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Application of Guided Inquiry Model Using Self-Regulated Learning Approach to Improve Student's Creative Disposition and Creative Thinking Skill in Biology Subject

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Abstract: Given the importance of globalization and the need to train students' thinking skills and broad knowledge to prepare them to face the demands of the 21st century work, education from the start needs to look more critically at educational practices and learning methods that should be directed. This study seeks to examine the effect of applying the guided inquiry model with the Self Regulated Learning approach to students' creative dispositions and creative thinking skills in high school biology learning. To achieve this goal, a sample of 70 students at one of the State Senior High Schools in Mataram, NTB. Subjects were purposively grouped into the experimental class, namely learning using the Guided Inquiry Model with the Self Regulated Learning (IT-SRL) Approach and the control class using the Ordinary Guided Inquiry (IT) model. Data on students' creative dispositions were obtained from a creative disposition questionnaire while data on students' creative thinking skills were obtained from tests of creative thinking skills which were compiled based on indicators of creative thinking skills. Hypothesis testing in this study uses. The results of the ANCOVA test showed that students who were taught using the guided inquiry model using the self-regulated learning (IT-SRL) approach had better creative dispositions and creative thinking skills than students who were taught using the inquiry method (IT).

Keywords: Creative dispositions; Creative Thinking Skill; Guided Inquiry Model; Self Regulated Learning

Introduction

Education plays an important role in forming quality human resources. Quality human resources will determine the quality of life of a nation. Quality education becomes an agent for change, improvement and progress of a nation (Manullang, 2013). In order to survive and compete globally in the 21st century, education must be oriented towards creating flexible, productive and responsible human resources through the integration of life skills into learning. One of the life skills needed by students is creative thinking skills (Andrini, 2016).

Students' creative thinking skills cannot develop if the learning process in class does not involve students actively (Sugilar, 2013). The inquiry learning model is a learning model that makes students active in discovering concepts and knowledge independently to build concrete thoughts in accordance with the nature of science. Student activity in inquiry learning has an impact on understanding that is strong and lasts longer than just receiving information from the teacher (Septiani & Susanti, 2021). The inquiry learning model becomes a 21st century learning model, which demands the integration of a scientific approach and real problems in students' lives. To deliver students as problem solvers, students must directly experience the

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process of finding information in the form of facts which are then analyzed to solve the problem. Students must also be able to look for various other possible answers based on their own thoughts which may differ from existing thoughts (Mufiannoor et al, 2017).

Self-regulated learning applies the concept of metacognition, which is a form of self-regulation in student learning, where students can monitor and regulate their own actions related to the learning process (Zimmerman, 2002). Self-regulation is a person's ability to regulate the responses that appear within, both in terms of emotions, thoughts and habits in an effort to achieve goals and interactions with others (Thompson S. & Jacue, 2017). Today the concept of metacognition is considered as an important component in the context of science learning (Zohar & Barzilia, 2013). Based on a study conducted by Ahmar (2016), self-regulation has a positive relationship to students' creative thinking abilities and recommends self-regulation as the basis for preparing lesson plans. The author tries to think of inserting elements of self-organized learning, in the syntax of guided inquiry learning in biology learning. It is hoped that this effort will be an alternative to improve students' creative thinking skills. Sukarso et al. (2019) revealed that applying appropriate learning can provide learning experiences that help students improve their creative thinking skills.

So far, studies on creative thinking skills have rarely been associated with creative dispositions, even though the two sides of a coin are inseparable (Widodo, 2015). Therefore, to obtain an overall picture of creative thinking skills, research on creative dispositions needs to be studied. Creative dispositions describe creative behavior patterns that are shown by individuals without coercion (Sukarso et al., 2019). Creative dispositions by Lucas et al. (2016) described in five domains, namely inquisitive, collaborative, persistent, imaginative, and disciplined which in previous research Sukarso & Muslihatun (2021); Sukarso et al (2022) influenced students' creative thinking skills.

It is hoped that the integration of self-regulated learning elements into guided inquiry will foster students' creative dispositions and, in the end, will also improve students' creative thinking skills. Research on the application of guided inquiry models that are integrated with Self Regulated Learning is important to do. The results of this study will provide information regarding how to improve students' creative thinking skills.

Method

This research was conducted on class X MIPA Odd Semester Academic Year 2022/2023 at one of the Mataram city public high schools. The research subjects totaled 70 students which were divided into 36 students in the experimental class and 34 students as the control class. The selection of research subjects was determined using a purposive sampling technique, namely using the regular class because the other classes are grouped in different programs (accelerated class). This research is a quasi-experimental study with a nonequivalent control group design that applies the guided inquiry learning model with the self regulated learning (IT-SRL) approach to the experimental class and applies the ordinary guided inquiry learning model (IT) to the control class. The syntax of the two learning models for the experimental class and the control class is shown in Table 1.

Table 1. The syntax of the IT-SRL Model and the IT Model

IT-SRL models	IT Model
1. Students analyze the problem to find a solution 2. Students set goals to be achieved based on the problems presented (forthought phase). This activity shows indicators of task analysis, which can guide students during learning activities 3. Students propose various possible answers to answer the problem (performance phase). This activity is a form of self-observation indicator, namely students do self-experiments so that they are more courageous in expressing their opinions 4. Students draw up an investigation plan in the form of a schematic/concept map (performance and forthought phase). This activity is a form of self-control indicator and task analysis, which can direct students to focus on the plan that will be carried out to solve a problem 5. Students search for and record the data obtained to be used as material for data analysis (performance phase). This activity shows self-observation indicators that direct students to record work results during the learning process	1. Students identify the problems presented by the teacher to find out the answers 2. Students do the preparation of hypotheses with the group 3. Students plan steps to investigate the answer to the problem formulation 4. Students search for data through various sources of literature 5. Students analyze the data found with their groups 6. Students make conclusions based on the analysis of the data and problems presented 7. Students make presentations about the results obtained

IT-SRL models	IT Model
6. Students compare the results of searching data with other groups (self-reflection phase) this activity as an indicator of self-assessment that can make students know the advantages or disadvantages of their work 7. Students carry out a class discussion process to solve problems with other students 8. Students make a scheme of the relationship between problems-evidence obtained-problem solving to draw conclusions (performance phase) show indicators of self-control by depicting the results that have been obtained through a scheme 9. Students evaluate the work of other groups (self-reflection phase) showing self-assessment indicators	

The instruments used to collect research data consisted of: 1) Creative disposition questionnaire, 2) Tests for creative thinking skills, and 3) Student activity observation sheets. The creative disposition questionnaire is used to measure students' creative characters and determine the position of students' creative dispositions compared to their peers. The type of questionnaire is a questionnaire with closed answers using a Likert scale with 5 parameters: Always, Often, Sometimes, Rarely, and Never. Questionnaire material is focused on inquisitive, collaborative, persistent, imaginative and discipline dimensions (Lucas et al. 2016) and in this study the questionnaire developed by Sukarso et al. (2019). The creative thinking skills test is in the form of 5 questions in essay form, used to measure students' creative thinking skills compiled and developed by researchers on biodiversity material. Test questions have been tested for validity and reliability and all valid questions with a reliability level of 0.702 are in the high category (Arikunto, 2012). The creative thinking skills test instrument was developed referring to Torrance's Torrance Tests of Creative Thinking (TTCT) (1979), including fluency (related to the number of ideas generated) a measure of the number of attempts made by the subject in an effort to produce a result, flexibility (related to various types ideas generated), originality (related to generating unique and new ideas) and elaboration (related to detailing the ideas generated). The scoring of students' creative thinking skills tests was carried out based on the creative thinking skills rubric created by the researcher. Student learning activities at IT-SRL and IT were observed using learning observation sheets focused on activities that describe creative dispositions during the learning process. Creative disposition questionnaires and creative thinking skills tests were given to both classes before and after the intervention (pretest and posttest).

The data from this research are in the form of quantitative data on the pretest and posttest scores of the creative disposition questionnaire on a scale of 1 – 5. The data on creative thinking skills are in the form of quantitative data on the pretest and posttest scores of creative thinking skills which are scored on a scale of 0 – 3 for each question, then the total score was converted to a scale of 0 – 100. Data on students' creative disposition and creative thinking skills that have been collected are then analyzed statistically with the Analysis of Covariance (ANCOVA) test after going through the prerequisite tests, namely the normality test and homogeneity test. All statistical tests were carried out with the help of the SPSS ver 26.0 programs. Student activity data is converted into percentage form to strengthen the description of students' creative dispositions and creative thinking skills.

Result and Discussion

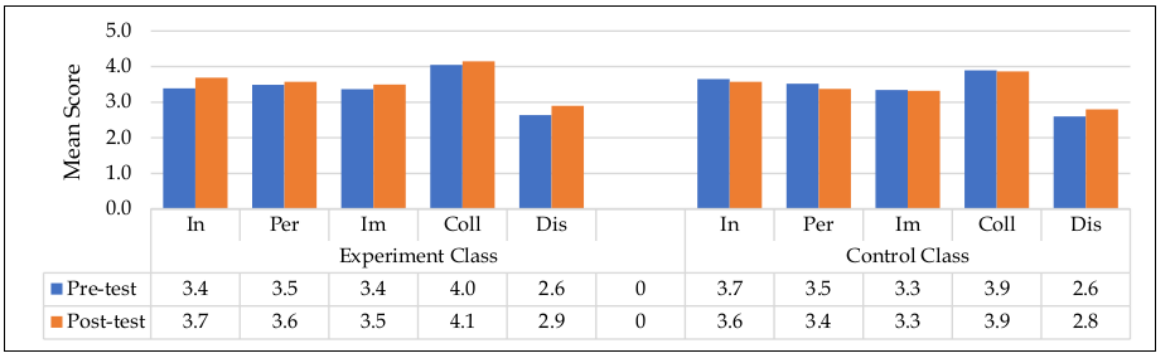
The Influence of the IT-SRL Model in Growing Creative Dispositions

The results of the research and data analysis on the creative disposition of students in the experimental class and the control class in a concise form as presented in Table 2. Based on Table 2, the initial creative disposition of students in both classes was the same and increased in both the experimental class and the control class.

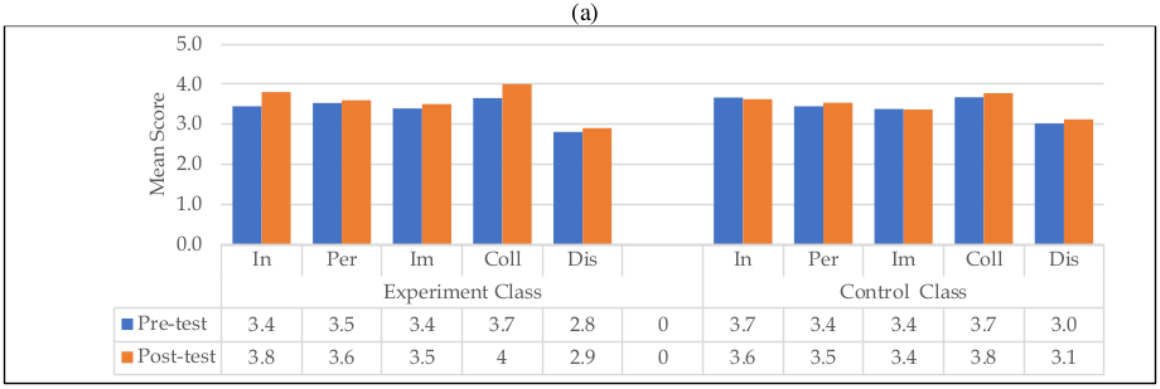
The pretest and posttest scores for both classes had normal data distribution and homogeneous data variance (Sig. > 0.05). The results of the hypothesis test with analysis of covariance (ANCOVA) obtained the Estimated Marginal Mean value of the experimental class (3.548) which was greater than the control class (3.411). The results of the ANCOVA test on the learning model (Sig. = 0.022) are less than (α) 0.05 so that H_0 is rejected. This means that the application of the IT-SRL model has a significant effect on students' creative disposition posttest scores. The increase in creative disposition and creative disposition in each domain in the experimental class and control class is presented in Figure 1.

Table 2. Recapitulation of pretest and posttest scores, and creative disposition statistical tests

Components	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of students	36	36	34	34
Average Score	3.39	3.55	3.40	3.42
Standard Deviation	0.209	0.240	0.208	0.237
Minimum Score	3.03	2.97	3.03	2.90
Maximum Score	3.87	4.03	3.83	4.13
Normality Test	0.111 (Normal)	0.200 (Normal)	0.163 (Normal)	0.68 (Normal)
Homogeneity Test	0.975 (Homogeneous)	0.676 (Homogeneous)	0.975 (Homogeneous)	0.676 (Homogeneous)
ANCOVA test pre-test and post-test creative disposition values of experiment class and control class ($\alpha = 0.05$)	Estimated marginal mean of experiment class (3.548) > control class (3.411), Sig. = 0.022 < 0.05. H_0 is rejected			



(a)



(b)

Figure 1. Comparison of each creative disposition domain of the experimental class and the control class; (a) creative disposition, (b) creative disposition position. In= inquisitive, Per= persistent, Im= imaginative, Coll= collaborative, El= elaboration.

Based on the research data above, the IT-SRL model intervention has a significant influence on students' creative dispositions. This result is in line with previous research by Sukarso et al. (2019) application of a practicum learning model based on creative research projects which has a positive effect on increasing students' creative dispositions. Data on the creative disposition of students in this study is in line with the position of the creative disposition of students based on the assessment of their colleagues. This means that the creative disposition of students who tend to increase is supported by the correctness of the creative disposition questionnaire answers by other students' answers to their colleagues (creative disposition position), thus the two reinforce each other. The infusion of self-regulated learning phases in guided inquiry syntax can be inferred to be able to trigger the growth of students' creative dispositions. Domains that tended to be higher in

improvement for the experimental class were seen in the inquisitive and discipline domains, while in the control class it was only in the discipline domain. In the other three domains, the IT-SRL learning model shows an increase in creative disposition, although the increase is not that strong.

Inquisitive Domains

The infusion of self-regulated learning phases in guided inquiry syntax can be inferred to be able to trigger the growth of students' creative dispositions. This result means that the experimental class is more developed in inquisitive character after being infused with forward thinking, good performance and self-reflection phases. Zimmerman (2002) states that the forthought phase is used as a process of preparing students for learning efforts. It is suspected that the infusion of the forward-thinking phase causes students to try to find new ways of setting a learning goal based on a high sense of curiosity. The IT-SRL learning syntax is in the form of a preparatory effort, it seems to be an initial introduction for students about the subject matter they will be studying causing students to be motivated to find out more deeply about the subject matter. Pluck & Johnson's (2011), results of his research indicate that active learning models such as PBL (Problem-Based Learning) can stimulate students' curiosity.

When students are able to solve a problem, students will feel satisfied so they will find out more information. Likewise, the results of research by Silmi & Kusmarni (2017) which used interesting learning media such as puzzles led to high student curiosity. This illustrates that the infusion of the forethought phase which is driven by student learning activities tends to foster student curiosity. The results of observations during the learning process with the IT-SRL model show that almost half of the students (47%) often show curiosity. Watson (2017) reveals that people with curiosity are very active in asking questions, in Bardone & Secchi's (2017) study, curiosity has a positive effect on the number of problem-solving generated.

Disciplines Domains

The infusion of the self-regulated learning phase in the guided inquiry syntax is thought to involve planning investigations and communicating results causing students to be active in seeking information, trying to innovate, thinking of something new using correct scientific concepts, trying to develop or master new techniques or information, like looking for something unusual, reflecting on its weaknesses and strengths and trying to improve or enhance existing knowledge. This is natural for students to do, because students have the task of making detailed investigation plan schemes, and focusing on solving problems, thus students are required to have a high understanding of the stages that must be carried out in an investigation (inquiry). Syntax of communicating results, which is done by exchanging worksheets between groups to provide comments about the results of other groups, trains students to recognize the shortcomings or strengths of their investigations to then improve or improve.

However, based on the results of observations of students' activeness in these two syntaxes, it does not seem to indicate that there are efforts related to increasing knowledge. It is suspected that this syntax has not provided a strong stimulus to students to actually develop themselves in increasing their knowledge. This shows that students' efforts to improve their knowledge in this study are still low, including important aspects that must be considered. SRL does not seem to provide stimulation for students to develop themselves and increase their knowledge. This shows that there is still a need for triggers that can increase students' self-confidence, for example through opportunities for deeper self-reflection. Jung et al. (2017) stated that self-efficacy is the beginning of the character of mastering knowledge. Self-efficacy makes a person understand his strengths and weaknesses, as a motivator to achieve goals and increase the achievement of higher success.

Imaginative Domains

The increase in creative disposition related to the domain of imaginative thinking in the application of the IT-SRL model in this study seems to be very low, only 11% of students are observed to often show character for imaginative thinking. When students try to understand a phenomenon, students will actually explore with their own imagination to find out the elements that exist in the phenomenon. Hadzigeorgiou (2016) revealed that there are several activities /strategies that can be carried out to improve students' imagination abilities, such as conducting an investigation of a phenomenon or problem, keeping daily journals for students, providing various questions that can link student facts and ideas, combining learning approaches science by manufacturing products. The low creative disposition in the imaginative domain in this study is allegedly not in line with what is stated above.

Persistent Domains

The learning syntax of the IT-SRL model in terms of research results in the persistent domain from the observation results is only 33% showing tenacity with frequent frequency in the learning process. This result contradicts the research of Graham et al. (2013), that the application of active learning which includes activities that emphasize students' thinking activities, analyzing,

and solving problems can increase students' tenacity and persistence.

Even though this research actually gives students freedom to empower all the resources and knowledge they have, the results of this study are not in line with the findings above. The results of research by Robson & Rowe (2012) also indicate that students' tenacious character appears efficiently in activities that free students to empower their learning resources and knowledge, besides that interaction with peers can make students more courageous in engaging in challenging activities such as discussions in learning. It is suspected that the low level of students' tenacious character is because from the beginning the students were not used to doing activities that involved kinesthetic activities as they had to be done according to the syntax of the IT-SRL model.

Collaborative Domains

The syntax of the IT-SRL model was observed to increase the cooperative character as shown in the activities of collecting data, analyzing data, and communicating results. The syntax of collecting data provides opportunities for students to exchange answers and various kinds of ideas and opinions, as well as the syntax of communicating results can train the character of cooperation in the learning process, 42% is supported by observational data on student activities that collaborate during the learning process. Group discussion activities and class discussions provide opportunities for students to practice adapting to how to work together on a smaller or larger scope. Warsono & Hariyanto (2017) revealed that learning that emphasizes student activities in groups can train student cooperation to build knowledge and achieve learning goals. The research results of Susetyarini et al. (2022) indicated that problem-based learning was able to improve students' cooperative skills.

The Effect of the IT-SRL Model in Improving Creative Thinking Skills

The results of research on the use of the IT-SRL and IT models in improving creative thinking skills are presented in a concise form as Table 3.

Table 3. Recapitulation of Pretest and Posttest scores, and Statistical Test of Creative Thinking Skills

Components	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of students	36	36	34	34
Average Score	27.22	50.25	28.87	45.74
Standard Deviation	5.648	7.627	6.875	7.926
Minimum Score	10	35	15	33
Maximum Score	38	67	40	67
Normality Test	0.150 (Normal)	0.200 (Normal)	0.200 (Normal)	0.138 (Normal)
Homogeneity Test	0.173 (Homogenous)	0.920 (Homogenous)	0.173 (Homogenous)	0.902 (Homogenous)
ANCOVA test pre-test and post-test creative thinking skills values of experiment class and control class ($\alpha = 0.05$)	Estimated marginal mean of experiment class (3.548) > control class (3.411), Sig. = 0.022 < 0.05. H_0 is rejected			

The results of this study indicate that students in the IT-SRL model class have better creative thinking skills than students in the IT model class. Based on the results, significant differences were seen in creative thinking skills between the two groups after learning. The results of testing the hypothesis with the ANCOVA test obtained the Estimated Marginal Mean (pretest corrected posttest mean) of the experimental class (50.25) greater than the control class (45.50). Students in the IT-SRL class showed a sizeable increase in pre-test and post-test measurements compared to the increase in students in the IT class. The results of the ANCOVA test on the learning model (Sig. = 0.013) are less than (α) 0.05 so that H_0 is rejected. This means that the treatment of the IT-SRL model has a significant effect on students' KBK posttest scores.

These findings explain that IT-SRL learning encourages the development of students' creative thinking skills, where students carry out several activities that are thought to increase the ability to think fluency, flexibility, elaboration and originality. Student activities in IT-SRL learning through stimulating problems are presented for the growth of the forward-thinking phase, making suggestions in answering problems, making plans, searching for information, making problem-proof-problem solving schemes through empowering the good performance phase, and self-reflection is thought to stimulate the growth of creative thinking skills. In this study, students have demonstrated active learning activities driven by the infusion of SRL phases. Other research using learning models or media that causes students to be active in their learning also shows similar results. For example, the application of the open inquiry model (Ramdani & Artayasa, 2020; Ramdani et al. 2021), the Project Based Learning learning model (Sukarso et al. 2019; Wijayati et

al. 2019), the application of augmented reality media (Faradillah & Maulida. 2022) can improve students' creative thinking skills. An overview of improving students' creative thinking skills in each aspect of thinking fluency, flexibility, originality, and elaboration is presented in Figure 2.

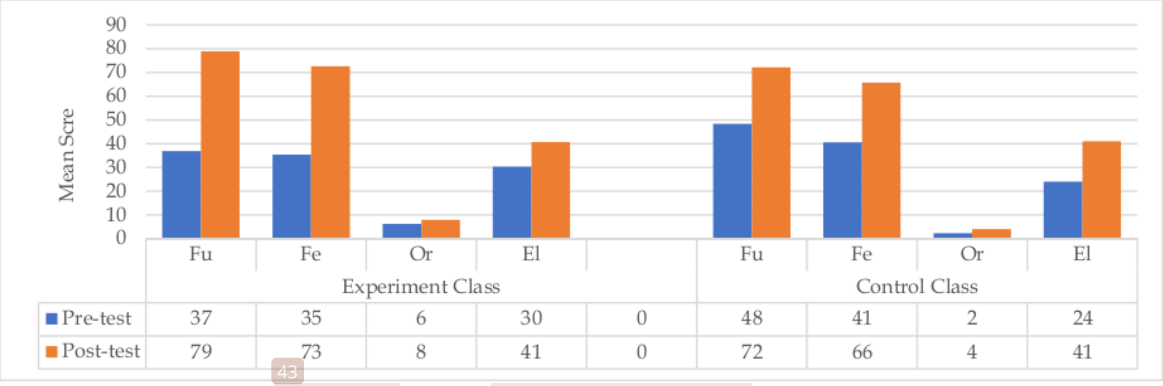


Figure 2. Comparison of each aspect of students' creative thinking skills in the two sample classes. Fu = Fluency, Fe = Flexibility, Or = Originality, El = Elaboration.

The application of the IT-SRL model in this study specifically shows its main impact on the high increase in fluency and flexibility thinking aspects, as also shown by the IT model in the control class. It's just that there is a difference in the proportion of the number of IT-SRL class students who experienced an increase in fluency and flexibility thinking skills from the previous (pretest) occurred in all students, while in the IT class the proportion of students experienced a lower increase. On the other hand, the proportion of students who experienced an increase in elaborative thinking skills in the IT class seemed to be better (71%) than students in the IT-SRL class (64%). These findings are interesting as material for further discussion and for a while it should be suspected that students' inquiry activities in both IT and IT-SRL are the cause of the development of students' ability to think elaboratively.

The syntax of the IT-SRL model in the form of presenting problems, compiling hypotheses and analyzing data which is optimized with good performance phases, is thought to be the cause of the development of students' fluent thinking skills. The syntax of presenting the problem leads to student activity in the activity of determining learning objectives by the students themselves. These activities will stimulate students to generate ideas in determining learning objectives. Meanwhile, the syntax for preparing hypotheses and analyzing data is done by means of class discussions giving students the opportunity to propose various answers that come to mind. This phenomenon is in line with the results of research by Fatmawati et al. (2022) that the application of the creative problem-solving-based learning model indicates a significant influence on students' fluent thinking.

Flexible thinking is known as thinking with many different kinds of new thoughts. The IT-SRL model seems to have succeeded in stimulating students' minds to think differently than IT. The IT-SRL model contains an investigation planning stage with activities that develop different thinking such as determining research variables, research focus, tools and materials and research steps. The process of guiding the teacher in this syntax also opens students' minds through brainstorming to make a more detailed description of the investigation plan regarding the focus of the investigation, the variables to be investigated, as well as the tools and materials needed during the investigation process. Student activity in this syntax should be strongly suspected of being a trigger for the emergence of different thoughts so that aspects of flexible thinking develop. In research focused on inquiry-based learning models by Ramdani et al. (2021), for example, can be a reinforcement in the findings of this study. The research results of Ramdani et al. (2021) indicated that the inquiry-based learning model can improve aspects of thinking differently, because the inquiry model has a positive effect on stimulating students' mindsets to generate a variety of different ideas to solve problems. In addition, the results of Nurisalfah et al. (2018) that students think differently well enough after students are trained to plan projects.

Originality thinking is the most difficult creative thinking skill for students to do. Sannomiya & Yamaguchi (2016) revealed that listening to the presentation of ideas produced by other people has the potential to train creative thinking skills, and stimulate the generation of their own ideas and the number of ideas produced is influenced by the ideas of other people

they have heard. So, the more individuals hear the presentation of other people's ideas, the more they produce various ideas. The resulting idea may also be a new idea that has never existed before, is unique, and rare. The study conducted by Agogué et al. (2014) indicated that people who hear lots of examples of unique ideas can produce more original ideas than participants who are exposed to general ideas. The low skill of students in generating original ideas in this study, in fact, is also commonly found in previous similar studies.

The IT-SRL model combines inquiry practicum activities with self-regulated learning to solve problems. The scientific syntax carried out in inquiry encourages and evokes students' elaboration creative thinking skills. Elaborative thinking is the ability to clarify and add detail to an idea. The syntax of planning, data collection, processing, interpretation, and reporting requires understanding and being able to perceive different perspectives (Moeed, 2013). When someone talks to other people, knowledge becomes more complicated, and because communication implies that the explanation, he wants to be understood by others then he must produce explanations that make sense (Fawcett & Garton, 2005).

Although the aspect of elaborative thinking shows better results in the IT-SRL class than the IT class, in reality, the mean final score for both is still relatively low. This indicates that the ability of students to provide or add details or detailed explanations about the ideas they express is still low and not satisfactory. Several other studies also show the same findings that elaborative thinking is a low barrier to divergent thinking compared to fluent, flexible, and original thinking (Runco & Acar, 2012; Ferrándiz et al., 2017).

The phenomenon of the research results as explained above, in this study is also related to the findings of the disposition to think creatively on the disciplined dimension which is relatively low compared to the inquisitive, persistent, collaboration and imaginative dimensions. This suggests the importance of content in the assessment of creativity warrants further study in the future. Educational efforts must include divergent and convergent thinking or evaluative thinking. This implies that developing content intelligence or convergent thinking intelligence is as important as developing creative intelligence or divergent thinking intelligence. Creative and critical thinking are interrelated, and cannot be separated from one another. Critical thinking is closely related to problem-solving and creative thinking (Facione et al., 1994), because there is an interesting interaction between critical and creative thinking when individuals need to solve problems whose completion process is difficult (Glassner & Schwarz, 2007).

Conclusion

The results of this study concluded that the guided inquiry learning model with the Self Regulated Learning (IT-SRL) approach could trigger the growth of students' creative dispositions and was especially prominent in the inquisitive and disciplined domains. Students' creative thinking skills also increased, especially in the aspects of fluency and flexibility thinking for biology subject matter on the topics of biodiversity. Growing and training creativity through IT-SRL learning is targeted to help build the current deficit of creativity and innovation.

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