



## THE EFFECTS OF BLENDED LEARNING AND PROJECT-BASED LEARNING ON PRE-SERVICE BIOLOGY TEACHERS' CREATIVE THINKING THROUGH ONLINE LEARNING IN THE COVID-19 PANDEMIC

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### ABSTRACT

The purpose of this study was to analyze the effect of Blended Learning (BL) and Project-Based Learning (Pj-BL) on the pre-service teachers' creative thinking in learning biology. This type of research is a quasi-experimental study with 76 biology education students as research subjects. In its implementation, the experimental class was taught using the BL and Pj-BL approach, the control class is conventional class. The parameters are creative thinking with 4 indicators. Data was collected using pretest and posttest assessments. Data is presented and analyzed descriptively. The results of the study were overall the average score of creative thinking of pre-service teachers in the experimental class was 91 with an N-gain index of 0.62, higher than in the control class (76) with an N-gain index of 0.51. From the results, it could be concluded that Blended Learning and Project-Based Learning are quite influential in increasing the creative thinking ability of pre-service biology teachers, and BL and Pj-BL is quite more effective than conventional in increasing the pre-service teachers' creative thinking in biology learning.

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Keywords: biology; blended learning; Project-based learning; creative thinking

### INTRODUCTION

WHO (World Health Organization) China Country Office reports a case of pneumonia with unknown etiology in Wuhan City, Hubei Province, China. It has been found that pneumonia is a new type of coronavirus (coronavirus disease, COVID-19). The university takes intensive steps to prevent and protect all pre-service teachers and staff members from highly contagious diseases. Faculty members are already in the process of transitioning to an online teaching platform (Sahu, 2020).

The worldwide locking of educational institutions will cause major (and possibly unequal) disruptions in student learning; impedance with evaluations; and dropping of open appraisals for capabilities or their supplanting with lower options. The COVID-19 pandemic is a wellbeing emergency above all else. Numerous nations (fittingly) choose to close schools and colleges. Extreme transient disturbance is felt by numerous families around the globe for which there is no model to anticipate it (Ivanov, 2020).

Learning from home is not only a big surprise for parents' productivity but also children's social life and learning. Furthermore, the low understanding of pre-service teachers

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about the COVID-19 pandemic (Harahap et al., 2019) needs to be considered in ongoing online teaching on a scale that has not been tested and has never happened before. Student assessments moreover move online, with parts of trial and error and uncertainty for everyone. Numerous assessments have been canceled. Critically, this obstacle will not only be a short-term issue but can be a long-term consequences for the influenced and tend to increase inequality. Children were sent home not to play but to study at home through online, accompanied and guided by the family, so as not to lag behind lessons. The closure of schools, colleges, and universities not only disrupts teaching for students around the world; it also coincides with the key assessment period and many exams have been postponed or canceled. In higher education, many universities and colleges replace conventional exams with online assessment tools (Burgess & Sievertsen, 2020).

In Indonesia, Minister of Education and Culture, Nadiem Makarim, supports higher education policies to dismiss lectures because of the increasingly worrisome distribution of COVID-19, so the learning process that usually includes class meetings is diverted by online meetings or work from home (WFH). In the 21st century, technology has become one of the key things in the implementation of various activities. The impact of progress in the 21st century also occurs in the field of education, one of which is technology-based learning. The progress that occurred in the 21st century is a challenge for teachers as educators, especially in implementing learning by integrating technology (Aini, 2020). E-learning has advantages, but sudden changes in the learning process of creating effective distance learning solutions are not as simple as they first appeared. In CoSN 2020, moving the school system to a distance learning environment is not just a technical problem. This is a pedagogical and instructional challenge. Technology is a means of delivery. Successful efforts to move schools outside traditional classrooms and buildings require close collaboration between teaching teams, content, and technology related to the 21st-century learning process.

Learning must be able to answer the challenges of the 21st century, one of which is information literacy and ICT (Information and Communication Technology) literacy. For the information literacy and ICT of students to develop, it is necessary to integrate ICT in the lecture process (Subekti et al., 2018; Widiana et al., 2017). Learning must be designed with multi-literacy pedagogical planning and have various competencies including mastering ICT well for

access to information, communication, delivering information to the public, having good critical thinking skills, being able to turn problems into opportunities, having good problem-solving skills (Holloway & Gouthro, 2020). One of the goals of Indonesian education is to develop the potential of forming creative students (Wahyudi et al., 2018).

Lecturers are challenged to be creative and adaptive, in the sense of being able to adjust to the demands of the development of science and technology. This is following the goal of learning innovation which is to increase creative skills. Creativity is the result of creative thinking in the learning process that involves creation and collaboration. According to Widiana et al. (2017), creativity is a dynamic activity, involving mental processes and the brain consciously; these processes produce something new or pay attention to novelty. In line with one of the objectives of the "biology learning innovation" course, namely to contribute to outcomes as creativity in the thesis of pre-service biology teachers and as outcomes of educational research subjects. Plus the conditions that require the learning process to be carried out remotely or online, of course, the role of technology is very vital. Many changes have occurred at the level of conventional structures with technological structures. Technological development cannot be avoided or rejected. The existence of technology has changed many life aspects, one of them is in the education field as E-learning (Syakur et al., 2020).

Analysis of the readiness of learning in the pandemic period found that pre-service biology teachers were not optimally utilizing CLS (Communication Literacy Systems). The availability of Google classrooms in lectures and their impact on the proposed thesis theme of pre-service biology teacher candidates tends to be concentrated on relatively similar types of research and material, learning models lacking novelty and less varied research outcomes. Besides, the current condition makes pre-service biology teachers increasingly depressed and stressed. On the one hand, they must maintain health by always staying at home, but the assignments given by lecturers are more and require an internet network. This is also a problem because in the village some do not have internet network facilities. They have to go to great lengths to look for signals on the mountain, on the summit, and some even climb. So, this also influences the power of thinking to be critical and creative because psychologically the teacher candidates are depressed. Starting from the identification of problems suspected to be the lack of creative thinking skills of pre-service bio-

logy teachers, the integration of biology learning innovation materials into research designs that require insight and access to information. E-learning is a form of learning model that is facilitated and supported by the use of information and communication technology, e-learning has some characteristics including (a) interactivity; (b) independence; (c) accessibility; (d) enrichment. It is also known that the *Project Based Learning* (Pj-BL) which is integrated with ethno-stem can improve critical thinking skills and also creative thinking (Sumarni & Kadarwati, 2020).

PjBL has several advantages including (Ummah et al., 2019): 1) facilitating students to collaborate in conceptual understanding, to apply prior knowledge, and to higher order thinking skills; 2) allowing students to show higher abilities; 3) challenging students to solve real problems, become good collaborators; 4) motivating students; and 5) increasing content knowledge, and meeting the needs of students with a variety of skills and learning styles (Coyne et al., 2016).

The results of other studies also say that PJBL has advantages, including: 1) learning by finding solutions through asking questions; 2) debating ideas; 3) designing plans, and communicating with others; shaping learning experiences; 4) explaining the main questions of the project; 5) giving instructions on specific tasks to be completed by students; 6) students develop plans for projects that include brainstorming ideas; 7) gathering facts, assigning different roles and tasks to one another; and 8) organizing thoughts and ideas (Choi et al., 2019). Other strengths include: 1) promoting critical thinking and problem solving; 2) personal communication; 3) information and media literacy; 4) collaboration ration, teamwork, and leadership; and 5) creativity and innovation (Chu et al., 2017). The results showed that through this PjBL students were able to work together and be better than before, help one another, explain one another, think creatively, and show patience with each other (Tsybulsky & Muchnik-Rozanov, 2019).

According to Anazifa & Djukri (2017), Pj-BL learning can influence creative student learning activities and skills. Creativity in the context of learning begins with the process of sensing, observing problems, hypothesizing problems, assessing, and testing hypotheses. The process further changes and performs tests, as well as delivering results. Creativity can be improved if the learning process is easier to understand and how strong the learning and training of creativity is interconnected (Bertoncelli et al., 2016). According to Rahardjanto (2019), through project activities,

students are encouraged to use their creativity to solve problems in their environment by leveraging their knowledge and skills so that they can produce unique and creative products.

The progress of technology is an important part of improving the quality of learning and research results. Research results are supported by various sources of literature, which can be accessed via the internet (online), and information collected is discussed through an offline face-to-face meeting. The combination or mixture of online and offline learning activities is called Blended Learning, which is a learning strategy that combines face-to-face learning and learning that uses online learning resources (Daulay, 2016). Research results by Arsat et al. (2017) showed that in the lecture process, it takes a learning pattern that integrates technology. Utilization of technology in learning with the PBLRQA integrated blended learning model can create more effective, efficient and attractive learning patterns following students' interest within the utilize of intuitive media such as portable workstations and smartphones so that theoretical material can be more effectively caught on and issues related to science learning anticipated to be settled. Bloom-Rederker-Guerra (B-R-G) mapping is utilized to speak to learning targets and classify learning exercises. If it is integrated with Blended learning methods, it will create a pleasant learning atmosphere because it is structured and easier to implement, especially by the teacher. Blended learning makes it easy for teachers to allow students to dig up as much information as possible (Bahri et al., 2019). According to Ch & Saha (2019), a computer-assisted instruction (CAI) platform can help students in effective preparation for their exams. The CAI or e-learning system in education is useful in carrying out a series of platform systems, namely: (i) reforming and providing sentences of meanings of unknown words, (ii) automatic identification of questionable sentences from textbook chapters, (iii) summary descriptions of concepts particular, (iv) providing solutions to existing questions, (v) taking a trial exam to foster trust, (v) automatic assessment of students' answers, and (vi) identifying the part where revision is needed. Comparative analysis of performance shows the CAI Remedial Tutor platform for effective learning through Blended learning in traditional classrooms. Students perform better in their tests when platforms are provided in addition to normal classroom resources, expanded to provide more relevant electronic resources. This indicates the usefulness of technology and the advantages of BL.

The advantages of BL as follows: providing individual learning experiences, supporting and encouraging independent and collaborative learning, increasing the involvement of pre-service teachers in learning, and providing flexible learning, anytime and anywhere (Martin et al., 2015). The influence of the use of blended learning on science process skills and learning outcomes (Harahap et al., 2019). Blended learning strategies are significantly more effective in improving student learning achievement and science process skills compared to conventional learning strategies. That there was a significant increase in the cognitive and psychomotor domains as well as student motivation and learning outcomes after learning was done using the Blended Learning model (Firdaus et al., 2018). The use of blended learning in improving student characteristics and design features has a significant category for student learning outcomes (Kintu et al., 2017). The use of Blended learning in learning design features (quality of technology, online tools, and face-to-face support) and student characteristics (attitudes and self-regulation) predicts the satisfaction of student learning outcomes. Based on the results of the study, it can be concluded that the application of the blended learning model in learning can improve student academic achievement (Ceylan & Kesici, 2017).

From the description above, it is explained that BL and PJBL can each affect students' creative skills but are not yet known whether the two approaches when combined can improve students' creative thinking in learning biology under the covid-19 conditions (Tsybulsky & Muchnik-Rozanov, 2019; Rahardjanto, 2019; Zainuddin & Attaran, 2016). This consider points to look at the impact of the Blended Learning and Project-Based Learning approaches on the ability to think creatively including the ability to think fluently, flexibly, originally, and elaborately by pre-service teachers in biology learning innovation courses during the COVID-19 pandemic. This research provides benefits and many implications for pre-service teachers, educators, and stakeholders to be able to implement an effective and efficient online learning process by implementing Blended Learning.

## METHODS

This research is a type of quasi-experimental research that refers to Sugiyono (2017) in the Biology Education Laboratory of Universitas Riau. The research population was 76 pre-service teachers in the fifth semester of the biology edu-

cation study program, Faculty of Teacher Training and Education, Universitas Riau, the academic year 2019-2020. The total sample technique is all populations sampled. The experimental class is in class VA and the control class is in class VB. Each group consists of 38 people. The sample is assumed to have the same cognitive abilities. Secondary data is in the form of student thesis documents in Academic Year 2016 - 2019. In the implementation, this study used a research design (Table 1), pretest-posttest group design.

**Table 1.** Research Design

Class	Pretest	Treatment	Posttest
Experiment	$M_0 Y_0$	$X_2$	$M_1 Y_1$
Control	$M_2 Y_2$	$X_1$	$M_3 Y_3$

Information:

X1: Conventional class

X2: Treatment with BL and Pj-BL

M0: Think creatively before treatment

M1: Think creatively after treatment

M2: Creative thinking before without treatment

M3: Creative thinking after treatment

Y0: Giving pretest before treatment

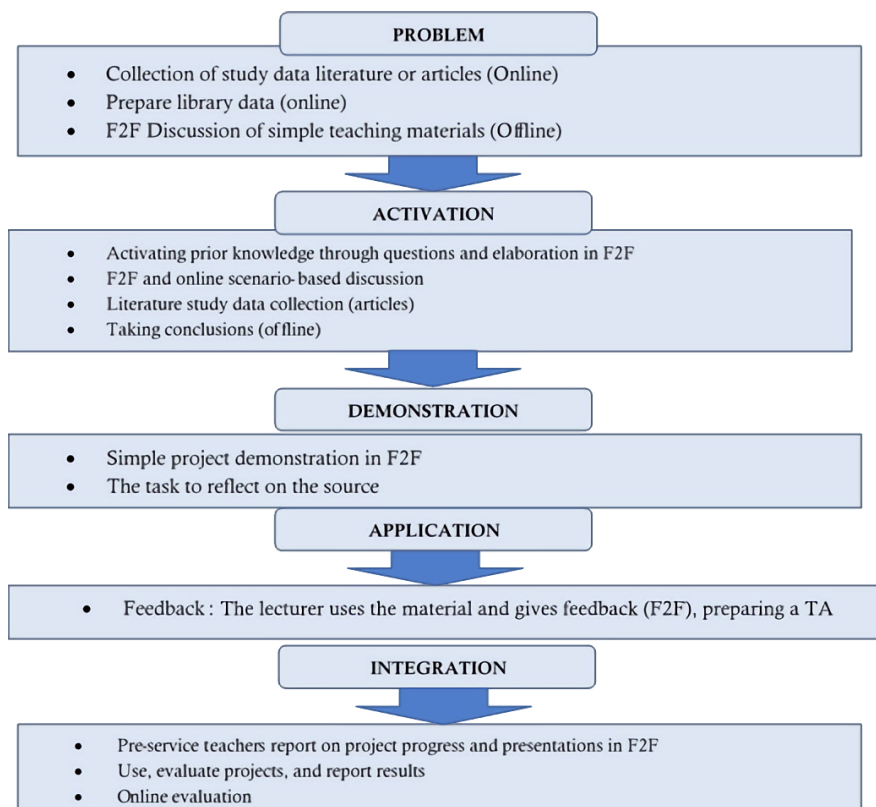
Y1: Giving posttest after treatment

Y2: Giving pretest before without treatment

Y3: Posttest after treatment

From the table above, it is known that the research procedure begins with (1) Preparation, preparation of instruments and research instruments for biology learning innovation courses; coordination with PUSKOM UNRI for Google Classroom internet connection (<https://classroom.google.com/>), (2) Submission of proposals, (3) Implementation, including; a) testing and revising research instruments; b) conducting lectures, online and offline lecture contracts through Pj-BL and BL, where the experimental class uses BL and Pj-BL while the control uses conventional class. Implementation of the test is carried out before learning and at the end of learning to determine the effect and impression of the treatment process given, observation, (5) collecting data, (6) analyzing data, (7) conducting reports. The research parameters are: 1) The results of learning the ability to think creatively in learning biology Pre and Post research which includes several indicators: fluent thinking, flexible thinking, original thinking, and elaborative thinking; 2) Gain index of creative thinking ability.

As an illustration, it can be seen the steps of Blended Learning and Project-Based Learning used in the implementation of this research can be seen in Figure 1 below.



**Figure 1.** Steps for Blended Learning and Project-Based Learning (Source: Modifications from Gedik et al., 2013)

The following is a brief explanation of the five steps of Blended Learning and Project-Based Learning (Figure 1) consists of: 1) learning is advanced when pre-service teachers are involved in solving real-world problems [PROBLEMS], 2) learning is advanced when existing knowledge is activated as a basis for new knowledge [ACTIVATION], 3) learning is advanced when new knowledge is shown to pre-service teachers [DEMONSTRATION], 4) learning is advanced when new knowledge is applied by pre-service teachers [APPLICATION], 5) learning is advanced when new knowledge is integrated into the world of pre-service teachers [INTEGRATION].

As for the data collection techniques and data analysis are as follows: (a) written test, conducted at the beginning of learning with Pre-test and post-test given at the end of learning. This instrument is used to assess creative thinking skills. The questions used were 20 multiple choice questions for 4 indicators, each indicator consisted of 5 items on each test indicator compiled by a creative thinking sheet and a creative thinking assessment sheet previously validated by a team of experts.

The score is obtained by dividing the score obtained with the maximum score multiplied by

100. Meanwhile, to find out the increase in creative thinking, the data used in the form of Gain score, which is the result of reducing the average score of the final test (post-test) with the average score of the initial test (pre-test) divided by the results of the reduction of the maximum score by the average score of the initial test (pre-test). The ability to think creatively, the results of the interpretation of the gain index ( $g$ ), according to the classification of (Hake, 1999) in Table 2 follows.

**Table 2.** Normalized Gain Index Score and its Classification/effectiveness

Normalized Gain Index	Classification
$(g) \geq 0,70$	High/Very effective
$0,30 \leq (g) < 0,70$	Medium/Effective
$(g) < 0.30$	Low/Less effective

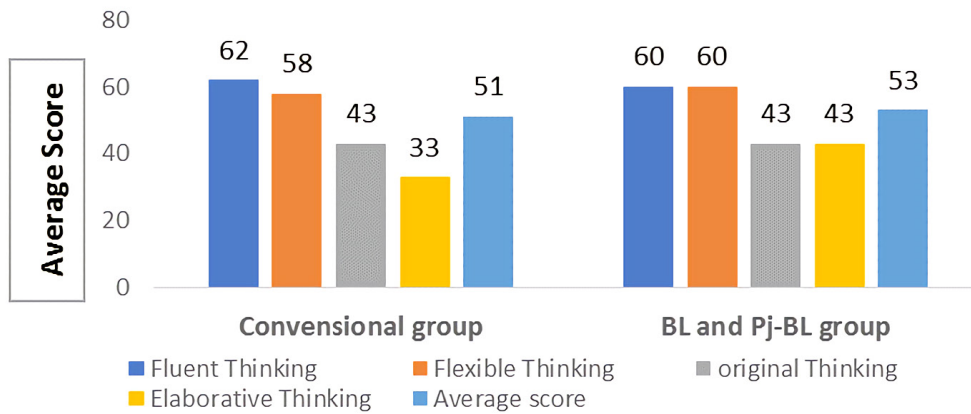
## RESULTS AND DISCUSSION

In carrying out this research, it is known that some research results from the implementation of the biology learning process in the experimental class uses BL and Pj-BL while the control class uses conventional learning. The results of

this study can be seen from the aspect of the ability to think creatively. The results of the study consisted of creative thinking skills at the pretest is in figure 2, posttest in figure 3, and for the results of the N-gain in Table 3.

**Pre-Creative Thinking Ability (Pretest)**

The results obtained for the ability to think creatively before the learning process can be seen as follows:



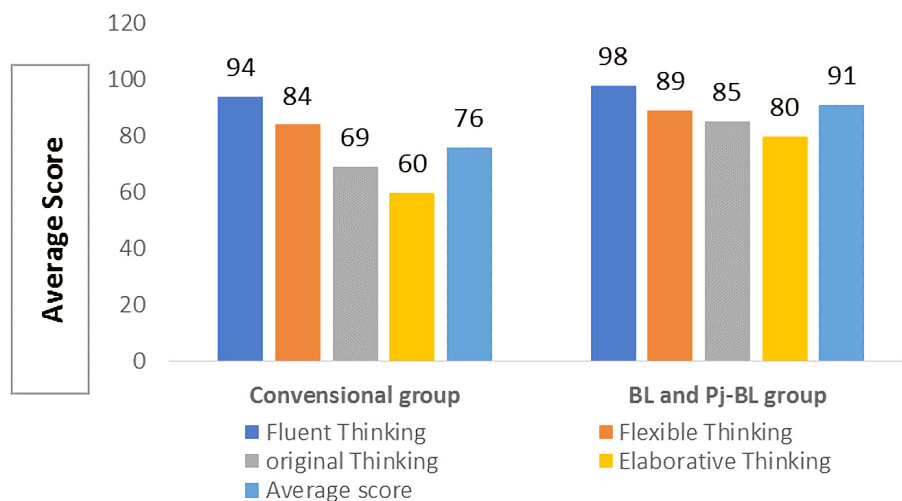
**Figure 2.** Histogram of Pre-Test Thinking Abilities Based on Project-Based Learning Models and Blended Learning in Biology Learning

Pre-pretest creative thinking skills in the conventional group of the four indicators obtained an average score of 51 and 53 in the BL and Pj-BL group. The highest creative thinking ability in both groups is fluent and flexible thinking, the scores of 62 and 58 in the conventional group, and the BL and Pj-BL group respectively with the same score of 60. In the conventional group, the lowest average score is the ability of elaborative thinking is 33, lower than the average

score of 43 in the original thinking ability, but in the BL and Pj-BL group both the ability of original and elaborative thinking respectively with an average score of 43.

**Post Creative Thinking Ability**

As for the results score of the students' critical thinking ability after treatment and care, the following results are known as we can see in the figure 3 below:



**Figure 3.** Histogram of Post-Test Thinking Abilities Based on Project-Based Learning Models and Blended Learning in Biology Learning

In Figure 3, post-test thinking ability, the average score of the four indicators in the conventional group is 76, lower than the BL and Pj-BL group's average score of 91. Of the four indicators, the highest average score in the two groups is fluent thinking. But the average score of the conventional group, 94, is lower than the average score of the BL and Pj-BL group which is 98. Overall, the indicator of creative thinking ability has increased both in the conventional group and the BL and Pj-BL group, but in the BL and

Pj-BL group, the increase in the average score of the four indicators get the score of each of the flexible, original and elaborative thinking which is 89.85 and 80 which tend to be higher than the conventional group namely 84.69 and 60.

#### Classification of Creative Thinking Ability of pre-service teachers.

For the N-gain index for each indicator, creative thinking and classification can be seen as follows:

**Table 3.** N-Gain Index for Each Indicator of Creative Thinking and its Classification

Group	Creative Thinking	Fluent Thinking	Flexible Thinking	Original Thinking	Elaborative Thinking	Creative Thinking
Control	N-Gain Index	0.69	0.56	0.42	0.37	0.51
	Classification	Medium	Medium	Medium	Medium	Medium
Experiment	N-Gain Index	0.79	0.62	0.60	0.45	0.62
	Classification	Very High	Medium	Medium	Medium	Medium

Based on Figure 2, Figure 3, and Table 3, it shows that the average score of the creative thinking ability from the pretest in the control class and the experimental class is before the implementation of Blended learning (BL) and Project-Based Learning (Pj-BL) learning, and respectively each pretest in the control class and experimental class the lowest average score is 33 and 43. The results of the posttest creative thinking ability of control class students are through conventional of 76 with an N = gain 0.51, and the experimental class after implementing BL and Pj-BL learning obtained an average score of 91, with an N-gain index = 0.62. In general, the ability to think quite creatively increases, especially on the indicators of original and elaborative thinking. But the N-gain index score in the conventional group tends to be lower than the BL and Pj-BL group. In terms of the four indicators, the highest n-gain score was obtained in the fluent thinking ability with an N-gain index of 0.79 classified as very high or very creative in the BL and Pj-BL group.

There are differences in traditional learning with e-learning (Blended learning). In conventional classrooms, teachers are considered as knowledgeable people and are assigned to provide knowledge to their students, while in e-learning, the main focus is students. Students are independent at certain times and responsible for their learning. The atmosphere of e-learning will force students to play a more active role in their learning. Students make the design and search for

material with their efforts and initiatives. Not that e-learning replaces conventional learning models in the classroom, but it strengthens the learning model through content enrichment and development of educational technology.

The ability of creative thinking of pre-service teachers increases because in the learning process the stages of providing stimulus and directing project assignments through Google Classroom provide benefits, including 1) classes are prepared more easily and able to share information such as assignments, announcements, and questions; 2) saving time and paper and management in one place; 3) better management, tasks can be seen on the assignments page, calendar of activities and material automatically stored in the Google Drive folder; 4) improving communication and input, teachers can share material and interact via email. Teachers can quickly see who has or hasn't completed an assignment, and immediately gives real-time grades and input; 5) safe and affordable, classes are provided free of charge and do not contain advertisements.

This causes pre-service teachers to become proficient and accustomed to giving various kinds of complete assignment answers from various kinds of literature and sources that have been prepared through the project task guide. The project task guide includes questions about; a) reference criteria in the thesis, b) criteria for quoting conclusions from an article, c) displaying data, and d) reviewing several articles through the integration of biology learning innovation issues with

student theses. The creative thinking ability in the experimental class is higher than the control class because through learning BL pre-service teachers get a lot of new information online and are unlimited, where and at any time, so it is more effective (saves time) and adds insight to students. This allows pre-service teachers to select information as needed, and to fluently answer, ask, or handle a problem.

Following the opinion of Kenedy et al. (2012), when the creative thinking ability develops, it will give birth to ideas, create and do imagination, and have many perspectives on a matter, and relate to skills in producing information, and provide more personalized learning support, fostere independent and collaborative learning. Although it is undeniable that the distance learning process has many benefits, including saving time, money, and is very effective in delivering because it can renew, store, distribute, and share teaching material or information. Distance learning is considered capable to answer learning problems as well as to increase awareness about the lifelong learning process (long-life education) (Anggrawan & Jihadil, 2018; Osman & Vebrianto, 2013).

Details of the results are reviewed based on fluent thinking indicators, the average score of the posttest obtained increases compared to the pretest in the control class that is from 62 to 94 at posttest with an N-gain of 0.69. Based on the analysis of students' answers to the indicators of fluent thinking in the experimental class, the average score of the posttest increased to 98 compared to the average score of achievement of 60, N-gain of 0.70. The fluent thinking ability tends to be very high, and then the teacher can identify and analyze relevant literature sources in the thesis, by writing and linking conclusions from the study of the article and being able to provide a variety of article criteria that are used appropriately using information effectively (quickly and precisely) from various sources through analyzing, interpreting, assessing and synthesizing, which emphasizes the active role of pre-service teachers in developing their understanding and processing information. This shows that pre-service teachers can provide various answers fluently. Test items with fluent thinking indicators are made to further stimulate the mindset of pre-service teachers to provide various kinds of answers, this is following the advantages of blended learning.

Bl-based learning is believed to improve the quality of learning by combining conventional learning with online-based learning. According

to (Zainuddin, 2017), conventional learning only applies one-way communication, causing students to only be passive listeners in other words conventional learning is a learning process that only transfers knowledge from educators to students. This makes the quality of students not creative and cannot develop their abilities; students' fluent thinking requires critical thinking to solve problems, oriented towards real action through empirical learning (Zainuddin, 2017).

Indicators of flexible thinking in posttests in the control class also increased. The average score obtained at the posttest was 84 in medium category compared to pretest only getting a score of 58 with an N-gain of 0.56 in quite creative category. Judging from the results of the posttest in the experimental class, the average posttest score increased to 89 compared to the average score of achievement of 60 with an N-gain of 0.62 categorized as quite creative. Flexible thinking students in the experimental class have been able to interpret the conclusions of the article or connect concepts according to various points of view because the behavior of someone who has the flexible thinking ability enough can provide a variety of interpretations of an image, story, or problem and produce ideas which vary. Applied BL so that the results obtained that the BL effect makes pre-service teachers candidates more flexible, varying in learning activities (Bhowmik et al., 2019). According to Sumarni & Kadarwati (2020), critical and creative thinking skills become a crucial factor in the educational process to be able to produce 21st-century skills so that they can face these challenges, such as original thinking skills. On the indicators of original thinking in the average control class posttest obtained by 69 compared to the pretest only obtained an average score of 43 (N = gain 0.42). The results of the analysis of student answers to the post-test in the experimental class obtained posttest 85 compared to the results of pre-test 43 with an N-gain of 0.60 in quite original category.

Original thinking, after going through BL and Pj-BL learning, students can provide answers from their findings and are different from what has been given by the lecturer, because students are accustomed to finding new things or answering with variations of answers and by using their sentences without copying the sentences in the book or the internet. This is also similar to the results of research that states the learning process of the ethno-stem project-based learning shows a significant influence in increasing critical and



creative thinking (Sumarni & Kadarwati, 2020). This might be because it has been integrated with Ethno-sten so that it is more significant. That original thinking causes a person to be able to produce new expressions, such as the ability to elaborate opinions from various viewpoints (Daulay, 2016).

The indicator of elaborative thinking in the control class has 60 of the average post-test score, this is an increase compared to the pretest score of 36, with an N-gain index of 0.37. In the experimental class, the average post-test score of 80 increased compared to the results of the average pretest score of 43 with the N-gain index of 0.45 is quite creative in collaborating. In this elaboration indicator, pre-service teacher can detail and develop a concept of learning material during discussion activities, identify problems, formulate problems, present literature studies, present frameworks, present hypotheses, develop research methods including designing research, determining parameters and research instruments, presenting flow diagram research procedures and data analysis techniques and data processing precisely and quickly. That the research component consists of background, procedures, implementation, research results, and discussion and publication of research results (Zainuddin, 2017). All of these components provide important meaning, can be seen how to formulate and solve problems, and the ability to communicate the benefits of research results in living life through research activities.

Blended learning fulfills all aspects that support the improvement of the quality of learning, provides many positive impacts on the learning process but in its application has its challenges including 1) Educators must have the ability or skill to use technology and require a lot of time in developing this learning method especially at the beginning implementation period 2) educators must be able to build materials following the method and be able to build a learning process for answering and giving statements in online classes (Agustina & Noor, 2016). Besides, the educational institution has socialized online learning. Effective online teaching is not the same as face-to-face teaching (Schwartz et al., 2020). There are online teaching activities that are better than face-to-face teaching but are not beneficial if the required independent and online learning resources are not met. Accessing online learning with appropriate devices is also required. Moreover, internet access with adequate speed is needed

because poor bandwidth can make many synchronous activities become complicated. For schools in areas with poor bandwidth, the combination of asynchronous activities and telephone check-in requires more support. Changing teaching timetables into shorter class time in the same time zone with more meetings but fewer students at one time are more effective in online learning situations. If the meeting time is combined with collaborative activities, students are likely to join and complete assignments or discussions, have effective feedback, and can check students regularly.

From the stage of providing stimulus to the presentation, the indicator of elaborative thinking is the highest indicator among other indicators and usually, this stage requires a long time. The indicator of creative thinking ability is given a weighting score, then the indicator of elaborative thinking occupies the highest position because, in this indicator, pre-service teachers always try to develop an idea or product from existing ones and try to add or detail in more detail to be more interesting than before. The increase in the score of creative thinking skills is also supported by several factors, including lecturers as facilitators to encourage as many independent pre-service teacher as possible so that pre-service teachers become more motivated to be more active in finding material concepts, which will train the creative thinking abilities of pre-service teachers. Plus according to Kim (2020), there is a relationship between the emotional level of students and friendship in learning science.

Creativity can be an innate characteristic but it can also be increased through various ways in the classroom, lecturers must include activities that encourage the emergence of teacher candidates' creativity (Yustina, 2016; Yustina et al., 2016). Furthermore, he stated, to strengthen creative thinking, lecturers can: (a) generate lots of ideas and thoughts about topics or problems, (b) involve pre-service teachers in exploring different points of view then reshaping or simplifying ideas, (c) increase mind openness and tolerance for imaginative and fun ideas, and (d) provide opportunities for pre-service teachers to develop and combine their ideas. Furthermore, helping pre-service teacher communicate effectively and information ideas, flexible, play a positive educational role (Dziuban et al., 2018). Educators must also be able to supervise and regulate learning conditions even though face-to-face learning that occurs in classrooms has been completed,

but online classes can be utilized by educators so that pre-service teachers can learn material before doing face-to-face learning (offline) and requires technology-based learning strategies (Zainuddin & Keumala, 2018).

The lecture process needed a learning pattern that integrates technology (Hasmunarti et al., 2019). Blended learning can create learning patterns that are more effective, efficient, and attractive following the interests of pre-service teachers towards the use of interactive media such as laptops and smartphones so that problems related to abstract biology learning can be more easily understood. Technology media that bring learning activities in several places (Hwang & Chen, 2017). Technological media used such as websites, videos, and Learning Management Systems (LMS), Blogs, Wikis, or social media such as Twitter, Podcasts, My-Space, and Facebook. LMS is an application or software that is used to manage online learning which includes several aspects, namely material, placement, management, and assessment. So that students can integrate biology learning innovation material into thesis using new ideas or techniques/methods of learning so that the desired learning outcomes are following the times (Wahyudi et al., 2018), and the process of learning ICT that can increase the interest of pre-service teachers. Also supported by Wijayanti (2017) which states that BL-based learning can increase students' interest in learning and train students' ability to use ICT, make full use of the internet, according to the 21st-century guidelines that graduates resulting from the learning process must have ICT skills.

In line with the same process in the research component, BL provides motivation and opportunities for students to get accustomed to thinking creatively with consideration of many sources, producing new works, modifying creatives as well as truly new works (Zainuddin & Keumala, 2018; Wahyudi et al., 2018) and the availability of online facilities and the experience of lecturers and students in online learning through a Management Learning System (MLS). The difficulties faced by online learning policies include: weaknesses in online teaching infrastructure, lack of teacher experience (including unequal learning outcomes caused by diverse teacher experiences), information gaps, the complex environment at home, and so on (Zhang et al., 2020). To overcome this problem, the government needs to further promote the construction

of an education information highway, consider equipping teachers and students with standardized home-based teaching/learning tools, conducting online teacher training, including developing large-scale online education at the national level, strategic plans, and supporting academic research into online education, specifically education to help students with online learning difficulties (Halim & Meerah 2016; Yustina et al., 2020). This interest in learning will be realized if the educator is skilled in facilitating the learning method with the learning style of the pre-service teacher.

Each pre-service teacher has a different learning style. Pj-BL provides opportunities for pre-service teachers to explore material by using various means that are meaningful to themselves, collaboratively, which enable each student to be able to answer guiding questions but are less able to facilitate various kinds of student difficulties (Palennari & Daud, 2019). The application of BL and Pj-BL can minimize conventional learning problems that are less able to facilitate various kinds of learning difficulties. Online learning is used to provide insights with diverse learning resources (Lin et al., 2016). BL learning is important to understand the form of the relationship, especially with context, definition, and concepts, bound indicators including cognitive, emotions as key aspects of BL setting, including online activities, task time, cognitive and metacognitive strategies (Halverson & Graham, 2019). According to Subahan & Ismail (2017), diverse information processing skills relate to students' ability to assess, organize, absorb, and use information effectively and emphasize the active role and creativity of students' thinking in developing their understanding.

## CONCLUSION

Based on data analysis, the results of the study found that overall the average score of creative thinking of students in the experimental class was 91 with an N-gain index of 0.62 higher (very creative) compared to in the control class (76) with an N-gain index of 0.51 (quite creative). Blended Learning and Project-Based Learning are quite influential in increasing the creative thinking ability of pre-service teachers, BL and Pj-BL are quite more effective than conventional learning in improving the creative thinking of pre-service teachers in biology learning (biology learning innovation courses) in the fifth semester

of biology education study programs because students and lecturers have a previous online learning experience. Then, it is also supported by the existence of internet network device facilities on campus that can be used by pre-service teachers and lecturers as well as pre-service teachers who have received training in the previous semester, namely online learning in virtual learning media courses. The implications of this research can contribute to how to implement an effective learning process using BL and this can be considered by policymakers for the future implementation of the learning system that can be implemented by Blended Learning (BL) and Project-based Learning.

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