

Research Article

RQA integrated with ADI: Empowering students' ability in posing higher-order thinking skill questions



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ABSTRACT

Questions serve as an element that can be used to access and stimulate students' thinking ability. This research aimed at analyzing the students' ability to pose higher-order thinking skill questions during the learning process. This research was a survey research using a descriptive quantitative approach. The samples used in the research were biology education students of UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi with the total of 92 students. The instrument used in this research was an observation sheet of questioning skills for the biology pre-service teachers. The results of this research showed that the implementations of RQA, ADI, and RQA integrated with ADI learning strategies were dominated with Higher-Order Thinking Skills (HOTS) questions, while the learning using the conventional learning strategy was dominated with the Lower Order Thinking Skills (LOTS) questions. The percentages of the Higher-Order Thinking Skills (HOTS) questions in the learning using RQA, ADI, RQA integrated with ADI, and the conventional learning strategy were 60.53%, 55.71%, 64.91%, and 19.35% respectively. This findings indicate that the RQA integrated with ADI strategy contributes the significant impact in stimulating students' ability in posing higher-order thinking level questions in the classroom.



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INTRODUCTION

National quality improvement can be achieved if the education is carried out in accordance with the fundamental provisions for the development of science (Aninda & Suryadarma, 2017). The improvement of the quality of learning outcomes is strongly influenced by the learning process, especially the interactions in the learning discussions (Jayawardana, 2017). The pattern of education through a learning process is needed to empower the human mind (Amri & Ahmadi, 2010). Students will be able to plan solutions and problem solving through thinking processes and reasoning if their thinking processes and reasoning are constantly stimulated

and trained (Brown, Lawless & Boyer, 2013). Therefore, a process of habituation and training is needed to develop students' thinking skills in the classroom learning process. This process can be done through the practice of asking questions and expressing opinions both during group interactive discussions and class discussions. Good questions lead to good understanding (Freatat & Smadi, 2014). Questions function as a means of organizing knowledge, or linking educational experiences (Underhill, 1991).

Questions are an element related to assessment or testing to access the learning curve and the cognitive level of students (Omar, Haris, Hassan, Arshad, Rahmad, Zainal, & Zulkifli, 2012). Learning in universities is not only limited to the transfer of knowledge but it must be accompanied with the development and reproduction of new knowledge (Tonissen, Lee, Woods, & Osborne, 2014). Questions can be used as a guide to understand concepts, to explore the previously acquired knowledge, to connect ideas between different students, to stimulate new ideas or opinions (Bowker, 2010; Hariyadi, Corebima, Zubaidah, & Ibrahim, 2017). Research results show that questioning skills is a reflection of students' thinking level (Chin, 2006; Chin & Chia, 2004). The stages of making questions will encourage students to absorb information in accordance with their level of understanding, so that they can stimulate students' thinking skills (Dootlitttle, Hick, Triplett, Nichols, & Young, 2006). The use of various questions with varying cognitive levels is essential in improving students' cognitive abilities (Ewing & Whittington, 2007).

Asking questions and expressing arguments are indicators of interactive learning. Questions and statements made by students in the learning process are a form of thinking processes (Clough, 2007). High order thinking skills are needed by students to manage information obtained to be expressed in a statement (Thomas, Dougherty, & Buttaccio, 2014). The learning objectives can be achieved through students' high-order thinking skills which are facilitated through questions and statements in the active interaction of the learning process (Blackwell, 2015). According to Brookhart (2010), high-order thinking skills (HOTS) include logic and reasoning abilities, analysis, evaluation, and creation, problem solving, and decision making.

Learning strategies have a significant effect on students' thinking skills, which indirectly influences the types of questions posed in classroom learning (Hariyadi et al., 2017). Teachers and lecturers can facilitate their students to be able to think using their higher-order thinking skills through learning models (Lee, Lee, Gong, Bae, & Choi, 2016; Lee & Lai, 2017). The young generation must have good resources by having the high-order thinking skills (Pantiwati & Permana, 2017). High-order thinking requires someone to apply new information or knowledge that he has and to manage the information to find possible answers in new situations (Heong, Othman, Md Yunos, Kiong, Hassan, & Mohamad, 2011). Questions have important functions to help teachers and lecturers in building students' understanding and encouraging students to think and act on structured concepts/materials (Khan & Inamullah, 2011).

The research conducted by Lateef, Dahar, and Latif (2016) concluded that higher-order thinking skills (HOTS) played an essential role in increasing students' academic achievement. Habituation is an important technique to develop a particular ability (Barrie, 2007). Habituation or stimulus cannot be carried out when the learning activities only use the conventional learning atmosphere, strategy, and models (Husamah, Fatmawati, & Setyawan, 2017). Educators must help their students to develop their critical thinking and problem solving skills (McCormick, Clark, & Raines, 2015). According to Limbach and Waugh (2010), to develop critical thinking skills, there are five points needed, namely: (1) determining learning goals, (2) teaching through inquiry, (3) practicing, (4) reviewing, improving understanding, and (5) training feedback and assessing the learning. Meanwhile, according to Krathworl (2002), the indicators for measuring high-order thinking skills are: analyzing, evaluating, and creating.

The research conducted by Kusdiningsih, Abdurrahman, and Jarmo (2016) revealed that the causes of the low percentage of the achievement in the indicator of beginning question were because the students were not able to make initial ideas or initial questions that supported the understanding of science concepts. Husnawati, Muhibbuddin, and Abdullah (2014) stated that the questioning skills of the pre-service biology teacher in developing students' thinking skills in the learning process were still low, in which the average level of the questions was in C1, C2, and C3. The students whose HOTS level is still low are not able to identify the main ideas, analyze arguments, and show the usefulness of things known to give answers, so that their analytical skills are poor (Kurniati, Harimukti, & Jamil, 2016). The results of a preliminary study conducted by Amin, Corebima, Zubaidah, and Mahanal (2017) showed that the quality of the questions made by the pre-service Biology teachers in Makassar indicated that 76.92% of the questions were classified as Lower-Order Thinking Skills (LOTS), and 23.08% were classified as Higher-Order Thinking Skills (HOTS).

Constructivist learning strategies which have the potential to empower higher-order thinking skills are Reading, Questioning, and Answering (RQA) strategy and Argument Driven Inquiry (ADI) strategy. RQA is a learning strategy that can improve thinking skills (Mulyadi, Adlim, & Djufri, 2014), critical thinking (Priantari, 2014), high-order thinking skills (Sumampouw, 2011). ADI learning strategy can have an effect on critical thinking and learning activities (Fitriyaningsih, Roshayanti, & Citraning, 2017). The implementation of Argument Driven-Inquiry

learning strategy is thought to be able to increase the questioning activities in the learning process which eventually can develop students' creative reasoning (Hidayat, 2017). However, it is necessary to further investigate the contribution of the RQA, RQA integrated with ADI, ADI, and conventional learning strategies in improving students' ability in asking higher-order thinking (HOT) questions to find out which strategy can provide the highest potential to improve students' thinking skills.

Based on the above mentioned conditions, this research aimed at analyzing the students' ability in posing higher-order thinking skills (HOTS) questions during learning process. This research focused on comparing the students' ability in posing higher order thinking skills questions in the RQA, ADI, RQA integrated with ADI, and conventional learning strategies. This research is expected to provide information for teachers and lecturers about the learning strategies having the potential to improve the students' ability in posing higher order thinking skills questions. The research results contribute to the biology lecturers, particularly in Indonesia, as the strong recommendation to develop various learning strategies which address the improvement of students' HOTS. To go further, this research can be an initial model for the next researchers to develop the similar topics.

METHOD

This survey research used descriptive quantitative approach. The population of this research was the fourth semester students of Biology Education program in Makassar and Maros, South Sulawesi, Indonesia which consisted of five universities with the total of 201 students. The sample of this research was the biology education students at UIN Alauddin Makassar and Universitas Muslim Maros, South Sulawesi which consisted of 92 students. This research was carried out for one semester, January to June 2018 in Animal Physiology course.

The instrument used in this research was the observation sheet of questioning ability of the pre-service biology teachers. The data were questioning ability gained by using observation sheet. The data then were analyzed descriptively. The questioning ability analysis used was based on the both quantity and the quality of the questions. The question quality was categorized based in the instrument determined. The higher the level and the dimension, the higher the quality of the questions (Tanaya, Suciati, & Maridi, 2017). The question quality was analyzed based on the cognitive level of revised Bloom taxonomy (Anderson & Krathwohl, 2001). The classification of cognitive domain levels were: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). These six cognitive levels were then grouped into LOTS and HOTS. The questions posed by students were categorized into the LOTS as they comprised of C1 (remembering), C2 (understanding), and C3 (implementing). Meanwhile, the questions generated from C4 (analyzing), C5 (evaluating), and C6 (creating) were grouped in HOTS.

The data collected in this research consisted of students' questioning abilities from each class through the implementation of RQA strategy, ADI strategy, RQA integrated with ADI strategy, and conventional learning strategy. The steps of the RQA learning strategy were: (1) stating the topics of learning; (2) arranging questions; (3) answering questions; (4) presenting group assignments. The steps of ADI learning strategy were: (1) identifying tasks, (2) collecting data, (3) producing tentative arguments, (4) interactive session arguments, (5) compiling written investigation reports, (6) reviewing reports, (7) revising the report, and (8) reflective discussion. Meanwhile, the RQA integrated with ADI learning strategy was the combination of RQA and ADI learning steps. These steps were: stating the learning topics, reading the learning material, arranging questions, identifying assignments, collecting data, producing tentative arguments, presenting group assignments, conducting interactive argumentation sessions, answering questions, compiling written investigation reports, revising reports, and conducting reflective discussions. Conventional learning was the learning strategy which was commonly implemented by the lecturers during the Animal Physiology learning, which was dominated with direct instruction using lecturing method as well as question and answer session.

The data were gathered using observation sheets. These data obtained then were recapitulated and categorized into the four categories (i.e. RQA, ADI, RQA integrated with ADI, and conventional). The data analysis was performed quantitatively through tabulation and interpretation of the quantitative data. The results of the analyses were recorded in tables containing frequencies and percentages.

RESULTS AND DISCUSSION

The students' questioning abilities in the learning process were identified through the observation sheet. The recapitulation of the results of the students' ability to pose LOTS and HOTS questions at the implementation of RQA, ADI, RQA integrated with ADI, and Conventional learning strategies can be seen in Table 1. Table 1 shows

that the students in the RQA learning dominantly posed questions on the cognitive level C4 and C6 with the percentage of 21.05% for level C4 and 21.05% for level C6. Whereas in the ADI learning, about 20% of questions were at the cognitive level C6 and 18.57% of the questions were at the cognitive level C4. In the RQA integrated with ADI learning, 24.56% of the questions were at the cognitive level C4, and 21.05% of the questions were at the cognitive level C6. Meanwhile, in the conventional learning, most of the questions posed by the students were at the cognitive level C3 (29.03%) and at the level C2 and C1 with the percentage of 25.81% of each level.

Table 1. Students' ability to pose LOTS and HOTS questions at the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies

| Learning strategies | Cognitive questions level (%) | | | | | | LOTS (%) | HOTS (%) |
|---------------------------|-------------------------------|-------|-------|-------|-------|-------|----------|----------|
| | C1 | C2 | C3 | C4 | C5 | C6 | | |
| ▪ RQA | 10.53 | 13.16 | 15.79 | 21.05 | 18.42 | 21.05 | 39.47 | 60.53 |
| ▪ ADI | 12.86 | 14.29 | 17.14 | 18.57 | 17.14 | 20.00 | 44.29 | 55.71 |
| ▪ RQA integrated with ADI | 8.77 | 8.77 | 17.54 | 24.56 | 19.30 | 21.05 | 35.09 | 64.91 |
| ▪ Conventional learning | 25.81 | 25.81 | 29.03 | 9.68 | 6.45 | 3.23 | 80.65 | 19.35 |

The graph of the comparison of the students' ability to pose LOTS and HOTS questions at the implementation of RQA, ADI, RQA integrated with ADI, and Conventional learning strategies can be seen in Figure 1.

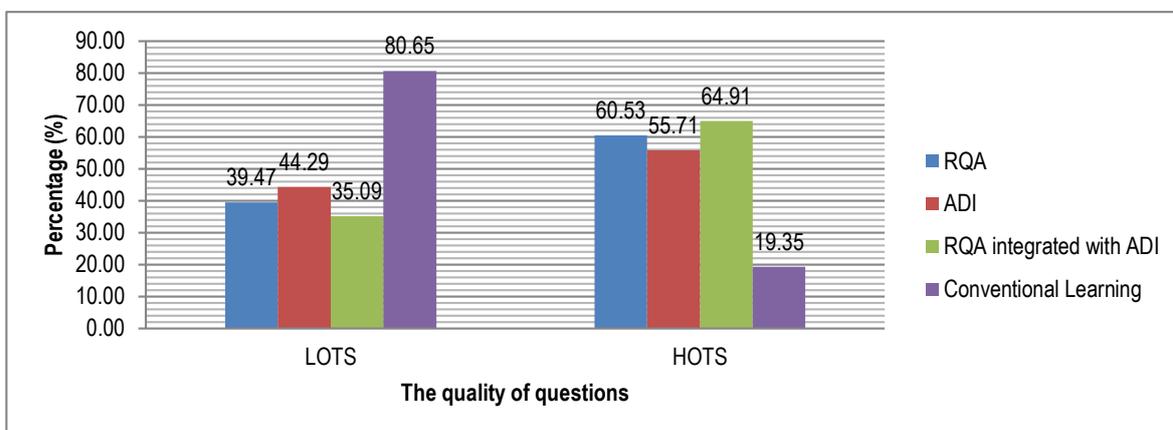


Figure 1. Comparison of students' ability to pose LOTS and HOTS Questions at the Implementation of RQA, ADI, RQA Integrated with ADI, and Conventional Learning Strategies

Based on Figure 1, it can be seen that the RQA, ADI, and RQA integrated with ADI learning strategies were dominated with the HOTS questions, while the conventional learning strategy was dominated with the LOTS questions. Figure 1 shows that the RQA integrated with ADI learning strategy provided the highest contribution to the improvement of the students' HOTS. Phases in the RQA integrated with ADI have the potential to stimulate students' reasoning and thinking skills. The "producing tentative arguments" and "interactive argumentation" phases in the RQA integrated with ADI provide opportunities for the students to leave their "comfort zone" and enrich their learning experiences through actively asking higher-order thinking questions and giving opinions.

The statements involving thinking processes support the activities to confirm the conclusions formulation that have been formulated with tentative answers. The questions and statements of the students which are dominated with cognitive process C1 and C2 on the dimensions of facts and concepts showed that their thinking abilities were in a low category (Marin & Halpern, 2011; Sim, 2013). Unidentified questions and statements of metacognition indicate that students are not able to ask questions or make statements related to self-awareness (Pintrich, 2002). Question C6 indicates that students have been able to create a new concept obtained from combining old concepts with the new one (Anderson & Krathwohl, et al., 2001). Educators consider that high-order thinking skills are as high as the order of thought that occurs when students gain new knowledge and store it in memory, then this knowledge will be correlated, organized, or evaluated to achieve more specific goals (Abosalem, 2016). Questions with a low cognitive level can increase the acquisition of factual knowledge and the foundation for achieving high cognitive skills. Contrarily, higher cognitive level questions are effective

tools to stimulate thinking and to develop other cognitive skills such as problem solving and decision making (Freahat & Smadi, 2014).

The research conducted by Hariyadi et al (2017) concluded that the class with RQA strategy provides conditions that trigger students' higher-order thinking skills. According to Amin and Corebima (2016), the RQA learning strategy has a continuous learning syntax which supports one another. The phases in this strategy begin with reading phase, questioning phase, and finally the answering phase. This syntax becomes an integrated process in improving students' thinking abilities and skills (Amin & Corebima, 2016). The answering phase in the RQA learning has the potential to encourage students to develop their metacognitive skills by adapting various learning strategies to meet the demands of the task (Sumampouw, 2011). RQA learning enables students to understand the content of a reading passage and to find the substantial ideas of the reading, so that the students already have the concept about the learning material when the classroom learning takes place (Corebima, 2009; Bahtiar, 2011; Sumampouw, 2013). Reading Questioning and Answering (RQA) can be one of the learning strategies that can be used to improve students' character, cognitive learning results and retention (Amin & Rosmiaty, 2017). The advantage of this RQA learning strategy is that it has been proven to increase the quality of the students' questions in higher cognitive levels.

One way to improve students' critical thinking skills is by improving their analysis skills. ADI learning is analytical and has an effect on students' critical thinking skills improvement (Fitriyaningsih et al., 2017). The ADI learning strategy provides the students with the opportunities to build their own explanations and to share ideas in small groups during class discussions. Thus, this strategy can create a culture of "process" in science teaching and learning (Amin & Corebima, 2016). According to Sampson and Gleim (2009), one of the strengths of ADI learning strategy is that it encourages individuals to learn how to articulate arguments and to justify explanations for research questions as part of the investigation process. Argumentation discourse is as a context where scientific understanding aims at coordinating statements, and as an evidence where statements are from a framework of various alternatives (Garcia-Mila, Gilabert, & Erduran, 2013). The ADI learning strategy has the potential to increase HOTS.

The results of this research indicate that the conventional learning was dominated with the LOTS questions. The learning process dominated with lecturing method, in fact, does not stimulate students to pose higher-order thinking skills questions. In the conventional learning, the questions during the learning process were spontaneous, with types of questions ranging from remembering, understanding and applying (Hariyadi et al., 2017). The recapitulation of the results of the students' ability to ask the factual, conceptual, procedural and metacognitive types questions at the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies can be seen in Table 2.

Table 2. Students' ability to pose factual, conceptual, procedural and metacognitive questions at the implementation of RQA, ADI, RQA integrated with ADI, and conventional learning strategies

| Learning Strategies | Types of Questions | | | |
|---------------------------|--------------------|----------------|----------------|-------------------|
| | Factual (%) | Conceptual (%) | Procedural (%) | Metacognitive (%) |
| ▪ RQA | 13.16 | 21.05 | 28.95 | 36.84 |
| ▪ ADI | 15.71 | 22.86 | 37.14 | 24.29 |
| ▪ RQA integrated with ADI | 10.53 | 21.05 | 29.82 | 38.60 |
| ▪ Conventional learning | 48.39 | 38.71 | 9.68 | 3.23 |

Table 2 shows that the questions raised by the students in the RQA learning were dominated by metacognitive questions (36.84%) and procedural questions (28.95%). Whereas in the ADI learning, the questions were dominated with procedural questions (37.14%) and metacognitive questions (24.29%). The questions posed in RQA integrated with ADI learning strategy class comprised of metacognitive questions (38.60%) and procedural questions (29.82%). Meanwhile, in the conventional learning, the questions posed by students were generally factual questions (48.39%) and conceptual questions (38.71%).

Based on Table 2, it is obviously seen that RQA had the potential to develop the ability of the students to organize metacognitive questions. RQA strategy has been proven effective in activating (Sumampouw, 2011; Corebima & Bahri, 2011; Bahri & Corebima, 2017) as well as inducing the development of students' metacognition (Khairil, 2009). The results of this study indicate that RQA can significantly stimulated students' higher order thinking skills.

Table 2 shows that ADI had the potential to develop the students' ability to organize procedural questions. This finding is corroborated by Roshayanti and Rustaman (2013) and Hasnuidah (2015) who suggested that ADI can improve students' critical thinking, metacognitive skills, and knowledge acquisition.

According to [Munzenmaier and Rubin \(2013\)](#), Q1, Q2, Q3 contain factual, conceptual, and procedural questions, respectively, while questions Q4, Q5 and Q6 consist of metacognitive questions. The students' scores of asking open-ended and close-ended questions in RQA, ADI, RQA integrated with ADI, and conventional were summarized in [Table 3](#).

Table 3. Students' ability to pose open-ended question and close-ended question in the RQA, ADI, RQA integrated with ADI, and conventional learning strategies

| Learning strategies | Types of Questions | |
|---------------------------|-------------------------|--------------------------|
| | Open-ended question (%) | Close-ended question (%) |
| ▪ RQA | 63.16 | 36.84 |
| ▪ ADI | 57.14 | 42.86 |
| ▪ RQA integrated with ADI | 68.42 | 31.58 |
| ▪ Conventional Learning | 25.81 | 74.19 |

[Table 3](#) shows that the questions asked by the students in the RQA learning were dominated with open-ended question (63.16%). In the ADI learning, the open-ended questions were about 57.14%, and the remaining 42.86% were closed-ended questions. The open-ended questions were also dominant in the RQA integrated with ADI learning (68.42%). Meanwhile, in the conventional learning, the open-ended questions were about 25.81%, and the remaining 74.19% were closed-ended questions. By getting these results, it can be concluded that at the implementation of RQA, ADI, ADI integrated with RQA learning strategies, the open-ended questions were dominant, while in the conventional learning, the close-ended questions were dominant.

The *open-ended question type* is believed to be a stepping stone for students to enrich their understanding and to create an atmosphere where students are comfortable to share their ideas with peers or teachers/lecturers in the class compared to the *close-ended question type* ([De Rivera, Girolametto, Greenberg, & Weitzman, 2005](#); [Peterson, Jesso, & McCabe, 1999](#); [Whitehurst, Arnold, Epstein, Angell, Smith, & Fischel, 1994](#)). Open questions can investigate abstract concepts of an argument, lead to unexpected context or other possible arguments for the validity of the arguments ([Walton & Godden, 2005](#)). Overall, high-quality (open) questions are defined as questions that arise from students' reasoning that requires them to analyze, predict, evaluate and produce ideas when they learn new concepts. Open questions guide the students to what they know and what they do not know because open questions require different answers.

The RQA, ADI, and RQA integrated with ADI learning strategies were dominated with open-ended questions. This is because the phases in these strategies have the potential to train students' reasoning ability. The open-ended question type helps students realize the appropriate learning methods in accordance with their own knowledge because it gives students the opportunity to make arguments. The support of concept mastery in the reading phase can become a basic capital for students to explore the knowledge they gained to make high quality arguments. Conversely, closed questions do not guide students to move to the next cognitive level because it emphasizes the memorizing or repeating knowledge without utilizing the reasoning process. The open-ended question type requires higher thinking ([Baird & Northfield, 1992](#)). Therefore, it can be concluded that RQA, ADI, and RQA integrated with ADI can stimulate students' higher order thinking skills to ask open-ended questions. In traditional classes, the teacher/lecturer asks many closed questions that require students to respond with specific answers. In this approach, the students have less opportunities to express their opinions and to use their reasoning. Some previous researches show that the longer the teacher talking time is, the shorter the student talking time will be. The inadequacy of high-quality (open) questions cannot support the creation of a creative environment which largely stimulates students' cognitive and linguistic abilities. The results of this study in general suggest that the RQA integrated with ADI strategy possesses the highest potential to stimulate students to ask open-ended questions which represent their higher order thinking skills.

CONCLUSION

Based on the results of the study, it was known that RQA, ADI, and RQA integrated with ADI were dominated by HOTS questions. The percentages of HOTS questions asked on RQA, ADI, Integrated RQA-ADI, and conventional were 60.53%, 55.71%, 64.91%, and 19.35%, respectively. Therefore, it can be concluded that the RQA integrated with ADI strategy was the most effective strategy to improve the students' ability to ask HOTS questions. It is expected that teachers and lecturers implement RQA, ADI, and RQA integrated with ADI learning strategies to improve the students' ability in posing HOTS questions. In addition, the results of this research are expected to be used by other researchers to conduct further research on HOTS.

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