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Research Article

Empowering critical thinking skills by implementing scientific approach-based models among various students' ethnics

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ABSTRACT

In empowering students' 21st century skills, the implementation of scientific approach-based models (SAbM) is recommended. This quasi-experimental research was conducted in senior high school in which the students were comprised of different ethnics. The aim of the study was to determine the effect of SAbM on empowering students' critical thinking skills (CTS). The SAbM implemented were Problem-Based Learning (PBL), Guided Inquiry (GI), and PBL+GI combination. Furthermore, the students' ethnics included were Javanese, Bugis, Kutai, Banjar, and Toraja. The purposive sampling was used to determine the classes employed (i.e. 11th classes from two senior high schools in Samarinda). The instrument used to collect CTS data was questions test. The data were analyzed using two-way ANCOVA. The results showed that there was no significant interaction between ethnic and learning models on the students' CTS (p = 0.219), as also shown by the main effect of ethnic types (p = 0.583). In contrast, there was a significant effect of SAbM on students' CTS (p = 0.0005) Through this study, SAbM need to be implemented continuously as it can optimize the empowerment of students' 21st Century skills.

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INTRODUCTION

Biology is a difficult subject for most high school students (Etobro & Fabinu, 2017). Various topics and concepts in this subject have a high level of difficulty (Çimer, 2012). One of the difficult topics to study is "Cells and tissue organisms' body" topic. The cell is the smallest unit of the living body. Its microscopic size makes it difficult for students to imagine and to learn this topic. One of the main skills to make it easier for them to learn

abstract topic is critical thinking skills (CTS) (Crowley, 2015). A scientific approach-based learning model (SAbM) seems to be appropriate to implement in such learning conditions.

The choice of learning models is adjusted or tailored to the learning objectives to be achieved by students (Tyabaev, Sedelnikova, & Voytovich, 2015). Problem-Based Learning (PBL) and Guided Inquiry (GI) are two examples of scientific approach-based learning models usually used in biology. These learning models allow students to gain experience in problem formulating, data collecting, data analysis, discussing the results, making conclusions, and predicting (Firman, Baedhowi, & Murtini, 2018).

In PBL activity, a real problem is faced at the beginning of learning activity then the students solve the problem by the teachers' guidance. However, the teachers do not dominate the learning activity (Servant-Miklos, 2019) to improve students' critical thinking skills and make the best decision (Dring, 2019). During PBL implementation, students are involved collaboratively in their groups to carry out problem-solving activities (Andersen, Brunoe, & Nielsen, 2019; Panlumlers & Wannapiroon, 2015). In these activities, students are formulating the problem, planning the problem-solving process, implementing the problem-solving plan, and reflecting their learning (Panlumlers & Wannapiroon, 2015). On the other hand, in GI, students will learn science concepts through the scientific process, from formulating problems to presenting findings (Arslan, 2014; Vlassi & Karaliota, 2013). GI offers an integrated unit of inquiry, planned, and guided by an instructional team of a school librarian and teachers, allowing students to gain deeper understandings of the subject's area of curriculum content and information literacy concepts.

Unfortunately, the learning activity in biology subject at the 11th class of Senior High School in Samarinda was still dominated by conventional learning (Boleng & Maasawet, 2018). In line with those condition, the skills level of the students in analyzing, making conclusions, and predicting, in the learning in the cell and tissue of organisms' body subject at Senior High School, was low. Students are less interested in asking questions, doing analysis, lacking data to make conclusions, and less skilled in predicting based on the data. A study conducted by students is still lacking in sharpness, lack of focus, and lack of data (Boleng, Lumowa, Palenewen, & Corebima, 2017). Therefore, the implementation of SAbM in biology subject in Samarinda is need to be carried out.

However, apart from choosing a learning model, there are other factors that also need to be considered to optimize student learning achievements. Students' ethnicity is believed can influences students' learning processes and outcomes. Different ethnics students bring out different attitudes and characters (Ahmad & Yusof, 2010; Jayapalan, Wong, & Aghamohammadi, 2018). The unique character of students tends to influence the learning process and the success of learning outcomes achievement, e.g., understanding concepts, critical thinking skills, creative thinking skills, social attitudes, and others. East Kalimantan is a region, which has multiethnic, socio-cultural, and religious diversity (Murjani, 2012). In 2018, the number of Senior High School students in Samarinda was 869, which was dominated by four major ethnic groups, i.e., Javanese, Bugis, Kutai, and Banjar about 36.13%, 10.12%, 10.12%, and 14.84%, respectively. While other ethnicities are 27.68%, consists of other ethnic groups, both local and migrant ethnic groups (Boleng & Maasawet, 2018).

Based on the diversity of ethnicities in Samarinda and the potential of several SAbMs in optimizing the biology learning process on the topic of "Cells and tissue organisms' 'bodies", it is necessary to conduct research that examines the effect of these two conditions on students' critical thinking skills. This study has a clear distinction from previous studies because most of the previous studies only examined the effect of SAbM on learning outcomes (Hsu, Yen, & Lai, 2016; Panasan & Nuangchalerm, 2010) or thinking skills (Ersoy & Baser, 2014; Hussin, Harun, & Shukor, 2018), while other studies only examined the effect of ethnicity on students' belief (Rubie-Davies et al., 2012) and learning participation (Ke & Kwak, 2013). Furthermore, previous studies have only examined the effect of PBL (Kuvac & Koc, 2018; Thakur & Dutt, 2017) and GI (Saefullah et al., 2017; Vlassi & Karaliota, 2013), while research that combines PBL and GI is still difficult to find. Therefore, the aimed of this study was to examine the effect of combining PBL and GI and ethnic differences on students' critical thinking skills. This research is urgent to do because the findings of this study can be used to optimize the learning process in multiethnic conditions. In addition, an assessment of the difference in effects between PBL, GI, and PBL+GI integration will provide new information on whether the combination of the two SAbMs have a significant effect on 21st Century skills empowerment or not.

METHOD

This study was a quasi-experiment, which conducted on the odd semester of the academic year of 2018/2019. Four classes were selected by purposive sampling of 11th class (primary in mathematics and natural sciences) from 2 senior high schools in Samarinda, Indonesia. The study population was all students with ethnic backgrounds of Javanese, Bugis, Kutai, Banjar, and Toraja. The sampling criteria were at least there are three students with the background of the five ethnicities in the class. A total of 143 students involved

in this study, divided in PBL, GI, PBL+GI and Conventional classes with the number of 31, 21, 22, and 32 students, respectively. While the number of students with different ethnicity background in the class implementing the PBL were 14, 4, 5, 4 and 4 for Javanese, Kutai, Toraja, Bugis, and Banjar, respectively; In the GI class were 4, 4, 4, 5 and 4 for Javanese, Kutai, Toraja, Bugis, and Banjar, respectively; In the PBL+GI class were 6, 4, 4, 4 and 4 for Javanese, Kutai, Toraja, Bugis, and Banjar, respectively; In the Conventional class were 13, 4, 6, 5 and 4 for Javanese, Kutai, Toraja, Bugis, and Banjar, respectively. The students have equality academic background as shown by National Junior High School student test score data. The ethnicity of the students was listed at the beginning of the experiment. The students were continuously participating in the learning activities (subject to their respective groups) during this study.

The experimental design of this study was the non-equivalent pre-test post-test control group design. The study group was divided into four groups. The four study groups consist of groups (classes) those applied: (1) Problem-Based Learning (PBL), (2) Guided Inquiry (GI), (3) a combination of PBL and Guided Inquiry (PBL+GI), and (4) Conventional. The four groups were subjective to a pre-test, in the beginning, then followed by a post-test at the end of the intervention (Figure 1).

The independent variable was a student-centered learning model and the Conventional learning model as control. The dependent variable was the critical thinking skills with indicators of (i) the skills of analyzing, (ii) making conclusions, and (iii) predicting. The relationship model between variables is shown in Figure 1.

The instruments used in the data collection process were: (1) questionnaires, and (2) questions test. The questionnaires were used to obtain information about the ethnicity of students. Furthermore, the questions test was used to collect information about the students' critical thinking skills scores before and after the application of the treatment. The form of test questions was essay. Several questions were five items, and are expected to be answered by the students within 90 minutes.

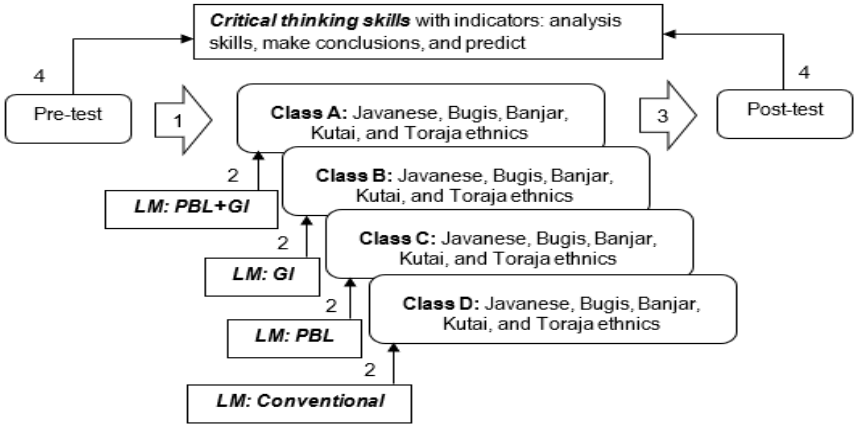

Figure 1. Model of the relationship between independent (LM = Learning Models) and dependent variables (Critical thinking skill) in the experimental design. *The experiment was conducted in the rows of [1] Pre-test was applied to all class (A, B, C, and D), [2] Treatment was applied, [3] Post-test was applied, and [4] Analysis of Pre-test and Post-test result for Critical thinking skill*

Table 1. Problem-Based Learning (PBL) and Guided Inquiry (GI) combined syntaxes

Syntaxes	Student Activities
Problem orientation (PBL)	○ Students observe/observe in groups the description of problems related to cells, body tissues of organisms.
Student organizations to carry out studies (observations) (PBL and GI)	○ Students in groups, formulate problems related to the concept of cells, organisms' body tissues, after observing the problem description. ○ Students are looking for ways to solve problems related to observation or understanding the gaps contained in the problem description.
Hypothesis (GI)	○ Students, as a group, formulate hypotheses.
Experiment (GI)	○ Students in groups carry out experiments.
Free group investigation (PBL & GI)	○ Students collect data needed to solve problems that have been formulated.
Discuss in groups related to the data obtained (PBL and GI)	○ Students discuss in their groups about the data obtained to solve the problems they have formulated.
Presentation (PBL and GI)	○ Students in groups present the results of their discussion to all other groups of students in the class.

In this study, the PBL+GI syntaxes are designed in seven steps (Table 1). Thus, the PBL+GI become new syntax and is expected to be more empowered in improving the students' critical thinking skills. The test questions given in the pre-test and post-test are similar. The pre- and post-test results were scored using a scoring rubric, as shown in Table 2., which adapted from the rubric developed by (Hart, 1994).

Table 2. Rubric scoring

Predictors	Score
All characters below appear	4
○ There is information/data following the problems related to the organisms' cells and tissues	
○ Analyze following issues related to the organisms' cells and tissues	
○ Make logical conclusions about the organisms' cells and tissues	
○ Make logical predictions about the cells and tissues of the organisms' body	
One of the characters below appears	3
○ There is insufficient information/data following the problems related to the organisms' cells and tissues, or	
○ Making analysis less relevant to the issues associated with the organisms' cells and tissues, or	
○ Making less logical conclusions about organisms' cells and tissues, or	
○ Make less logical predictions about the cells and tissues of the organisms' body	
All characters below appear	2
○ Lack of information/data following the problems related to the organisms' cells and tissues	
○ Making analysis fewer following issues related to the cells and tissues of the organisms' body	
○ Making less logical conclusions about the cells and tissues of the organisms' body	
○ Make less logical predictions about organisms' cells and body tissues	
One of the characters below appears	1
○ There is no information/data following the problem related to the organisms' cells and tissues, or	
○ Making analysis incompatible with issues concerning the organisms' cells and tissues, or	
○ Make illogical conclusions about organisms' cells and tissues, or	
○ Make unreasonable predictions about the cells and tissues of the organisms' body	
The answer sheet is blank, or the answer does not match the problem	0

A two-way ANCOVA was conducted to examine the effects of the ethnic and learning model on critical thinking of biology subject of "cell and tissue of organisms' body" by post-test, after controlling for the pre-test. A posthoc analysis by Bonferroni test was conducted. Due to the limitation to fulfill the assumptions for ANCOVA, e.g., normality and/or variance equality of the data in each group, the data were transformed into squared data before data analyzed. Only eight of twenty groups fulfill the assumptions of the two-way ANCOVA (all of learning model types and two ethnic types, i.e., Javanese and Banjar).

RESULTS AND DISCUSSION

Hundred forty-three students from the four classes were involved in this study. The PBL, GI, PBL+GI, and Conventional classes each have a number of students of 36, 35, 36, and 36, respectively. Only eight combinations from twenty groups are fulfilling the two-way ANCOVA, i.e., all the learning models types and two ethnics (Javanese and Banjar), following squared data transformation (Table 3).

Table 3. Distribution of the observed student based on learning model (class) and ethnic

Learning model / class	Ethnic		Total samples[a]	Total students[b]
	Javanese	Banjar		
PBL	14	4	31	36
GI	4	4	21	35
PBL+GI	6	4	22	36
Conventional	13	4	32	36
Total	37	16	106	143

Note: PBL = Problem-Based Learning, GI = Guided Inquiry. a) The number of students involved in this study (Javanese, Banjar, Bugis, Kutai, and Toraja). b) The number of students in the class.

The eight combinations showed a linear relationship between pre-test and post-intervention post-test for each intervention group, as assessed by visual inspection of a scatterplot. The homogeneity of regression slopes was also determined by a comparison between the two-way ANCOVA model with and without interaction terms, $F(7,37) = 0.683$, $p = 0.722$. The homoscedasticity within groups was proofed as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group, and variances were homogeneous, as determined by Levene's test of homogeneity of variance ($p = 0.448$). There were no outliers in the data following deleted one data from the combination of the Javanese and Conventional learning model, as assessed by no cases with studentized residuals greater than ±3 standard deviations. There were no leverage or influential points, as evaluated by leverage values and Cook's distance, respectively. Studentized residuals were normally distributed, as assessed by Shapiro-Wilk's test ($p > 0.05$).

There was not a statistically significant two-way interaction between ethnic and learning models on the post-test of biology subject while controlling for pre-test, $F(3,44) = 1.535$, $p = 0.219$, partial $\eta^2 = 0.095$ (Table

4). However, the main effect of ethnic showed no statistically significant difference in adjusted marginal mean post-test for those ethnic types, which Javanese (5070.687) versus Banjar (4885.891), 184.796 (95% CI, -488.495 to 858.087), p = 0.583. However, there was a statistically significant main effect of the LM, $F(3,44)$ = 42.098, p < 0.0005, partial η^2 = 0.742. Adjusted marginal mean post-test increased in a row of Conventional (2006.052), GI (5324.744), PBL (6107.057), and PBL+GI (6475.304). A statistically significant difference to Conventional of 3318.69 (95% CI, 1978.65 to 4658.73, p < 0.0005), 4101.01 (95% CI, 2890.2 to 5311.29, p < 0.0005), and 4469.25 (95% CI, 3197.86 to 5740.65, p < 0.0005) for GI, PBL and PBL+GI, respectively. The pairwise comparison between learning models in each ethnic type was shown in Table 5, and the trend of the effect was shown in Figure 2.

Table 4. Two-way ANCOVA table

Source	Type III Sum of Squares	df	Mean Square	F	*p*	Partial η^2
Pre-test	2,761,047.749	1	2,761,047.749	2.443	0.125	0.053
Ethnic	345,874.401	1	345,874.401	0.306	0.583	0.007
SAbM	142,760,697.856	3	47,586,899.285	42.098	0.000	0.742
Ethnic * SAbM	5,206,843.918	3	1,735,614.639	1.535	0.219	0.095
Error	49,737,277.641	44	1,130,392.674			

Dependent Variable: Squared Post-test; a. R2 = 0.787 (R2adj = 0.749); LM=Learning Model

Table 5. Pairwise comparisons of effect between learning model in each ethnic

Ethnic	(I) Learning Model	(J) Learning Model	Mean Difference (I-J)	Std. Error	Sig.[b]	95% CI[b]	
						Lower Bound	Upper Bound
Java	Conventional	PBL	-3300.403*	423.155	0.000	-4469.502	-2131.305
		GI	-3355.598*	609.842	0.000	-5040.479	-1670.716
		PBL+GI	-4279.375*	533.785	0.000	-5754.123	-2804.626
	PBL	GI	-55.194	622.423	1.000	-1774.834	1664.445
		PBL+GI	-978.971	518.862	0.395	-2412.491	454.548
Banjar	Conventional	PBL	-4901.608*	756.005	0.000	-6990.311	-2812.906
		GI	-3281.787*	752.417	0.000	-5360.576	-1202.999
		PBL+GI	-4659.129*	751.990	0.000	-6736.739	-2581.520
	PBL	GI	1619.821	759.836	0.232	-479.466	3719.108
		PBL+GI	242.479	758.000	1.000	-1851.736	2336.694

*Dependent Variable: Squared Post-test, Covariates (Squared Pre-test) = 379.7736; Based on estimated marginal means; *) The mean difference is significant at the 0.05 level; b) Adjustment for multiple comparisons: Bonferroni.*

Through implementing SAbM, students are facilitate to develop their thoughts and ideas and work together with friends to solve a problem (Nurhasanah, Arasti, Susanti, Rumperiai, & Hindun, 2020; Wormack et al., 2019). A learning environment that enables the empowerment of critical thinking skills allows students to apply critical thinking skills (Petchtone & Sumalee, 2014). However, students from various ethnic groups have a unique learning experience after implementing the syntaxes of the learning models applied. Therefore, the results of this study inform that, although not significant, there were differences in critical thinking skills' test achievement of students who have different ethnic backgrounds.

The achievement of students' critical thinking skills in each learning model requires the collaboration of students of different ethnic backgrounds. Their ethnic background determines the character of students. Ethnic students who vary in the class also raises the character of students. Teachers, educators, and policymakers have to design together on exciting activities in learning, including learning materials, syllabi, and learning methods that are suitable for fostering positive attitudes of students (Aladdin, 2010; Batarchuk, 2017).

Indicators of students' critical thinking skills, such as analytical skills, conclusion skills, and predictive skills, can be owned by students if, in the learning process, students conduct scientific studies. The learning models allows students to formulate problems, conduct data collection (investigation), analyze data, discuss the results of data analysis, and conclude; enable students to develop analytical skills, conclude based on analysis and discussion, and predict based on the data they have related to cells and tissues of the organisms' body subject. Data collection activities in learning, and literacy activities enable students to explore scientific cases (Odegaard, Haug, Mork, & Sorvik, 2015), in which guide students in carrying out scientific activities logically by the guidance of trained teachers (Sarigoz, 2012). Therefore, biology teachers are expected to prefer and apply learning models whose syntax allows students to carry out activities scientifically to empower their critical thinking skills.

Furthermore, the ethnicity of students does not affect students' critical thinking skills (Table 5). The results of the data analysis show that the five types of ethnicities of students (Javanese, Bugis, Kutai, Banjar, and

Toraja), statistically did not have a different effect in empowering students' critical thinking skills. Students in overseas areas, such as in the city of Samarinda, who was born and grew up and mature in the city of Samarinda, tended to interact with students with different ethnic backgrounds continuously. The theory has affected modern social psychology only in the last decade or so, focusing on the effect of cross-ethnic interaction. The theory has the vision on the possibility of positive outcomes from ethnic relations if the surrounding gave suitable support (Zainal, Abu, & Mohamad, 2010), heterogeneous cultures and identities exist within these distinct groups (Jamil, 2010), but integration does not require the loss of one's identity or origins (Ruthner, 2012).

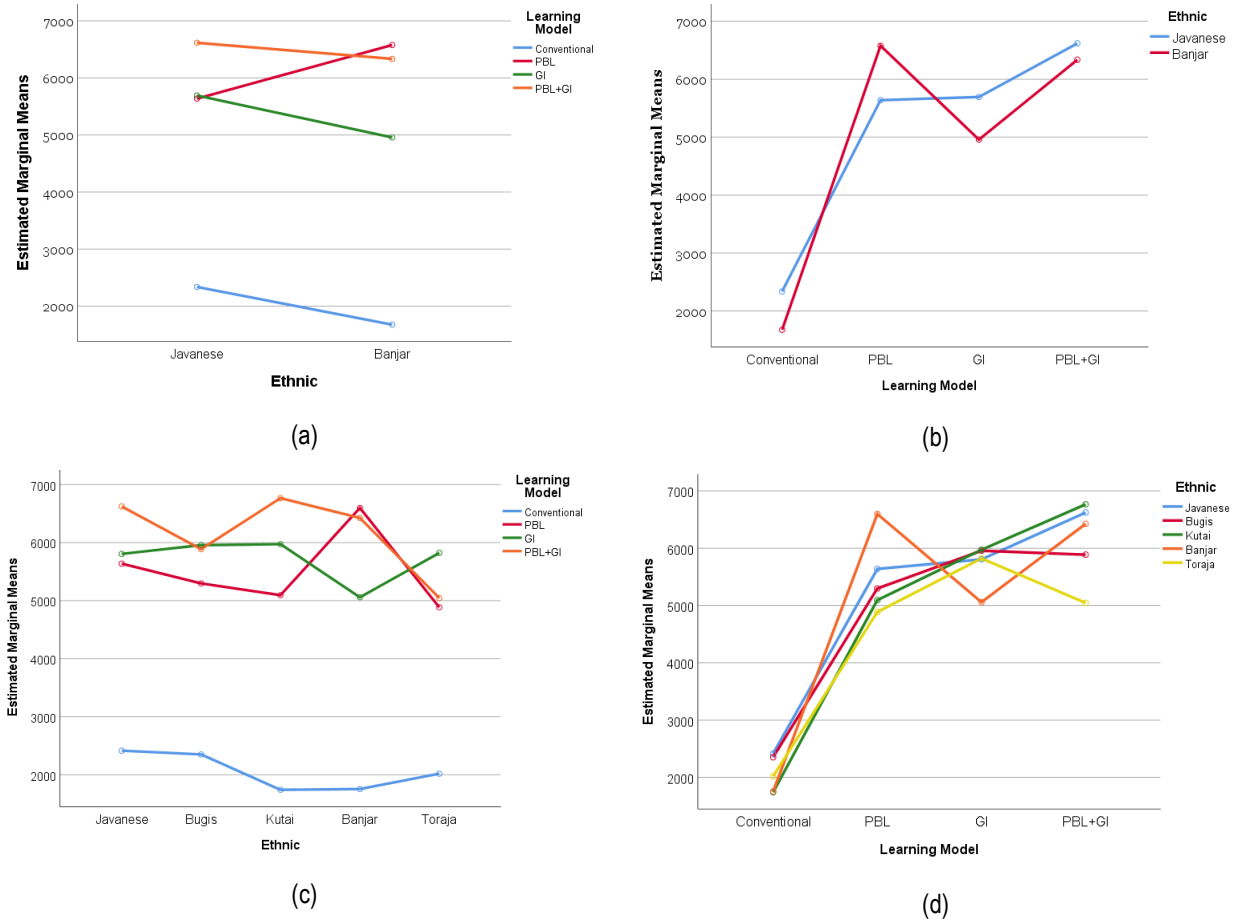

Figure 2. The trend of effect between the learning model in each ethnic. *Data (squared post-test) fulfilled all of the two-way ANCOVA assumption (a and b) with the covariate (pre-test) of 379.7736, while (c and d) were from all data collected in this study with the covariate (pre-test) of 430.7264.*

The sample size factors for each ethnicity included in the study were not the same. An optimal sample size should be carefully evaluated and determined (Wang, Xu, Li, Tian, & Chen, 2019). Therefore, it is recommended for similar research in the future to increase the sample size for each ethnic student. Besides, the size of the number of students in each ethnic group is not too much different.

Students who have a particular ethnicity tend to have unique characters that are different from students with different ethnicities. Student character gives influence to students in acting, including in following the learning process in class. For generations, unique characters from certain ethnic groups are taught and passed on by parents to their children. Bugis ethnic characteristics in general are: *sipakatau* (the nature of respect as individuals with dignity), *siri* (self-esteem, shame), *pesse* (brotherhood of fellow Bugis ethnicity, and with other ethnicities) (Syarif, Sumarmi, & Astina, 2016). Javanese ethnic character, in general, is: maintaining harmony and respect (Idrus, 2012). The Banjar ethnic character is of a high religious nature (Hidayat, 2013). The Toraja ethnic character is always learning about the Toraja ethnic culture, namely: Toraja language, Toraja exceptional food, and Toraja special food (Bahfiarti, 2015). The ethnic character of Kutai is to always live according to the teachings of Islam for its adherents, and the kinship system, in general, is patrilineal (fatherly line) and has a religious system and customs that are held in high esteem (Murjani, 2012). However, the interaction between students with different ethnicities may also affect the student character.

The average score of critical thinking skills for each learning model is different (Table 6). However, overall, the application of SAbM (PBL, GI, and PBL+GI combination), gives the same score, and is equally higher than conventional learning. The inquiry experiment improved the participants' critical thinking skills (Zhou, Guo, Liu, Wang, & Ma, 2010). Besides, the application of the combined PBL+GI provides the highest score among other learning models in empowering critical thinking skills of students of varying ethnicity. Learning models that are based on a scientific approach enable students to develop critical thinking skills (indicators: analysis, inferring, and predicting). Students experience more experience in analyzing problems/data, concluding, and predicting data-based on the cells and tissues of organisms' subject.

Table 6. The empowerment of critical thinking skills in the biology object of "Cells and Tissue organisms' body"

Ethnics	Learning Model (N)	Post-test Mean	SD	Empowerment (%)
Javanese	Conventional (13)	45.77	14.09	-
	PBL (14)	75.54	6.52	65.04
	GI (4)	74.38	5.91	62.50
	PBL+GI (6)	81.58	8.09	78.25
Banjar	Conventional (4)	39.00	11.17	-
	PBL (4)	81.25	7.22	77.52
	GI (4)	69.50	4.93	51.85
	PBL+GI (4)	78.75	7.77	72.06

Note: N = number of students. Covariates (pre-test) was 18.48.

The application of PBL+GI for Javanese, gives the highest score of critical thinking skills (81.58) compared to other learning models (Table 6). In the application of combined PBL+GI, students have gained more experience in analyzing problems/data, concluding, and predicting data-based about cells and body tissues of organisms' subject. Students can learn how to formulate apparent research problems. Furthermore, students can also learn to choose ways to collect data, analyze data, and discuss the results of data analysis obtained. Finally, students can make conclusions to determine accepted or rejected hypotheses that they have formulated. Javanese character is cooperation, always compact with people who are not Javanese in one group of collaboration, respect, a sense of equality with people who are not Javanese or others (Susetyo, Widiyatmadi, & Sudiantara, 2014). Usually, Javanese succeed in interacting with other ethnic groups, have an attitude of tolerance, are patient in facing problems (Idrus, 2012).

Related to the application of learning models in the Banjar ethnic group, Table 6 shows that PBL gives the highest critical thinking skills score (81.25) compared to other learning models. Application of the PBL, students observe the real (contextual) data, formulate problems, collect data, analyze data, discuss the results of data analysis earnestly to solve the problem, and make conclusions. The character of Banjar ethnic (a local ethnic in East Kalimantan Province, who migrated from South Kalimantan Province, Indonesia), is always in contact with God, the concept of *bubuhan* (which helps one another), being severe in working in solving problems in his life (Istiqomah, 2014).

Conventional learning only makes it possible to practice listening, taking notes, and asking the teacher. Students are less trained to interact with their peers to analyze equally, formulate problems, formulate hypotheses, collect data, analyze data, discuss the results of data analysis, and make conclusions. As a result, students are weak in analyzing, making conclusions, and predicting. Therefore, biology teachers need to reduce the application of conventional learning, to empower students' critical thinking skills further. However, it has been realized that a preservice teachers' ability is essential to be developed in parallel to increase the teachers' capacity in practicing the science-approach learning models (Zhou et al., 2010).

Application of the scientific approach-based learning model significantly empowers (p = 0.0005) the critical thinking skill of the students on the biology object of "Cell and tissue organisms' body" (Table 5). Base on the ANCOVA result (Table 5), the empowering effectiveness is shown more directly using the raw data, as shown in Table 6. The PBL was more effective than GI and PBL+GI in empowering the critical thinking skill of Banjar ethnic students, while the PBL+GI was more effective for Javanese students. The GI shows the lowest effectiveness than the two other learning models for the two ethnicities.

The results of the analysis of the empowerment of learning models applied in the study (Table 6) indicate that learning models based on scientific approach (PBL, GI, and PBL+GI) provide higher critical thinking skills scores compared to conventional learning. The learning process is based on a scientific approach, allowing students to experience stages of scientific assessment. The scientific assessment stages include: formulating the problem, formulating hypotheses, collecting data, discussing the data obtained, making conclusions, and sharing the findings with other students in the class. The stages of learning like this allow students to be able to do analysis, make conclusions, and can make predictions based on data obtained.

Through a scientific approach, students are more active, and not only learn in the classroom, but also make observations in their environment in collecting data following problems in learning. In this such condition, students can find the fact that there is a relationship between the object being analyzed with learning material (Susilo, 2016). This approach avoids verbalism concept in the learning activity, has a principle of the learning process for the students from 'be informed' to 'actively find out'. In discussing the material of cells and tissues of the organism's body, students are expected not to be passive in receiving information in class. Still, it is also necessary to make observations in the laboratory and find information from other sources. Cells and body tissues of the organism are microscopic. Therefore, to study this material, it is necessary to observe this object using another microscope for assistive devices, which could reduce misconceptions in understanding the substance of cells and body tissues of organisms.

CONCLUSION

Based on the results, there is no interaction between learning models and ethnic groups on critical thinking of the biological subject as shown by the main effect of ethnicity. However, the SAbM (PBL, GI, PBL+GI) implementation significantly affects students' critical thinking skills among various ethnic students. Within Javanese, PBL+GI is the most powerful in empowering critical thinking, while within Banjar ethnic, the PBL was the most effective.

Based on the conclusions obtained, the application of SAbM needs to be applied massively. The number of schools that still apply conventional learning in Samarinda needs to be followed up because they are unable to optimize the empowerment of students' thinking skills. Therefore, it is hoped that researchers and policy makers will be able to encourage teachers to consistently implement various SAbM, especially PBL+GI.

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