Enhancing Cognitive Retention of Different Academic Abilities Undergraduate Students Through PBLRQA Strategy

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Abstract. The success of learning is generally measured by how far students master the concepts being taught. However, to find out the effectiveness of the learning strategy, it is necessary to analyze whether the concepts taught can be retained in students' long-term memory (retention). This research is a quasi-experimental research, which aims to increase the cognitive retention of students with different academic abilities through the PBLRQA strategy in Animal Physiology lectures. The research design used a pretest-posttest non-equivalent control group design. The sample of this study was all first-year biology students of academic year 2020/2021 with a total of 115 people spread over 4 classes. Student cognitive retention is measured by using essay questions. Research data were analyzed by using descriptive and inferential statistics with two-way covariate analysis (ANACOVA). The results showed that the PBLRQA strategy was an effective learning strategy to increase students' cognitive retention. The percentage of improvement in students' retention from pretest to posttest through the PBLRQA strategy and traditional strategy was 4.57% and 0.57%, respectively. The Least Significance Difference (LSD) test showed differences in cognitive retention, the interaction of PBLRQA strategy - upper academic ability was significantly higher 14.70% than the PBLRQA- lower academic ability, while the traditional- upper academic ability strategy was significantly higher 5.50% than the traditional strategy - lower academic ability. Based on the results of the study, it was concluded that the PBLRQA strategy could increase the cognitive retention of students with different academic abilities.

Keywords: Cognitive Retention · Academic Ability · Learning Strategy · PBLRQA

1 Introduction

The development of science in the 21st century required students to be able to compete by developing their skills and knowledge [1, 2]. Well-honed skills and knowledge were

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able to produce a sticking power to the long-term memory of students which later has an impact on student learning outcomes [3, 4]. Good learning outcomes could not be separated from the student's memory (retention) of the material studied [3].

Retention was the memory as a proficiency in receiving, storing, and re-producing impressions that students have [5]. Good retention is the need for every student to learn optimally because student learning outcomes in school are measured based on students' mastery of the subject matter, the process of which is inseparable from the activity of remembering, then with good retention students will be able to learn easily and achieve optimal learning outcomes [6, 7]. Students could have good memory skills if they were able to process information well [8].

Considering the material taught was one of the indicators of the quality of the learning process [9]. Memory as a retention of information over time that involved encoding, storing, and resurfacing information [10]. Retention occurs due to the transfer of new information gleaned from short-term memory to long-term memory. Retention could be seen from the amount of knowledge that can be stored in long-term memory and applied again correctly at certain times or to other problems [11, 12]. But the fact on the ground shows that student retention is still low.

Some studies have noted that student retention in Indonesia was still low [13, 14]. This can be seen in the pattern of lectures in the Department of Biology FMIPA Makassar State University, especially in animal physiology lectures which were still largely dominated by learning strategies that are oriented towards cognitive learning outcomes and have not sought the empowerment of thinking skills including student metacognitive skills [15]. In addition, Bahri's research [16] shows that students' reading interest in lecture materials to prepare for the next lecture is still very low, so the initial knowledge of students at the time of the lecture, is still lacking. According to Watson & Chen [5] in the constructivistic paradigm, a teacher should see the protégé rather than as a blank sheet with the theory of empiricism, where, the protégé has the initial knowledge that they will make the basis for building further knowledge.

Learning success is generally measured by how far students master the concepts taught. However, to find out the effectiveness of the learning model, it is necessary to analyze whether the concepts taught can be attached in the long-term memory (retention) of students, even though retention is one of the indicators of the quality of learning. The survey showed that only 60% of lecturers seek to implement learning strategies that allow students to store the knowledge gained to be attached to their long-term memory [15]. Student retention could be improved by actively engaging them in the learning process [17]. Understanding of concepts and retention of materials is influenced by learning models and strategies.

Referring to the reality, a learning strategy is needed that is able to empower the cognitive retention of students who are strong and trained in organizing their own learning, then by itself student learning outcomes will increase. From this, the authors are interested in conducting research with the title of improving the cognitive retention of students with different academic abilities through the PBLRQA strategy.

2 Method

2.1 Type of Research

This study was a quasi experiment research design. Independent variable in this study was a learning strategy consisting of 2 types, namely *PBLRQA,* and traditional learning as factor A, while factor B is academic ability consisting of upper and lower academic ability as a moderator variable. The dependent variable was the cognitive retention of students.

2.2 Research Subjects

The subjects of this study were all first-year students of Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Indonesia, academic year 2020/2021 with a total of 115 people spread over 4 classes.

2.3 Research Instruments and Procedures

The research instrument used was a test to measure a student's cognitive retention. Cognitive retention data of students is collected using test instruments in the form of *essay* questions as many as 7 numbers. The student's answer sheet was corrected using a rubric consisting of 5 scales (0–4) and as a reference to examine the subject's answer of each test item he has answered [13]. The test instrument were validated including content validation, construct validation, and empirical validation and determined its reliability value. The results of validity and reliability test showed the instruments were valid and reliable.

2.4 Data Analysis

Data analysis techniques in this study, used Descriptive and Inferential analysis. The study data was analyzed using descriptive statistics to show the description or retention profile of students, while the infrential analysis used two ways analysis of covariate (ANCOVA) with a significant level of 5% to test the difference hypothesis. Data is analyzed using the *SPSS 22.0 for Windows* program. If the results of ANCOVA test significant then continue with the Least Significance Difference (LSD) test.

3 Results and Discussions

3.1 Research Results

This research aims to improve the cognitive retention of students with different academic abilities of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar. The results of this study are qualitative descriptive data and inferential data.

Table 1. The Average Score and Percentage Change in Cognitive *Posttest* Score-Cognitive Retention on Each Learning Strategy by Academic Ability

No	Learning Strategies	Academic Ability	Average		Percentage %	Note
			Posttest	Retention		
1	*PBLRQA*	Upper	49.95	55.73	11.57	Increase
		Lower	29.95	31.82	6.24	Increase
		Total	79.90	87.55	9.57	Increase
2	Traditional	Upper	28.67	27.46	4.41	Decreased
		Lower	19.46	19.23	1.19	Decreased
		Total	48.13	48.69	1.08	Increase
Total		Upper	78.62	85.19	8.36	Increase
		Lower	49.41	51.05	3.32	Increase

Student retention was measured two weeks after being given a cognitive *posttest.* Next, the data was analyzed with descriptive statistics to find out the average and percentage change in student scores from cognitive *posttest* to cognitive retention. Data on the results of the study related to the average score and percentage change in cognitive *posttest* scores to cognitive retention in each learning strategy according to Academic Ability shown in Table 1.

Based on Table 1 it can be known that the retention of students taught with *the PBLRQA* strategy has increased while the retention of students taught with traditional strategies decreased. The average data retention can be visualized as in Fig. 1.

The results of the ANCOVA test showed a difference in the cognitive retention of students with different academic ability in animal physiology. Lectures between those given the PBLRQA strategy, and traditional learning shown in Table 2.

Based on the source of learning strategies, academic ability and interaction of learning strategies with academic ability obtained p-levels smaller than alpha 0.05 ($p < 0.05$) with sig. 0.000, 0.000, and 0.002. It menas that Ho was rejected and that the research hypothesis stating "There was an influence of learning strategies, academic ability and interaction of learning strategies with academic ability on student retention" was accepted. It can be concluded that there was a significant influence of learning strategies, academic ability, and the interaction of learning strategies with academic ability towards cognitive retention of students. The results of further tests on the influence of learning strategy interactions on student retention are seen in Table 3.

Based on Table 3 it is seen that the average corrected the lowest retention score in the combination of traditional learning strategies-lower academic ability which was 2.24 and the highest in the combination of *PBLRQA* strategy – upper academic ability was 4.47. In the results of the LSD test, it was explained that the average corrected student retention score on the combination of *PBLRQA* strategy- upper academic abuility was significant different as much as 14.70% than the combination of *PBLRQA*-lower academic ability, as well as the combination of traditional-KA learning strategy differed

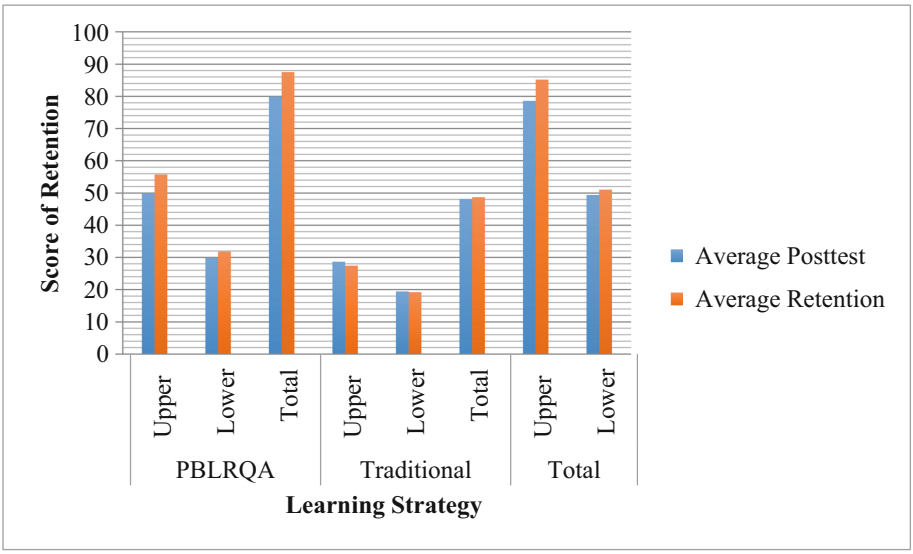

Fig. 1. The Average Score of Posttest -Cognitive Retention on Each Learning Strategy by Academic Ability

Table 2. Summary of ANCOVA Test Results of Students' Cognitive Retention

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21355.853[a]	4	5338.963	163.221	0.000
Intercept	779.495	1	779.495	23.83	0.000
XRet	2646.857	1	2646.857	80.919	0.000
Learning Strategy	2641.925	1	2641.925	80.768	0.000
Academic Ability	598.251	1	598.251	18.29	0.000
Learning Strategy * Academic Ability	351.896	1	351.896	10.758	0.002
Error	2387.827	73	32.71		
Total	101231.19	78			
Corrected Total	23743.68	77			

5.50% higher than with the traditional strategy-lower academic ability. Thus, it can be known that *PBLRQA* learning strategies are more appropriate to maintain student retention compared to traditional strategies.

3.2 Discussion

The results showed that there was a difference in the retention of students who were taught with *the PBLRQA* strategy, compared to traditional strategy. The study is also in

Table 3. Summary of LSD Results Influence of Interaction of Learning Strategy and Academic Ability on Students' Cognitive Retention

Strategy	Academic Ability	XRet	YRet	Difference	Retcor	LSD Notation
PBLRQA	Upper	49,94	55,73	5,78	4,47	a
	Lower	29,95	31,82	1,88	3,32	b
Traditional	Upper	28,67	22,79	-5,88	2,49	c
	Lower	19,46	14,44	-5,01	2,24	c

line with Bahri's findings [16] which showed that the *PBLRQA* strategy has an effect on student retention. The ability to store knowledge in long-term memory in students who are taught with *PBLRQA* is also caused by the stage where students perform individual activities and group activities. In this phase, students work together to find problem solving in a cooperative atmosphere both in group discussions, and class discussions. Student activities at this stage show the existence of learning act learning by doing and learning together. Thus, students receive information not only from lecturers, but also from their own learning activities and cooperation with their friends. In addition, the *PBLRQA* strategy not only involves the sense of hearing but involves more than one five senses so that learning outcomes can be stored for a long time. Meaningfully learned information was longer remembered than memorized information [18, 20].

Another cause of the great ability of students who are taught with *PBLRQA* strategy to maintain their knowledge in long-term memory, is the existence of collaborative activities in *PBLRQA* learning. The results of the Alsharari & Alshurideh study [21] reported that students who were taught cooperative learning strategies were able to maintain the concept better than the students who were taught using traditional learning strategies. The study also showed that the retention scores of upper academic ability students were higher than those with lower academic ones. This study was in line with the results of Pallenari's study [22], and Bahri [23] which reported retention differences between upper academic ability and lower academic ability of students, where the increase in the retention score of upper academic ability students was higher compared to the students with lower academic ability.

Nonetheless, academic ability is not the only factor influencing retention. Other factors that can affect retention are attention (concentration) as the learning process progresses, as well as the interest or willingness of students to remember [24]. In addition, strong motivation, especially intrinsic motivation and awareness of goals that must be achieved encourage learners to involve themselves in the learning process that will have an impact more easily remembering the material being studied. This statement is supported by Adler et al. [25] that the extent to which metacognitive skills affect achievement, actually depends largely on motivational patterns. In addition, according to some researchers, there were five conditions that can affect retention, namely expectations, support, feedback, involvement, and learning [6, 9]. Based on this opinion, it can be said that the retention of students with high and low academic ability can increase if the

five conditions are actually implemented. Thus, even students with low academic ability could have better retention if they get these five conditions well [19, 26].

The results also reported that classes taught with *the PBLRQA* strategy more appropriately maintain the retention of students who are academically capable up and down than classes taught with traditional strategies. These results are also supported by interaction tests, where interaction between strategy and academic ability had a significant effect on student retention [27] This is because during the study of *PBLRQA* strategy, students with academic ability up and down strive to be able to know and understand the problems and solutions so that students can teach their fellow group members. Such student activities can spur the formation of thinking skills and metacognitif skills in him. During the implementation of *the PBLRQA* strategy, students are more helped to develop metacognition skills and maintain an understanding of the concepts they know during their studies.

Related to learning, learning using *PBLRQA* strategies that involve many five senses in the thought process could allow learning to be more meaningful, thus enabling strong retention of students to the concepts taught [15, 28]. The learning experience conducted by students directly would have a great impact on the material received by students, so that they can store and remember the material they have obtained well [14, 29]. Learning strategies used in learning can affect retention and impact student learning outcomes [30, 31]. If students are given the opportunity to perform or observe objects directly, then the concepts learned will last a long time in memory. This condition applies to all students, both high and low academic ability students. Students with high and low academic ability in learning with *PBLRQA* strategy are required to be actively involved in the learning process.

4 Conclusion

Based on the results of research that has been done, it can be concluded that the *PBLRQA* Strategy has the potential to increase student retention than traditional strategies. The corrected average of student retention values of upper academic ability is higher compared to lower academic ability students. The interaction between learning strategies and academic ability affects student retention.

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