Enhancing students’ creativity in problem-solving through online reading-concept mapping-group investigation

Nur Lina Safitri, Siti Zubaidah, Fatchur Rohman, Sulisetijono
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Malang, Indonesia

Article Info
Article history:
Received Jan 23, 2023
Revised Aug 16, 2023
Accepted Oct 8, 2023

Keywords:
Cooperative learning
Creativity
Group investigation
Problem-solving
Prospective biology teacher

ABSTRACT
Enhancement of students’ creativity and problem-solving is essential to science education. The learning accentuating students’ interaction to generate creative ideas becomes the ideal forum for developing those two skills. This study aims to amplify the current understanding of the effects of reading-concept mapping (Remap)–cooperative learning on college students’ creative and problem-solving skills. For cooperative learning, we used group investigation (GI). This study involved 60 college students from three Biology Education classes. Further, each class consists of 20 students with Remap-GI, GI, and conventional learning. The analysis results suggested that the creativity and problem-solving skills of students from all classes increased, with the most significant increase observed in students attending Remap-GI class which also presented substantial differences from the other two classes. In conclusion, GI presents positive effects in enhancing prospective teachers’ skills. However, an additional structured program (Remap) is still required to improve the future teachers’ contribution to their group.

This is an open access article under the CC BY-SA license.

Corresponding Author:
Siti Zubaidah
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang
Jalan Semarang No 5, Malang, East Java, Indonesia
Email: siti.zubaidah.fmipa@um.ac.id

1. INTRODUCTION
Creativity and problem-solving skills must be incorporated into science learning [1]. As these two skills can stimulate someone’s career path, they attain greater concern in science education [2]. Creativity represents flexibility and fixation during problem-solving [3]. Through high creativity, students can employ a more broad perspective in examining an issue, developing ideas, and resolving undefined problems [4]. Creativity and problem-solving are intercorrelated and interdependent. Their interdependency places these two skills as crucial in 21st-century curriculum development [2].

A number of studies suggested that creativity and problem-solving skills are stimulated by several contextual factors [5], [6], such as the teacher’s characteristics [7]. An educator plays essential roles in developing students’ creativity and problem-solving skills [4]. Accordingly, teachers have to transform their teaching practice following students’ needs [8]. Besides, teachers must have the capacity to provide supportive and encouraging facilities to improve students’ creativity skills for the problem-solving process [9].

In addition, developing students’ creativity also requires a social setting that enables students to conduct self-exploration to generate innovative ideas [10]. Further, that environment helps students exchange ideas and information, which later aids them in enhancing their learning efficiency using creative means [9]. Therefore, teachers are expected to provide training on cooperative work for students [11]. Accordingly, to influence students’ learning outcomes, cooperative learning should be implemented in the learning
process [12]. Cooperative learning has been acknowledged as a pedagogical means that positively affects students’ creative [13] and problem-solving skills [14].

However, cooperative learning cannot be carried out simply by asking students to work in groups [15]. Collaborative learning requires a structured work allocation and individual accountability [16]. Further, a previous study suggested that cooperative learning did not improve personal accountability [17]. To date, only a minimum number of teachers can formulate innovative means for the cooperative learning process by constructing a data collection system [14]. Accordingly, we need a specific effort to help students complete their work so they do not incriminate another group member [18].

A previous study reported that students' problem-solving skills could be accelerated if the students have sufficient comprehension of the problem while understanding the procedure and pattern [3]. Another research described that direct reading airs students construct creative problem-solving [2]. Besides, teachers must emphasize students' conceptual understanding during cooperative learning [19]. Thus, students must build their initial knowledge, such as through reading and creating map concepts activities, before the cooperative learning process.

This study explores the differences between students who attended learning using reading-concept mapping (Remap)-cooperative learning (with problem-solving and creativity enhancement) and those with conventional learning. In this study, Remap was positioned as the primary element of structured cooperative learning. Besides, group investigation (GI) was selected as the cooperative learning implemented in this study for several reasons. First, this model encourages students to resolve a problem based on various perspectives or ideas [20]. Second, it improves the learning level, further enhancing individual accountability (participation, interaction, and investigation) [21]. Therefore, GI is a robust and effective type of cooperative learning to increase problem-solving [22] and creative thinking skills [23]. Another research also reported that Remap-GI improved students' thinking and skills [24].

This study was conducted to identify the student's creativity and problem-solving skills after they attended learning using Remap-GI. Further. We used quasi-experiment to compare the creative and problem-solving skills of a group of students who attended learning using Remap-GI and those attending learning with GI and conventional methods. Further, we also analyzed the capacity of Remap to improve students' role in the cooperative learning process conducted online. Thus, this study also promotes online learning.

Generally, many students do not favor online learning as they feel isolated and perceive online learning as accentuating high independence [25], [26]. This shortcoming obstructs students’ further participation and high-order thinking skills [27]. Also, we aimed to report the means to overcome these hindrances and promote the students’ creativity and problem-solving skills in online learning. Thus, this study filled the gap by identifying the positive effects of Remap-GI on students' skills during online learning, as a previous study has confirmed the positive impact of cooperative learning during online learning [28].

2. RESEARCH METHOD
2.1. Participant and design

This study used a quasi-experimental approach with a pretest-posttest nonequivalent control group design [29] in evaluating the differences between GI-Remap class (class A), GI-only class (class B as a positive control group) and conventional class with discussion-presentation (class C as a negative control group). The learning efficiency of these three classes was evaluated. The learning was carried out online using an e-learning platform provided by the university for asynchronous and synchronous models (video conference and google meeting).

In this study, 60 students from the Biology Education Department of one of the private institutions in East Java, Indonesia, participated. They were divided into three classes. At the beginning of the semester, all students in classes A and B used GI for two sessions (one session per week and 100 minutes per session). Meanwhile, class C used conventional learning. In the first two meetings, students were given explanations related to the details of the learning process. During this adaptation, the student's initial skills were also measured. Class A was given additional reading and concept (Remap) learning model, while classes B and C were given the same model. Further, the same learning model was applied until the fifteenth meeting. In the last session, we measured students' skills to identify the effects of each learning model.

2.2. Procedure

This study was completed through some stages. We sent a permission letter to the target university in the initial step. After we obtained the permission, we attained informed consent from the candidate of participants. During this stage, we explained our research procedure and told the candidate they have the right to walk out of the research at any time. They also said that the variables measured throughout the research would not affect their scores.
In the end, 60 students agreed to participate in this study voluntarily. They were not obligated to attend every session, but they must be present in 14 out of 16 meetings and attend the pretest and posttest in the first and last meetings. All of the 60 students have agreed and fulfilled this minimum requirement. Therefore, we obtained complete data and proceeded with the data analysis process. The same lecturer taught all the classes with five years of experience in cell courses. All the class were given the same learning topics, namely cell course development in Biology, the concept of the cell, the position of the cell in an organism, structure, and function of the plasma membrane, cell communication and death, structure and function of energy-producing organelles, structure and function of the nucleus as the center of information, as well as organelles that regulate life at the cellular level.

2.3. Intervention

The interventions provided in classes A, B, and C were Remap-GI, GI, and discussion-presentation learning methods. The learning process of these three classes was carried out online, synchronously, and asynchronously. The example of learning activities for cell development in Biology material is summarized in Table 1 [24], [30].

Two non-participant observers supervised the learning and ensured that all learning models were carried out properly by filling out the observation sheet. At the end of the period, the observers calculated their scores to achieve agreement. The average calculation showed a higher kappa index than 80%.

### Table 1. Intervention in three classes

<table>
<thead>
<tr>
<th>Class B</th>
<th>Class C</th>
<th>Syntax (mode)</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ - -</td>
<td>✓ - -</td>
<td>Reading (asynchronous)</td>
<td>Students were asked to read the materials related to cell biology and general analysis technique for cell biology (SEM, PCR, Microsatellites, and so forth) to build their initial knowledge</td>
</tr>
<tr>
<td>✓ - -</td>
<td>✓ - -</td>
<td>Creating a map concept (asynchronous)</td>
<td>Students were assigned to make a map concept based on their reading results as a summary of information they had collected.</td>
</tr>
<tr>
<td>✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>Identifying topics and forming groups (synchronous)</td>
<td>Students were provided four topics of plasmolysis, SEM, the difference between animal and plant cells, and PCR. Then, they were asked to form a group of four to five people.</td>
</tr>
<tr>
<td>✓ ✓ -</td>
<td>✓ ✓ -</td>
<td>Designing investigation (synchronous)</td>
<td>Students were asked to determine the topic for their investigation and formulate their design of the investigation. For instance, if the students selected a topic of differences between animal and plant cells, then their design of investigation is practice or experiment.</td>
</tr>
<tr>
<td>✓ ✓ -</td>
<td>✓ ✓ -</td>
<td>Investigating (synchronous)</td>
<td>Students gather data and information from different sources, such as through an experiment on the cell of Lumbricina sp (worm) and Allium cepa (shallot).</td>
</tr>
<tr>
<td>✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>Writing a final report (synchronous)</td>
<td>Students construct a final report using the results of their GI in the form of a map concept.</td>
</tr>
<tr>
<td>✓ ✓ ✓</td>
<td>✓ ✓ ✓</td>
<td>Presenting investigation results (synchronous)</td>
<td>In groups, the students orally presented their work and held a question-and-answer session. Then, they also stated the evaluation related to their learning process.</td>
</tr>
</tbody>
</table>

2.4. Instrument

We used two instruments in this study, namely the test of creativity and problem-solving skills, in the form of an open-ended question. We developed these two instruments. Then, these instruments were validated by three experts in Biology from Indonesia concerning their content and face validity. The results of empirical try-out involving students from Biology education showed that both instruments were valid and reliable as the p-value from coefficient correlation was 0.05 and more than 0.70 Cronbach alpha.

2.4.1. Test of creativity

Students’ creativity was evaluated using an essay test adapted from Greenstein [31]. The creativity test included many creativity indicators, such as curiosity, fluency, originality, elaboration, imagination, and flexibility. The example of the creativity question and the assessment rubric is presented in Table 2.

2.4.2. Test of problem-solving

Students’ problem-solving skills were measured using an essay test adapted from Polya [32]. The problem-solving essay test consisted of some indicators such as problem identification, problem-solving plan development, information gathering, and analysis, as well as interpreting the findings and problem-solving. The example of the problem-solving skills question item and its assessment rubric adapted from the Association of American Colleges and University [33] is presented in Table 3.
2.5. Data analysis

The obtained data were analyzed using descriptive and inferential statistics. The researchers analyzed the mean (M) and standard deviation (SD) for the descriptive statistic. Meanwhile, for the inferential statistic, we carried out an analysis of covariance (ANCOVA) test to identify the learning efficiency in the experiment class and compare it with the other two control classes. If the ANCOVA test generated significant results, we analyzed the data using least-significant-difference (LSD) to find the class with the highest scores and potential and the significant difference from other classes. Before this analysis, the normality and homogeneity of data had been tested using one-sample Kolmogorov-Smirnov and Levene's equality of error variances. The results of these two tests showed that all of our data were homogeneous and normally distributed.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Creativity

All of the students in the three classes had similar initial creativity skills of 46.33 (SD=2.25), 46.71 (SD=2.01), and 45.06 (SD=1.95) for classes A, B, and C, respectively. In contrast, they presented relatively different creative skills at the end of the research. Class A and B had comparable average creativity scores of 94.96 (SD=2.08) and 91.06 (SD=2.60), respectively. Meanwhile, the average creativity for class C was 69.96 (SD=2.11), lower than for classes A and B. The initial and final creativity scores from the three classes are summarized in Table 4.
Further, we conducted an ANCOVA test to confirm the significant difference between the three groups. The analysis results presented in Table 5 show significantly different creativity between students who attended Remap-GI class and the ones attending learning using GI and conventional methods (F=1691.955; p=0.000). To find the most effective learning method for enhancing students' creativity, we carried out an LSD test. As presented in Table 6, the LSD results show that students' creativity skills in class A increased by 104.99%. Meanwhile, the students in classes B and C experienced a 99.20 and 55.26% increase in creative skills. From the gap between the average pretest and posttest, we concluded that students in class A (EM score=94.40) presented greater creativity than classes B (EM score=91.05) and C (EM score=70.53). Thus, the Remap-GI learning model has the potential to improve students' creativity.

### Table 4. Descriptive statistical calculation results in creativity variable

<table>
<thead>
<tr>
<th>Class</th>
<th>Test</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment class (A)</td>
<td>Pretest</td>
<td>46.33</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>94.96</td>
<td>2.08</td>
</tr>
<tr>
<td>Positive control class (B)</td>
<td>Pretest</td>
<td>45.71</td>
<td>2.01</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>91.06</td>
<td>2.60</td>
</tr>
<tr>
<td>Negative control class (C)</td>
<td>Pretest</td>
<td>45.06</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>69.96</td>
<td>2.11</td>
</tr>
</tbody>
</table>

### Table 5. Results of ANCOVA test on creativity variable

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III sum of squares</th>
<th>df</th>
<th>Mean square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected model</td>
<td>7441.494a</td>
<td>3</td>
<td>2480.498</td>
<td>1323.197</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>245.420</td>
<td>1</td>
<td>245.420</td>
<td>130.917</td>
<td>.000</td>
</tr>
<tr>
<td>Pretest</td>
<td>206.507</td>
<td>1</td>
<td>206.507</td>
<td>110.159</td>
<td>.000</td>
</tr>
<tr>
<td>Class</td>
<td>6343.562</td>
<td>2</td>
<td>3171.781</td>
<td>1691.955</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>104.979</td>
<td>56</td>
<td>1.875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>444367.810</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected total</td>
<td>7546.472</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 6. Results of LSD test on creativity variable

<table>
<thead>
<tr>
<th>Class</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Difference</th>
<th>EM score</th>
<th>Notation*</th>
<th>Increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>45.1</td>
<td>69.96</td>
<td>24.90</td>
<td>70.53</td>
<td>a</td>
<td>55.26</td>
</tr>
<tr>
<td>GI</td>
<td>45.7</td>
<td>91.06</td>
<td>45.35</td>
<td>91.05</td>
<td>b</td>
<td>99.20</td>
</tr>
<tr>
<td>Remap-GI</td>
<td>46.3</td>
<td>94.96</td>
<td>48.64</td>
<td>94.40</td>
<td>c</td>
<td>104.99</td>
</tr>
</tbody>
</table>

Note: * Different notation represents significant differences with other classes.

### 3.1.2. Problem-solving

Different from creative skills, students' initial problem-solving skills were slightly different. Class A had an initial problem-solving score of 53.15 (SD=2.08), followed by classes B and C, with scores of 49.72 (SD=6.08) and 46.59 (SD=6.98), respectively. Similarly, students' posttest scores also showed that class A had the highest problem-solving score (M=93.77; SD=4.84), followed by classes B (M=82.84; SD=7.63) and C (M=65.65; SD=6.39). The results of students' problem-solving skills evaluation are presented in Table 7.

### Table 7. Descriptive statistic results on problem-solving variable

<table>
<thead>
<tr>
<th>Class</th>
<th>Test</th>
<th>Average</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment class (A)</td>
<td>Pretest</td>
<td>53.15</td>
<td>2.08</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>93.77</td>
<td>4.84</td>
</tr>
<tr>
<td>Positive control class (B)</td>
<td>Pretest</td>
<td>49.72</td>
<td>6.08</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>82.84</td>
<td>7.63</td>
</tr>
<tr>
<td>Negative control class (C)</td>
<td>Pretest</td>
<td>46.59</td>
<td>6.98</td>
</tr>
<tr>
<td></td>
<td>Posttest</td>
<td>65.65</td>
<td>6.39</td>
</tr>
</tbody>
</table>

In addition, the results of the ANCOVA test presented in Table 8 showed significantly different problem-solving skills of students after the learning process. The results suggested a significant difference in problem-solving skills between the students who attended Remap-GI and those who used GI and conventional learning methods (F=89.056; p=0.000). We carried out the LSD test as a further test to identify the class with the most substantial potential. As shown in Table 9, the LSD results suggested that class A presented the highest problem-solving skills increase of 76.43%, compared to classes B and C, which had 66.62 and 40.91% increases. Additionally, from the difference between the average pretest and posttest scores,
we concluded that class A (EM score=94.36) had better results than classes B (EM score=82.82) and C (EM score=65.08). Consequently, the Remap-GI learning method has more extensive potential to enhance students’ problem-solving skills.

### Table 8. Results of ANCOVA test on problem-solving skills

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III sum of squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected model</td>
<td>8122.038*</td>
<td>3</td>
<td>2707.346</td>
<td>64.047</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>8553.665</td>
<td>1</td>
<td>8553.665</td>
<td>202.352</td>
<td>.000</td>
</tr>
<tr>
<td>Pretest</td>
<td>84.485</td>
<td>1</td>
<td>84.485</td>
<td>1.999</td>
<td>.163</td>
</tr>
<tr>
<td>Class</td>
<td>7529.029</td>
<td>2</td>
<td>3764.515</td>
<td>89.056</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>2367.192</td>
<td>56</td>
<td>42.271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>401739.130</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected total</td>
<td>10489.230</td>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 9. Results of LSD test on problem solving variable

<table>
<thead>
<tr>
<th>Class</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Difference</th>
<th>EM score</th>
<th>Notation*</th>
<th>Increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>46.6</td>
<td>63.65</td>
<td>19.06</td>
<td>65.08</td>
<td>a</td>
<td>40.91</td>
</tr>
<tr>
<td>GI</td>
<td>49.7</td>
<td>82.84</td>
<td>33.12</td>
<td>82.82</td>
<td>b</td>
<td>66.62</td>
</tr>
<tr>
<td>Remap-GI</td>
<td>53.2</td>
<td>93.77</td>
<td>40.62</td>
<td>94.36</td>
<td>c</td>
<td>76.43</td>
</tr>
</tbody>
</table>

Note: * Different notation represents significant differences with other classes

#### 3.2. Discussion

The primary purpose of this study was to compare the effects of three different learning models, consisting of two cooperative GI learning models (with and without Remap) and one conventional learning (discussion and presentation method). Our data analysis results suggested that students attending the GI learning method presented significantly different learning results compared to the other control method (GI and conventional learning), with two main variables of creativity and problem-solving. This study aimed to report the level of Remap-GI efficiency in online learning.

Our finding is linear with the result of a previous study reporting the use of the same learning model increases students' high-order thinking skills in face-to-face learning [24]. Meanwhile, our results confirm the capacity of the Remap-GI learning model to promote student creativity and problem-solving skills in online learning. A combination of Remap and GI learning model reinforce their ability to improve students' cooperative learning features, especially their accountability [16] and cooperation with their colleagues [2], leading to higher creativity and problem-solving skills.

Our analysis results on the first data set suggested that the students attending the experiment class (using the Remap-GI learning model) experienced increasing creativity skills, which were significantly different from the control groups. This finding reinforces the theory describing that creativity can be improved by associating the initial knowledge (through Remap) with the strategy for cultivating cognitive skills (GI) [34]. Studies investigating GI learning models have been massively carried out [20], [23], but this study offered a different context as it used online learning.

The explanation provided during the learning using Remap-GI can trigger students’ creativity development critical space for digital resource awareness, which further help students find new digital learning resources [35]. Besides, reading construction also presents a close correlation with creativity skills [36]–[38]. According to previous studies, reading activities have received significant consideration as they may help students enhance their creativity [39], [40].

In addition, the results of our study also confirmed that the Remap-GI learning model should be designed and implemented synchronously at first, followed by asynchronous learning. In this study, the reading and concept mapping (Remap) was carried out asynchronously using e-learning and guidelines in the form of students’ worksheets. Meanwhile, creative learning was carried out synchronously using video conference instruments. This stage is analogous to the results of the previous study in engaging students in cooperative online learning settings [41]–[43]. The precise use of technology in the learning process facilitates students to develop their ideas using their initial knowledge [44]. Synchronous cooperative learning facilitates students’ discussion and enables the realization of creative and effective learning [45].

The analysis results on the second data set indicated that the problem-solving skills of students who attended learning using the GI learning method also increased significantly. This finding is consistent with the results reported by previous studies that GI enhances students’ problem-solving skills [20], [22]. Combining problem-solving and cooperative learning strategies promotes students’ high-order thinking skills through collaborative interaction [46]. Further analysis suggested that students attending the Remap-GI learning model...
have higher problem-solving skills than students who were provided with only group interaction and conventional learning. Cooperative learning in this study was initiated by reading and creating a map concept (Remap) activity, followed by group discussion (Remap-GI) improves the results.

Remap plays a substantial role in shaping students’ knowledge before participating in cooperative learning. In daily life, problem-solving skills frequently cover the collection and interpretation of information [47]. Therefore, reading activity is essential for problem and situation comprehension. Additionally, in relation to concept mapping, map concept connects conceptual and practical knowledge (from reading) with students’ collaboration (cooperative learning process) [48]. Previous studies have highlighted that the map concept has the potential to promote problem-solving skills [49] as it lowers word retention and improves knowledge transfer [50]. Therefore, institutions interested in applying cooperative learning should be aware that GI cannot be carried out by merely forming groups. Therefore, the formative activities should be prepared carefully to ensure that students can be held accountable for their actions and give maximum group participation. In other words, cooperative learning should be started by synchronous meetings (such as through an online e-learning platform) to ensure that they have sufficient understanding. Then, students should also be encouraged to allow and listen to other people’s opinions to generate creative ideas.

This study also has some limitations. First, this study was carried out using the existing group. Second, this study involved a relatively small group, with only 20 students per group. Third, we completed this study in only 13 meetings, with two initial and one last session not included in the data collection process as those meetings were used for the pretest and posttest. Therefore, the future experiment study has to pay attention to the distribution of participants, with a greater sample size and a more extended intervention period. Besides, this study used a methodological approach of the Remap-GI learning method in the online learning context, so further research in the same context is still required to gain more extensive findings.

4. CONCLUSION

In conclusion, GI is one of the cooperative learning strategies with positive effects on students’ creativity and problem-solving skills enhancement. However, this learning model should be carried out in a structured manner (involving Remap) to attain a maximum result. The analysis results generally confirmed that an effective cooperative learning process requires a structured learning framework, such as by associating Remap and cooperative learning model. Besides, this study also corroborates that creative learning presents equal positive results for online learning. Thus, it can be used to decrease students’ dependence and face-to-face interaction.

REFERENCES


Higher Education


BIOGRAPHIES OF AUTHORS

Nur Lina Safitri is a student at Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. She also a lecturer at Institute of Technology and Science Nahdlatul Ulama Pasuruan. She can be contacted at email: Safitrilina1992@gmail.com or nurlinasafitri@itsnupasuruan.ac.id.

Siti Zubaidah is a professor at Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Her research areas: biology education, critical and creative thinking skills, metacognitive skills, 21st century learning. She can be contacted at email: siti.zubaidah.fmipa@um.ac.id.

Fatchur Rohman is Professor of Ecology at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. His research focuses on ecology, agriculture, and the development of learning biology. He can be contacted at email: fatchur.rohman.fmipa@um.ac.id.

Sulisetijono is a lecturer at the Department of Biology, Universitas Negeri Malang, Indonesia. He completed undergraduate program from IKIP Malang, in biology education program, master degree at the Bandung Institute of Technology (ITB), and doctoral education at Brawijaya University. His research interest and expertise are plant development and biostatistics. He can be contacted at email: sulistijono.fmipa@um.ac.id.