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The effectiveness of modified flip-based argumentation learning in improving students' argumentation skills about hydrocarbon

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Abstract: The FBAL learning model is a learning model that has a specific purpose to improve students' argumentation skills by integrating Toulmin's argumentation pattern. This study aimed to see the effectiveness of the Modified Flip-Based Argumentation Learning in improving students' argumentation skills about the concept of hydrocarbon compounds. The effectiveness was examined by comparing this model to Flip-Based Argumentation Learning and Flipped Classroom model. The factors that influence the differences in students' argumentation skills amongst the three classes were also investigated. Concurrent embedded mix method design was used in this study. Some 93 students of 11 grade of SMA Negeri 1 Merangin Jambi were participated in this study. Data were collected using argumentation test (pre-test and post-test) and observations. The results showed that there was no difference between the Modified FBAL and FBAL in improving the students' argumentation skills but both were different from the Flipped Classroom. The N-gain was 0.80 and 0.81 respectively for the Modified FBAL and FBAL. However, those were higher than the N-Gain of Flipped Classroom which was 0.71. Difference in providing the students with opportunities to practice their argumentation skills amongst the three models was the major factors influencing the students' argumentation skills in the three classes.

Keywords: argumentation skills, flip based argumentation learning, modified FBAL, flipped classroom, hydrocarbon compounds

1. Introduction

Chemistry learning consists of three aspects of study, including macroscopic, microscopic and symbolic aspects. Basically, the three aspects of chemistry learning studies require a higher level of student thinking (Rosalia et al. 2019; Muchtar et al. 2020; Siahaan et al. 2021). One of chemistry learning materials is hydrocarbon compounds. The material characteristics of hydrocarbon compounds are abstract, conceptual, and applicable (Crucho

et al. 2020). Hydrocarbon compounds have links between concepts that are quite complicated. If students do not understand the concept correctly, then students can have difficulty in studying the next sub-chapter of material so that which affects students' cognitive learning outcomes. To understand the concept correctly, students need to develop abstract, critical, and analytical thinking skills, including the ability to argue (Matuk, 2016).

According to Dawson & Carson (2016) Argumentation ability is the ability to give reasons or opinions based on clear facts. Toulmin's argumentation skills include the ability to make claims, evidence, warrants, backing, qualifiers, and rebuttals. Argumentation skills plays an important role in developing critical thinking skills and adding a deep understanding of an idea or idea. Siswanto et al. (2014) stated that argumentative skills play an important role in building an explanation, model, and theory of a concept being studied because practicing argumentation skills means training cognitive and affective abilities that can be used to help understanding concepts.

Based on research by Agustiningsih (2019) at one of the senior high schools in Jambi City, it was stated that the level of students' argumentation skills was still quite low. Where students are still not able to argue well. One of them is the students' lack of courage in expressing their opinions and students who can only state opinions but have not been able to convey reasons and evidence to support these opinions or statements. In line with the results of the interview with the chemistry teacher at SMAN 1 Merangin, she informed that most students have not been able to argue well. This is confirmed by Devi et al. (2018) who have researched on the argumentation skills of students at one high school in Surakarta on the material of Buffer Solution. The results showed that the categorization of students' argumentation skills was at level 1 and level 2 of argumentation. This shows that students' argumentation skills are still at a low-medium level (only showing claims or claims with data). This is also in line with the opinion of Effendi-hasibuan et al. (2020) which states that high school students are generally only able to reach level 3 arguments (providing claims, relevant data, and reasons connecting claims with data).

Efforts to improve students' argumentation skills, of course, cannot be separated from efforts to improve the quality of learning in schools in this case is related to the model used by a teacher. Several learning models have been used by previous researchers to improve students' argumentation skills. Amelia et al. (2021) have applied the Argument-Driven Inquiry (ADI) learning model to determine the effect of the ADI learning model in improving students' argumentation skills on colloidal material. The results showed that the ADI model was more effective in improving students' argumentation skills than the model Inquiry. The different experiences experienced by students in the three classes are the factors that determine the differences in abilities between students. Another study by Effendi-Hasibuan et al. (2019) have used the jigsaw learning model, TSTS, and Discovery Learning to improve the chemical argumentation skills of high school students in Jambi. These researchers found that these three models succeeded in improving students' argumentation skills on the reaction rate material. However, the jigsaw model is more effective among the three.

The Flipped Classroom learning model is a reverse classroom learning model where students obtain material through videos delivered outside the classroom and then conduct discussions, problem-solving, and even debate on the material when in class (Billings, 2016). The model Flipped Classroom utilizes learning media that can be accessed online by students

who can support their learning materials (Maolidah et al. 2017). According to the research results of Yulianti & Wulandari (2021) flipped classroom learning is by following per under the learning principles in the 2013 curriculum. The activities of observing, asking questions, gathering information, associating and analyzing, and communicating can be implemented in learning flipped classroom with a mix of technology utilization in it so that students will have skills according to the 21st century.

Based on the description above, it can be seen that the Flipped Classroom learning model is an effective learning model to use (Akçayır & Akçayır, 2018). However, the learning model has Flipped Classroom not specifically designed to improve students' argumentation skills. For this reason, the researcher offers a new learning model that prioritizes students' argumentation skills and provides opportunities for students to develop their argumentation skills to the fullest. The learning model referred to here is the learning model Flip Based Argumentation Learning (FBAL).

The FBAL learning model is a learning model that has a specific purpose to improve argumentation skills by integrating Toulmin's argumentation pattern (Agustiningsih, 2019). According to Agustiningsih (2019), the learning model FBAL has not passed the test of the effectiveness of using the model on students' argumentation skills. Agustiningsih (2019) has just reached the stage of making the model syntax and testing the feasibility of the model in a small group in one of the SMAN in Jambi City. Therefore, researchers are interested in researching to test the effectiveness of using the learning model FBAL in improving students' argumentation skills. In this study, the FBAL model will be compared with the modified FBAL model and the model Flipped Classroom and the effectiveness will be seen from the argumentation skills of students in the three classes.

2. Methods

The FBAL learning model is a learning model that has a specific purpose to improve students' argumentation skills where there are 9 steps. However, because the steps of the FBAL model is too long, the researchers did the following Modify the steps of the FBAL learning model into 6 learning steps to adapt the learning system during the current pandemic. The difference steps of FBAL and Modified FBAL learning can see in Table 1.

Table1
The difference between FBAL and Modified FBAL learning steps

Learning Activities	Steps of FBAL Learning Model	Steps of Modifed FBAL Learning Model
Online Learning	Content Delivery	Content Delivery
	Argumentation Examplary	Argumentation Examplary
	Problem Delivery	Problem Delivery
	Group Arrangement	
Classroom Learning	Group Discussion Argumentation	Group Discussion Argumentation
	Classroom Debate	Classroom Debate and Confirmation
	Review	Evaluation (Quiz)
	Reward	
	Quiz	

The method used in this research is the mixed method concurrent embedded with three groups pretest-posttest control group design. The population in this study were students of class XI MIPA at SMA N 1 Merangin, Jambi Province in the 2021/2022 school year.

Table 2
Category N-Gain Score

N-Gain Score	Category
g > 0.70	High
0.30 > g < 0.70	Medium
g < 0.30	Low

The sampling technique was done by simple random sampling and obtained three sample classes namely class XI MIPA 2 as an FBAL 1 calss with a total of 31 students, class XI MIPA 1 as an FBAL 2 calss with a total of 31 students, and class XI MIPA 4 as a control class with a total of 31 students. The research instrument was an observation sheet on the implementation of the three models learning with interpretive descriptive analysis techniques and an essay test which includes aspects of argumentation skills (claim, evidence, and reason) with N-Gain test analysis (Table 2), One Way Anova test followed by test Tukey.

3. Results and Discussion

Data on students' argumentation skills were obtained from the results of the pretest given before treatment and results posttest given after treatment in the three experimental classes. The data from the pretest and posttest students' argumentation skills are summarized in Table 3 and Table 4.

Table 3
Data on Pretest students' argumentation skills

Learning Strategies	Mean	Standard deviation	Mean of Skill	Level of Argimentation				
				1	2	3	4	5
FBAL 1	13.55	4.30	0.68	10.21	3.01	0.32	-	-
FBAL 2	12.90	4.10	0.65	11.18	1.72	-	-	-
FC	13.01	5.67	0.65	9.03	3.66	0.32	-	-

Table 4
Data of Posttest students' argumentation Skill

Learning Models	Mean Score	Standard deviation	Mean of Skill	Level of Argumentation				
				1	2	3	4	5
FBAL 1	83.33	8.03	4.17	-	-	13.23	31.40	38.71
FBAL 2	82.26	7.12	4.11	-	-	8.39	48.60	25.27
FC	75.05	7.45	3.75	-	3.01	15.48	40.43	16.13

Based on table 3 it can be seen that the argumentation skills of students in the three experimental classes has an average value of the average with less significant differences, with the average value of FBAL 1 class of 13.55, FBAL 2 class of 12.90, and FC class of 13.01. This proves that the three classes have the same argumentation skills before being given treatment. The argumentation level of students in the three experimental classes only reached level three. In this case, it shows that students can provide claims (statements) but have not been able to provide relevant data with logical reasons (connecting). The low argumentation skills of students is influenced by various factors including the opportunity to argue and *prior knowledge* students', therefore the teacher's role is very important in developing this argumentation skills (Devi et al. 2018). Based on research of Witri et al. (2020) at SMA Negeri 11 Jambi City, generally students have weaknesses in arguing because students are not used to it. This is also because the teacher has not trained students to argue. Arguments in learning have not received special attention from teachers. To see the distribution of the argumentation skills pretest data in the three classes, it can be seen in Fig 1.

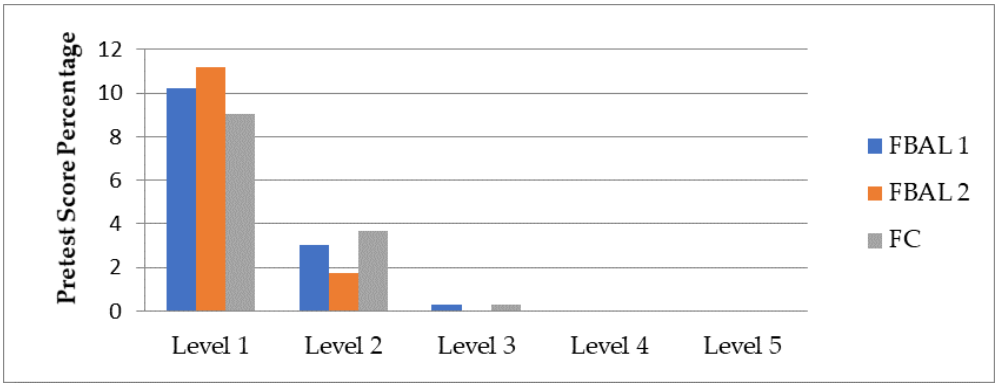

Fig 1. *Pretest of* students' argumentation skill

Based on the table above, it can be seen that the of students in FBAL 1 class is higher than that in FBAL 2 and *Flipped Classroom.* FBAL 1 class also has a higher level of argumentation skills than the FBAL 2 class and *Flipped Classroom.* The highest level 5 argumentation skills is in the FBAL 1 class. Meanwhile, the highest level 3 argumentation skill is in FC class and argumentation skills level 4 has the highest percentage in FBAL class 2. To see the distribution of posttest data in the three classes, can be seen in Fig 2.

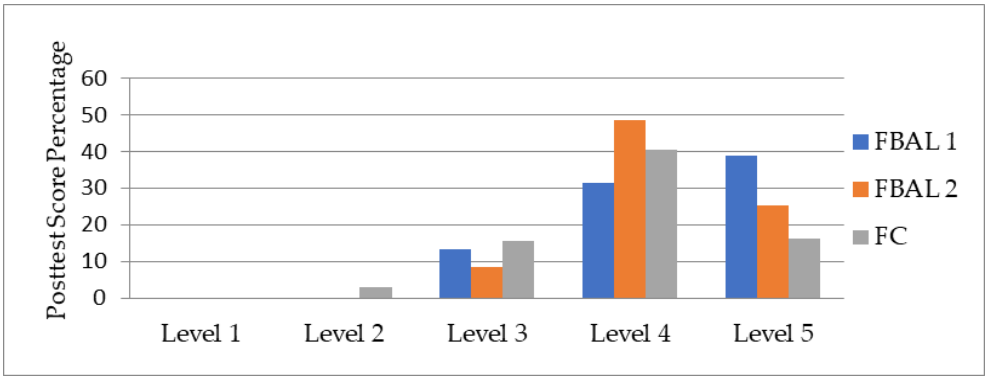

Fig 2. Posttest of students' argumentation skill

Based on the results of the description of Figure 2 in the FBAL 1, FBAL 2 and classes, it Flipped Classroom can be concluded that the experimental class that applies the FBAL 1 and FBAL 2 model has a level value higher argumentation skills than the control class that applies the learning model Flipped Classroom. Average Pretest-Posttest Argumentation Skill in the three classes, it can be seen in Fig 3.

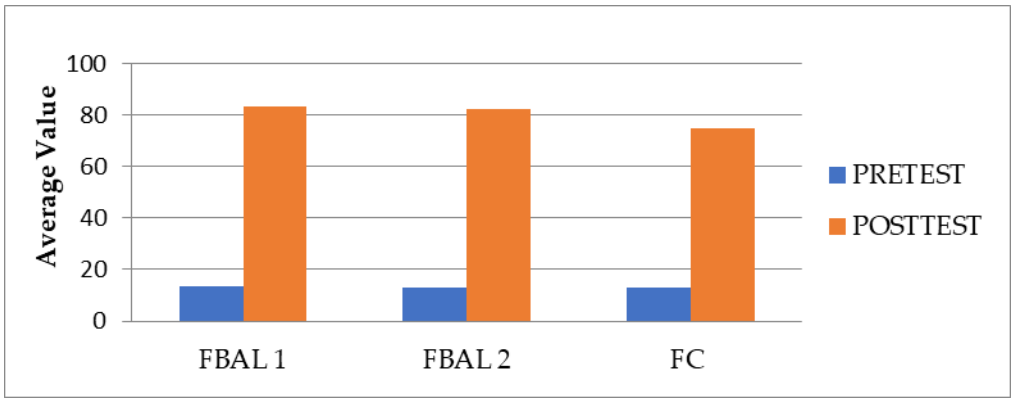

Fig 3. Average *pretest-posttest* argumentation skill

Based on Figure 3 in the FBAL 1, FBAL 2 and classes, it *Flipped Classroom* can be concluded that the experimental class that applies FBAL 1 and FBAL 2 models have an average value of argumentation skill is higher than the control class that applies the learning model *Flipped Classroom*. Furthermore, the N-gain test was carried out to determine the increase in cognitive learning outcomes of students' argumentation skills after being given treatment. N-gain test results are shown in Table 5.

Table 5
Test results n-gain value *pretest* and *posttest*

Learning Models	N-Gain Score	Category	N-Gain Percent	Category
FBAL 1	0.81	High	80.98	Effective
FBAL 2	0.80	High	79.79	Effective
FC	0.71	High	71.56	Quite Effective

Based on table 5 shows that the average value of N-gain percent of 80.98% (80.98 > 75) is included in the effective category. FBAL 2 class has an average N-gain score of 79.79% (79.79 > 75) included in the effective category. Meanwhile, the FC class has an average N-gain percentage is 71.56% (71.56 < 75) is included in the category of quite effective (Lestari & Mujib 2018).

Thus, it can be concluded that the use of the FBAL 1 and FBAL 2 learning models is effective in improving students' argumentation skills on the material of hydrocarbon compounds. Meanwhile, the use of the FC learning model is quite effective in improving students' argumentation skills on the material of hydrocarbon compounds.

Before testing the hypothesis, a prerequisite test is carried out, namely normality and homogeneity tests. The level of confidence used is 95% or the level of significance is 5%. The test was carried out using SPSS version 20. The data from the pretest and posttest normality tests are summarized in Table 6 and Table 7.

Table 6
Normality test result data value *pretest* FBALin class 1, FBAL 2, and FC

	Learning Models	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Argumentation	FBAL 1	.153	31	.062	.914	31	.016
	FBAL 2	.154	31	.058	.918	31	.020
	FC	.135	31	.156	.953	31	.183

Table 7
Normality test results data for values *posttest for* FBAL 1, FBAL 2, and FC

	Learning Models	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	Df	Sig.
Posttest Argumentation	FBAL 1	.119	31	.200*	.939	31	.076
	FBAL 2	.150	31	.074	.942	31	.096
	FC	.140	31	.126	.942	31	.093

Based on Table 6, in class FBAL 1 has a significance value of 0.062 (0.062 > 0.05) while in class FBAL 2 has a significance value of 0.058 (0.058 > 0.05) and in class FC has a significance value of 0.156 (0.156 > 0.05). So it can be concluded that the value data *pretest* from the three experimental classes are normally distributed (Ross & Willson, 2017). Based on table 7, in class FABL 1 has a significance value of 0.200 (0.200 > 0.05) while in class FBAL 2 has a significance value of 0.074 (0.074 > 0.05) and in class FC has a significance value of 0.126 (0.126 > 0.05). So it can be concluded that the value data *posttest* from the three experimental classes are normally distributed (Ross & Willson, 2017).

Data on the results of students' argumentation skills were also tested for homogeneity taken from variance data or f-test on SPSS. Data on the results of the homogeneity test of students' argumentation skill obtained from the *pretest-posttest* and *scores* can be seen in Table 8.

Table 8
Data of homogeneity test results in *pretest-posttest scores for* FBAL 1, FBAL 2 and FC

	Levene's Statistic	df1	df2	Sig.
Pretest	1.607	2	90	.206
Posttest	.182	2	90	.834

Based on Table 8, significance value homogeneity test *pretest*> of 0.206 0.05. Thus, it can be concluded that the value data *pretest* from the three experimental classes is homogeneous (Ross & Willson, 2017). Homogeneity test *Meanwhile Posttest*, the obtained a significance value of 0.834 > 0.05. Thus, it can be concluded that the value data *posttest* from the three experimental classes is homogeneous (Ross & Willson, 2017).

After testing the prerequisites, then testing the hypothesis using parametric statistics, namely the one-way ANOVA test. ANOVA test data *pretest* and *posttest* can be seen in Table 9 and Table 10.

Table 9
Data results of one way ANOVA Value *pretest* model FBAL 1, FBAL 2, and FC

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7.414	2	3.707	.165	.848
Within Groups	2022.847	90	22.476		
Total	2030.261	92			

Table 10
Data result of one way ANOVA value *posttest* model FBAL1, 2 and FC FBAL

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1256.432	2	628.216	11.046	.000
Within Groups	5118.424	90	56.871		
Total	6374.855	92			

Based on the significance of the scores *pretest* and *posttest* in the three experimental classes, it can be shown that students have the same initial ability as evidenced by the difference in the average value of the results *pretest* which is not significant (0.848 > 0.05). And after being given treatment using the FBAL 1, FBAL 2, and FC learning models, there were differences in students' argumentation skills as evidenced by the significant difference in the average value of the results *posttest* (0.000 < 0.05) (Ross & Willson, 2017). The next step is the Tukey test. Tukey's test was used as a follow-up test of the ANOVA test to see the extent of the difference in significance between FBAL 1, FBAL 2, and FC classes based on scores *posttest*. The Tukey test results data scores *posttest* can be seen in Table 11.

Table 11
Tukey Test Results Data *Posttest scores*

(I) Learning Models		(J) Learning Models	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	FBAL 1	FBAL 2	1.07548	1.91549	.841	-3.4893	5.6403
		FC	8.27903*	1.91549	.000	3.7142	12.8439
	FBAL 2	FBAL 1	-1.07548	1.91549	.841	-5.6403	3.4893
		FC	7.20355*	1.91549	.001	2.6387	11.7684
	FC	FBAL 1	-8.27903*	1.91549	.000	-12.8439	-3.7142
		FBAL 2	-7.20355*	1.91549	.001	-11.7684	-2.6387

Based on table 10, the results showed that there were differences in the improvement of students' argumentation skills, in the experimental class taught using the FBAL 1, FBAL 2 and FC models on hydrocarbons. The significance value between classes taught using the FBAL1 and FBAL 2 models is 0.841 (0.841 > 0.05) and the average value is 83.33 and 82.26 so that the two classes are not significantly different. This is because the FBAL1 and FBAL 2 models are both designed to train students' argumentation skills. Meanwhile, the experimental class

taught using the FBAL 1 learning model and the FC class had a significance of 0.000 (0.000 < 0.05) and the average value for the FC class was 75.05 so that the two classes were significantly different. Meanwhile, the experimental class taught using the FBAL 2 and FC models has a significance of 0.001 (0.001 < 0.05) which indicates that the two models are significantly different (Ross & Willson, 2017).

The causes of differences in the argumentation skills of students in FBAL 1, FBAL 2, and FC classes are; FBAL 1 and FBAL 2 models provide opportunities for students to practice argumentation skills by involving students in direct argumentative discussions Agustiningsih (2019), while the flipped classroom model does not. The existence of an argumentation group discussion session allows students to try to work on argumentation questions such as making claims, evidence, and reason independently and verifying their answers to the group. This is in line with the opinion of Matuk (2016) that argumentation skills can be achieved in a learning atmosphere that stimulates students to carry out argumentation activities.

While the focus of learning on the Flipped Classroom model is on observing, asking questions, gathering information, associating and analyzing and communicating a problem (Yulianti & Wulandari, 2021). In the Flipped Classroom learning model the teacher only guides students during the learning process while students are responsible for their own learning to produce solutions. This motivates students to learn and develop independent skills to enable students to solve problems. This is in line with research of Lestari et al. (2020) an effect of the flipped classroom approach on the guided inquiry model is evidenced by the results of students' creative thinking abilities that are higher than students who learn with the guided inquiry model without the flipped classroom approach. In the learning process students who learn to use the guided inquiry model with the flipped classroom approach are more focused and active when the problem solving process is in the classroom. Based on this statement, it can be seen that the Flipped Classroom learning model is an effective learning model to use. However, the Flipped Classroom learning model is not specifically designed to improve students' argumentation skills.

Although the FBAL 1 and FBAL 2 models are learning models that focus on training argumentation skills, based on the average *posttest* value, the FBAL 1 learning model has a higher score of 83.33 while the FBAL 2 model has an average value of 82.26. Based on the level of argumentation level 5 in the FBAL 1 model is higher with a percentage of 38.71% while in the FBAL 2 model it is 25.27%. This can be caused by differences in the syntax of the FBAL 1 and FBAL 2 models. Where in the FBAL 1 model there is a session *reward* by the teacher which allows students to be more enthusiastic and competitive when working on argumentation assignments. In line with the theory of *operant conditioning* by B. F Skinner who uses pleasant and unpleasant consequences in changing behavior. Which in its implementation there are *rewards* and *punishments.* According to Afifah (2017) *reward is* seen as positive *reinforcement (reinforcement)* to bring up a positive behavior and as a form of appreciation for a positive action that has been taken. Faidy & Arsana (2014) said that in addition to being a fun repressive educational tool, rewards can also be a motivator or

motivation for studentd to learn. While in the FBAL 2 model there is a no session *reward* by the teacher.

4. Conclusion

Based on the results of the research and discussion, it can be concluded that the application of Flip Based Argumentation Learning and Modified Flip Based Argumentation Learning models is more effective in improving students' argumentation skills than the Flipped Classroom learning model. Difference in providing the students with opportunities to practice their argumentation skills amongst the three models was the major factors influencing the students' argumentation skills in the three classes.

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