stages	Activities	Completed Implementation (%)	
		Photosynthesis	Respiration
Opening	Preparing class readiness	100	100
	Motivating and apperception	100	100
	Delivering learning objectives	100	100
Whilst	Orientation process	100	97.69
	Formulating research problems	100	100
	Proposing hypotheses	100	100
	Identifying variables	100	100
	Planning experiment	100	83.33
	Conducting experiment	100	100
	Collecting data	100	100
	Analyzing data	100	100
	Drawing conclusion	100	100
	Communicating experiment results	100	100
Closing	Concluding the concept	100	100
Average score of the completed		100	98.64

implementation of the teaching and learning process		
Average score of the completed implementation of the first and second teaching and learning processes	99.32 %	

The obtained average score from the first and second teaching and learning processes was 99.32% with a very good and effective category. However, still few of students found difficulties in designing the experiment.

3. Students' Responses to the Implementation of Inquiry-Based Learning Model

Table 4 depicts students' responses to the implementation of inquiry-based learning model. Students showed both positive and constructive responses.

Table 4. Students' responses to the implementation of inquiry-based learning model

No	Aspects	Positive Response (%)
1	Student's attracted feeling to the implemented teaching and learning process - Students felt that the teaching and learning process was interesting Reasons: ➤ Existing interaction between students and lecturer ➤ Varied teaching and learning process including practicum, presentation, and explanation of the theory ➤ Practicum that made the learning process interesting ➤ Existing handouts containing the taught materials ➤ Students were actively involved in the learning process ➤ Enhancing student's understanding on the delivered materials ➤ Existing problems to be discussed during the learning process ➤ Interesting presentation ➤ Interesting and not boring learning process ➤ Clear and understandable lecturer's explanation	100 10.3 5.1 10.3 10.3 17.9 17.9 10.3 2.6 5.0 10.3
2	Benefits from the learning process - Improving students' knowledge regarding photosynthesis and respiration - Developed students' observation skill - Students experienced practicum - Structured learning process - Revealing students' initial and last skills	100 84.6 5.1 5.1 2.6 2.6
3	Aspects that need to be improved during the conducted teaching and learning process: - Nothing to be improved, already good - The deeper understanding of the taught concept - Materials should be delivered slower - The use of interesting and effective learning media - Efficient times - Material structure - Students' affective	20.8 10.2 5.1 20.3 13.1 12.6 15.4 2.5

No	Aspects	Positive Response (%)
	• More distributed handouts for each student	
4	Forbidden things for students to do during learning process: • Being less focused during the learning process • Joking while the learning process • Discussing topics out of the lesson • Playing hand phone during the learning process • Being late • Being disobedient to the lecturer's instruction • Being busy with the group's work and neglecting other groups' presentation • Ignoring handouts • Being passive • Being sleepy	5.1 20.5 20.4 10.3 2.6 12.6 16.6 4.6 4.7 2.6
5	Suggestions for the better upcoming teaching and learning processes: • Improving the active, creative, and innovative learning process • Improving various learning model for the classroom activities • The learning process was already good • Improving how the materials were delivered in order to make students easily understood • Giving more often feedbacks • Interesting learning process • Students got more knowledge during the learning process • Helpful handouts and student's worksheet to assist students learn • The theory should be simplified • Students should be more ready to come into the class • Enhancing time management • Giving more student-lecturer interaction • Improving interesting learning media • The materials in a form of power point format should be initially distributed before the learning process conducted • Improving the structure of the concept taught • Interesting learning process	7.6 8.6 12.8 7,6 5.6 10.5 12.6 10.5 2.3 2.6 2.6 3.1 3.2 2.6 2.6 5.2

Based on Table 4, students' responses were positive to the conducted learning process (average score = 96.15). They were very interested in learning (92.3%), and 100% of students said that the use of inquiry-based learning model increased their insight about photosynthesis and respiration materials. Students also provided suggestions to further improve the quality of the learning process, especially on the use of student's worksheet, handouts, and learning variations.

B. Discussion

The results of the scientific process skills on photosynthesis material showed that the students gained an average score of 3.74 (with total score of 93.5), categorized as very good and effective (scores ranging from 86 to 100 = very good). The best score was in conducting experiments then followed by formulating hypotheses and presenting data. The results of the science process skills on respiration material showed that the students gained an average

score of 3.47 (with total score of 86.9), categorized as very good and effective (scores ranging from 70.39 to 97.37 = very good). The best score was in formulating hypotheses then followed by conducting experiments and formulating research problems.

The increased scores obtained in the present study was due to the fact that the students were given a prior understanding of the stages, definitions, and examples of each stage in scientific process skills before the learning activities conducted. In addition, researchers also assisted each group and help students complete each stage of scientific process skills to make students understand the stages of scientific process skills. The researchers also gave several questions to group members related to the stages of scientific process skills as stabilization. Based on the data obtained, the application of inquiry-based learning model could improve students' scientific process skills (Yuliani, *et al.* 2017).

The results of the present study also indicated that the students' skills in formulating hypotheses were very good because they were able to identify manipulation and response variables and formulate research problems. The hypotheses were made during the research planning process to provide predictions about the effect that might occur from the manipulation variable on the response variable. The formulation of the hypotheses was done through the following stages: (1) the hypotheses were generated from the identified problems or the proposed questions, (2) the hypotheses must be tested through an investigation, and (3) the hypotheses were formulated in a form of a statement, not in a question (Cigrik and Muhlis, 2015).

The results showed that most students started to get used to and mastered all stages of process skills. They were accustomed to abstract thinking by getting used to the stages of scientific process skills. According to Piaget's theory of cognitive development, children at the age of 11 or above entered the formal operational stage (Suparno, 2007) and already had the ability to think abstractly, to reason logically, and to draw conclusions precisely from the available information.

Ogan-Bekiroğlu & Arzu (2014) explained that by conducting inquiry-based learning model could improve students' scientific process skills. Pedaste *et al.* (2012) and Windschitl *et al.* (2008) concluded that inquiry-based learning model could improve scientific process skills. Likewise, Njoroge *et al.*, (2014) and Lee (2014) stated that using inquiry-based learning model or also called as Inquiry-Based Teaching (IBT) could make students get better learning achievements.

The average score of the implementation of the conducted teaching and learning process was 99.32% with a very good category. Even so, there were students who still experienced difficulties related to designing experiments. Students also gave a positive response to the conducted learning process (mean = 96.15). They were very interested in learning (92.3%), and 100% of students said that inquiry-based learning model could increase students' insight about photosynthesis and respiration materials. Teaching and learning process using inquiry-based learning model did not only increase students' insight but also train students' process skills.

RECOMMENDATION

1. Inquiry-based learning model on the material of carbohydrate metabolism is effective in terms of the mastery of scientific process skills, 93.5 (A) for photosynthesis material and 86.9 (A) for respiration material. 100% of students majoring Biology Education enrolled in 2015 passed the course focusing on scientific process skills.
2. The implementation of the teaching and learning process was 99.32% with a very good category where students' responses are positive at 96.15%, of which students are very interested in learning.
3. The application of inquiry-based learning model could improve students' scientific process skills, such as formulating research problems and hypotheses, identifying variables, devising experimental designs, analyzing data, and drawing conclusion.

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