Students' Argumentation Quality and Argumentation Skill After the Implementation of RQA, ADI, RQA Integrated with ADI And Conventional Learning Strategies

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ABSTRACT

The ability to give arguments is very essential for students in order that they can take more roles in various aspects of life. The quality of students'arguments can be reflected in their ability to accommodate higher-order thinking skills to generate an argument. This study aims at analyzing students' ability to make arguments and the quality of their arguments after the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies. This research is a survey research using a descriptive quantitative approach. The subjects of this research were the Biology Education students of UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi, consisting of 92 students. The collected data were in the form of students' argumentation skill data obtained from the observation sheets in each class through the implementation of RQA strategy, ADI strategy, RQA integrated with ADI strategy, and conventional learning strategy on Animal Physiology learning. The results of this research showed that the quality of students' arguments at the implementation of RQA, ADI, RQA integrated with ADI learning strategies was at the level of application, analysis, evaluation and creation, while at the implementation of conventional learning their argumentation quality was at the level of memorizing and understanding.

Introduction

Higher order thinking skills, life (problem-solving) skills, literacy skills, and communication skills are reliasble resources which are required to face challenges in the 21st century (Wicaksono and Hayat, 2016). To master these abilities, education serves an essential function as a strategic vehicle that helps individuals develop their potentials as a whole. Therefore, as a future educator, pre-service biology teachers should possess adequate thinking and argumentation skills which are indicated by the ability to relate new information to prior knowledge to find alternative solutions to a problem. The level of one's concept/theory mastery and thinking power will affect the quality of arguments delivered by that particular individual.

Debating on an issue or a topic can lead university students to improving their argumentative thinking skills into higher cognitive levels (Leiato, 2000).

Argumentation skills are part of communication skills that must be promoted in students (Muhajir, Oktaviani, Yuningsih, Mulhayatiah, 2016). Keraf (2007) points out that argumentation skills contain logical principles to justify facts. Learning experiences enriched with various devices that can be used to establish good interactions between students and learning environment will assist them in synthesizing, evaluating, and implementing acquired knowledge (Willey, 2006). In addition, Idrus (2009) emphasizes that university students who are able to express their opinions can take on more roles in various aspects of life. In a learning context, university students can be actively engaged in a discussion which provides them a lot of opportunities to ask questions and give opinions. Students' intelligence is reflected in their ability to argue. This intellectual ability will provide more benefits for the students if it is combined with the ability to communicate opinions and elaborate arguments to solve a problem (Syaifuddin and Sulistyaningrum, 2015).

Erduran (2008) has discovered two research frameworks that are normally applied in studies discussing students' argumentation skills in science learning. The first framework analyzes the importance of argumentation discourse in a process of constructing scientific knowledge and its potential consequences on education. The other explores the important role of social interactions in learning and thinking processes. Wink (2010) argues that from a constructivist point of view, learning should be held to assist learners in constructing skills, concepts, or principles through an internalization process and through transformation, the students are allowed to develop new skills, concepts and principles from a number of information obtained during the process. According to Woolfolk (2009), students' collaboration is important and so is student-centered learning. Therefore, university students have to be introduced to more than one models, analogies, or ways to understand learning contents.

A study by Asniar (2016) showed that the majority of university students could not perform sufficient scientific reasoning and argumentation abilities. One of the factors that might contribute to the students' lack of ability in conveying their ideas was the difficulty to express what was in their mind (Sharbinie & Suryana, 2006). Santoso *et al* (1999) also stated that every individual might have anxiety or shyness that could prevent them from having an effective communication with others. University students who can actively participate in a classroom discussion have been proven to be skilful in communicating since they are categorized into medium or high ability students. They tend to dominate the classroom by not giving a chance for other students to express their opinions and mostly disrespecting them. They are also reluctant to work in a group and pay attention to presentations delivered by their peers (Priantari and Nurmala, 2016).

Sugiyanto (2009) has found that these anxiety issues result from the high intensity of lecturing used to deliver learning materials in the classroom. However, students' scientific reasoning and argumentation skills can actually be trained and facilitated through a proper evaluation tool. The quality of the students' arguments can also be improved by bringing up challenging and interesting topics in a discussion (Wicaksono and Hayat, 2016) because Kuhn (1991) believes that motivation comes when people are asked to talk about issues that they think important for them. In other words, the quality of the issues discussed has a direct and stronger effect on the improvement of students' ability in arguing (Sockalingam and Schmidt, 2011). Cognitive conflicts such as those can be used to stimulate the students' argumentation skills; among which are to strengthen or evaluate statements made during the learning process.

Lecturers at universities have a great responsibility to shape the students' learning independence and experiences. According to Gasong (2009), lecturers play an important role

as a mediator and facilitator meanwhile the students must be more encouraged to participate actively in learning process. University students, particularly, have to be able to construct their own knowledge of a concept based on the results of science activities analysis. Therefore, it is necessary to review and implement a learning strategy that can help stimulate the students' activeness in expressing high quality ideas. It is also needed to create a longer training session and a more direct remediation to provide opportunities for the students to reason and understand learning concepts correctly (BouJaoude & Attieh, 2008). High quality arguments must be based on strong and relevant theories, facts, or data. Innovative learning strategies and models have been proven able to improve the argumentation and scientific reasoning skills of pre-service biology teachers (Probosari et al., 2016).

Reading, Questioning, and Answering (RQA) and Argument Driven Inquiry (ADI) are two exemplary inventive learning strategies that have potentials to develop university students' argumentation skills. The implementation of RQA in learning has demonstrated an effect on university students' ability to comprehend assigned course materials and make questions. As a result, the students' learning achievement can be improved by almost 100% (Corebima, 2009). Science learning in the majority of the classrooms puts more emphasis on practices rather than involving students in the process of thinking through a set of scientific discourse such as discussion, argumentation, and negotiation (Kim & Song, 2005).

Learning which focuses on argumentation activities is more likely to generate active learners because through these activities, learners learn how to connect ideas and evidence to validate their ideas as well as how to communicate them (Andriani & Riandi, 2015). A more sophisticated analysis on developing students' scientific reasoning and argumentation skills has resulted in an inquiry-based learning model, commonly known as Argument-Driven Inquiry (ADI) (Osborne, 2010; Toyep, Prabowo, Kardi, 2015). ADI strategy effectively improve academic achievement, scientific process skills and levels argumentation (Amin & Corebima, 2016).

Based on the explanations above, the problem of this study can be formulated as follows: How do RQA, ADI, RQA integrated ADI, and conventional learning strategies improve the arguments' quality and argumentative skills of university students?

Method

The current study was designed as a descriptive quantitative study which was conducted for six months from January to June. The subjects of the study involved 92 second-year biology students who were currently studying Animal Physiology at UIN Alauddin Makassar and Universitas Muslim Maros. Data of the research were collected using an observation sheet to examine the pre-service biology teachers' argumentation skills. The participants were taught using four different strategies, namely RQA, ADI, RQA integrated ADI, and conventional learning. The students' inquiry ability was analyzed descriptively meanwhile the ability of the participants to argue was analyzed from the quality of the opinions expressed during the classroom interactive discussion. These opinions were evaluated based on Bloom's taxonomy revised (Anderson and Krathwall, 2001). The taxonomy levels are classified into six cognitive domains: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) which then fall into two categories, Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).

The steps in RQA include: (1) delivering the topic; (2) arranging questions; (3) answering the questions; (4) presenting work group. Meanwhile, ADI contains eight activities as follows: (1) identifying the task, (2) collecting data, (3) generating tentative arguments, (4) conducting an interactive argumentation session, (5) writing the investigation report, (6) reviewing the

report, (7) revising the report, (8) doing a reflective discussion. The third strategy which is the "RQA integrated ADI" strategy combines the learning steps in RQA and ADI.

Results and Discussion

The results of the observation were recorded as scores representing the participants' argumentative skills. The students' final scores after implementing the four strategies (RQA, ADI, RQA integrated ADI, and conventional) were presented in Table 1.

Table 1. University Studentts' Argumentative Skills: RQA, ADI, RQA Integrated ADI, and Conventional.

Learning Strategies	Cognitive Levels of Arguments (%)						LOTS (%)	HOTS (%)
	C1	C2	C3	C4	C5	C6		
▪ RQA	11.90	9.52	19.05	21.43	21.43	16.67	40.48	59.52
▪ ADI	11.90	11.90	19.05	19.05	16.67	21.43	42.86	57.14
▪ RQA integrated ADI	7.27	7.27	16.36	23.64	25.45	20.00	30.91	69.09
▪ Conventional	28.00	32.00	16.00	16.00	4.00	4.00	76.00	24.00
Average	14.77	15.18	17.61	20.03	16.89	15.52	47.56	52.44

Table 1 indicated that the participants' argumentative skills in RQA were dominantly placed at the C4 and C5 levels (21.43%). Meanwhile, in ADI, 21.43% of the students' argumentative skills was at the C6 cognitive level. RQA integrated ADI reported 25.45% at the C5 level and conventional learning strategy designated the students' argumentative skills for C2 (32.00%) and C1 (28.00%). Table 1 provided information that RQA, ADI, RQA integrated ADI learning was dominated by arguments categorized into the Higher Order Thinking Skills (HOTS) levels while the conventional learning strategy was identified by arguments at the Lower Order Thinking Skills (LOTS) levels. Preliminary research conducted by Amin, Corebima, Zubaidah & Mahanal (2017), concluded that the ability of biology teacher candidates in tertiary institutions at STKIP PI Makassar, UIN Alauddin Makassar, UPRI Makassar 86.66% is classified as Lower Order Thinking Skills (LOTS) and 13.34% is classified as Higher Order Thinking Skills (HOTS).

Research findings on the students' activities during the RQA integrated ADI learning suggested that the participants had been able to provide arguments based on strong and relevant theories and evidence and had been actively engaged in the discussion. Their arguments mostly represented the cognitive levels of higher order thinking skills (applying, analyzing, evaluating, and creating). The steps in RQA integrated ADI, therefore, have been proven able to stimulate and train the students to improve the quality of their arguments. Providing an opportunity for the students to understand materials related to the topic brought to the classroom discussion was one way to encourage them to participate actively in the process. Backing showed that the university students were able to justify their arguments by presenting accurate facts, data, and literature. The appearance of the argument's backing indicated that the students' argumentative skills were already on the higher levels (Wicaksono and Hayat, 2016).

The analytical ADI was reported to have an impact on students' critical thinking skills (Fitriyaningsih et al., 2017). The steps in ADI are apparently focused on the improvement of students' thinking and argumentation skills. Analysis skills allow an individual to identify parts of a problem, highlight the connection between the parts, look at the causes of an event, and provide arguments that can support an assertion. The tentative argument phase and the

interactive argumentation phase were considered new by the participants of this research. Despite the fact that the students faced some difficulties dealing with these activities in the beginning, eventually they were able to catch up with the concepts. Consequently, the students started to show their active participation in producing argumentation. The quality of the arguments provided by the students kept increasing as they were used to expressing opinions in the interactive session. The role of the lecturer in facilitating and guiding these activities also contributed positively to the development of the pre-service biology teachers' argumentation skills.

On the other hand, the RQA learning strategy led to the increase of the students' arguments' quality by 59.52% (on the Higher Order Thinking Skills (HOTS) levels). The RQA phases, especially the reading and questioning phases, provided the participants with an opportunity to understand biology concepts that shall be used to support their arguments and thus improve them. Research conducted by Lateef, Dahar, and Latif (2016) has showed that higher order thinking skills (HOTS) play a crucial role in enhancing university students' academic achievement. HOTS are needed in the process of formulating tentative arguments from phenomena observations or information acquired from various sources (Thomas, Dougherty, & Buttaccio, 2014). The learning concepts, thus, can be easily discovered through problem-solving activities (Sarabeth, 2013). Empowerment and training of argumentation skills are very important to improve the quality and complexity of learners' knowledge (Amin, 2017).

The factor causing the low ability to argue is because the learning process does not maximize students to carry out argumentation activities (Bustami, Suarsini, and Ibrohim, 2019). Argumentation plays an important role in developing critical thinking patterns and adds a deep understanding of an idea or idea (Deane and Song, 2014). Mastery of one's concept greatly affects the scientific way of thinking, argumentation and the quality of the opinions produced (Acar, Patton, and White, 2015). Argumentation skills are also influenced by the extent to which students' initial understanding of the core of the problem and the ability to reason to uncover issues related to problem topics that can lead to debate of opinions (Istiana, Herawati, and Ardianto, 2020). The more intense the teacher teaches argumentation in the learning process in the classroom, the skills of prospective teachers will be trained in expressing scientifically correct, relevant and quality (Litman and Greenleaf, 2018). Argumentation skills can develop if students understand the concept of the material well then use synthesis analysis skills and reasoning skills in solving problems (Amin & Adiansyah, 2018).

Participants who are involved in arguments in class show good collaboration with colleagues or study partners in discussing and debating so that this can motivate other members to be motivated to express their opinions (Vogel et al., 2016). Argumentation skills must be familiarized in the classroom so that students are able to integrate science problems in social conditions including personal decision making, debate, and anything that has an impact on the quality of individuals and society (Christenson, Gericke, & Rundgren, 2017). The ability of students to explain reasons and supporting scientific evidence is needed for perfecting the reconstruction of scientific findings (Yasir et al., 2020). The ability to think critically in classroom learning can be in the form of students' ability to solve problems, the courage to respond as a form of response to problems (Addy, LePrevost, & Stevenson, 2014). There are many things that are felt by prospective biology teachers in developing critical thinking skills, one of which comes from students' own motivation to dare to submit opinions, ideas, arguments and questions (Amin & Adiansyah, 2018). The ability to assume, argue, analyze, including indicators of critical thinking (Istiyono, Mardapi, & Suparno, 2014).

Brookhart (2010) describes four indicators in measuring one's analysis skill. These indicators include the abilities to focus on the main ideas, analyzing arguments, comparing the arguments, and contrasting them. Argumentation skills can help learners to understand the content of a text, develop their interests, improve their motivation and problem-solving

performance (Shin, Jonassen, & McGee, 2003). Habituation is an important form of learning that can be used to shape particular abilities or skills (Barrie, 2007), such as argumentation skills. The role of the lecturer is very important to implement argumentation-based learning so that students can be trained and directly practice the integration of science with the social environment so as to increase the quality of thinking (McNeill, Singer, Howard, & Loper, 2016). Building positive perceptions of students towards the treatment that will be carried out is expected to provide positive energy for the ability to adapt to learning models or strategies in the classroom (Amin, 2016). Biology teacher candidates must be given opportunities and learning experiences that allow them to argue, solve problems, metacognitive awareness to build new knowledge (Amin & Adiansyah, 2020). RQA, ADI, RQA integrated ADI learning strategies implemented in the present research have been proved more effective in improving the pre-service biology teachers' argumentation skills compared to conventional learning.

Conclusion

The results of the present study suggested that the university students' argumentation skills during the RQA, ADI, and RQA integrated ADI learning processes were on the higher levels of the cognitive domains (applying, analyzing, evaluating, and creating) while during the conventional learning process, the students could only perform remembering and understanding skills. Learning facilitated with RQA, ADI, and RQA integrated ADI was dominated by arguments on the Higher Order Thinking Skills (HOTS) levels whereas conventional learning was identified by arguments on the Lower Order Thinking Skills (LOTS) levels. Therefore, it is recommended for lecturers and teachers to utilize RQA, ADI, and RQA integrated ADI learning strategies in the classroom so that students' argumentation skills can be stimulated.

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Students' Argumentation Quality and Argumentation Skill After the Implementation of RQA, ADI, RQA Integrated with ADI And Conventional Learning Strategies.

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ABSTRACT

The ability to give arguments is very essential for students in order that they can take more roles in various aspects of life. The quality of students'arguments can be reflected in their ability to accommodate higher-order thinking skills to generate an argument. This study aims at analyzing students' ability to make arguments and the quality of their arguments after the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies. This research is a survey research using a descriptive quantitative approach. The subjects of this research were the Biology Education students of UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi, consisting of 92 students. The collected data were in the form of students' argumentation skill data obtained from the observation sheets in each class through the implementation of RQA strategy, ADI strategy, RQA integrated with ADI strategy, and conventional learning strategy on Animal Physiology learning. The results of this research showed that the quality of students' arguments at the implementation of RQA, ADI, RQA integrated with ADI learning strategies was at the level of application, analysis, evaluation and creation, while at the implementation of conventional learning their argumentation quality was at the level of memorizing and understanding.

Introduction

Higher order thinking skills, life (problem-solving) skills, literacy skills, and communication skills are reliasble resources which are required to face challenges in the 21st century (Wicaksono and Hayat, 2016). To master these abilities, education serves an essential function as a strategic vehicle that helps individuals develop their potentials as a whole. Therefore, as a future educator, pre-service biology teachers should possess adequate thinking and argumentation skills which are indicated by the ability to relate new information to prior knowledge to find alternative solutions to a problem. The level of one's concept/theory mastery and thinking power will affect the quality of arguments delivered by that particular individual.

Debating on an issue or a topic can lead university students to improving their argumentative thinking skills into higher cognitive levels (Leiato, 2000).

Argumentation skills are part of communication skills that must be promoted in students (Muhajir, Oktaviani, Yuningsih, Mulhayatiah, 2016). Keraf (2007) points out that argumentation skills contain logical principles to justify facts. Learning experiences enriched with various devices that can be used to establish good interactions between students and learning environment will assist them in synthesizing, evaluating, and implementing acquired knowledge (Willey, 2006). In addition, Idrus (2009) emphasizes that university students who are able to express their opinions can take on more roles in various aspects of life. In a learning context, university students can be actively engaged in a discussion which provides them a lot of opportunities to ask questions and give opinions. Students' intelligence is reflected in their ability to argue. This intellectual ability will provide more benefits for the students if it is combined with the ability to communicate opinions and elaborate arguments to solve a problem (Syaifuddin and Sulistyaningrum, 2015).

Erduran (2008) has discovered two research frameworks that are normally applied in studies discussing students' argumentation skills in science learning. The first framework analyzes the importance of argumentation discourse in a process of constructing scientific knowledge and its potential consequences on education. The other explores the important role of social interactions in learning and thinking processes. Wink (2010) argues that from a constructivist point of view, learning should be held to assist learners in constructing skills, concepts, or principles through an internalization process and through transformation, the students are allowed to develop new skills, concepts and principles from a number of information obtained during the process. According to Woolfolk (2009), students' collaboration is important and so is student-centered learning. Therefore, university students have to be introduced to more than one models, analogies, or ways to understand learning contents.

A study by Asniar (2016) showed that the majority of university students could not perform sufficient scientific reasoning and argumentation abilities. One of the factors that might contribute to the students' lack of ability in conveying their ideas was the difficulty to express what was in their mind (Sharbinie & Suryana, 2006). Santoso et al. (1999) also stated that every individual might have anxiety or shyness that could prevent them from having an effective communication with others. University students who can actively participate in a classroom discussion have been proven to be skilful in communicating since they are categorized into medium or high ability students. They tend to dominate the classroom by not giving a chance for other students to express their opinions and mostly disrespecting them. They are also reluctant to work in a group and pay attention to presentations delivered by their peers (Priantari and Nurmala, 2016).

Sugiyanto (2009) has found that these anxiety issues result from the high intensity of lecturing used to deliver learning materials in the classroom. However, students' scientific reasoning and argumentation skills can actually be trained and facilitated through a proper evaluation tool. The quality of the students' arguments can also be improved by bringing up challenging and interesting topics in a discussion (Wicaksono and Hayat, 2016) because Kuhn (1991) believes that motivation comes when people are asked to talk about issues that they think important for them. In other words, the quality of the issues discussed has a direct and stronger effect on the improvement of students' ability in arguing (Sockalingam and Schmidt, 2011). Cognitive conflicts such as those can be used to stimulate the students' argumentation skills; among which are to strengthen or evaluate statements made during the learning process.

Lecturers at universities have a great responsibility to shape the students' learning independence and experiences. According to Gasong (2009), lecturers play an important role

as a mediator and facilitator meanwhile the students must be more encouraged to participate actively in learning process. University students, particularly, have to be able to construct their own knowledge of a concept based on the results of science activities analysis. Therefore, it is necessary to review and implement a learning strategy that can help stimulate the students' activeness in expressing high quality ideas. It is also needed to create a longer training session and a more direct remediation to provide opportunities for the students to reason and understand learning concepts correctly (BouJaoude & Attieh, 2008). High quality arguments must be based on strong and relevant theories, facts, or data. Innovative learning strategies and models have been proven able to improve the argumentation and scientific reasoning skills of pre-service biology teachers (Probosari et al., 2016).

Reading, Questioning, and Answering (RQA) and Argument Driven Inquiry (ADI) are two exemplary inventive learning strategies that have potentials to develop university students' argumentation skills. The implementation of RQA in learning has demonstrated an effect on university students' ability to comprehend assigned course materials and make questions. As a result, the students' learning achievement can be improved by almost 100% (Corebima, 2009). Science learning in the majority of the classrooms puts more emphasis on practices rather than involving students in the process of thinking through a set of scientific discourse such as discussion, argumentation, and negotiation (Kim & Song, 2005).

Learning which focuses on argumentation activities is more likely to generate active learners because through these activities, learners learn how to connect ideas and evidence to validate their ideas as well as how to communicate them (Andriani & Riandi, 2015). A more sophisticated analysis on developing students' scientific reasoning and argumentation skills has resulted in an inquiry-based learning model, commonly known as Argument-Driven Inquiry (ADI) (Osborne, 2010; Toyep, Prabowo, & Kardi, 2015). ADI strategy effectively improve academic achievement, scientific process skills and levels argumentation (Amin & Corebima, 2016).

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Based on the explanations above, the problem of this study can be formulated as follows: How do RQA, ADI, RQA integrated ADI, and conventional learning strategies improve the arguments' quality and argumentative skills of university students?

Method

The current study was designed as a descriptive quantitative study which was conducted for six months from January to June. The subjects of the study involved 92 second-year biology students who were currently studying Animal Physiology at UIN Alauddin Makassar and Universitas Muslim Maros. Data of the research were collected using an observation sheet to examine the pre-service biology teachers' argumentation skills. The participants were taught using four different strategies, namely RQA, ADI, RQA integrated ADI, and conventional learning. The students' inquiry ability was analyzed descriptively meanwhile the ability of the participants to argue was analyzed from the quality of the opinions expressed during the classroom interactive discussion. These opinions were evaluated based on Bloom's taxonomy revised (Anderson and Krathwall, 2001). The taxonomy levels are classified into six cognitive domains: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) which then fall into two categories, Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).

The steps in RQA include: (1) delivering the topic; (2) arranging questions; (3) answering the questions; (4) presenting work group. Meanwhile, ADI contains eight activities as follows: (1) identifying the task, (2) collecting data, (3) generating tentative arguments, (4) conducting an interactive argumentation session, (5) writing the investigation report, (6) reviewing the

report, (7) revising the report, (8) doing a reflective discussion. The third strategy which is the "RQA integrated ADI" strategy combines the learning steps in RQA and ADI.

Results and Discussion

The results of the observation were recorded as scores representing the participants' argumentative skills. The students' final scores after implementing the four strategies (RQA, ADI, RQA integrated ADI, and conventional) were presented in Table 1.

Table 1. University Studentts' Argumentative Skills: RQA, ADI, RQA Integrated ADI, and Conventional.

Learning Strategies	Cognitive Levels of Arguments (%)						LOTS (%)	HOTS (%)
	C1	C2	C3	C4	C5	C6		
▪ RQA	11.90	9.52	19.05	21.43	21.43	16.67	40.48	59.52
▪ ADI	11.90	11.90	19.05	19.05	16.67	21.43	42.86	57.14
▪ RQA integrated ADI	7.27	7.27	16.36	23.64	25.45	20.00	30.91	69.09
▪ Conventional	28.00	32.00	16.00	16.00	4.00	4.00	76.00	24.00
Average	14.77	15.18	17.61	20.03	16.89	15.52	47.56	52.44

Table 1 indicated that the participants' argumentative skills in RQA were dominantly placed at the C4 and C5 levels (21.43%). Meanwhile, in ADI, 21.43% of the students' argumentative skills was at the C6 cognitive level. RQA integrated ADI reported 25.45% at the C5 level and conventional learning strategy designated the students' argumentative skills for C2 (32.00%) and C1 (28.00%). Table 1 provided information that RQA, ADI, RQA integrated ADI learning was dominated by arguments categorized into the Higher Order Thinking Skills (HOTS) levels while the conventional learning strategy was identified by arguments at the Lower Order Thinking Skills (LOTS) levels. Preliminary research conducted by Amin, Corebima, Zubaidah and~~&~~ Mahanal (2017), concluded that the ability of biology teacher candidates in tertiary institutions at STKIP PI Makassar, UIN Alauddin Makassar, UPRI Makassar 86.66% is classified as Lower Order Thinking Skills (LOTS) and 13.34% is classified as Higher Order Thinking Skills (HOTS).

Research findings on the students' activities during the RQA integrated ADI learning suggested that the participants had been able to provide arguments based on strong and relevant theories and evidence and had been actively engaged in the discussion. Their arguments mostly represented the cognitive levels of higher order thinking skills (applying, analyzing, evaluating, and creating). The steps in RQA integrated ADI, therefore, have been proven able to stimulate and train the students to improve the quality of their arguments. Providing an opportunity for the students to understand materials related to the topic brought to the classroom discussion was one way to encourage them to participate actively in the process. Backing showed that the university students were able to justify their arguments by presenting accurate facts, data, and literature. The appearance of the argument's backing indicated that the students' argumentative skills were already on the higher levels (Wicaksono and Hayat, 2016).

The analytical ADI was reported to have an impact on students' critical thinking skills (Fitriyaningsih et al., 2017). The steps in ADI are apparently focused on the improvement of students' thinking and argumentation skills. Analysis skills allow an individual to identify parts of a problem, highlight the connection between the parts, look at the causes of an event, and provide arguments that can support an assertion. The tentative argument phase and the

interactive argumentation phase were considered new by the participants of this research. Despite the fact that the students faced some difficulties dealing with these activities in the beginning, eventually they were able to catch up with the concepts. Consequently, the students started to show their active participation in producing argumentation. The quality of the arguments provided by the students kept increasing as they were used to expressing opinions in the interactive session. The role of the lecturer in facilitating and guiding these activities also contributed positively to the development of the pre-service biology teachers' argumentation skills.

On the other hand, the RQA learning strategy led to the increase of the students' arguments' quality by 59.52% (on the Higher Order Thinking Skills (HOTS) levels). The RQA phases, especially the reading and questioning phases, provided the participants with an opportunity to understand biology concepts that shall be used to support their arguments and thus improve them. Research conducted by Lateef, Dahar, and Latif (2016) has showed that higher order thinking skills (HOTS) play a crucial role in enhancing university students' academic achievement. HOTS are needed in the process of formulating tentative arguments from phenomena observations or information acquired from various sources (Thomas, Dougherty, & Buttaccio, 2014). The learning concepts, thus, can be easily discovered through problem-solving activities (Sarabeth, 2013). Empowerment and training of argumentation skills are very important to improve the quality and complexity of learners' knowledge (Amin, 2017).

The factor causing the low ability to argue is because the learning process does not maximize students to carry out argumentation activities (Bustami, Suarsini, and Ibrohim, 2019). Argumentation plays an important role in developing critical thinking patterns and adds a deep understanding of an idea or idea (Deane and Song, 2014). Mastery of one's concept greatly affects the scientific way of thinking, argumentation and the quality of the opinions produced (Acar, Patton, and White, 2015). Argumentation skills are also influenced by the extent to which students' initial understanding of the core of the problem and the ability to reason to uncover issues related to problem topics that can lead to debate of opinions (Istiana, Herawati, and Ardianto, 2020). The more intense the teacher teaches argumentation in the learning process in the classroom, the skills of prospective teachers will be trained in expressing scientifically correct, relevant and quality (Litman and Greenleaf, 2018). Argumentation skills can develop if students understand the concept of the material well then use synthesis analysis skills and reasoning skills in solving problems (Amin & Adiansyah, 2018).

Participants who are involved in arguments in class show good collaboration with colleagues or study partners in discussing and debating so that this can motivate other members to be motivated to express their opinions (Vogel et al., 2016). Argumentation skills must be familiarized in the classroom so that students are able to integrate science problems in social conditions including personal decision making, debate, and anything that has an impact on the quality of individuals and society (Christenson, Gericke, & Rundgren, 2017). The ability of students to explain reasons and supporting scientific evidence is needed for perfecting the reconstruction of scientific findings (Yasir et al., 2020). The ability to think critically in classroom learning can be in the form of students' ability to solve problems, the courage to respond as a form of response to problems (Addy, LePrevost, & Stevenson, 2014). There are many things that are felt by prospective biology teachers in developing critical thinking skills, one of which comes from students' own motivation to dare to submit opinions, ideas, arguments and questions (Amin & Adiansyah, 2018). The ability to assume, argue, analyze, including indicators of critical thinking (Istiyono, Mardapi, & Suparno, 2014).

Brookhart (2010) describes four indicators in measuring one's analysis skill. These indicators include the abilities to focus on the main ideas, analyzing arguments, comparing the arguments, and contrasting them. Argumentation skills can help learners to understand the content of a text, develop their interests, improve their motivation and problem-solving

performance (Shin, Jonassen, & McGee, 2003). Habituation is an important form of learning that can be used to shape particular abilities or skills (Barrie, 2007), such as argumentation skills. The role of the lecturer is very important to implement argumentation-based learning so that students can be trained and directly practice the integration of science with the social environment so as to increase the quality of thinking (McNeill, Singer, Howard, & Loper, 2016). Building positive perceptions of students towards the treatment that will be carried out is expected to provide positive energy for the ability to adapt to learning models or strategies in the classroom (Amin, 2016). Biology teacher candidates must be given opportunities and learning experiences that allow them to argue, solve problems, metacognitive awareness to build new knowledge (Amin & Adiansyah, 2020). RQA, ADI, RQA integrated ADI learning strategies implemented in the present research have been proved more effective in improving the pre-service biology teachers' argumentation skills compared to conventional learning.

Conclusion

The results of the present study suggested that the university students' argumentation skills during the RQA, ADI, and RQA integrated ADI learning processes were on the higher levels of the cognitive domains (applying, analyzing, evaluating, and creating) while during the conventional learning process, the students could only perform remembering and understanding skills. Learning facilitated with RQA, ADI, and RQA integrated ADI was dominated by arguments on the Higher Order Thinking Skills (HOTS) levels whereas conventional learning was identified by arguments on the Lower Order Thinking Skills (LOTS) levels. Therefore, it is recommended for lecturers and teachers to utilize RQA, ADI, and RQA integrated ADI learning strategies in the classroom so that students' argumentation skills can be stimulated.

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Students' Argumentation Quality and Argumentation Skill After the Implementation of RQA, ADI, RQA Integrated with ADI And Conventional Learning Strategies.

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ABSTRACT

The ability to give arguments is very essential for students in order that they can take more roles in various aspects of life. The quality of students'arguments can be reflected in their ability to accommodate higher-order thinking skills to generate an argument. This study aims at analyzing students' ability to make arguments and the quality of their arguments after the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies. This research is a survey research using a descriptive quantitative approach. The subjects of this research were the Biology Education students of UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi, consisting of 92 students. The collected data were in the form of students' argumentation skill data obtained from the observation sheets in each class through the implementation of RQA strategy, ADI strategy, RQA integrated with ADI strategy, and conventional learning strategy on Animal Physiology learning. The results of this research showed that the quality of students' arguments at the implementation of RQA, ADI, RQA integrated with ADI learning strategies was at the level of application, analysis, evaluation and creation, while at the implementation of conventional learning their argumentation quality was at the level of memorizing and understanding.

Introduction

Higher order thinking skills, life (problem-solving) skills, literacy skills, and communication skills are reliasble resources which are required to face challenges in the 21st century (Wicaksono and Hayat, 2016). To master these abilities, education serves an essential function as a strategic vehicle that helps individuals develop their potentials as a whole. Therefore, as a future educator, pre-service biology teachers should possess adequate thinking and argumentation skills which are indicated by the ability to relate new information to prior knowledge to find alternative solutions to a problem. The level of one's concept/theory mastery and thinking power will affect the quality of arguments delivered by that particular individual.

Debating on an issue or a topic can lead university students to improving their argumentative thinking skills into higher cognitive levels (Leiato, 2000).

Argumentation skills are part of communication skills that must be promoted in students (Muhajir, Oktaviani, Yuningsih, Mulhayatiah, 2016). Keraf (2007) points out that argumentation skills contain logical principles to justify facts. Learning experiences enriched with various devices that can be used to establish good interactions between students and learning environment will assist them in synthesizing, evaluating, and implementing acquired knowledge (Willey, 2006). In addition, Idrus (2009) emphasizes that university students who are able to express their opinions can take on more roles in various aspects of life. In a learning context, university students can be actively engaged in a discussion which provides them a lot of opportunities to ask questions and give opinions. Students' intelligence is reflected in their ability to argue. This intellectual ability will provide more benefits for the students if it is combined with the ability to communicate opinions and elaborate arguments to solve a problem (Syaifuddin and Sulistyaningrum, 2015).

Erduran (2008) has discovered two research frameworks that are normally applied in studies discussing students' argumentation skills in science learning. The first framework analyzes the importance of argumentation discourse in a process of constructing scientific knowledge and its potential consequences on education. The other explores the important role of social interactions in learning and thinking processes. Wink (2010) argues that from a constructivist point of view, learning should be held to assist learners in constructing skills, concepts, or principles through an internalization process and through transformation, the students are allowed to develop new skills, concepts and principles from a number of information obtained during the process. According to Woolfolk (2009), students' collaboration is important and so is student-centered learning. Therefore, university students have to be introduced to more than one models, analogies, or ways to understand learning contents.

A study by Asniar (2016) showed that the majority of university students could not perform sufficient scientific reasoning and argumentation abilities. One of the factors that might contribute to the students' lack of ability in conveying their ideas was the difficulty to express what was in their mind (Sharbinie & Suryana, 2006). Santoso *et al* (1999) also stated that every individual might have anxiety or shyness that could prevent them from having an effective communication with others. University students who can actively participate in a classroom discussion have been proven to be skilful in communicating since they are categorized into medium or high ability students. They tend to dominate the classroom by not giving a chance for other students to express their opinions and mostly disrespecting them. They are also reluctant to work in a group and pay attention to presentations delivered by their peers (Priantari and Nurmala, 2016).

Sugiyanto (2009) has found that these anxiety issues result from the high intensity of lecturing used to deliver learning materials in the classroom. However, students' scientific reasoning and argumentation skills can actually be trained and facilitated through a proper evaluation tool. The quality of the students' arguments can also be improved by bringing up challenging and interesting topics in a discussion (Wicaksono and Hayat, 2016) because Kuhn (1991) believes that motivation comes when people are asked to talk about issues that they think important for them. In other words, the quality of the issues discussed has a direct and stronger effect on the improvement of students' ability in arguing (Sockalingam and Schmidt, 2011). Cognitive conflicts such as those can be used to stimulate the students' argumentation skills; among which are to strengthen or evaluate statements made during the learning process.

Lecturers at universities have a great responsibility to shape the students' learning independence and experiences. According to Gasong (2009), lecturers play an important role

as a mediator and facilitator meanwhile the students must be more encouraged to participate actively in learning process. University students, particularly, have to be able to construct their own knowledge of a concept based on the results of science activities analysis. Therefore, it is necessary to review and implement a learning strategy that can help stimulate the students' activeness in expressing high quality ideas. It is also needed to create a longer training session and a more direct remediation to provide opportunities for the students to reason and understand learning concepts correctly (BouJaoude & Attieh, 2008). High quality arguments must be based on strong and relevant theories, facts, or data. Innovative learning strategies and models have been proven able to improve the argumentation and scientific reasoning skills of pre-service biology teachers (Probosari et al., 2016).

Reading, Questioning, and Answering (RQA) and Argument Driven Inquiry (ADI) are two exemplary inventive learning strategies that have potentials to develop university students' argumentation skills. The implementation of RQA in learning has demonstrated an effect on university students' ability to comprehend assigned course materials and make questions. As a result, the students' learning achievement can be improved by almost 100% (Corebima, 2009). Science learning in the majority of the classrooms puts more emphasis on practices rather than involving students in the process of thinking through a set of scientific discourse such as discussion, argumentation, and negotiation (Kim & Song, 2005).

Learning which focuses on argumentation activities is more likely to generate active learners because through these activities, learners learn how to connect ideas and evidence to validate their ideas as well as how to communicate them (Andriani & Riandi, 2015). A more sophisticated analysis on developing students' scientific reasoning and argumentation skills has resulted in an inquiry-based learning model, commonly known as Argument-Driven Inquiry (ADI) (Osborne, 2010; Toyep, Prabowo, Kardi, 2015). ADI strategy effectively improve academic achievement, scientific process skills and levels argumentation (Amin & Corebima, 2016).

Based on the explanations above, the problem of this study can be formulated as follows: How do RQA, ADI, RQA integrated ADI, and conventional learning strategies improve the arguments' quality and argumentative skills of university students?

Method

The current study was designed as a descriptive quantitative study which was conducted for six months from January to June. The subjects of the study involved 92 second-year biology students who were currently studying Animal Physiology at UIN Alauddin Makassar and Universitas Muslim Maros. Data of the research were collected using an observation sheet to examine the pre-service biology teachers' argumentation skills. The participants were taught using four different strategies, namely RQA, ADI, RQA integrated ADI, and conventional learning. The students' inquiry ability was analyzed descriptively meanwhile the ability of the participants to argue was analyzed from the quality of the opinions expressed during the classroom interactive discussion. These opinions were evaluated based on Bloom's taxonomy revised (Anderson and Krathwall, 2001). The taxonomy levels are classified into six cognitive domains: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) which then fall into two categories, Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).

The steps in RQA include: (1) delivering the topic; (2) arranging questions; (3) answering the questions; (4) presenting work group. Meanwhile, ADI contains eight activities as follows: (1) identifying the task, (2) collecting data, (3) generating tentative arguments, (4) conducting an interactive argumentation session, (5) writing the investigation report, (6) reviewing the

report, (7) revising the report, (8) doing a reflective discussion. The third strategy which is the "RQA integrated ADI" strategy combines the learning steps in RQA and ADI.

Results and Discussion

The results of the observation were recorded as scores representing the participants' argumentative skills. The students' final scores after implementing the four strategies (RQA, ADI, RQA integrated ADI, and conventional) were presented in Table 1.

Table 1. University Studentts' Argumentative Skills: RQA, ADI, RQA Integrated ADI, and Conventional.

Learning Strategies	Cognitive Levels of Arguments (%)						LOTS (%)	HOTS (%)
	C1	C2	C3	C4	C5	C6		
▪ RQA	11.90	9.52	19.05	21.43	21.43	16.67	40.48	59.52
▪ ADI	11.90	11.90	19.05	19.05	16.67	21.43	42.86	57.14
▪ RQA integrated ADI	7.27	7.27	16.36	23.64	25.45	20.00	30.91	69.09
▪ Conventional	28.00	32.00	16.00	16.00	4.00	4.00	76.00	24.00
Average	14.77	15.18	17.61	20.03	16.89	15.52	47.56	52.44

Table 1 indicated that the participants' argumentative skills in RQA were dominantly placed at the C4 and C5 levels (21.43%). Meanwhile, in ADI, 21.43% of the students' argumentative skills was at the C6 cognitive level. RQA integrated ADI reported 25.45% at the C5 level and conventional learning strategy designated the students' argumentative skills for C2 (32.00%) and C1 (28.00%). Table 1 provided information that RQA, ADI, RQA integrated ADI learning was dominated by arguments categorized into the Higher Order Thinking Skills (HOTS) levels while the conventional learning strategy was identified by arguments at the Lower Order Thinking Skills (LOTS) levels. Preliminary research conducted by Amin, Corebima, Zubaidah & Mahanal (2017), concluded that the ability of biology teacher candidates in tertiary institutions at STKIP PI Makassar, UIN Alauddin Makassar, UPRI Makassar 86.66% is classified as Lower Order Thinking Skills (LOTS) and 13.34% is classified as Higher Order Thinking Skills (HOTS).

Research findings on the students' activities during the RQA integrated ADI learning suggested that the participants had been able to provide arguments based on strong and relevant theories and evidence and had been actively engaged in the discussion. Their arguments mostly represented the cognitive levels of higher order thinking skills (applying, analyzing, evaluating, and creating). The steps in RQA integrated ADI, therefore, have been proven able to stimulate and train the students to improve the quality of their arguments. Providing an opportunity for the students to understand materials related to the topic brought to the classroom discussion was one way to encourage them to participate actively in the process. Backing showed that the university students were able to justify their arguments by presenting accurate facts, data, and literature. The appearance of the argument's backing indicated that the students' argumentative skills were already on the higher levels (Wicaksono and Hayat, 2016).

The analytical ADI was reported to have an impact on students' critical thinking skills (Fitriyaningsih et al., 2017). The steps in ADI are apparently focused on the improvement of students' thinking and argumentation skills. Analysis skills allow an individual to identify parts of a problem, highlight the connection between the parts, look at the causes of an event, and provide arguments that can support an assertion. The tentative argument phase and the

interactive argumentation phase were considered new by the participants of this research. Despite the fact that the students faced some difficulties dealing with these activities in the beginning, eventually they were able to catch up with the concepts. Consequently, the students started to show their active participation in producing argumentation. The quality of the arguments provided by the students kept increasing as they were used to expressing opinions in the interactive session. The role of the lecturer in facilitating and guiding these activities also contributed positively to the development of the pre-service biology teachers' argumentation skills.

On the other hand, the RQA learning strategy led to the increase of the students' arguments' quality by 59.52% (on the Higher Order Thinking Skills (HOTS) levels). The RQA phases, especially the reading and questioning phases, provided the participants with an opportunity to understand biology concepts that shall be used to support their arguments and thus improve them. Research conducted by Lateef, Dahar, and Latif (2016) has showed that higher order thinking skills (HOTS) play a crucial role in enhancing university students' academic achievement. HOTS are needed in the process of formulating tentative arguments from phenomena observations or information acquired from various sources (Thomas, Dougherty, & Buttaccio, 2014). The learning concepts, thus, can be easily discovered through problem-solving activities (Sarabeth, 2013). Empowerment and training of argumentation skills are very important to improve the quality and complexity of learners' knowledge (Amin, 2017).

The factor causing the low ability to argue is because the learning process does not maximize students to carry out argumentation activities (Bustami, Suarsini, and Ibrohim, 2019). Argumentation plays an important role in developing critical thinking patterns and adds a deep understanding of an idea or idea (Deane and Song, 2014). Mastery of one's concept greatly affects the scientific way of thinking, argumentation and the quality of the opinions produced (Acar, Patton, and White, 2015). Argumentation skills are also influenced by the extent to which students' initial understanding of the core of the problem and the ability to reason to uncover issues related to problem topics that can lead to debate of opinions (Istiana, Herawati, and Ardianto, 2020). The more intense the teacher teaches argumentation in the learning process in the classroom, the skills of prospective teachers will be trained in expressing scientifically correct, relevant and quality (Litman and Greenleaf, 2018). Argumentation skills can develop if students understand the concept of the material well then use synthesis analysis skills and reasoning skills in solving problems (Amin & Adiansyah, 2018).

Participants who are involved in arguments in class show good collaboration with colleagues or study partners in discussing and debating so that this can motivate other members to be motivated to express their opinions (Vogel et al., 2016). Argumentation skills must be familiarized in the classroom so that students are able to integrate science problems in social conditions including personal decision making, debate, and anything that has an impact on the quality of individuals and society (Christenson, Gericke, & Rundgren, 2017). The ability of students to explain reasons and supporting scientific evidence is needed for perfecting the reconstruction of scientific findings (Yasir et al., 2020). The ability to think critically in classroom learning can be in the form of students' ability to solve problems, the courage to respond as a form of response to problems (Addy, LePrevost, & Stevenson, 2014). There are many things that are felt by prospective biology teachers in developing critical thinking skills, one of which comes from students' own motivation to dare to submit opinions, ideas, arguments and questions (Amin & Adiansyah, 2018). The ability to assume, argue, analyze, including indicators of critical thinking (Istiyono, Mardapi, & Suparno, 2014).

Brookhart (2010) describes four indicators in measuring one's analysis skill. These indicators include the abilities to focus on the main ideas, analyzing arguments, comparing the arguments, and contrasting them. Argumentation skills can help learners to understand the content of a text, develop their interests, improve their motivation and problem-solving

performance (Shin, Jonassen, & McGee, 2003). Habituation is an important form of learning that can be used to shape particular abilities or skills (Barrie, 2007), such as argumentation skills. The role of the lecturer is very important to implement argumentation-based learning so that students can be trained and directly practice the integration of science with the social environment so as to increase the quality of thinking (McNeill, Singer, Howard, & Loper, 2016). Building positive perceptions of students towards the treatment that will be carried out is expected to provide positive energy for the ability to adapt to learning models or strategies in the classroom (Amin, 2016). Biology teacher candidates must be given opportunities and learning experiences that allow them to argue, solve problems, metacognitive awareness to build new knowledge (Amin & Adiansyah, 2020). RQA, ADI, RQA integrated ADI learning strategies implemented in the present research have been proved more effective in improving the pre-service biology teachers' argumentation skills compared to conventional learning.

Conclusion

The results of the present study suggested that the university students' argumentation skills during the RQA, ADI, and RQA integrated ADI learning processes were on the higher levels of the cognitive domains (applying, analyzing, evaluating, and creating) while during the conventional learning process, the students could only perform remembering and understanding skills. Learning facilitated with RQA, ADI, and RQA integrated ADI was dominated by arguments on the Higher Order Thinking Skills (HOTS) levels whereas conventional learning was identified by arguments on the Lower Order Thinking Skills (LOTS) levels. Therefore, it is recommended for lecturers and teachers to utilize RQA, ADI, and RQA integrated ADI learning strategies in the classroom so that students' argumentation skills can be stimulated.

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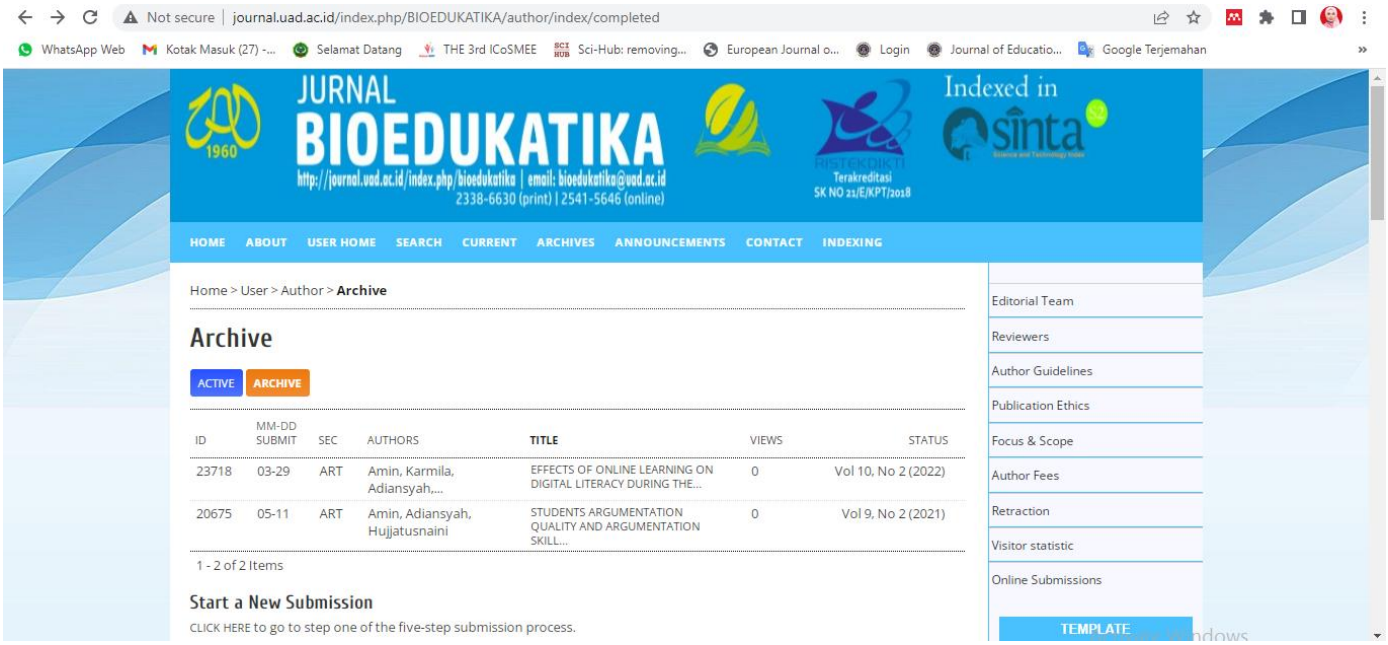

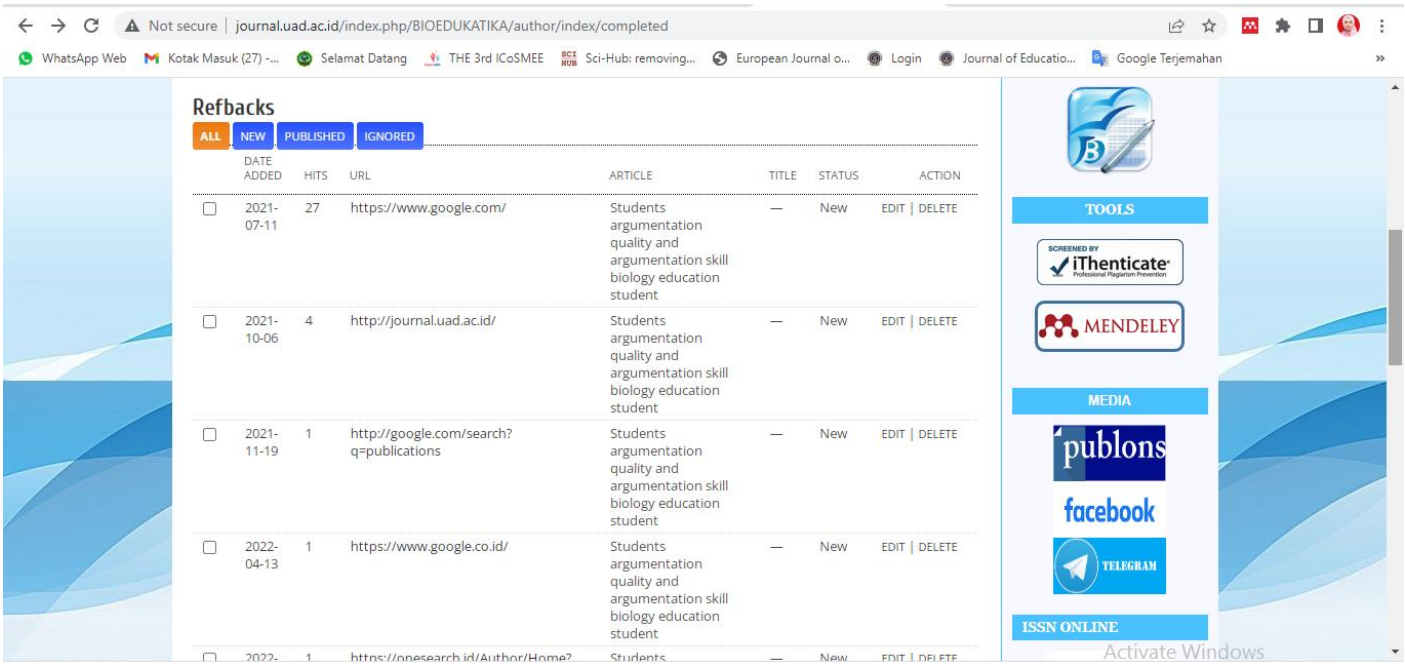
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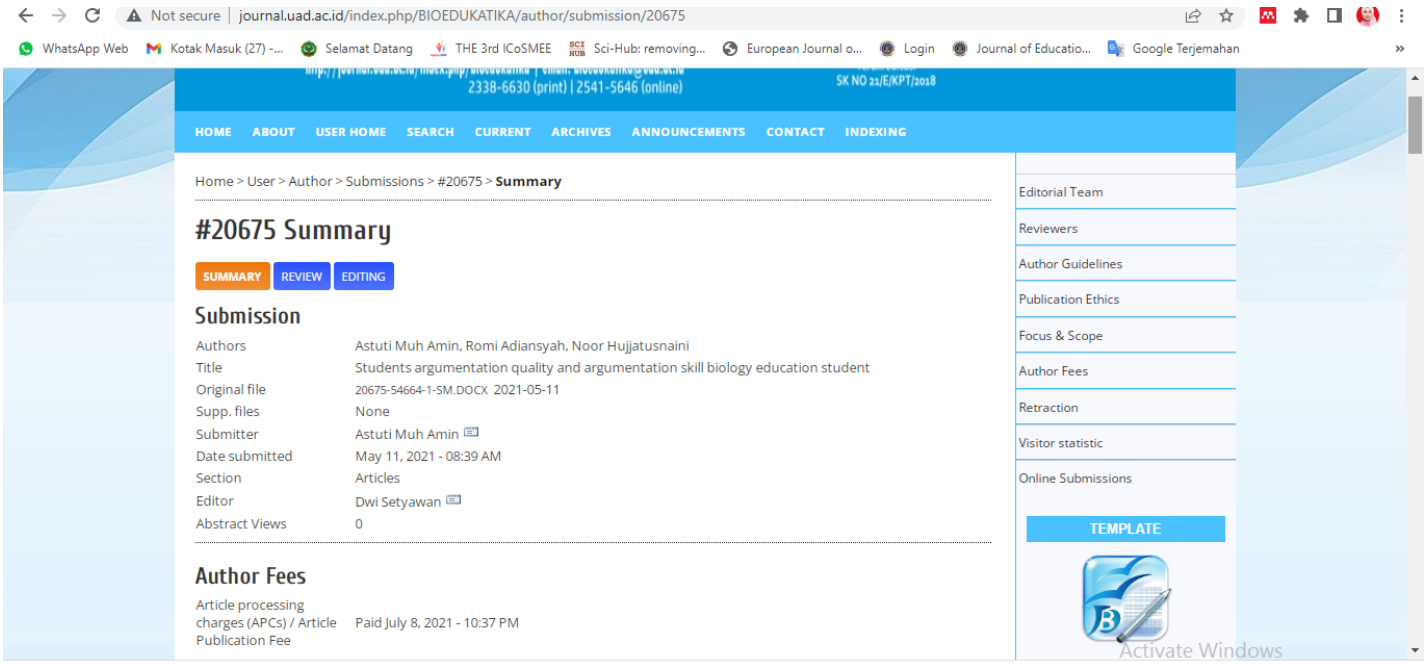
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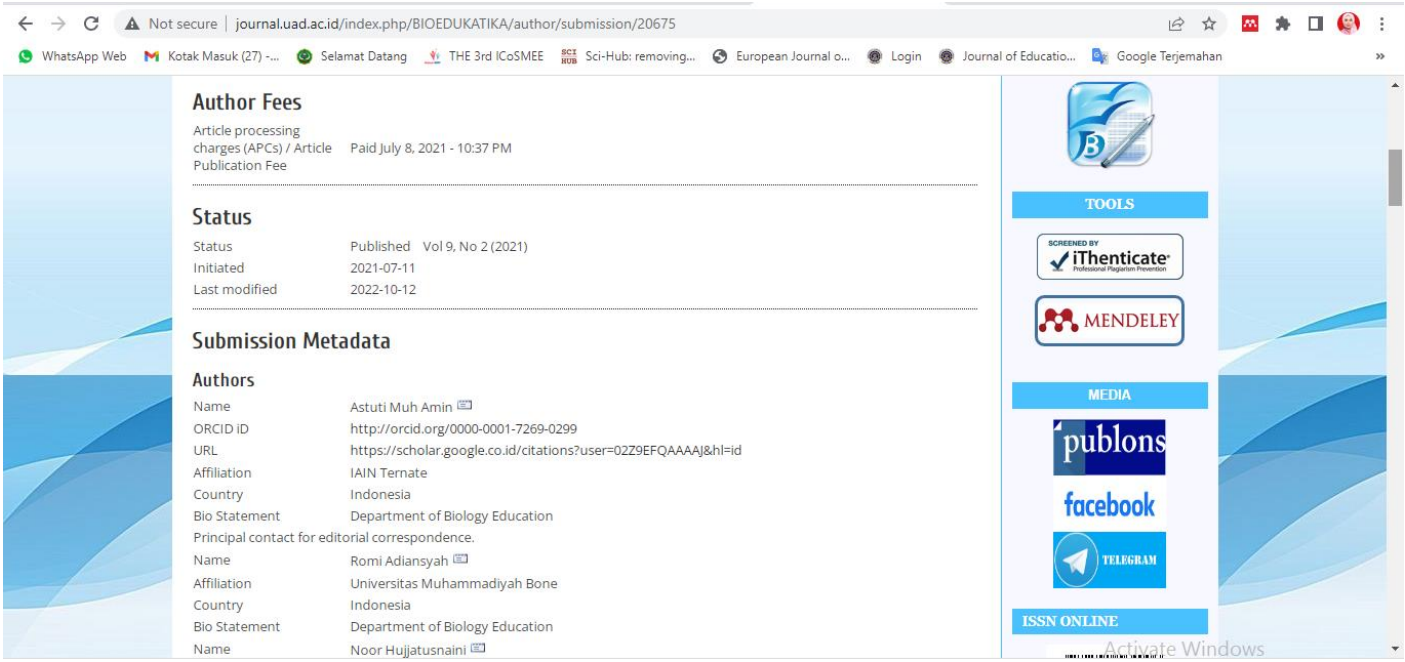
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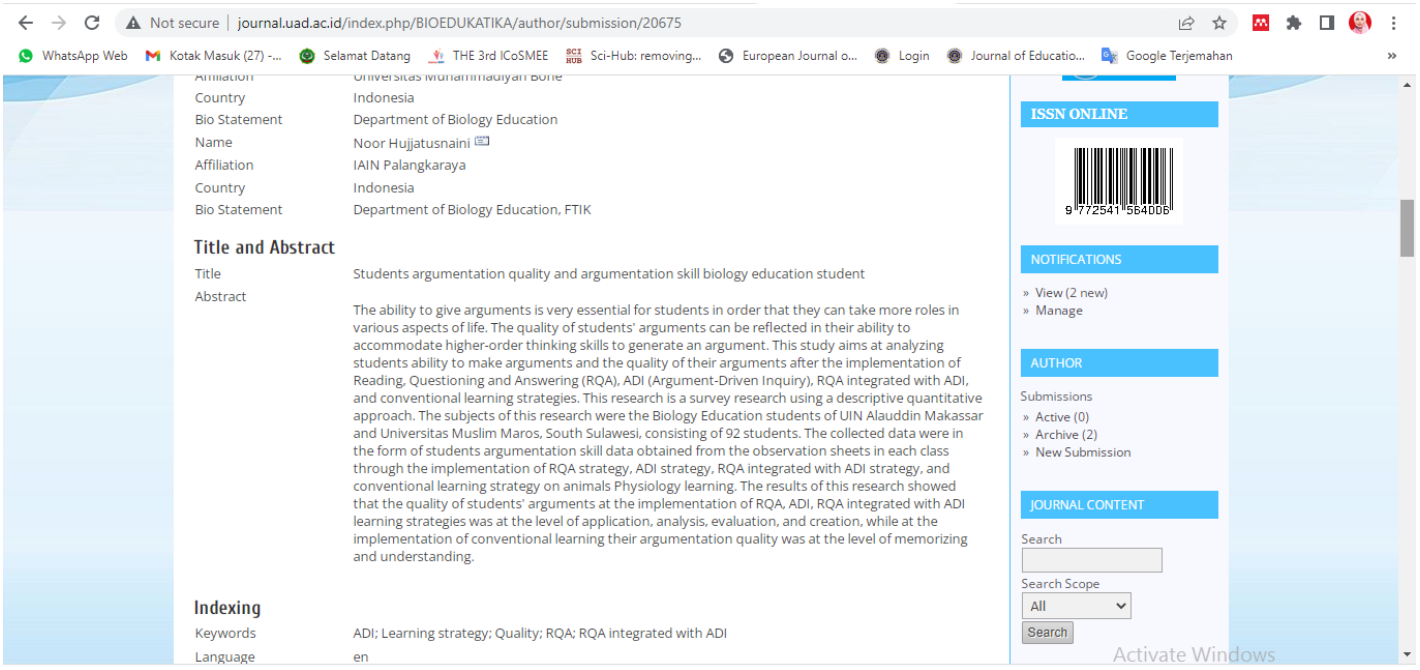
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Abstract
The ability to give arguments is very essential for students in order that they can take more roles in various aspects of life. The quality of students' arguments can be reflected in their ability to accommodate higher-order thinking skills to generate an argument. This study aims at analyzing students ability to make arguments and the quality of their arguments after the implementation of Reading, Questioning and Answering (RQA), ADI (Argument-Driven Inquiry), RQA integrated with ADI, and conventional learning strategies. This research is a survey research using a descriptive quantitative approach. The subjects of this research were the Biology Education students of UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi, consisting of 92 students. The collected data were in the form of students argumentation skill data obtained from the observation sheets in each class through the implementation of RQA strategy, ADI strategy, RQA integrated with ADI strategy, and conventional learning strategy on animals Physiology learning. The results of this research showed that the quality of students' arguments at the implementation of RQA, ADI, RQA integrated with ADI learning strategies was at the level of application, analysis, evaluation, and creation, while at the implementation of conventional learning their argumentation quality was at the level of memorizing and understanding.
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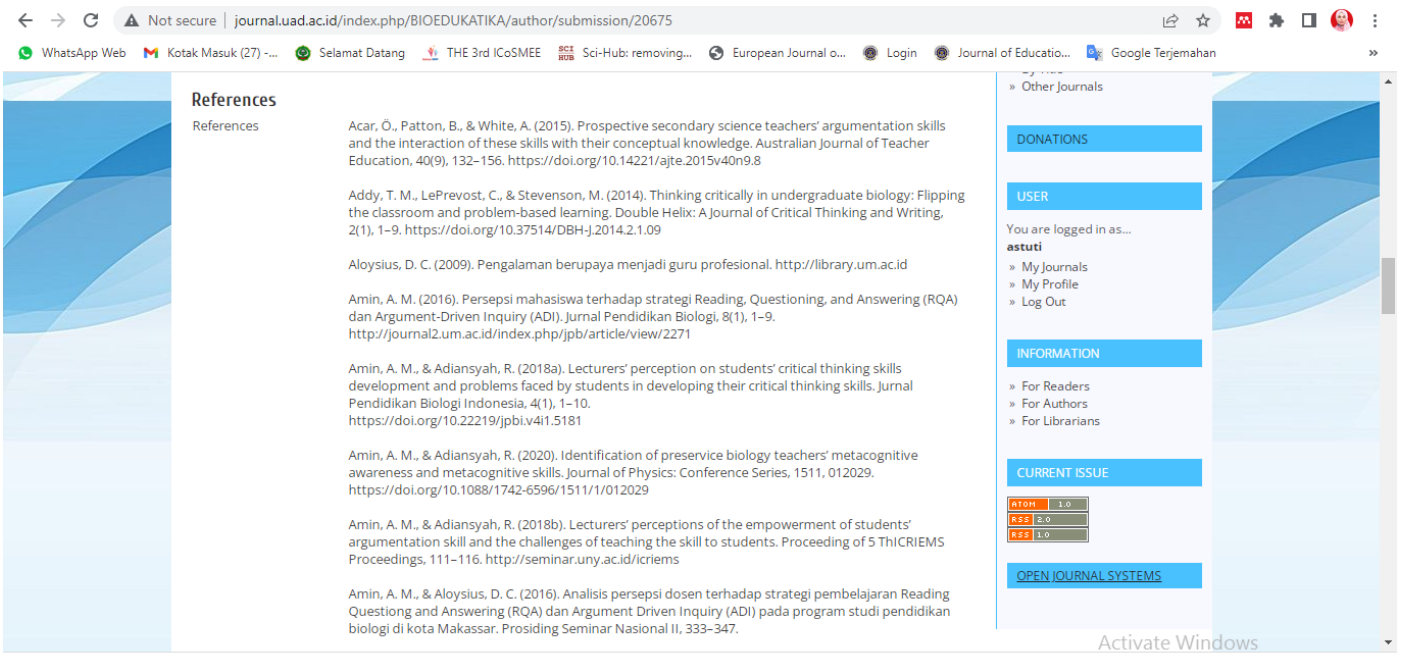
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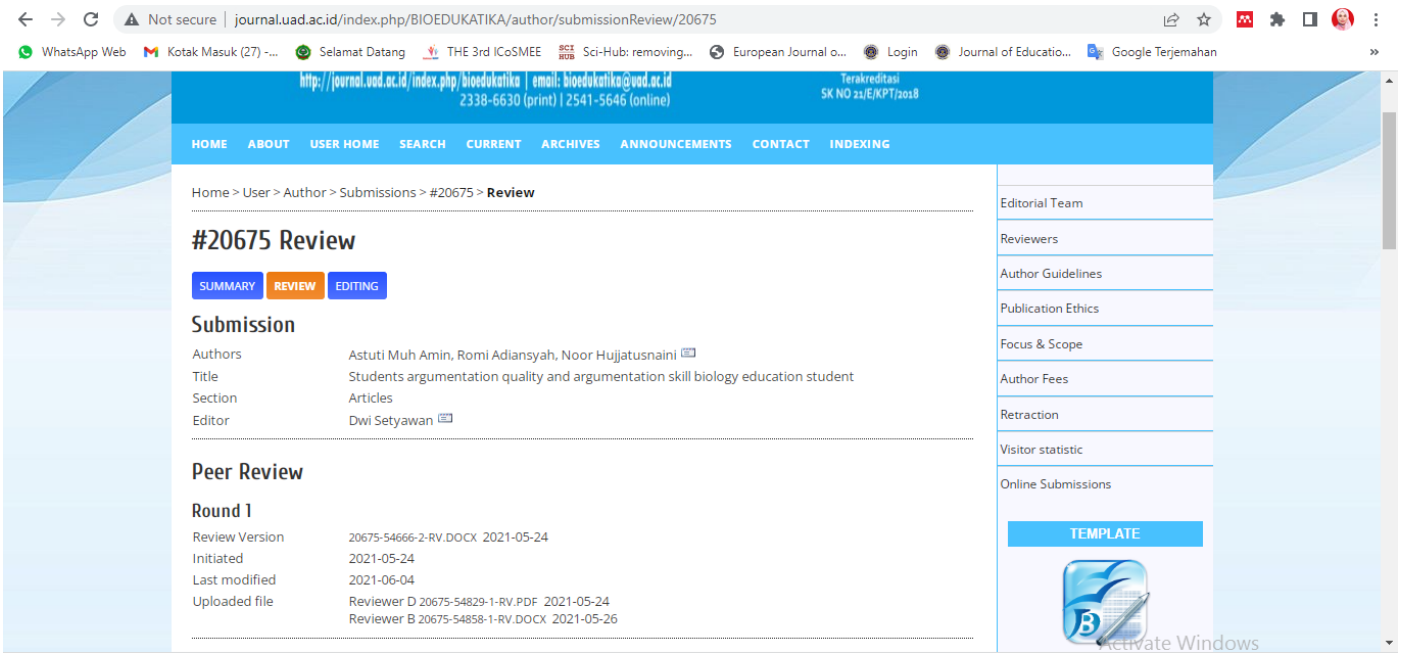
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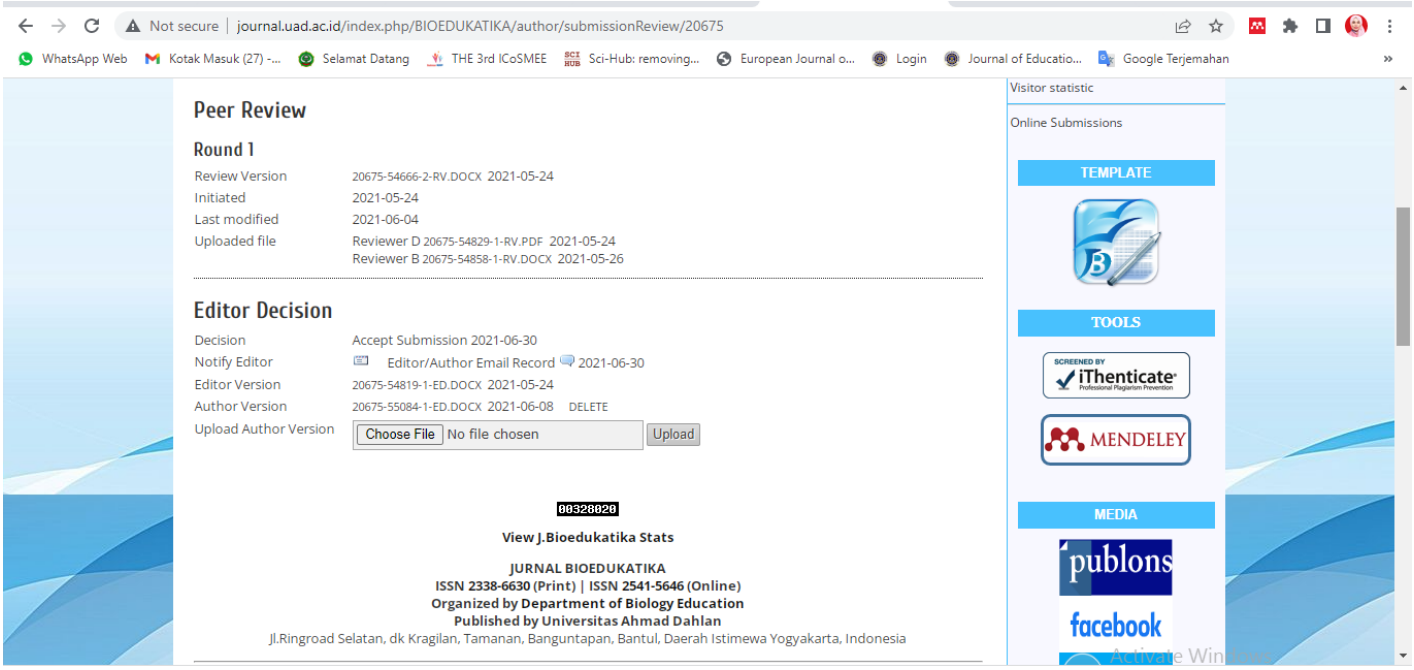
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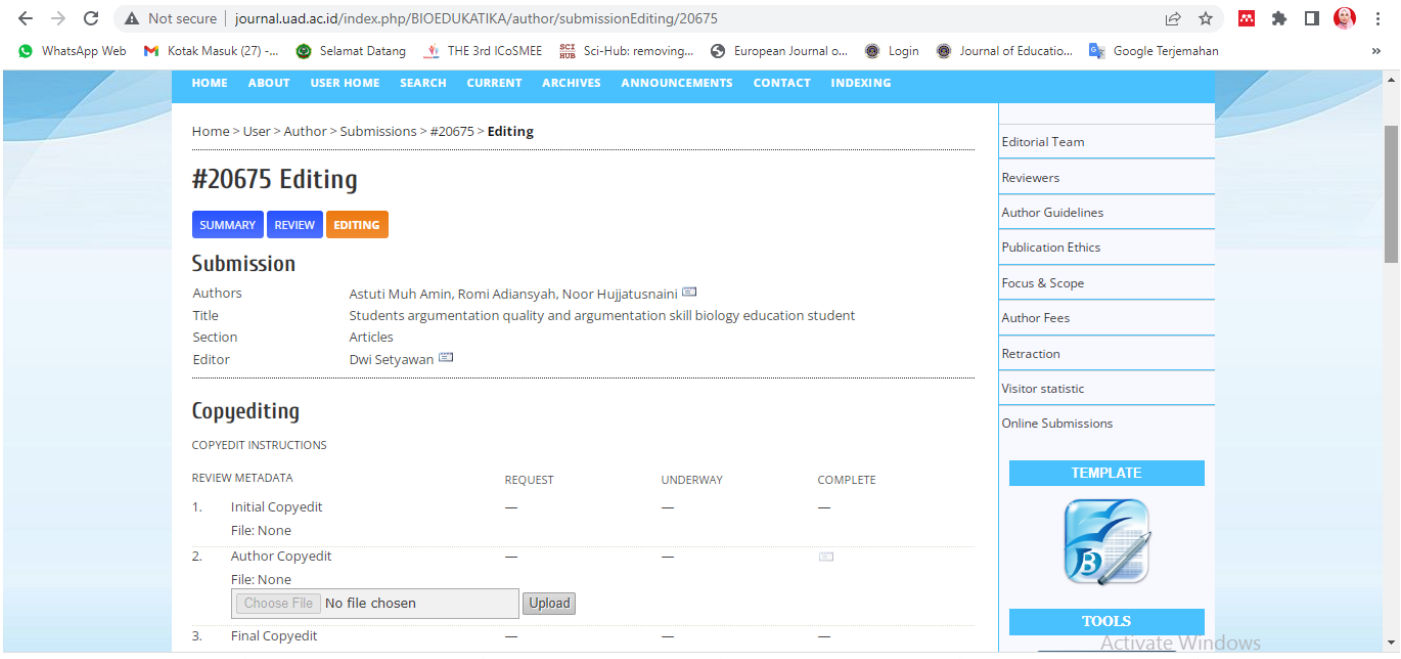
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