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Argumentation skill through a scientific approach: Study at different school accreditations rating

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ABSTRACT

This study aims to determine the differences in students' argumentation skills in learning biology on the subject matter of the respiratory system through a scientific approach. This research was conducted in class XII SMA in Way Kanan Regency, Lampung Province with an ex post facto design. The sampling technique used in this study was stratified random sampling with the determination of research subjects at SMAN 1 Baradatu which was accredited A, SMAN 2 Buay Bahuga was accredited B and MA Miftahul Ulum Way Tuba which was accredited C. Data collection instruments consisted of argumentation skill tests, interviews, study documentation and questionnaires. The argumentation skill data were analyzed with the help of Excel, hypothesis testing was carried out with one-way ANOVA and LSD test, interview data and learning documents were analyzed descriptively qualitatively with the Miles and Huberman model and questionnaire data were analyzed descriptively in percentage form. The results showed that there was a significant difference in argumentation skill among high school students with accreditation of A, B and C (sig. < 0.05). The average argumentation skill of students from A-accredited high schools was higher than B and C accredited high schools, but the average value of the three schools was very low. Students from A, B and C accredited high schools could make claims well, but had not been able to provide grounds, warrants and backings that are relevant to the claim. This was because students wer not used to working on argumentation questions and teachers had not optimized learning activities with a scientific approach.

Keywords: argumentation skill, respiratory system, scientific approach

INTRODUCTION

Argumentation skill is an important ability in learning biology as part of scientific inquiry and literacy. Arguments play a role in constructing explanations to link evidence with claims through warrants and backing. This can support the epistemological development of science and understanding of scientific knowledge (Erduran et al., 2015).

Argumentation in the practice of learning biology is the main thing that underlie students' ways of thinking, acting and communicating like true scientists. Scientific argumentation has distinctive characteristics compared to argumentation in everyday contexts and in other fields of science, namely the existence of a link between statements (claims), evidence and justification. Arguments must contain strong reasons to solve a problem so that students are required to think critically, be able to communicate and collaborate well, and have creativity to create arguments that can be accepted by others in improving self-quality in facing the progress of the 21st century (Probosari et al., 2016).

The development of argumentation skills requires the right learning approach. The right learning approach can be a guide to achieving learning goals and equip students with life skills (Hasnunidah et al., 2018). The learning approach mandated by the 2013 curriculum is a scientific approach. This approach should have been implemented by teachers in the implementation of the 2013 curriculum in schools accredited A, B and C. The scientific approach consists of five learning activities, namely observing, asking, gathering information/ trying out, associating and communicating (Permendikbud No. 103 2014).

Learning with a scientific approach can support the achievement of learning outcomes because this approach emphasizes student

activity and provides opportunities for students to build concepts independently, familiarizes students in formulating, dealing with and solving a problem. The purpose of implementing a scientific approach is to improve thinking skills, shape students' ability to solve problems systematically, create learning conditions where students feel that learning is a necessity, train students to communicate ideas and develop student character. The scientific approach also develops critical thinking, communication, collaboration and investigation skills because the learning experiences provided can fulfill educational goals and are useful in solving real-life problems (Machin, 2014).

The scientific approach can improve argumentation skills because the 5M activities (observing, asking, trying, associating and communicating) facilitate students to connect data with claims that are formed and strengthened by justifications (warrants) and supports (backings) (Siswanto et al., 2014; Mubarok et al., 2016; Nasir & Suryani, 2018). Biology learning that is carried out with scientific investigations trains students to solve problems by doing scientific work so that students can consider evidence and data, draw conclusions, test and evaluate a theory (Duschl & Osborne, 2002).

The scientific approach is suitable for application to the material of the respiratory system because it emphasizes students' activeness in learning so that students can build concepts independently through observation, data collection and literature, as well as communication to obtain explanations that can be trusted (Ramdani & Badriah, 2018; Yasin et al., 2017). Using a scientific approach to respiratory system material can increase student interest and learning outcomes (Satnawati, 2020), higher-order thinking skills (HOTS) (Napitupulu et al., 2019) and critical thinking skills (Syafrida, 2019; Ristanto et al., 2020).

Several high schools in Way Kanan district have implemented a scientific approach in teaching biology. This was shown from the results of interview with biology teachers in class XI IPA in three schools with different accreditations, namely SMAN 1 Baradatu (A accredited), SMAN 2 Buay Bahuga (B accredited) and MA Miftahul Ulum Way Tuba (C accredited). The teacher stated that he had implemented the 2013 curriculum and a scientific approach in the biology learning process as evidenced by the lesson plan and student worksheets that had been made by the teacher and supported by student worksheets that had been worked on by students. However, the use of the scientific approach that was applied has never been studied in relation to students' argumentation skills. One of the reasons was that the teacher never gave tests to measure argumentation skill because of the teacher's limited knowledge about it.

The school accreditation rating is divided into four, namely A (excellent), B (good), C (sufficient), and Not Accredited. Several studies have been conducted to test the quality of schools with different accreditation ratings by measuring the abilities of their students. Students who study at A acrredited high school have better science process skills than B acrredited high school students (Safahi et al., 2019; Aswar et al., 2019). B acrredited school have higher science process skills than C acrredited school (Aswar et al., 2019). Students from A accredited schools have better scientific literacy skills and higher-order thinking skills than students from B accredited schools (Angraini, 2014). Schools that are accredited A have higher problem solving skills than B, C accredited and are not yet accredited (Mairing, 2016).

Based on the description above, the researcher found problems regarding how students' argumentation skills through a scientific approach in high schools with different accreditation ratings. The purpose of this study was to compare students' argumentation skills on the subject matter of the respiratory system through a scientific approach in A, B and C accredited high schools.

METHOD

This research was conducted at high school schools in Way Kanan District, Lampung Province with a research focus on different school accreditation ratings. The schools involved in the research were: 1) SMAN 1 Baradatu which was accredited A, 2) SMAN 2 Buay Bahuga which was accredited B and 3) MA Miftahul Ulum Way Tuba which was accredited C. The samples were collected using stratified random sampling technique. The distribution of the population and sample is presented in Table 1.

Table 1. Population and sample

No.	Accreditation	Population	Sample
1.	A	126	62
2.	B	175	73
3.	C	31	31
	Total	332	166

The design of this research was ex-post facto design. Data was collected from the results of argumentation skill tests, teacher interviews, learning documents and student response questionnaires.

The argumentation skill test consisted of 10 descriptive questions that focus on the subject matter of the respiratory system with reference to the Competing Theory model where students are given two theories regarding a phenomenon and then students are asked to choose one theory that is considered correct accompanied by facts or data (grounds), warrants and backing (Osborne, 2004). The quality of the argumentation was assessed based on Toulmin's (2003) rubric which was adapted by Hazeltine (2017). The categories of achievement of argumentation skills can be seen in Table 2. Data on argumentation skills were analyzed with the help of Ms. Excel and hypothesis testing with one-way ANOVA and Least Significant Different (LSD) test at 5% significance level.

Table 2. Category of achievement of argumentation skill

Argumentation Skill (%)	Category
88-100	Very Good
75-87	Good
62-74	Moderate
49-61	Poor
<49	Very Poor

(Source: Suwono et al., 2017)

Interviews were conducted with biology teachers who taught material on the respiratory system for class of XI IPA to find out the application of the scientific approach in schools. The teacher interview grid is presented in Table 3.

Table 3. Interview grid

No	Learning Aspects	Questions Number	
		Argumentation Skill	Scientific Approach
1.	Planning	1, 4, 5, 7	2, 3, 6
2.	Implemen-tation	10, 11, 12	8, 9, 13, 14, 15, 16, 17, 18, 19
3.	Evaluation	20	21, 22, 23, 24

The documentation study was carried out by reviewing the lesson plan and student worksheets to find out the lesson plans made by the teacher. While the questionnaire consisted of 20 closed statements with a Guttman scale to gather information about the learning process experienced by students when the respiratory system material was taught. The questionnaire statement grid is presented in Table 4.

Table 4. Questionnaire Grid

No.	Aspects studied	Questions Number
1.	Argumentation skills development	8, 10, 11, 12, 19
2.	Application of scientific approach	1, 2, 3, 4, 5, 6, 7, 9, 13, 14, 15, 16, 17, 18, 20

Data obtained from interviews and documentation studies were analyzed descriptively qualitatively using the Miles and Huberman model. Student questionnaire data were analyzed descriptively qualitatively in the form of percentages and categorized based on Table 5.

Table 5. Interpretation of Student Responses

Percentage (%)	Category
81-100	Very Good
61-80	Good
41-60	Sufficient
21-40	Bad
<21	Very Bad

(Source: Tohirin, 2007)

RESULTS AND DISCUSSION

The results of this study consisted of four data including argumentation skill data, teacher interview results, learning documents and student response questionnaires.

Argumentation skill

Based on the research results, it could be seen that the average value of the argumentation skill of students from A accredited high school was higher than B and C accredited high schools. However, the average value of argumentation skill in the three schools was in the very poor category (Table 6). Students' grades were then categorized based on the achievement of argumentation skills and it was known that students from the three schools had a tendency for argumentation skills to be in the very poor category (Table 7).

Table 6. Category of achievement of argumentation skill

Category	Argumentation Skill (%)		
	A	B	C
Poor	19,35	10,95	-
Very Poor	80,65	89,05	100
Total	100	100	100

The arguments studied consisted of four components, namely claims (statements), grounds (data/facts), warrants (guarantee), and backing (support). The results showed that some students from A and B accredited high schools could make good claims (score 4) but students could not provide grounds, warrants, and backing relevant to the claim (score 1). While the claims of students from C accredited high school tend not to be good (scores 1 and 2) and only a few can make good and distinguishable claims (scores 3 and 4), besides that the grounds, warrants and backing made by students tend to be irrelevant (scores 1) (Table 8).

Table 7. Students' argumentation skill.

Accreditation Rating	N	Mean ± St. Dev	Highest Score	Lowest Score	Category
A	62	43,03±7,00	61,88	32,50	Very poor
B	73	39,93±6,12	52,50	29,38	Very poor
C	31	31,81±5,41	43,13	18,75	Very poor

Table 8. Argumentation skill of high school students with different accreditation ratings.

Acr	Score Percentage (%)															
	Claim				*Grounds*				*Warrant*				*Backing*			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A	29,68	0,65	9,19	59,35	68,87	19,03	7,74	0,81	71,94	18,23	4,52	0,81	64,52	18,55	8,87	1,29
B	26,16	6,03	10,55	56,44	78,49	14,38	5,34	0	87,95	7,81	1,92	0,27	83,29	8,77	2,74	0,14
C	36,13	34,52	8,71	19,68	90,65	3,87	0,32	1,94	93,87	1,29	0,32	0	89,68	1,94	0,32	0

Note: Acr.= accreditation rating; 4= very good; 3= good; 2= poor; 1= very poor

The argumentation skill data that had been obtained was then tested for its normality and homogeneity. Table 5 shows that the significance values for normality and homogeneity are more than 0.05 (sig. > 0.05) so that the data is normally distributed and comes from a population with homogeneous variance (Table 9).

Table 9. Normality and homogeneity test.

Accreditation	Normality	Homogeneity
A	0,194	
B	0,200	0,065
C	0,200	

Once it is known that the data was normal and homogeneous, then a hypothesis test was carried out with one-way ANOVA (Table 10). The results of the ANOVA test show a significance value (sig. <0.05) so that H_0 is rejected. So it could be concluded that there were differences in the argumentation skills of students in high schools with different accreditation ratings. To find out which groups were significantly different, then a BNT follow-up test was carried out (Table 11).

Table 10. ANOVA test results

Source	Sum of Square	df	Mean Square	F	Sig.
Between Groups	2617,098	2	13,08	32,448	0,000
Within Groups	6573,336	163	40,327		
Total	9190,434	165			

Table 11. LSD test results

Accreditation Rate		Difference in Average Value	Sig.
A	B	3.10277*	.005
	C	11.21750*	.000
B	C	8.11473*	.000

The LSD test result in Table 11 shows that the argumentation skills of students in A accredited high school was significantly different from those of B and C accredited high school. The argumentative skills of students of B accredited high school was significantly different from those of A and C accredited high school. The argumentative skills of students in C accredited high school was significantly different with A and B accredited high schools.

Interview result

Interview were conducted by meeting teachers directly at school. Teachers from SMA accredited A, B and C had not planned to develop their argumentation skills to the fullest. In the aspect of lesson planning, teachers from the three schools had designed learning with a scientific approach well. In the aspect of implementing learning, the teacher had not carried out the maximal development of argumentation and learning skills with scientific approach (Table 12).

Evaluation of the planning and implementation of the scientific approach was carried out well in C accredited high school, while A and B accredited high schools had not carried out proper assessments. In the aspect of implementing learning, teachers had not carried out the development of argumentation skills and learning with a scientific approach to the fullest. Assessment of students' argumentation skills was not carried out by teachers from the three schools (Table 12).

Table 12. Teacher interview results.

No	Questions	Teacher's Answer		
		A	B	C
	Planning			
1.	Did you make formulations of learning outcomes that contain the ability to argue? If not, why?	No, only formulated cognitive achievements	No, only formulated cognitive achievements	No, only formulated cognitive achievements
2.	Did you formulate a learning model based on a scientific approach. If not, why?	Yes	Yes	Yes
3.	Did you design media and learning resources that support the implementation of the scientific approach? If not, why?	Yes	Yes	Yes
4.	Did you design media and learning resources that can develop students' argumentation skills? If not, why?	Yes	Yes	Yes
5.	Did you design learning steps that include developing students' argumentative skills such as making claims, grounds, warrants, and backing? If not, why?	No. The ability to argue that was developed so far is only limited to expressing opinions without basis, guarantees and support.	No. Learning steps was sought to achieve learning objectives such as cognitive learning outcomes only.	No, because I did not understood the components of claims, grounds, warrants, and backing.
6.	Did you design learning materials that contain relevant facts, concepts, principles and procedures, and are written in the form of points in accordance with the formulation of	Yes	Yes	Yes

	competency achievement indicators? If not, why?			
7.	Did you design an assessment technique to measure students' argumentative skills? If not, why?	No. The design of the assessment technique includes cognitive, affective, psychomotor aspects and there was no argumentative skill assessment	No. Argumentation was seen through the ability to give an opinion only. There is no argumentative skill test design.	No, only designing multiple choice questions and short answer essays but not containing the skill to argue
	Implementation			
8.	Did you implement a learning model based on a scientific approach during the learning process? If not, why?	Yes	Yes	Yes
9.	Were the learning steps in the model that you use implemented well? If not, why?	No, the presentation of the results of the group discussion was not implemented.	No, due to limited time and interactions so there was no presentation.	No. There are no group presentation activities.
10	Did you train your students' argumentation skills during the learning process, such as making claims, grounds, warrants, and backing? If not, why?	No. Only trained students' ability to express opinions (claim).	No. Just practiced expressing opinions.	No. Only train students to express opinions only.
11.	Did you think that the learning model used could train students' argumentation skills? If not, why?	Yes	Yes	Yes
12.	Were students able to express their arguments orally or in writing during the lesson? If not, why?	Yes	Yes	Yes
13.	Did an interactive learning atmosphere between students and students and teacher and students always occur when you used learning models based on a scientific approach? If not, why?	No. Students tend to be passive when learning.	Yes	No, because it was done online so the interaction was limited.
14.	Did you always have an inspiring learning atmosphere when you used learning models based on a scientific approach? If not, why?	Yes	No because there awere always students who were not interested in the material being taught.	Yes
15.	Did a pleasant learning atmosphere between students and students and teacher and students always occur when you used learning models based on a scientific approach? If not, why?	Yes	Yes	Yes
16.	Did you always have a challenging learning atmosphere when you used learning models based on a scientific approach? If not, why?	Yes	No because of the limitations of the media used.	Not because students quickly feel bored during learning
17.	Was there always a learning atmosphere that motivated students to actively participate when you used learning models based on a scientific approach? If not, why?	Yes	Yes	No, because only a few students wanted to be involved in learning
18.	Did you always provide sufficient space for initiative, creativity, independence according to the talents, interests and physical and psychological development of students when you used learning models based on a scientific approach? If not, why?	Yes	Yes	Yes

19.	Did you provide exemplary, mentoring and facilitation when you used learning models based on a scientific approach? If not, why?	Yes	Yes	Yes
	Evaluation			
20.	Did you carry out an assessment of student argumentation activities such as making claims, grounds, warrants, and backing? If not, why?	No. Assessment was limited to cognitive aspects. Even if there were only a few.	No. Even if there was only an oral opinion assessment, there are no grounds, warrants and backing components	No. Only assesse the opinions expressed by students, did not contain claims, grounds, warrants and backing
21.	Did you assess the learning process using authentic assessment? If not, why?	Yes	Yes	Yes
22.	Did you carry out assessments by fellow teachers on the planning and implementation of the scientific approach that has been implemented? If not, why?	No. Due to the busyness of other teachers.	No. Due to the busyness of other teachers.	Yes
23.	Did you carry out an assessment by the Principal of the planning and implementation of the scientific approach that had been carried out? If not, why?	Yes	Yes	Yes
24.	Did you carry out assessments by students on the planning and implementation of the scientific approach that has been carried out? If not, why?	No. Because students did not understand about the assessment of the planning and implementation of learning.	No because students did not understand the planning and implementation of learning with a scientific approach	No because students did not understand the planning and implementation of learning.

Learning documents

The learning documents studied were lesson plans and worksheets to find out the teacher's design regarding the application of learning with a scientific approach and the development of argumentation skills. The results of the document review are presented in Table 13. Table 13 showed that the lesson plans for A and B accredited high schools had led to the application of a scientific approach with the discovery learning model. Meanwhile, in the lesson plan for C accredited high school, it could be seen that the teacher did not design verification activities as part of the discovery learning model. Student worksheets from A, B and C accredited high schools had not shown the steps of discovery learning properly because there was a syntax that the teacher did not write down, namely verification activity. Student worksheets from the three high schools indirectly led to the development of argumentation skills, but students were not accustomed to conveying arguments through communicating the results of group discussions.

Table 13. Comparison of learning documents.

No	Document Component	Aspects studied	Document Review Results		
			A	B	C
			Lesson Plans		
1.	Formulation of learning achievements	Development of argumentation skill	The formulation of learning outcomes did not link the relationship between structure, bioprocess and disturbance and was not yet C4 (anaysis) as requested by basic competency (KD) of 3.8 and there was no	The formulation of learning outcomes did not link the relationship between structure, bioprocess and disturbance, not yet C4 and the materials were too broad so that they did not match what was requested by KD 3.8, and there was no	The formulation of learning outcomes was not clear because it directly wrote KD 3.8 without being accompanied by C4 operational verb (KKO) and did not lead to the development of argumentation skill.

			development of argumentation skill.	development of argumentation skill.	
2.	Learning model	Scientific approach	The discovery learning model was suitable with the scientific approach.	The discovery learning model was suitable with the scientific approach.	The discovery learning model was suitable with the scientific approach.
3.	Learning model syntax	Scientific approach	Each syntax was designed according to discovery learning.	Each syntax was designed according to discovery learning.	Syntax was not written clearly and There was no verification activity.
		Development of argumentation ability	The data collection and processing stage trains students to collect data/facts (grounds), warrants, and supporting theories (backing), the verification stage trains students to convey arguments.	The data collection and processing stage trains students to collect data/facts (grounds), warrants, and supporting theories (backing), the verification stage trains students to convey arguments.	The data collection and processing stage trains students to collect data/facts (grounds), warrants, and supporting theories (backing). There was no verification activity so it did not train students to give arguments.
4.	Learning media	Scientific approach	Videos, pictures and power points of the respiratory system could support stimulation and data collection activities.	Videos, pictures and power points of the respiratory system could support stimulation and data collection activities.	Respiratory system videos could support stimulation and data collection activities.
		Development of argumentation skill	The media used can help students formulate claims and collect data (grounds).	The media used can help students formulate claims and collect data (grounds).	The media used can help students formulate claims and collect data (grounds).
		Scientific approach	Biology books and the internet can support the implementation of information collecting activities.	Biology books and the internet can support the implementation of information collecting activities.	Biology books can support the implementation of information collecting activities.
5.	Learning resources	Development of argumentation skill	Books and the internet could help students to look for data/facts (grounds) and supporting theories (backing). Facts/data should also be explored in the surrounding environment.	Books and the internet could help students to look for data/facts (grounds) and supporting theories (backing). Facts/data should also be explored in the surrounding environment.	Books could help students to look for supporting theories (backing), but facts/data can be searched more broadly with additional learning resources in the form of the environment and the internet.
6.	Assessment technique	Development of argumentation skill	Cognitive assessment was done by giving multiple choice questions, psychomotor assessment with performance assessment (worksheet). There was no assessment of argumentation skill. The questions were not yet C4 and did not require students to connect structural, bioprocess and obstructions in the respiratory system.	Cognitive assessment was carried out by giving description questions and there were no questions that direct students to argue. Psychomotor assessment was done by portfolio and performance (worksheet). The questions were not yet C4 and did not insist students to connect structural, bioprocess and obstructions in the respiratory system.	Cognitive assessment was done by giving description questions and psychomotor assessment with performance assessment (worksheet) which did not contain an assessment of the ability to argue. There were no questions that demand students to connect the links between structure, bioprocess and obstructions and there were no C4 questions.

			Student Worksheet of Discovery Learning Model		
7.	Stimulation	Scientific approach	Animated video about the structure and process of entering air into the lungs.	Discourse text about the respiratory system.	Explanation videos on the structure of respiratory organs, chest and abdominal breathing mechanisms and the process of air exchange.
		Development of argumentation skill	Stimulated students to make claims about the videos that were shown.	Stimulated students to make claims about the phenomena in the text presented.	Students could immediately made claims with backing based on the video presented.
8.	Problem Statement	Scientific approach	The problem formulation consisted of questions about the structure and function of the respiratory system and the mechanism of air exchange.	The problem formulation consisted of questions about the structure and function of the respiratory system, the mechanism of inhalation and exhalation, and the process of air exchange.	The problem formulation consisted of questions about the structure and function of the respiratory system, chest and abdominal breathing, and the process of gas exchange.
9.	Data collection	Scientific approach	Students were asked to collect information from books and other resources to answer questions so as to support "collecting information" activities.	Students were asked to collect information by observing four videos to answer questions so as to support "collecting information" activities.	Students were asked to read books or literature in order to collect information to answer questions so as to support the "information collecting" activity.
		Development of argumentation skill	Trained students to collect data/facts (grounds) and supporting information (backing).	Trained students to collect data/facts (grounds) and supporting information (backing).	Trained students to collect data/facts (grounds) and supporting information (backing).
10.	Data processing	Scientific approach	Supported the implementation of "associating" activities because students had to choose which information was correct to answer questions and then wrote down the answers in the tables.	Students were asked to write answers in notebooks and were not directed to how to present data so that they did not support "associating" activities.	Students were asked to write answers in notebooks and were not directed to how to present data so that they did not support "associating" activities.
		Development of argumentation skill	Trained students to choose grounds, connected grounds with claims (warrants) and backings that were relevant to claims.	Trained students to choose grounds, connected grounds with claims (warrants) and backings that were relevant to claims.	Trained students to choose grounds, connected grounds with claims (warrants) and backings that were relevant to claims.
11	Verification	Scientific approach	Students were not asked to re-check answers in other literature and there were no presentation activities to "communicate" the result.	Students were asked to re-check answers in other literature and there were no presentation activities to "communicate" the results of the work.	Students were not asked to re-check answers in other literature and there were no presentation activities to "communicate" the result.
		Development of argumentation skill	There were no communicating activities to present student arguments.	There were no communicating activities to present student arguments.	There were no communicating activities to present student arguments.
12	Generalization	Scientific approach	Students were asked to conclude so as to support the "associate" activity.	Students were asked to conclude so as to support the "associate" activity.	Students were asked to conclude so as to support the "associate" activity.

	Develop-ment of argumen tation skill	Helped students to strengthen their claim.	Helped students to strengthen their claim.	Helped students to strengthen their claim.

Table 14. Students questionnaire results

No	Statements	Response	Acrreditation Rating (%)		
			A	B	C
1.	The teacher conveyed the learning objectives when the material on the respiratory system was taught.	Yes	83,9	89	74
		No	16,1	11	26
		Category	BS	BS	B
2.	The teacher conveyed material on the respiratory system which contains facts, concepts, principles and procedures that were relevant to the learning objectives presented.	Yes	32,3	32,9	29
		No	67,7	67,1	71
		Category	K	K	K
3.	During the learning process, the teacher gave me the opportunity to observe a phenomenon, picture or video.	Yes	85,5	98,6	71
		No	14,5	1,37	29
		Category	BS	BS	B
4.	During the learning process, the teacher gave me the opportunity to ask questions about the results of my observations.	Yes	82,3	100	74,2
		No	17,7	0	25,8
		Category	BS	BS	B
5.	During the learning process, the teacher gave me the opportunity to collect information from various sources/conduct experiments.	Yes	64,5	91,8	74
		No	35,5	8,2	26
		Category	B	BS	B
6.	During the learning process, the teacher gave me the opportunity to relate phenomena/information in order to find a pattern and draw conclusions.	Yes	64,5	65,8	32
		No	35,5	34,2	68
		Category	B	B	K
7.	During the learning process, I was given the opportunity by the teacher to communicate observational/experimental data.	Yes	27,4	32	23
		No	72,6	68	77
		Category	K	K	K
8.	I felt that the learning media (eg ppt, videos, pictures, charts) used by the teacher can develop my argumentation skills.	Yes	59,7	54,8	39
		No	40,3	45,2	61
		Category	C	C	K
9.	During the learning activities, I was given student worksheets consisting of 5M activities (observing, asking, gathering information/trying, reasoning, communicating) by the teacher.	Yes	61,3	61,6	48
		No	38,7	38,4	52
		Category	B	B	C
10.	I felt that the learning resources (eg books, internet, worksheet) used by the teacher can develop my argumentation skills.	Yes	56	77	45
		No	44	23	55
		Category	C	B	C
11.	During the lesson, the teacher trained my argumentation skills such as making claims, grounds, warrants and backing.	Yes	12,9	1,37	3,2
		No	87,1	98,6	96,8
		Category	KS	KS	KS
12.	During the learning process, the teacher gave me the opportunity to present arguments both orally and in writing.	Yes	75,8	71	71
		No	24,2	29	29
		Category	B	B	B
13.	There was an interactive learning atmosphere between me and other students and me and the teacher, especially when the material on the respiratory system was taught.	Yes	75,8	38	52
		No	24,2	62	48
		Category	B	K	C
14.	There is an inspiring learning atmosphere during the lesson, especially when the material on the respiratory system is taught.	Yes	50	40	61
		No	50	60	39
		Category	C	K	B
15.	There was a fun learning atmosphere during the lesson, especially when the material on the respiratory system was taught.	Yes	74,2	78	61
		No	25,8	22	39
		Category	B	B	B
16.	There was a challenging learning atmosphere during the lesson, especially when the respiratory system material was being taught.	Yes	64,5	23	19
		No	35,5	77	81
		Category	B	K	KS
17.	During the learning process I was given enough space for initiative, creativity, independence according to my talents, interests and physical and psychological development.	Yes	61,3	86	71
		No	38,7	14	29
		Category	B	BS	B

18.	The teacher provided exemplary, mentoring and facilitation during teaching and learning activities.	Yes	75,8	100	81
		No	24,2	0	19
		Category	B	BS	BS
19.	The teacher had given argumentation skill tests.	Yes	11,3	1	0
		No	88,7	99	100
		Category	KS	KS	KS
20.	The teacher asked to do an assessment of the implementation of teaching and learning activities.	Yes	17,7	1	0
		No	82,3	99	100
		Category	KS	KS	KS
The average aspect of argumentation skill (statementrs number 8, 10, 11, 12, 19)		Yes	43,2	41,1	31,6
		No	56,8	58,9	68,4
		Category	C	C	K
The average aspect of learning with a scientific approach (statementrs number 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 17, 18, 20)		Yes	61,4	62,6	51,6
		No	38,6	37,4	48,4
		Category	B	B	C
		Total average	52,3	51,8	41,6
		Category	C	C	C

Note: BS= very good; B= good; C= moderate; K= bad; KS= very bad

Student responses' result

Student responses indicated that the development of argumentation skills in A and B accredited high schools were in the sufficient category, while in C accredited high school it was in the bad category. Student responses to learning with a scientific approach in A and B accredited high schools were in the good category, while those in C accredited high school were in the sufficient category (Table 14).

Based on the results of the data analysis that had been done, it showed that the argumentation skills of A accredited high school students were higher B accredited high school. The argumentative skills of B accredited high school students were higher than C accredited high school. The results of hypothesis testing in Table 10 and Table 11 show that there were differences in argumentation skills between A, B, and C accredited high school students. This was due to differences in the learning process experienced by the students. This was supported by the results of teacher interviews (Table 12) and learning document data (Table 13) which showed that although the three teachers used the discovery learning model, the learning steps were designed and implemented in different ways.

Stimulation activity by teacher from A accredited school was carried out by providing a short video about the structure and process of air entering the lungs. The use of video to provide a stimuly gives students the opportunity to observe by listening and seeing. Teacher from B accredited school provided stimuly by asking students to read text about the respiratory system so as to train students to observe by looking and reading. Meanwhile, teacher from C accredited school provided a stimulus by asking students to observe a video explaining the material on the respiratory system. The video chosen by the C accredited high school teacher can train students to observe by seeing and listening but the video contained all the answers to the questions presented in the worksheet so that it did not train students to collect information from various sources. Permendikbud No.103 (2014) state that observing activities are carried out with the senses such as reading, hearing, paying attention, seeing, watching with or without tools.

Problem statement stage in the three lessons planning was carried out by giving students the opportunity to ask questions. At this stage, teachers from A and B accredited high schools asked students to provided hypotheses on the formulation of the problem so that they can train students to make claims, while teachers from SMA accredited C did not design hypotheses by students. This caused students from A and B accredited high schools to be able to provide better claims than C accredited high school students. At the data collecting stage, teachers from the three schools designed student activities

to collect information from various sources such as books, YouTube videos and internet. This activity is in accordance with asking questions and g athering information on a scientific approach listed in Permendikbud No.103 2014 that asking questions is done by making and asking questions. The activity of collecting information is done by reading various literature. Musfiqon & Nurdyansyah (2015) added that in the questioning activity, the questions asked by students should start from factual questions to lead to hypothetical questions.

At the data processing stage, teachers from A accredited high school asked students to presented data or information related to the structure and function of the respiratory organs in the table and then connect the relationship between structure and function of the respiratory system organs. The teacher also presented pictures of the process of exchanging air so that students can relate one piece of information to another in order to find concepts in the respiratory system. Teachers from B and C accredited high school did not plan to present information at the data processing stage, students were only asked to write down their worksheet answers in notebooks.

At the verification stage, teachers from B accredited high school designed a re-check of the information collected through other literature and related it to the hypothesis. Meanwhile, teachers in A and C accredited high school did not ask students to do it. At the end of the activity, the three high schools were asked to make conclusions (generalizations). Data processing, verification and drawing conclusions are in line with reasoning/associating activities in the scientific approach listed in Permendikbud No.103 2014 that reasoning/associating activities are carried out by processing the information that has been collected, analyzing data, linking related phenomena/information in order to find a pattern and conclude. This activity develops interpretation and argumentation skills regarding the interrelationship of various facts/ concepts/ theories/ opinions. Data collection and conclusion drawing activities can develop students' argumentation skills to collect various data/facts (grounds), connecting grounds with claims (warrants) and supporting theories (backing).

Lesson plan designed by teachers from A and B accredited high school indicated that there was a presentation activity, but during the interview the teacher stated that this activity was not carried out due to time limitation and learning media. Whereas in the lesson plan and the results of interview with teacher from C-accredited high school, there was no presentation activity to communicate student work results. The "communicating" activity that was not carried out caused students' argumentation skills to not develop. In addition, students cannot confirm the truth of the knowledge they had acquired with other students or with the teacher. This caused students to not be accustomed to conveying arguments such as agreeing or denying the results of discussions from other groups by using data (grounds), warrants and support (backing) that had been collected to strengthen their statements (claims). So that the basic, guarantee and supporting components of the three schools tend to be irrelevant. Afifa et al. (2021) states that giving students the opportunity to argue allows students to exchange information by comparing findings between groups so that students can convey, correct or refute the opinions of other groups with investigative evidence supported by various theories to obtain the truth.

Utami et al. (2015) also find that in the lesson plans made by teachers from three public high schools in Palembang, there are several activities that are inconsistent with the scientific approach, including observing, associating and communicating. Gunawan et al. (2021) states that the scientific approach used by teachers is usually incompatible between the learning model used and the characteristics of the material being taught, especially to improve skills in explaining scientific phenomena.

Several studies about student abilities and school accreditation show that students studying

in A accredited high school have higher science process skills than B accredited high school. B accredited high school has higher science process skills than C accredited high school. A accredited school has a higher score of national standards education than B and C accredited schools so that it can support the learning process which can develop students' process skills (Safahi et al., 2019; Aswar et al., 2019).

The quality of the arguments of students from the three schools in Table 8 shows that students from A, B and C accredited high schools tend to provide reasons, warrants and backing that are lacking or even irrelevant to claims. The quality of grounds, warrants and backing that does not support claims is mostly made by students from C accredited school, then B and A accredited schools. Some students from A and B accredited high school write good claims and some others choose the right opinion (claim) but incomplete. Meanwhile, C accredited high school students tend to make claims that are not clear enough. This is because during the learning process the teacher has not trained students' abilities to provide grounds, warrants and backing that are relevant to claims. This is supported by the results of the interviews (Table 12) and questionnaires (Table 13) which show that the arguments trained by the teachers from the three schools were in the form of giving opinions or statements orally or in writing about a phenomenon (claim). The teacher does not dig deeper into the statements given by students so that student claims are not supported by data (grounds), warrants, and backing.

In line with this finding, Oktaviyani (2013) and Syerliana & Setiawan (2018) state that students are able to make claims well but are not accompanied by grounds, warrants and backing that can support claims. Pritasari et al. (2016) stated that students' argumentation skills in class X MIA 1 SMA Batik 2 Surabaya were low because students had not been trained to reason. Student arguments are only in the form of statements without supporting evidence and reasons.

Although students from SMA accredited A have a higher average score of argumentative skills than SMA accredited B and C, students from the three schools are in the "very poor" category. The students' argumentation skills were "very lacking" because the teacher had not maximized learning with a scientific approach and had not developed students' argumentation skills. It is shown in Table 12 and Table 13 that teachers from A, B and C accredited high school have not designed learning objectives and steps that lead to the development of students' argumentative skills. Lesson planning of the three schools show the design of learning objectives in the aspect of of knowledge and skills. However, the learning objectives in the lesson plans from C accredited high school was only writing basic competence (KD) knowledge and skills, there was no writing operational verbs that refer to KD. The learning objectives written by the three teachers did not lead to the achievement of basic competence (KD) 3.8 because they did not connect the link between structure and bioprocess, structure and obstructions in the human respiratory system. The operational verbs (KKO) used by the teacher were also included under C4 (analysis) so that it can be said that the learning objectives were not aligned with KD 3.8. This finding is in line with Budiastuti et al. (2021) which states that the learning objectives in the lesson plan from SMK in Yogyakarta are not in accordance with the basic competencies of knowledge and skills. This is because the KKO chosen by the teacher is below the minimum level of ability that should be mastered by class X students. Operational verbs in learning objectives should refer to basic competencies aimed at one learning topic at a certain period.

In the aspect of lesson planning, teachers in A, B and C accredited high schools stated that they had designed models, media and learning resources that supported the implementation of the scientific approach. This is supported by learning documents (lesson plan) which show that teachers from the three schools designed learning models with discovery learning.

Teachers from A accredited school use videos, pictures and power points as learning media, books and the internet as learning resources. Based on the results of the questionnaire, students from A accredited school felt that media and learning resources were included in the sufficient category to develop argumentation skills. The media and learning resources used by teachers from B accredited school same with the teacher from A accredited school. According to the responses of students from B accredited school, learning media are included in the sufficient category and learning resources are included in the good category for developing argumentative skills.

The media used by C accredited high school teacher is video and the learning source is books. Student responses to the use of instructional media in SMA accredited C are included in the bad category and learning resources are included in the sufficient category to develop argumentation skills. Media and learning resources are used by the teacher to support the implementation of the discovery learning model, especially at the stage of providing stimulus and data collection.

Implementation of learning in the three schools using WhatsApp and Google Classroom. The teacher had never done virtual face-to-face meetings because of network limitations. This caused the teacher to be unable to monitor all learning activities. Based on the results of the teacher interviews in Table 12, it shows that teachers from the three schools had not implemented the steps of the discovery learning model to the fullest. The teacher stated that they could not carry out the activity of communicating the results of student work which should have been carried out at the verification stage due to limited time and learning media.

The results of the questionnaire analysis (Table 14) show that students from A and B accredited school felt that learning with a scientific approach that had been done by the teacher is included in the good category, the teacher gave students worksheets containing the 5M steps but students felt the teacher did not give them the opportunity to communicated their work. Student response to learning with a scientific approach in C accredited school is included in the sufficient category. According to the students' answers, during the lesson the teacher gave worksheet which contained 5M activities but the teacher did not give students the opportunity to associate and communicate their work results. The results of research by Hasnunidah et al. (2018) also show that 42% of junior high school science teachers in Bandar Lampung use a scientific approach but the activity steps are not complete.

Teachers from A, B and C accredited high school had never assessed students' argumentation skills. Teachers did not understand Toulmin's assessment of argumentation skills such as making claims, grounds, warrants and backing so the teacher did not make questions related to argumentation skills. Based on the lesson plan made by the teacher, the questions given to students tend to only measure aspects of knowledge. The answers from the student questionnaire also showed that teachers from the three schools had not trained and had never given tests of argumentation skill such as making claims, grounds, warrants and backing. This was caused students not to be accustomed to working on argumentation questions so that their argumentation skill were classified as "very poor". Planning and implementation evaluation of the scientific approach by school principals was done in A and B accredited high schools during supervision, but both did not carry out evaluation by fellow teachers because of the busyness of other teachers. Meanwhile, teachers in C accredited high school carry out evaluation by fellow teacher and school principals. Evaluatiom by students was not carried out due to lack of understanding of students regarding the components of planning and implementing a scientific approach.

Syerliana & Setiawan (2018) state that there are three factors that influenced students'

argumentation skills including that students are not used to working on questions of argumentation skill, the learning model used by the teacher when teaching can not develop students' argumentation skills, and the lack of clear guidelines for teachers to carry out assessment and development argumentation skill. Budiman (2021) states that the change from face-to-face learning to online learning has an impact on the misalignment of the planning, implementation and evaluation of learning activities that have been designed by the teacher. The impact of this obstacle is that the online learning process becomes very monotonous and meaningless because it is limited to uploading material, asking students to study material independently or in groups and then giving assignments as material for evaluating competency achievement.

The responses of teachers and students to the implementation of learning with a scientific approach are also different. Teachers from A accredited high school felt that learning using a scientific approach during the pandemic was less interactive because communication between teachers and students did not run optimally and many students did not actively participate in learning activities. The results of the student questionnaire show that students felt that the learning carried out by the teacher is included in the good category because it creates an interactive, fun, challenging atmosphere and provides sufficient space for students to develop. Inspiring learning atmosphere is included in the sufficient category for students.

Teachers from B accredited high school felt that learning with a scientific approach was not inspiring because students were not always interested in the material being taught, besides that there was no challenging atmosphere due to limited media. Questionnaire answers from students from B accredited high school show that during the learning process there was a pleasant atmosphere and they were given enough space to develop, including in the good and very good categories. However, students felt that the teacher's learning was less interactive, inspiring and less challenging.

Teachers from C accredited high school felt that learning was not interactive because of the lack of interaction between teachers and students, teachers also felt that learning was not challenging because students quickly feel bored during learning, besides that teachers felt students did not actively participate during online learning, very few want to be involved in learning. The response of C accredited high school students shows that there was a fairly interactive learning atmosphere during learning. An inspiring, fun learning atmosphere and sufficient space for students are included in the good category. However, according to students, there had not been a challenging learning atmosphere during the learning of respiratory system material which was taught online.

Maulana (2021) reported that students in class X MA Muhammadiyah Salaka were less actively involved in the learning process. Gunawan et al. (2021) stated that sometimes in the learning process, the teacher was optimal but the responses given by students are relatively passive. According to Haryadi & Rosiana (2020) during the online learning period, teachers must be able to apply media in an interesting way so students don't get bored and bored easily during online learning because biology is a subject which is quite difficult to understand for students taking online learning.

CONCLUSION

Based on the results of the study, it can be concluded that there were significant differences in argumentation skills between students in high schools with A, B and C accreditation ratings. The average argumentation skill of students from A accredited high school was higher than B an C accredited high school. The argumention skill of students from the three schools were included in the very low category. Students from A, B and C accredited high schools could make good claims, but had not been able to provide grounds, warrants and backings that were relevant to the

claims they choose. Teachers from the three schools had not maximized the application of the scientific approach in learning, causing a lack of students' argumentation skills.

The result of this study provide a reference for teachers to optimize all scientific approach activities and start training students' argumentation skill by designing and implementing argumentation development and also getting students used to working on argumentation skill problems. Future researchers are expected to be able to develop a learning model based on a scientific approach that can improve students' argumentation skills in A, B and C accredited high schools.

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